Storage Pool Management Feature in EMC Virtual Storage Integrator

- Installation and Configuration of SPM
- Detailed Use Cases
- Customer Example

Drew Tonnesen
Lee McColgan
Bill Stronge
## Preface

## Chapter 1 Concepts

### Introduction

### Concepts

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- Integration with VMware resources
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If a product does not function properly or does not function as described in this document, please contact your EMC representative.

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**Purpose**

This TechBook describes how the VMware vSphere products work with EMC Symmetrix storage systems and software technologies. This document focuses on the Storage Pool Management feature of EMC Virtual Storage Integrator.

**Audience**

This document is part of the EMC Symmetrix documentation set, and is intended for use by storage administrators, system administrators, and VMware Infrastructure administrators.

Readers of this document are expected to be familiar with the following topics:

- EMC Symmetrix system operation.
Conventions used in this document

EMC uses the following conventions for special notices.

**Note**: A note presents information that is important, but not hazard-related.

**CAUTION**

A caution contains information essential to avoid data loss or damage to the system or equipment.

**IMPORTANT**

An important notice contains information essential to operation of the software or hardware.

Typographical conventions

EMC uses the following type style conventions in this document:

**Normal**

Used in running (nonprocedural) text for:
- Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus)
- Names of resources, attributes, pools, Boolean expressions, buttons, DQL statements, keywords, clauses, environment variables, functions, utilities
- URLs, pathnames, filenames, directory names, computer names, filenames, links, groups, service keys, file systems, notifications

**Bold**

Used in running (nonprocedural) text for:
- Names of commands, daemons, options, programs, processes, services, applications, utilities, kernels, notifications, system calls, man pages
- Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus)
- What user specifically selects, clicks, presses, or types

**Italic**

Used in all text (including procedures) for:
- Full titles of publications referenced in text
- Emphasis (for example a new term)
- Variables

**Courier**

Used for:
- System output, such as an error message or script
- URLs, complete paths, filenames, prompts, and syntax when shown outside of running text
The team that wrote this TechBook

This TechBook was authored by a team from Symmetrix Partner Engineering based in Hopkinton, MA.

Drew Tonnesen is a Consulting Systems Integration Engineer in the EMC Symmetrix Partner Engineering team focusing on VMware and Cisco technologies. Before starting in his current position, Drew worked as a Global Solutions Consultant focusing on Oracle Technology. He has worked at EMC for 5 years in various capacities. Drew has over 15 years of experience working in the IT industry. Drew holds a master’s degree from the University of Connecticut.

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This chapter introduces the Storage Pool Management concepts:

- Introduction ........................................................................................ 20
- Concepts .............................................................................................. 21
- High-level architectural description................................................ 25
- Plug-in management ........................................................................... 32
- VSI feature management................................................................... 33
- Functional description........................................................................ 34
Introduction

In virtual computing environments, IT is being offered as a service, user requirements change dynamically and the underlying infrastructure is transparent to the end user. For example, in a VMware environment, virtual machines (VM™) can be provisioned in minutes to meet the demands of the users. As such, any underlying infrastructure, that is, storage that supports the new VM will need to be provisioned quickly to meet the IT Service Level Agreement of the user. With EMC Virtual Storage Integrator (VSI) and Symmetrix Management Console (SMC), storage is managed as a shared resource pool. When used together, VSI and SMC accelerate storage provisioning, so the IT service is available to the end-user faster.

Using SMC’s Storage Pool Management (SPM) feature, a storage administrator (SA) creates a virtualization domain that corresponds to a vCenter instance with physical pooled storage. This pooled storage resource is made accessible through VSI that enables the VMware administrator to allocate as needed to the VMware resources, similar to the way that CPU and memory resources are subdivided. With the combination of VSI and SMC, storage resources are provisioned dynamically and the virtual administrator is able to meet the dynamic requirements of the end users faster.
SPM introduces three concepts:

- **Storage Resource**
- **Storage Type**
- **Virtualization Domain**

These concepts are critical in bringing storage provisioning to the nonstorage savvy VMware user.

### Storage Resource

Storage resources are storage-containing-objects in the Symmetrix that contain real, physical storage. They are attached to virtualization domains and backup the storage types shown in VSI with actual storage. Specifically they can be either thin pools or FAST VP policies.

### Storage Type

A storage type is simply a label that the VMware user utilizes to select the storage he wants. It is defined by a storage administrator during SPM configuration and is utilized by a VMware user when provisioning storage. This makes it simple for a user to provision the type of storage he wants.

The SA defines the types of storage, or storage resource, available to the VMware user in one of two ways:

- Using any already defined Fully Automated Storage Tiering (FAST) tier
- Creating a custom type

Custom types are created by selecting the properties of the physical storage:

- Disk type (SATA, Fibre Channel (FC), Flash (EFD))

---

1. Storage Resources are covered more extensively in the section “Storage Resources” on page 81 in Chapter 2. Storage Resources are introduced in SMC 7.3.
Storage Pool Management Feature in EMC Virtual Storage Integrator

Concepts

- Disk speed (7200, 10,000, 15,000)
- RAID configuration (RAID6 14+2, RAID6 6+2, RAID5 7+1, RAID5 3+1).

The SA can use this label to describe storage by its physical type, or for what application it is intended, such as Exchange, or even for what group it is intended, such as QA.

**Note:** A custom storage type need not have any properties associated with it. This is always the case for a FAST VP policy.

Virtualization Domain

While SPM allows VMware users to provision storage, it recognizes that the SA still owns and controls the array, and as such must be able to set boundaries around what storage the users can provision. These boundaries are defined by a virtualization domain.

The virtualization domain represents a vCenter. It contains information about the vCenter, for example, the GUID. It also contains other information needed to provision storage to the vCenter, such as the masking views to use, and the physical storage (storage resources) from which the VMware users will actually provision their storage. Finally, the SA can attach policies to the virtualization domain that can restrict or limit how VMware users can provision storage. Multiple storage resources can be added to the same virtualization domain as long as they are from the same array and are different storage types. Therefore, it would be possible for a virtualization domain to have 250 GB of gold storage, 500 GB of silver storage, and 1000 GB of bronze storage. Figure 1 on page 23 provides details of this example.

---

1. A separate storage type is required for each storage resource (thin pools, FAST VP policy) that is added to a virtualization domain, even if the storage resources being added have the same characteristics. For example, a virtualization domain could have three thin pools associated with it which are all comprised of EFD disk; however each of those storage resources would need to be assigned a separate storage type, despite the fact that they each have the same type of disk backing them.
VMware manages CPU cycles and memory as resources that can be allocated to create virtual machines. For instance, it takes the sum of all the CPU cycles on all the processors and all the memory on all the servers in a cluster and creates a pool of CPU and memory for the clusters. As users create VM's they allocate CPU cycles and memory from this pool for the individual VM. Furthermore, the cluster's pool of CPU cycles can be broken down into subpools, called resource pools, to provide a finer granularity of control. For example, the business units of a company might each have their own resource pool of CPU and memory from which to draw when creating VMs. A VMware user in marketing, for instance, could only create a VM from the CPU and memory resources available in the marketing resource pool. The user would be unable to access any of the resources in the other business units' resource pools.

One of the great benefits of SPM is that it can be controlled and allocated in the same way CPU and memory is in VMware, in this case for RDMs. Those very same resource pools that are set up for...
CPU and memory can also be used to allocate the storage that is presented to VMware by using the virtualization domain. Figure 2 on page 24 provides a high-level view of this.

Note: The Section “Allocating storage to VMware resources” on page 52 provides more detail on using resource pools with SPM.
High-level architectural description

SPM enhances and abstracts the Symmetrix array functionality in order to integrate storage provisioning into the VMware environment. This functionality is accomplished by adding on to the feature sets of several, already existing components. The SMC server is upgraded with the centralized SPM functions. The SMC GUI is enhanced with the SPM UI functions needed for the storage administrator, and the VMware user and administrator functions are added to the VSI for vSphere Client plug-in.

The SPM environment is shown in Figure 3 on page 26. The components that comprise this environment are:

- Symmetrix VMAX™ or VMAXe™ Array
- ESX Servers
- SAN
- SMC Server with SPM functionality
- vSphere Client with VSI
- Browser that runs the SMC GUI with SPM functionality
**SMC server**

The SMC server is the server component of the EMC element manager for the Symmetrix array. It allows a storage administrator to control one or more Symmetrix arrays through its browser-based GUI. The SMC server stores the SPM data and performs SPM functions as requested by the system administrator, through the SMC GUI, and VMware users and administrators through VSI. A single SMC server can support multiple vSphere Clients.

**SMC GUI**

The SMC GUI is a client front end to the SMC server.
EMC Virtual Storage Integrator for vSphere Client

Virtual Storage Integrator (VSI) for vSphere Client is a plug-in to the VMware vSphere Client. The VSI framework is included as part of each of the four installable features of VSI: Path Management, Storage Pool Management, Storage Viewer, and SRA Utilities. The Storage Pool Management (SPM) feature for VSI provides the user interface for VMware users and administrators to interact with the SPM functionality, allowing the user to provision storage from within the vSphere Client. In addition, the Storage Viewer (SV) feature for VSI provides reporting and monitoring capabilities to the user of SPM. SV integrates with SPM so that many SPM operations, such as removing a datastore or RDM, are available from SV views and menus.

Using SPM, a vSphere Client can talk to more than one SMC server.

Note: The VSI product guide provides more information on VSI.

vSphere Client components

The vSphere Client has a range of components that comprise its overall graphical user interface (GUI), each of which is extensible.

Figure 4 on page 28 shows the home view of the vSphere Client. This view contains a variety of global views, which can be grouped into subcategories, such as inventory, administration, management, and solutions and applications. A vSphere Client plug-in can extend this view by creating custom global views to be included here, in any of the available sub-categories. The EMC icon is included in the solutions and applications group of the home view and will allow the user to configure global settings for the plug-in throughout the vSphere Client. The EMC global view also allows the user to discover new storage arrays and synchronize with existing storage arrays.
By selecting Hosts and Clusters as shown in the Inventory section of the home view in Figure 5 on page 29, the user is presented with a typical vSphere Client view.
From here, the user is presented with a tree structure of objects in the left pane, and an array of tabs that pertain to each object in the right pane. A vSphere Client plug-in can extend the inventory in a number of ways including:

- Creation of custom menu items on the inventory objects in the left pane.
- Creation of custom tabs in the right pane for each type of inventory object.

For certain objects, VSI will create a custom EMC VSI tab in the right pane.
By selecting VMware inventory menus, the user may begin operations which present a VMware-styled wizard. These wizards break multistep configurations into several pages followed by a summary of the choices made. The pages are navigable through Next and Back buttons as well as a table of contents. Wizard page contents are validated dynamically to disable navigation if invalid values are entered.

For certain objects, VSI creates a custom wizard to configure complex operations such as in Figure 6 on page 30.

![Sample VSI Wizard](image)

**Figure 6** Sample VSI Wizard

Many operations executed by vSphere are executed asynchronously on the vCenter or ESX servers. To keep clients appraised of the recent changes to the VMware environment, these tasks can have their progress monitored in the Recent Tasks section of the vSphere Client.

For certain operations, VSI will create a custom task which can be monitored in the Recent Tasks section as shown in Figure 7 on page 31.
Recent Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Target</th>
<th>Status</th>
<th>Details</th>
<th>Initiated by</th>
<th>Requested Start Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rename resource pool</td>
<td>Archive_R...</td>
<td>Completed</td>
<td></td>
<td>Administrator</td>
<td>3/16/2010 4:36:54 PM</td>
</tr>
<tr>
<td>Rename resource pool</td>
<td>Move_R...</td>
<td>Completed</td>
<td></td>
<td>Administrator</td>
<td>3/16/2010 4:26:44 PM</td>
</tr>
<tr>
<td>Rename resource pool</td>
<td>High/...</td>
<td>Completed</td>
<td></td>
<td>Administrator</td>
<td>3/16/2010 4:26:26 PM</td>
</tr>
</tbody>
</table>

Figure 7  Recent Tasks
Plug-in management

Once a plug-in is installed, it is enabled by default. If the user no longer wants to use a plug-in, but does not want to uninstall it, they can simply disable it. These operations are performed through the following dialog box, which can be accessed through the Plug-ins root menu item of vSphere Client. From within that menu, choose Manage Plug-ins.

![Plug-in Manager](image)

**Figure 8 Plug-in Manager**

This dialog box in Figure 8 on page 32 lists both the installed plug-ins, as well as plug-ins that are available for download from the vCenter Server. Furthermore, each installed plug-in can be enabled or disabled by choosing the respective command after right-clicking on the plug-in. Each plug-in includes a version and description to identify itself.

**Note:** If VSI is disabled, all installed features become disabled.
VSI feature management

In addition to the top-level plug-in management, VSI may also be enabled or disabled at the feature level. The VSI framework lists each installed feature from the EMC global view as seen in Figure 9 on page 33.

Figure 9 VSI feature management

From here one can disable or even uninstall a particular feature such as Storage Pool Management without needing to disable the entire VSI plug-in, causing all features to be disabled. Though the individual features can be uninstalled from this screen, they cannot be installed here. Each feature must be installed through its own executable.

Note: The VSI plug-in as a whole can only be uninstalled through the Add/Remove Programs in the Windows Operating System.
Concepts

Functional description

This section provides a high level functional description of Storage Pool Management (SPM).

The SPM functions are performed by two types of users, or roles. These roles are listed next and are detailed in “Roles” on page 34:

- Storage administrator
- VMware administrator

The functions of SPM can be broken down into four operational phases which are listed next and detailed in Chapter 2:

1. Preparing the storage environment
2. Setting up the virtualization domain
3. Allocating storage to VMware resources
4. Creating VMware storage

Roles

SPM recognizes three roles:

- Storage administrator
- VMware administrator
- VMware user

Storage administrator (SA)

The SA is responsible for:

- Creating the following autoprovisioning objects:
  - Masking views
  - Initiator groups
  - Port groups
  - Storage groups
- Setting up authorization on storage groups and thin pools
- Creating and defining storage types
- Creating and deleting virtualization domains
- Assigning thin pools to virtualization domains
Functional description

**Concepts**

- Assigning views to the virtualization domains
- Setting policies for virtualization domains including:
  - Maximum and minimum LUN size
  - Maximum number of LUNs created
  - Precreation policies

**Note:** For all of these functions, except for the setting up the authorizations, the SA must be logged into SMC as a user with the admin or storage admin role. For setting up the authorizations, he must be logged in as a user with the admin or security admin role.

---

**VMware administrator**

The VMware administrator interacts with SMC through the vSphere Client GUI with the VSI plug-in. The VMware administrator is responsible for:

- Assigning storage to VMware objects including:
  - Datacenters
  - Clusters
  - Resource pools
- Creating and deleting an RDM LUN for a VM
- Creating and deleting a VMFS datastore for a cluster
- Expanding a VMFS datastore

**Note:** The VMware administrator is restricted to assigning storage only to those VMware objects to which he has VMware authorization to administer.

---

**VMware user**

The VMware user interacts with SMC through the vSphere Client GUI with the VSI plug-in. The VMware user can:

- Create and delete an RDM LUN for a VM
- Create and delete a VMFS datastore for a cluster
- Expanding a VMFS datastore

**Note:** The VMware user is restricted to provisioning storage only to those virtual machines to which he has VMware authorization to configure:
This chapter discusses the operation of Storage Pool Management:

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Operational environment

The following are the minimum system requirements for a Storage Pool Management environment:

- Symmetrix Management Console (SMC) server
  - Server 2000, SP4 +
  - Server 2003
  - Server 2008
  - Server 2008 R2 (64-bit)
  - SunOS 5.10 SPARC
  - Red Hat AS/ES 4 update 3
  - SUSE Linux 9 SP2
- EMC Virtual Storage Integrator
- SMC GUI
  - IE 6.0 through 8.0
  - Firefox 1.0 through 3.0

Software versions required:
- Symmetrix VMAX 5874 or later; VMAXe 5875 or later
- vCenter and vSphere Client 4.0
- SYMAPI 7.1.1 or later

SMC server configurations

The following are the SMC server configurations that are supported.

Client/Server

In the client/server configuration, the SMC server resides on a separate server from the SE server.

Local

In the local server configuration, the SMC server and the SE server reside on the same physical server.
The SMC server on the service processor is not supported because there is no way for the SPM metadata to be backed up. The SMC virtual appliance is also not supported for this reason.

Dependencies

The dependencies are as follows:

- Minimum vCenter 4.0 and vSphere 4.0
- Minimum SMC 7.1.1
- Minimum SYMAPI 7.1.1
Symmetrix VMAX/VMAXe configuration

The following settings on the Symmetrix Fibre Channel1 ports are essential when using the Symmetrix with VMware ESX 4.x and ESXi 5 and VSI:

- ACLX
- UWN for Unique WWN
- SPC-2 bit for presenting SPC-2 compliant EMC Symmetrix devices.

Note: Please consult the EMC Support Matrix for an up-to-date listing of port settings.

⚠️ CAUTION

The bit settings described previously, and in the EMC Support Matrix, are critical for proper operation of VMware virtualization platforms and EMC software. The bit settings can be either set for the Symmetrix FA port or per HBA. Solutions Enabler version 6.4 and later support setting of HBA port flags on a per-initiator basis.

Note: The SPC-2 bit setting is on by default in newly shipped Symmetrix DMX arrays running 5773 and all Symmetrix VMAX/VMAXe arrays.

Note: The setting for a common serial number, C, is no longer required in VMware environments.

The host which is going to serve as the Solutions Enabler server (either local or remote) must have access to at least one LUN, preferably a gatekeeper (GK) device, from each of the Symmetrix arrays that must be resolved. If possible, have more than one LUN accessible from each Symmetrix. Without this LUN, Solutions Enabler will not be able to discover the array, and therefore VSI will not be able to resolve the devices.

1. At this time SPM supports Fibre Channel and no other protocols, e.g. iSCSI.
Solutions Enabler configuration

There are various aspects to Solutions Enabler configuration that depend on whether a local or remote Solutions Enabler database is used. Certain Solutions Enabler configurations will require additional work after Solutions Enabler is installed.

Licensing

Virtual Storage Integrator does not require any Solutions Enabler licenses. All Solutions Enabler license checking will be disabled for any operations run through VSI. This means that the user will not need to enter any Solutions Enabler licenses on the client host where VSI is installed or the Solutions Enabler server host (if one is used). SMC, on the other hand, does require a license. These two products together enable the feature of SPM.

Note: Licenses will need to be entered if the user plans to use Solutions Enabler outside of VSI, such as through the command line interface (symcli).

Local mode

Using Solutions Enabler in local mode means that the Solutions Enabler database will be maintained on the local host. Furthermore, all required connections to storage arrays will need to be made from the local host. For this reason, local mode is only supported with server operating systems that EMC supports for connection to their storage arrays. Client and desktop operating systems such as Windows XP and Windows Vista are not supported in this mode.

When Solutions Enabler is being used in local mode, the Remote Server Name text box in the Solutions Enabler Server group shown in Figure 33 on page 103 should be empty. This implies that the local Solutions Enabler database will be used. The Port text box will be ignored.

Advantages

The following are the advantages of using Solutions Enabler in local mode:

- Local mode is straightforward. There are no additional configuration steps required.
Operation

- There is no need to build and maintain a secondary host, thus reducing complexity of the solution.

Disadvantages

The following are the disadvantages of using Solutions Enabler in local mode:

- Laptops, desktops, and client operating systems such as Windows XP, are not supported in local mode because they cannot be connected to the storage.
- The host must be connected to the storage arrays which could present a security risk, and will require additional infrastructure work such as fiber connections and zoning.
- VSI will be tied to this one host which prevents it from moving with the user to other clients in the network.

Setup

In order for Solutions Enabler to perform an in-band discovery of a storage array in local mode, at least one LUN from that storage array must be accessible to the local host. Symmetrix arrays can only be discovered in-band, so this means that at least one LUN must be accessible for that Symmetrix array.

Note: If the local host is a virtual machine, then all LUNs used for in-band discovery must be raw device mappings (RDM) LUNs in physical compatibility mode so that they are not masked underneath VMFS.

Remote mode or client/server mode

Using Solutions Enabler in a client/server configuration means that the Solutions Enabler database will be maintained on a remote Solutions Enabler server. Therefore, all required connections to the storage arrays will need to be made from that remote server. Due to this connection requirement, remote mode is the only mode that can be used with client and desktop operating systems such as Windows XP and Windows Vista.

When Solutions Enabler is being used in remote mode, the Remote Server Name text box in the Solutions Enabler Server group shown in Figure 33 on page 103 should contain the IP address or fully resolved host name of the Solutions Enabler server. The Port text box should contain the port number (default 8443) where Solutions Enabler
server will be servicing requests. It is the user’s responsibility to ensure that both the server’s IP address and port are accessible from the client machine.

**Advantages**

The following are the advantages of using a remote Solutions Enabler server:

- Since a connection to the array is not required, remote mode can be used with all of the operating systems that are supported by VSI.
- A single, centralized Solutions Enabler server (such as the Solutions Enabler Virtual appliance) can service various clients and applications (including VSI), thus reducing infrastructure costs and improving security.
- VSI becomes portable and can move with the user to various client machines, provided that they are running a supported operating system.

**Disadvantages**

The following are the disadvantages of using a remote Solutions Enabler server:

- A separate host must be configured as the Solutions Enabler server. The Solutions Enabler Virtual Appliance can lessen this investment cost.
- Additional steps must be taken on both the Solutions Enabler server and the client machine in order to properly configure the security relationship.
- Depending on the port used for the Solutions Enabler server, additional network changes may be required to configure firewalls, proxies, and such.

**Setup**

When configuring a remote Solutions Enabler server, the first step is to install and start the Solutions Enabler Server daemon (storsrvd). If this service was not created at the time when Solutions Enabler was installed, then it can be created with the following Solutions Enabler command:

```
stordaemon install storsrvd -autostart
```
This service can then be started with the following command:

```
stordaemon start storsrvd
```

Without this service, your client will not be able to connect to the Solutions Enabler server.

In order for Solutions Enabler to perform an in-band discovery of a storage array in remote mode, at least one LUN from that storage array must be accessible to the remote Solutions Enabler server. Symmetrix arrays can only be discovered in-band, so this means that at least one LUN must be accessible for that Symmetrix array.

**Note:** If the local host is a virtual machine, then those LUNs must be raw device mapping (RDM) LUNs in physical compatibility mode so that they are not masked underneath VMFS.

It is possible to utilize a VMware ESX Server as the Solutions Enabler server. The steps for installing Solutions Enabler on a VMware ESX Server can be found in the *EMC Solutions Enabler 7.1.1 Installation Guide* available on Powerlink®.

- The advantage to this is that the ESX Server presumably already has access to the storage arrays, thus simplifying the setup of the Solutions Enabler server.
- The disadvantage is that it does add some complexity and load to the ESX Server.

In order for the Solutions Enabler server to communicate with clients, the chosen port must be opened in the ESX Server’s firewall. The following command will open the 2707 port for the Solutions Enabler server:

```
esxcfg-firewall -o 2707,tcp,in,SYMAPI
```

**Security considerations**

By default, all communication between VSI and the Solutions Enabler server will be secured by using SSL. Additionally, the Solutions Enabler server will verify the client’s certificate before permitting connection. More information regarding these security settings, as well as others, can be found in the *EMC Solutions Enabler 7.1.1 Installation Guide* available on Powerlink.
Symmetrix Management Console configuration

In order to provide SPM functionality in VSI, a storage administrator must first have configured a virtualization domain in SMC.

Setup

To aid SMC administrators in configuring SMC to share storage with a vCenter environment, a VMware administrator must provide details about the vCenter environment to the SA. This data includes the name of the vCenter server, a vCenter Globally Unique Identifier (GUID), and Fibre Channel port information. To simplify this process and enable the SA to take advantage of automated virtualization domain creation, the VMware administrator can export a file that contains this information and forward it to the SMC administrator. This is done in the Storage Pool Management tab through the Export configuration option. Figure 32 on page 102 provides an example of this file.

Security

All communication between VSI and SMC are performed securely over HTTPS. Clients to SMC servers must register with each server by using a client ID and password, which is provided to them by an SMC administrator. VSI registration is created on per user and per host basis. So if a currently registered user attempts to communicate with SMC from another host, or if a new user tries to communicate with SMC from the same host, a new registration will be required with SMC. Registration in this manner ensures trust that allows for messages to be digitally signed by VSI.
EMC Virtual Storage Integrator

The following prerequisites must be met before using SPM functionality in VSI.

VMware vSphere Client

The Virtual Storage Integrator currently supports VMware's vSphere Client 4.x and 5.x. VSI will not install unless the VMware vSphere Client is already installed. Due to differences in the VMware APIs, VSI will not operate with any earlier versions.

VSI will support any operating system supported by VMware vSphere Client. The VMware support matrix for vSphere Client on the VMware website can provide more details. Additionally, as long as a local installation of Solutions Enabler is required, there will be a requirement that the platform be supported by Solutions Enabler.

Despite being a 32-bit application, the VMware vSphere Client supports x64 platforms by running in compatibility mode. Likewise, the 32-bit VSI will install on x64 platforms and run in compatibility mode.

Note: As long as the vSphere Client is connecting to a vCenter Server at version 4.0 or higher, VSI will continue to function even if the ESX hosts backing that vCenter are at 3.x.

Product installation

Each executable of a VSI feature will install all of the required files. The user cannot change the install path. If vSphere Client was open during the install of VSI, then it must be closed and reopened.

Limitations

The limitations of Storage Pool Management within VSI include:

- Custom tasks can only be enabled when the vSphere Client is connected to a vCenter Server. Connecting directly to an ESX host disables all SPM functionality.
- Custom tasks can only be enabled when the VMware administrator (and subsequent users) is granted the following permissions on the vCenter: Extension.Register
Operation

Extension.Update, Extension.Unregister, Task.Create, and Task.Update. If these permissions are not set then all VSI functionality is disabled.

- The use of metavolumes is only supported when using a VMAX/VMAXe running a minimum of Enginuity 5875 and version 7.2 or later of SMC.
- The use of FAST VP policies with SPM requires version 7.3 or later of SMC and Enginuity 5875 Q2 2011 SR or higher.

Upgrade

VSI supports upgrades from VSI version 3.0 and later. The vSphere Client must be closed for the upgrade to complete successfully. All settings files, option files, and log files should remain between version upgrades. Any version earlier than 3.0 must first be uninstalled before installing VSI 5.0.

Uninstall

The VSI product can be disabled in the vSphere Client or can be uninstalled through the Add/Remove Programs applet in the Windows Control Panel. When uninstalling VSI, it is important that vSphere Client be closed to perform a clean removal of all plug-in files.

Individual VSI features can be disabled or uninstalled in the vSphere Client.

Symmetrix Management Console

In order to provide Storage Pool Management (SPM) functionality, the SPM feature of VSI requires SMC 7.1.1 or later (7.2 for metavolumes, and 7.3 for FAST VP policies) to be installed in the storage environment and configured to communicate with VSI clients. The SMC software is not a requirement of any other VSI feature.

EMC Solutions Enabler

Virtual Storage Integrator for VMware vSphere version 4.x is supported with EMC Solutions Enabler version 7.1.2 or later. Installation of Solutions Enabler software is required for the Storage Viewer feature to enable the browsing capabilities of Symmetrix and device attributes.
Note: When running on an x64 platform, the x86 version of Solutions Enabler must be installed because both the VMware vSphere Client and the VSI are x86 applications running in compatibility mode.

**PowerPath Remote Tools for Windows (optional)**

In order to successfully integrate with PowerPath/VE, the PowerPath Remote Tools for Windows Version 5.4.1 (also referred to as 5.4 SP1) or later must be installed on the client (local host) where VSI is running. VSI will use these binaries and libraries to communicate with the PowerPath/VE service that runs on the ESX hosts. The version of PowerPath/VE installed on the ESX hosts must be version 5.4 or later. The PowerPath functionality within VSI is optional. As such, this software is not a hard requirement in order to install the VSI features.
Operation

This section describes the four operational phases of SPM. It will include information on the integration of FAST VP with Storage Pool Management.

Note: In order to use FAST VP policies with SPM, version 7.3 or higher of SMC is required.

Preparing the storage environment

Preparing the storage environment is done by the storage administrator, and involves some setup of the Symmetrix array so that later operations, such as virtualization domain creation can be successfully completed.

The following is a set of array operations that the SA must perform before SPM can be used successfully. These can be completed by using standard SMC functionality, or through the CLI for Solutions Enabler. Some of these operations will be handled through the automated virtualization domain creation wizard if it is employed instead of manual setup:

1. Creation of storage resources that will later be placed into virtualization domains.
   - Thin pools
   - FAST VP policies. This includes the creation of a storage group for the policy.

2. Creation of masking views for the server clusters in the VMware environment. For each VMware cluster that LUNs will be provisioned to, a view must be created. Each view must have:
   - A port group whose ports are in the same zone as the ports in the VMware cluster
   - An initiator group which contains all the WWNs for each port on each server in the VMware cluster, regardless of whether the port is in use or zoned to the array. SPM also supports cascaded initiator groups so if the cluster server ports are in more than one initiator group they can be cascaded into a single initiator group.
• A storage group that can be an existing one, or a newly created one. If existing it cannot be associated with a FAST VP policy. If it is a new one, it will require at least one device which may be adopted later by using the virtualization domain. Alternatively, this one device could be a gatekeeper or six cylinder device.

**Note:** Empty storage groups cannot be created on the Symmetrix unless running a VMAX/VMAXe with Enginuity 5875 and higher. However, it will not be possible to create a masking view with an empty storage group.

3. Setting up the authorizations on the Symmetrix. These authorizations allow VMware administrators, through SMC, to create/delete LUNs and mask them to the VMware servers. The Section “Symmetrix authorization” on page 87 provides more details on the Symmetrix authorizations.

If enabled, the following authorizations are needed:

• Thin pool storage resource - Authorize each vCenter server on each thin pool that is to be assigned to it.

• FAST VP policy storage resource
  – Authorize each vCenter server on all the thin pools associated with the policy.
  – Authorize each vCenter server on a storage group associated with the policy that is not in the masking view.

• Authorize each vCenter server on each storage group in the views in each virtualization domain assigned to the vCenter.

In addition to these array functions, the SA must ensure that the SAN is zoned so that front-end array ports are to be used are in the same zones as the servers in the VMware clusters.

The SPM functions that are performed in preparing the storage environment are as follows:

• Creating the storage types.

• Setting up the client security. This involves the setting of a password that authenticates the VSI clients with the SMC server.
Setting up a virtualization domain

After the storage environment has been prepared, the storage administrator can begin creating virtualization domains for the vCenter. Setting up a virtualization domain involves the following steps:

1. Creating a virtualization domain with the vCenter name, description, and the GUID\(^1\) of the vCenter to which the virtualization domain is assigned. The GUID and vCenter should be copied from the exported file from VSI. The Section “Storage Pool Management” on page 97 provides detail on exporting the SPM configuration details from VSI.

⚠️ CAUTION ⚠️

Due to the potential of duplicate GUIDs, SPM does not support a vCenter installed on a cloned Windows VM that has not had sysprep run on it. Sysprep ensures that a new GUID is generated. Each vCenter used with SPM must have a unique GUID.

2. Assigning previously created views to the virtualization domain. There must be one, and only one, view for each VMware cluster that the storage in the virtualization domain will service.

3. Add previously created storage resources to the virtualization domain.

IMPORTANT

All storage resources added to the virtualization domain must come from the same array.

When adding a storage resource to the virtualization domain the SA has two decisions to make:

a. Storage Type — If the storage resource matches more than one storage type, then the SA needs to choose which one to assign to it.

1. The GUID is unique to each vCenter and is derived from the Windows operating system.
IMPORTANT

Each storage resource in an individual virtualization domain must have its own storage type. Storage types cannot be shared among different storage resources. New ones must be created for those other storage resources.

b. Capacity to commit to the virtualization domain — Typically all of a thin pool’s available capacity is committed to the virtualization domain as the thin pool is created specifically for SPM, however, it is possible to commit only a portion of it. The capacity that is committed is subscribed capacity and not physical capacity.

4. Determine the provisioning policies. The policies that can be set for a virtualization domain are:
   a. Maximum number of devices that can be provisioned for the virtualization domain
   b. Maximum size of a device
   c. Minimum size of the device
   d. Only allow LUNs of sizes that match the precreated sizes to be provisioned (enforce precreated LUNs)

5. Set any precreation policies. The Section “Precreation of thin devices” on page 59 provides details.

The previous set of steps provides for a manual setup of a virtualization domain. An example of this can be found in Chapter 4, “Customer Example”. Note that all the preparing of the storage environment and setting up the virtualization domain can all be done automatically using the automated virtualization domain setup wizard, provided SMC and the VMAX/VMAXe are at the previously noted releases. An example of automated creation is also covered in Chapter 4.

Allocating storage to VMware resources

After a virtualization domain has been created for a vCenter server by the storage administrator, the next operational phase is for the VMware administrator to allocate storage to VMware resources or objects. In VMware, the highest level object is the vCenter. It is a
centralized management server. A vCenter server can control one or more datacenters. A datacenter is comprised of one or more clusters. A cluster is comprised of one or more ESX servers.

CPU cycles and memory are compute resources. The sum of all the CPU cycles and memory of the servers in the cluster determine the cluster’s compute resources. A cluster’s compute resources can be divided into resource pools. Resource pools can be further divided into more resource pools. VM’s are created from the compute resources of a cluster or one of its child resource pools. An example is illustrated in Figure 10 on page 53.
After the SA creates a virtualization domain for the vCenter and the VMware administrator registers the SMC server, the storage in the virtualization domain is available as a storage resource to datacenters, clusters, and resource pools managed by that vCenter. A VMware administrator, who has the permissions necessary to set the compute resources for a cluster or resource pool, can also set the amount of storage available to that cluster or resource pool as well.

Figure 11 on page 55 shows an example of how the storage can be added as a third resource to the CPU and memory resources shown in the previous example. In this example:

1. The storage administrator has assigned a virtualization domain with 50 GB of gold, 200 GB of silver and 500 GB of bronze storage to the vCenter. This makes the storage in the virtualization domain available to the vCenter.

2. A VMware administrator can now assign the storage available to the vCenter to datacenters that are children of the vCenter. In this example, since there is only one datacenter controlled by the vCenter, the administrator assigns all of the storage to that datacenter.

3. There is only one cluster in the datacenter, so the administrator also assigns all the storage in the datacenter to the cluster. The cluster has compute resources (CPU and memory) and the storage assigned to the cluster becomes a third resource to the cluster.

4. A VMware administrator who has control over the cluster can divide the storage resources among the cluster’s child resource pools, in the same way that the CPU and memory resources were divided.
In Figure 11 on page 55, the VMware administrator explicitly assigned storage resources to each datacenter, cluster, and resource pool. However, it is not necessary to do this. If storage resources are not explicitly assigned to a VMware object, such as a resource pool, then the object has access to all the storage resources assigned to its parent object. If none are assigned to its parent object, then it can get resources from its parent’s parent and so on all the way up to its parent object.
parent vCenter. Thus, if no storage resources are explicitly assigned, each datacenter, cluster and resource pool has access to all the storage in the virtualization domains assigned to the vCenter. However, once storage is explicitly assigned to an object, it cannot go up to its parent to get additional storage resources.

### Creating VMware storage

The final operational phase is the actual provisioning of storage by the VMware administrator. There are two types of VMware storage: Raw Device Mappings or RDMs and VMFS datastores. RDMs are LUNs that are seen by the ESX Server and passed to a VM. This allows the VM direct access to and ownership of the LUN. VMFS datastores are also built from LUNs. They contain numerous VMware files, including files that represent virtual hard drives used by the VMs. A VMware administrator can use SPM functionality to create either one of these types of VMware storage.

To create an RDM or datastore through the vSphere Client, the following steps will take place:

1. The administrator selects the VM for which the RDM will be created or for a VMFS datastore this requires selecting the cluster where the VMFS datastore will reside.
2. In either case a LUN must be created and exposed to the ESX cluster, either the cluster the VM is running on, or the one for the VMFS:
   a. The LUN is created from the storage available to the cluster for the VMFS, or the cluster or resource pool the VM is in for an RDM.
3. The administrator enters a size and selects a type of storage, such as gold or silver, from the cluster's or resource pool's available storage.
4. This request is sent from the vSphere Client to the SPM/SMC server which determines the correct Symmetrix thin pool to use, creates a thin device in that pool, and then masks it to the cluster's server ports.
5. After the LUN/thin device has been created, and mapped and masked, the vSphere Client maps it as an RDM to the VM or formats it as a VMFS.
The Section “Cluster menus” on page 130 provides more detail on creating datastores with SPM. The Section “Virtual Machine menus” on page 144 provides more detail on creating RDMs with SPM.
Automated functions

Storage Pool Management automates several functions that would otherwise need to be performed by the storage administrator or VMware administrator.

Mapping and masking

When the VMware administrator creates a LUN for an RDM or VMFS, a thin device is created in a thin pool. This thin device must be mapped to a set of front-end array ports and then masked to the ESX cluster on which the LUN is needed. SPM does this by automatically putting the device into the storage group. This storage group belongs to the view associated with the virtualization domain. The virtualization domain in turn has an initiator group that matches the server ports for the VMware cluster for which the LUN is being created. If there is no masking view associated with the virtualization domain that has an initiator group with all the cluster ports, then the create LUN fails. This prevents LUNs from being created that are only masked to only some of the servers in the cluster or not masked to all the paths to each server.

VMFS datastore creation

A VMware administrator can create a new VMFS datastore from the EMC Storage menu. In addition to creating the LUN and masking it to the cluster, the vSphere Client portion of SPM takes care of the additional VMware steps that turn the LUN into a VMFS datastore. The Section “Cluster menus” on page 130 provides details.

RDM creation

A VMware administrator can create a new RDM LUN for a VM. In addition to creating the LUN and masking it to the cluster on which the VM resides, the vSphere Client portion of SPM takes care of the additional VMware steps to turn the LUN into an RDM and map it to the VM. The Section “Virtual Machine menus” on page 144 provides details.

Cluster server membership changes

The VMware administrator can use the vSphere Client to refresh the server membership of a cluster. This updates SPM knowledge of what server port WWNs comprise the clusters. Each time a LUN is created the WWNs for the cluster are checked against the initiator groups to ensure that the LUN is masked correctly to the cluster. If
the server membership changes, the storage administrator must update the initiator group for the server cluster. To refresh server membership, simply choose Update Storage Adapters from the EMC Storage menu at the cluster level.

**Tracking of used and available storage for VMware objects**

SPM automatically tracks the used and available storage for each VMware object. For example, a resource pool has 60 GB of silver storage, of which 10 GB is used. A VMware administrator creates a 15 GB RDM from the silver storage for a VM in that resource pool. After the RDM creation there will be 25 GB of used and 45 GB of available silver storage for the resource pool.

**Policy enforcement**

SPM enforces the provisioning policies that the storage administrator sets on the virtualization domain. Policies include:

- Maximum number of LUNs provisioned
- Maximum LUN size
- Minimum LUN size
- Provision only precreated LUN sizes

**Precreation of thin devices**

VMware VMs can be created in less than a minute. However, even with SPM’s automated functionality it can still take three to six minutes to create a new thin device and map and mask it to a cluster. In order to bring the time it takes to provision storage more in line with the time it takes to create a VM, SPM allows the storage administrator the option of setting one or more thin device precreation policies for a virtualization domain. A precreation policy allows the SA to specify that ‘x’ thin devices of a particular size and a particular type are precreated for the virtualization domain when all the devices of that size are used. Thus when a VMware administrator creates a thin device, for an RDM or VMFS, if one of the precreated sizes is chosen, the provisioning time is reduced to the time it takes to map and mask the device. If a size that is not precreated is chosen, then the administrator must wait the additional time it takes to create the thin device.
Reservations

On each Symmetrix, a Symmetrix reservation is created for SPM. Thin devices created by SPM, including precreated ones, are automatically reserved under this reservation. This allows storage administrators managing a Symmetrix to know which devices are under the control of SPM.

IMPORTANT

Certain Symmetrix tasks may require that the SPM reservation be released from a particular device after it has been created using SPM. For example, in order for an SPM device to be used in an SRDF relationship, it cannot have a reservation. Removing the SPM reservation from a device, however, will not change how SPM views that device. For example the device size will still count towards capacity.
Additional functionality

This section contains descriptions of several maintenance functions. Details on these functions may be found in Chapter 3.

Backup/restore configuration

The SPM metadata can be backed up to an external directory. (The metadata exists as a set of files.) The SPM configuration can be restored from a previous backup.

Note: Best practice is for the SPM metadata to be backed up along with the masking database.

Refresh

It is possible for the SPM configuration to get out of sync with the VMware configuration. This is because the VMware administrator can take actions through vSphere Client that SPM will not be aware of. An example of this is moving a VM from one resource pool to another. Refreshing the SPM configuration aligns it with the current VMware configuration.

Adopt an existing configuration

The expectation is that SPM may be deployed in an existing VMware configuration so that it can be used to handle any new storage provisioning. This requires that SPM be able to adopt existing LUNs and bring them under SPM control.

Note: This feature is only available for thin LUNs/devices.
Detailed behavior

This section details some of the internal behavior of SPM.

LUN creation

LUN creation is initiated by a VMware administrator who wants to create a LUN as an RDM for a VM, or as a VMFS datastore for a VMware cluster. The request comes to the SMC server as a request to create a LUN with the following parameters:

- Virtualization domain from which to take the storage
- Storage type in the virtualization domain to use
- Capacity or size
- Cluster to which the LUN will be masked

The virtualization domain and storage type are used to determine the thin pool in which the device will be created.

Several validations are done before the device is created on the Symmetrix. These are:

- The cluster is used to verify that all the server ports in the VMware cluster are represented in an initiator group in a view that is associated with the virtualization domain.
- The storage resource is examined to make sure there is enough available capacity.
- The virtualization domain provisioning policies are examined to ensure that creating this device would not violate any of the policies, such as those for maximum or minimum size.
- The vCenter is authorized to perform operations. This includes:
  - Verifying the authorization on the storage group in the masking view to be used to mask the LUN to the cluster.
  - Verifying the authorization the storage resource.
    - For a thin pool resource this means verifying there is authorization on the thin pool.
    - For a FAST VP policy resource, this means verifying the authorization on the thin pool associated with the policy to be used to create the device and the storage group associated with the policy the device will be placed in.
After the validations are done, the virtualization domain precreation policies are examined. If the capacity of the device to create matches one of these policies, then the Symmetrix is searched for an unused SPM device of that capacity. If one is found, it uses that device by:

- Releasing the device from the SPM reservation.
- Binding the device to a thin pool.
- Adding the device to the SPM reservation.
- If the storage resource is a FAST VP policy, adding the device to a storage group associated with the policy.

**Note:** An SPM unused device will be reserved with the SPM reservation, but not exist in any storage group.

If there are no unused devices of that size, or the size does not match a precreation policy, a new device must be created from scratch. Creating a device from scratch involves:

- Creating a device.
- Binding the device to a thin pool.
- Adding the device to the SPM reservation.
- If the storage resource is a FAST VP policy, adding the device to a storage group associated with the policy.

If the device size matches a precreation policy and there are no unused devices of that size remaining after the device for the LUN is created, the precreation policy activates and ‘x’ (as defined by the policy) the unused devices are created in the thin pool.

If the LUN size requested is larger than the maximum size of a single Symmetrix device then a meta LUN is created. A meta LUN is LUN created by combining several devices on the array. The algorithm for determining what size and how many devices are combined into a meta is:

- Divide the size of the LUN requested by the max size single device. If there is any remainder add one to this number. This is the number of devices that need to be created.
- Divide the size of the LUN requested by the number of devices to be created. This is the size of each device, thus all devices are the same size.
If an error occurs during the creation of a LUN, an attempt will be made to unwind the process and delete the device that was created.

Note: There are errors which make it impossible to unwind the device creation. Examples include: a stuck configuration lock on the Symmetrix and a loss of communication with the array.

Figure 12 on page 65 shows a flowchart of LUN creation.
Figure 12  Flowchart for LUN creation
Meta devices

Meta devices are supported with SPM when using version 7.2 or later of SMC and a VMAX/VMAXe running Enginuity 5875 or later. Devices larger than ~240 GB will be configured as a metavolume on the Symmetrix. To determine the number of meta members, SPM will take the requested device size, divide it by ~240GB and then add one to it if there is a remainder. In essence, therefore, SPM rounds up to the nearest whole number. For example if a request is made for an 800 GB device, that would be 800 divided by 240 which is 3.33 and rounding up to the nearest whole number would mean there would be 4 meta members, each 200 GB.

CAUTION

The Autometa feature is not supported with Storage Pool Management.

FAST for virtual pools

Fully Automated Storage Tiering for virtual pools (FAST VP) is supported with SPM when using SMC version 7.3 or higher and a Symmetrix VMAX/VMAXe array running Enginuity release level 5875 Q2 2011 SR or higher.

LUN expansion

LUN expansion is initiated by a VMware user requesting to extend an existing LUN as an RDM for a VM or a VMFS datastore for a VMware cluster. The request comes to the SMC server as a request to expand a LUN with the following parameters:

- LUN to expand
- Capacity to expand the LUN by, in other words the capacity of the LUN after it has been expanded

1. VSI will query the server to make sure a LUN can be extended before giving a user the option to do so. The server will reject a request to extend a LUN that is not already a Meta for arrays with microcode versions less than 5875.
Several validations are done before the device is extended on the Symmetrix. These are:

- The virtualization domain provisioning policies are examined to make sure that expanding this device would not violate the maximum LUN size.
- There is enough available storage capacity of the type from which the original LUN was created.
- The vCenter is authorized to perform operations on the thin pool.

After the validations are done, the number of devices that are required for the expansion is calculated. If more than one device is needed, then these devices are created from scratch. If only one device is needed, then the virtualization domain precreation policies are examined. If the expansion capacity matches one of these policies then the Symmetrix is searched for an unused SPM device. If none is found then a new device is created. If the current device is already a meta then it is simply expanded with the new device(s), otherwise it is formed into a new meta with it as the meta head.

Figure 13 on page 68 shows a flowchart of LUN expansion.
LUN deletion

LUN deletion is initiated by the VMware administrator when he wants to delete a VMFS datastore for a cluster or an RDM for a VM.
Before the device is deleted on the Symmetrix, it is verified that the vCenter is authorized to perform operations on the thin pool and the storage group the device is in.

After the validation is done, the virtualization domain precreation policies are examined. If the capacity of the LUN matches a precreation policy, then the device is:

- Released from the SPM reservation.
- Removed from all storage groups.
- Unbound from the thin pool it is bound to.
- Added to the SPM reservation.

If the capacity does not match a precreation policy, the device is completely deleted by:

- Releasing it from the SPM reservation.
- Removing it from all storage groups.
- Unbinding it from the thin pool it is bound to.
- Dissolving the meta if one exists.
- Deleting the device(s).

There is no recovery from an error that occurs during the deletion of a LUN. It is simply reported. Figure 14 on page 70 shows the flowchart for LUN deletion.
A precreation policy causes devices of particular sizes to be precreated and reserved for SPM use. This is the case for both meta and nonmeta devices. These are called SPM unused LUNs. When a VMware administrator creates a LUN of this size, SPM will look for an SPM unused LUN of that size. If one exists, SPM will use that LUN instead of creating a new device. This significantly speeds up the provisioning process as the precreated device simply has to be added to the correct storage group to mask it to the VMware servers.

A precreation policy is defined by:

- Capacity
- Number of devices that will be precreated at one time
- Virtualization domain associated with the policy
- Storage type for the policy

The combination of the virtualization domain and the storage type determines in which thin pool the precreated devices are created. Precreated devices are created by:

- Using the storage type to determine which storage resource to create the device in.
- Determining a thin pool to use in the storage resource.
- Creating and binding the device in the thin pool.
- Unbinding the device from the thin pool.
- Reserving the device with the SPM reservation.

After the last device of a precreated size is used, ‘x’ more devices of that size are created in the thin pool, and added to the SPM reservation. The ‘x’ is the number specified in the precreation policy.

New, precreated devices are not created when a new precreation policy is set up or modified. They are created only after a LUN is created and there are no precreated devices of that size left. Thus, the first LUN created of a size that matches a newly set up precreation policy will always be created. The LUN takes longer to create, but afterwards the ‘x’ precreated devices of that size will also be created, and the second LUN of that size will use one of those precreated devices.

**Note:** Precreated meta devices cannot be used to extend and existing device.

### SPM reservation

On a Symmetrix, SPM automatically creates an SPM reservation. All devices that are under SPM control are reserved with this reservation. This makes the storage administrators working on the Symmetrix aware that these devices are being used by SPM.

Devices are added to the SPM reservation when:

- They are created by SPM.
- They are adopted into SPM.
Devices are released from the SPM reservation when:
- They are deleted by SPM.
- The storage resource they are in is removed from a virtualization domain. If a storage resource is associated with multiple virtualization domains, then only the devices for LUNs in the virtualization domain that the thin pool is being removed from are released from the reservation.

Mapping and masking

After the SPM device is created, it must be masked to the servers in a VMware cluster. Ultimately this is accomplished by putting the device into a storage group which is in a view that has an initiator group with all the WWNs of the HBA ports on the servers in the cluster. Figure 15 on page 72 demonstrates the mapping and masking steps.
Note: If a storage administrator changes a view name, VM administrators will be unable to create LUNs for the cluster the view is for. The storage administrator must update each virtualization domain with the new view name.

SPM LUNs

LUNs or devices that SPM controls are individually tracked by SPM by storing metadata information about each device in its persistence store. In addition, all the devices that SPM controls are reserved by the SPM reservation. Each LUN or device has two states:

- **Used** — Device is being used by a VMware cluster. The device is:
  - Tracked by SPM metadata.
  - Reserved by the SPM reservation.
  - Masked to a VMware cluster because it is in a storage group in a view associated with a virtualization domain.

- **Unused** — Device has been precreated and is waiting to be masked to a VMware cluster. The device is:
  - Reserved by the SPM reservation.

Adopt LUNs

The adopt LUNs process is used to bring LUNs or devices, that are not currently under SPM control, under SPM control. Adopting LUNs is done typically to repair an SPM configuration that has been corrupted or lost, or to put an existing VMware configuration under SPM control. Below are the requirements for a LUN to be adoptable into a virtualization domain:

- Must be in a storage group that is part of a masking view associated with a virtualization domain. This ensures that the LUN has been masked to one or more of the vCenter’s VMware cluster.
- Not reserved, or already reserved by SPM.
- Come from a storage resource, thin pool, or FAST VP policy that has been assigned to the virtualization domain.
- If the storage resource is a policy, then the policy’s storage group the LUN is in must have an authorization for the vCenter.
When a LUN is adopted the following things occur:

- The LUN is added to the SPM reservation, if it does not already belong to it.
- The LUN’s storage capacity is added to its storage resource’s capacity that is committed to the virtualization domain. This keeps the virtualization domain’s available capacity from this storage resource the same.
- If there is a value for the max number of LUNs in the policy of the virtualization domain, the number of LUNs adopted is added to it.
- The total capacity of the virtualization domain. The capacity of the LUN is counted as used capacity, not available capacity.

Initially the LUN’s storage is accounted for at the vCenter level. To have its capacity be accounted for at the correct VMware object level, a VMware administrator needs to update the VMware configuration in the Storage Viewer by running a refresh configuration as seen in Figure 106 on page 195 of Chapter 4. A refresh is required even if LUNs are adopted during the creation of a virtualization domain.

Automated virtualization domain creation

The algorithm for automatically setting up a virtualization domain derives input from the exported vCenter XML file and from the storage administrator. The storage administrator must run this as an SMC user with the Admin role, as the wizard does both storage configuration changes and authorization changes. The input data is as follows:

1. From the vCenter XML file the following information is automatically obtained:
   a. vCenter server name
   b. vCenter GUID
   c. ESX clusters
      – List of FC ports and their WWN’s for each cluster
2. The following is entered by the Storage Administrator:
   a. Existing port group per cluster to use

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1. Requires a minimum of VSI 4.0, SMC 7.3, and Enginuity 5875 Q2 2011 SR.
b. Provisioning policies for the virtualization domain:
   1. Maximum number of LUNs (optional)
   2. Maximum LUN size (drop-down selection or manually enter custom size)
   3. Minimum LUN size (drop-down selection or manually enter custom size)

c. For each storage resource on the array:
   1. User indicates whether the user should be added to the virtualization domain
   2. Storage type to use (select an existing storage type or enter the name of a storage type to be created)
   3. Capacity to assign from this resource to the virtualization domain
   4. Whether to adopt LUNs from this resource

With the above input, the algorithm goes through the following steps:
1. Creates the virtualization domain from the vCenter server name and vCenter GUID
2. Sets the virtualization domain policies with the user’s input
3. For each cluster, if a port group has been entered, sets up its masking:
   a. Finds, or creates a new initiator group for each ESX cluster in the vCenter. See the section “Initiator group selection or creation” on page 76 for details.
   b. Finds, or creates a storage group. Adds an authorization if necessary.
   c. Finds, or creates a view. See the section “Masking view selection or creation” on page 78 for details.
   d. Adds the view to the virtualization domain
4. For each storage resource being added to the domain
   a. If the storage resource is a thin pool:
      1. Creates an authorization for the thin pool
   b. If the storage resource is a FAST VP policy:
Operation

1. Selects one of the storage groups from those associated with the policy or creates a new one. See the section “Storage group device creation” on page 79 for details.

2. Creates an authorization for the vCenter on the selected storage group.

3. Creates an authorization for the vCenter on each thin pool in the policy.

c. Creates a new storage type if needed for the storage resource.

d. Adds the storage resource to the virtualization domain.

e. If the adopt LUNs flag is set then adopts the LUNs from that storage resource.

Initiator group selection or creation

The ideal case when creating a virtualization domain is to find or create an initiator group for each ESX cluster that contains all the initiator ports for that cluster. However, if only some of an ESX cluster’s ports already exist in an initiator group then cascaded initiator groups need to be used.

The algorithm, therefore, performs the following:

1. Creates a list of all the initiator groups that contain one or more of the cluster’s initiators.

2. If there is already one initiator group that contains all the cluster’s initiators then that one is used.

3. If this list is empty, it creates a new initiator group containing all of the cluster’s initiators.

4. If there is one or more initiator groups that contain some but not all the cluster’s initiators:
   a. Creates an initiator group containing the remaining initiators.
   b. Creates an initiator group and make it a parent initiator group with all the other initiator groups as children.

1. Automated virtualization domain creation cannot create multiple initiator groups if no groups (with initiators from the cluster) currently exist, and therefore cannot be used when a cluster has more than 32 initiators (max per initiator group). In this case the manual virtualization domain creation needs to be used. If the initiator groups exist already, however, it can create a parent initiator group for the cluster which has more than 32 initiators.
Port flags

Front end ports on the Symmetrix carry flags which determine how they interact with server HBAs. Initiator flags can override port flags, or add flags for particular initiators. VMware clusters have the following flag requirements:

1. Required Port Flags - Must be set
   a. UWN - Universal World Wide Name
   b. ACLX - Access control logic
   c. SPC-2 - Set as a port flag or an initiator group flag
2. Optional Port Flags - have no impact
   a. EAN - Enable auto negotiate
   b. SCSI3 - SCSI version 3
   c. C - Common serial number
   d. OS2007
3. Optional Initiator Flags
   a. SPC-2 - Only optional if the ports already have this flag set
   b. SCSI3
   c. C - Common serial number
   d. OS2007
   e. Consistent LUN

Initiators also have disable flags which can be used to disable undesirable flags that have been set on the ports. For example, if the Volume Set Addressing port flag is set (invalid for a VMware installation), the disable Volume Set Addressing flag could be set on the initiators making it valid for a VMware environment.

If an initiator group is created for a masking view during automated virtualization domain setup, the flags will be set using the following rules:

1. Existing initiator group flags will not be changed.
2. The ports in the port group for the masking view must all have the same flags set for the required port flags. Optional port flags are ignored.
3. If there is an already existing initiator group(s) which covers some or all of the VMware’s cluster WWN’s, their flags must meet the following requirements:
   a. If there is more than one initiator group then all the initiator groups must have the same flags set
   b. The initiator group(s) may only have flags set which are optional.
   c. If the port group does not have the SPC-2 set, then the initiator groups must have it set.
   d. If the port group has any flag set that is not required or optional then the initiator group flags must disable it.
4. If a new initiator group is created and there are already existing initiator groups then it will have the same flags set and disabled as the existing ones.
5. If there are no existing initiator groups then the new initiator groups created will fulfill the requirements:
   a. If the port group does not have the SPC-2 set, then the initiator group(s) will have it set.
   b. If the port group has any flag set that is not required or optional then the initiator group(s) flags will disable it.

**Masking view selection or creation**

Automated virtualization domain setup attempts to give each cluster its own masking view, which is either an existing one, or a newly created. The algorithm for selecting or creating a view is as follows:

1. Looks for a view that contains the initiator group for the cluster, the port group that the user selected for the cluster, and a storage group that is not in a policy. The initiator group for the cluster is either found or created using the algorithm from the previous section “Initiator group selection or creation” on page 76. If a view is found then use it.
2. If no view is found then one must be created along with a new storage group. The following steps are taken:

---

1. If a single view is required for more than one cluster, manual virtualization domain creation needs to be used.
a. Create a device. See the section “Storage group device creation” on page 79 for more details.
b. Create a new storage group using that device.
c. Create a masking view with the cluster’s initiator group, the user entered port group, and the newly created storage group.

Storage group device creation

When a new storage group is created, for a FAST VP policy or a new masking view, it must be created with a device. For a new storage group for masking:
1. A single device will be created for all the storage groups needed for masking.
2. The device will be created in the first storage resource that is being assigned to the virtualization domain.
3. The device capacity will be 200 MB
4. This capacity will be subtracted from the to use capacity of the first storage resource
5. The device will not have an SPM reservation

For a new storage group for a FAST VP policy:
1. A new device will be created for each new storage group for a policy.
2. The device will be created in the thin pool associated with a policy that would be selected for provisioning, see the following section “Thin pool assignment when provisioning devices in a FAST VP policy” on page 84.
3. The device capacity will be 200 MB
4. This capacity will be subtracted from the to use capacity of this FAST VP policy storage resource
5. The device will not have an SPM reservation

FAST VP policy storage group selection

This algorithm is used to select the storage group associated with a policy to add an authorization for the vCenter server. It is also the same algorithm used to select which policy’s storage group to add a device to when doing provisioning. The algorithm is as follows:
1. Get all the storage groups associated with the policy
2. Filter out those associated with a view
3. From the remaining storage groups select one based on the following criteria:
   a. First SPM storage group with SPM reserved devices in it. An SPM storage group is identified by parsing its name and looking for the SPM prefix.
   b. Otherwise, the first SPM storage group
   c. Otherwise the first storage group with SPM reserved devices in it.
   d. Otherwise the first storage group
Storage Resources

Storage resources are storage-containing-objects in the Symmetrix that contain real, physical storage. They are attached to virtualization domains and backup the storage types shown in VSI with actual storage. Specifically they can be either thin pools or FAST VP policies.

Thin pool as a storage resource

A thin pool can be a storage resource, as long as it does not belong to a storage tier.

Thin pool capacity calculations

When a thin pool is added, or modified, to a virtualization domain, the storage administrator must specify the amount of capacity from the thin pool to assign to the virtualization domain. The amount that is assigned is a subscribed, or virtual, capacity. Subscribed capacity is a presented capacity and not a physical capacity. Thus, the storage administrator can choose to oversubscribe the thin pool by assigning more storage than is physically available. Three values guide the storage administrator in determining how much subscribed capacity to assign to the virtualization domains:

1. Maximum Subscribed Capacity: This value is calculated by multiplying the maximum subscription percent (set by the storage administrator in SMC) by the physically enabled capacity of the thin pool. Thus this value represents the total subscribed capacity available.

2. Current Subscription Capacity: This value is the amount of the maximum subscribed capacity of the thin pool that has already been promised, but not necessarily used, to other things. It is calculated by adding up all the capacity that has been assigned to all virtualization domains and the sum of capacities of all the thin devices in the pool that are not managed by SPM.

3. Available Subscription Capacity: This value is the difference between the maximum and current subscribed capacities. It represents the maximum capacity that a storage administrator can further assign from the thin pool.
Note: If the storage administrator does not want to enable overprovisioning of the thin pool, the maximum subscribed capacity should be set to 100 percent when creating the thin pool for SPM. Note that this is not the same as leaving the field null.

**FAST VP policy as a storage resource**

A FAST VP policy can be a storage resource.

⚠️ **CAUTION**

In VMware vSphere 5 there is a new concept called Storage Distributed Resource Scheduler, or SDRS which operates on a new vCenter object called a Datastore cluster. The Datastore cluster object is created in vCenter and is comprised of a pool of datastores. SDRS serves to balance VMs within the Datastore cluster using algorithms based on capacity and/or IO response times. This balancing can be achieved manually through recommendations, or can be fully automated. When using a FAST VP policy as a storage resource in SPM, it is important to note that only capacity-based SDRS is supported with EMC’s FAST VP, not performance-based SDRS.

**FAST model**

A FAST VP policy is composed of up to three different tiers of storage. Each tier is composed of one or more thin pools. In addition to the tiers of storage, a policy also includes one or more storage groups. Thin devices that are placed in these storage groups have their storage split between the tiers of storage based on the parameters set in the policy.
Virtualization domain setup

A virtualization domain has one or more masking views associated with it in order to mask LUNs to the VMware clusters. Typically there is one masking view per cluster. Each masking view has a storage group. In addition, a FAST VP policy has one or more storage groups where devices created for the FAST VP policy can be placed.
Note: When assigning a policy to a virtualization domain, the storage type used cannot have any properties, e.g. disk type or RAID configuration. This is because a policy has multiples of these properties.

Thin pool assignment when provisioning devices in a FAST VP policy

When a LUN is provisioned from a FAST VP policy storage resource, a device is created in one of the thin pools associated with the policy. The thin pool is selected by using the following algorithm:

1. The tiers are sorted by the percent of the tier that can be used by devices with this policy

2. Starting with the tier with the highest percent, the tier's thin pools are examined for their unsubscribed capacity. The thin pool with the largest amount of unsubscribed capacity that is greater than the capacity requested is selected.
3. If none of a tier’s pools have enough unsubscribed capacity the tier with the next highest percent is examined.

**Storage group assignment when provisioning devices in a FAST VP policy**

This algorithm is used to select which policy’s storage group to add a device to when doing provisioning. The algorithm is as follows:

1. Get all the storage groups associated with the policy
2. Filter out those associated with a view
3. From the remaining storage groups select one based on the following criteria:
   a. First SPM storage group with SPM reserved devices in it. An SPM storage group is identified by parsing its name and looking for the SPM prefix.
   b. Otherwise, the first SPM storage group
   c. Otherwise the first storage group with SPM reserved devices in it.
   d. Otherwise the first storage group

**Calculating a FAST VP policy’s capacity**

Storage pool management calculates and manages subscribed capacity. The maximum subscribed capacity of a FAST VP policy is determined by:

1. For each thin pool in each tier of the policy, multiply the max subscription percent by the thin pool’s physical capacity. This creates a max subscribed capacity for the thin pool.
2. Sum the max subscribed capacities for each thin pool in a tier and then multiply by the policies percent for that tier to get the tier’s max subscribed capacity for the policy.
3. Sum the max subscribed capacities for each tier in the policy to get the policy’s max subscribed capacity.

The available capacity of a FAST VP policy is determined by:

1. For each FAST VP policy that shares thin pools with this FAST VP policy:
   a. Determine how much capacity is assigned to virtualization domains.
b. Determine how much of the capacity assigned to virtualization domains can be accounted for by thin pools not in the original policy

1. This is done by adding up the total capacity in all the thin pools that are not used by the original policy, less any non-SPM devices that are created in these pools.

2. The capacity assigned to virtualization domains is subtracted from this number, if the remainder is positive then this policy does not have to use any of the capacity in the original policy’s thin pools. If it is negative, then this policy has already committed some of the capacity from the original policy’s thin pools.

2. The original policy’s available capacity is the sum of its thin pool’s max subscribed capacities less any non-SPM devices and less any capacities committed from those pools by other policies.

### Maximum LUN Size

In release 7.2 of SMC, the maximum LUN size that can be created is limited by the max LUN size policy for the virtualization domain or, if smaller, the available capacity for that type of storage. In release 7.3 of SMC, another restriction to the maximum LUN size is added for types of storage that consist of FAST VP policies. This restriction limits the maximum LUN size to the maximum available space in the largest thin pool under the policy. This is because a device can only be bound to one of those thin pools, though it may eventually have data in the other pools. For example, a “Gold” storage type is built on a FAST VP policy containing three thin pools in a virtualization domain that has a max LUN size policy of 1 TB. In VSI that Gold storage shows 800 GB of total available storage. Looking at the individual thin pools in the policy, however, it shows that there is 200 GB available in one, 400 GB in another, and 600 GB in the last. Therefore 600 GB is the maximum LUN size because that is the most capacity available in any of the thin pools under the policy.
Security and authorization

This section describes the security used in SPM.

Symmetrix authorization

There are specific SYMAPI authorizations for SPM to provide additional security within the Symmetrix:

- The Storage Admin — Virtualization Domain role has the ability to perform operations on thin pools and storage groups. All vCenter Administrators are given this role.
- Authorizations can be set for groups.
- Authorizations can be set on individual thin pools and storage groups.
- An authorization on a thin pool also allows the user to:
  - Create or delete a device.
  - Bind a device to an authorized thin pool.
  - Unbind a device from an authorized thin pool.
  - Reserve a thin device that belongs to an authorized thin pool.
  - Release a thin device that belongs to an authorized thin pool from a reservation.
- An authorization on a storage group allows a user to put a device into a storage group or remove a device from a storage group

These authorizations have two functions. One is to ensure that vSphere Clients can manipulate only Symmetrix storage objects on which they are authorized. The other is to provide some protection from other storage administrators to the Symmetrix objects that SPM is using.

Storage provisioning commands from the vSphere Client come with a user ID and group ID. The user ID is the name the user used to log in to the vCenter server. For instance, in order for a user on vCenter server ABC to create a LUN through SPM, two privileges are required to have been granted:

- The role of Storage Admin — Virtualization Domain on the thin pool associated with the virtualization domain.
Operation

- The role of Storage Admin — Virtualization Domain on the storage group associated with the virtualization domain.

**Note:** The Symmetrix authorizations are automatically configured when using the Auto

### SMC roles

A choice for StorageAdmin — Virtualization Domain is available in the Role choices specifically for SPM (Figure 19 on page 90 shows this). This role indicates that the user is attempting to set up a virtualization domain permission rule. When this choice is selected:

- The Name field will change to Virtualization Domain Name.
- The Component fields will become active.
- The Type choices for selecting user/group will change to an uneditable WebLabel and have group selected.

The user will enter the virtualization domain name in the Virtualization Domain Name field. Realizing that the fully qualified name is of the form V:xxx\users, and that the V: and users portions do not change, the user must only enter the xxx portion. This Virtualization Domain Name will be used to construct the fully qualified name for the user. This will help eliminate any questions about the format of the name and reduce the possibility of the user typing it in wrong. Should the user try to enter the fully qualified name, then an error message will be presented:

*Please enter the Virtualization Domain without V: or \users.*

The virtualization domain must be the name of the vCenter that will be provisioning the storage. It can be obtained by exporting the environment from the vSphere Client. The Section “Storage Pool Management” on page 97 has more detail. When the OK button on the Add Permission dialog box is clicked, a message that confirms the creation of a virtualization domain rule appears to the user. A rule will be created for V:xxx\users. This message displays the option Don’t show this confirmation dialog box again so that the user can bypass the message.
A selection button and dialog box help select a storage group or thin pool. Depending on the selected type of component a dialog box displays a table of storage groups or thin pools. Figure 21 on page 91 and Figure 22 on page 91 show this. The text box that gets populated with the name will be editable so that the user can delete the entry. Figure 18 on page 89, shows entries for a normal permission rule.

![Add Permission Dialog Box](image)

**Figure 18 Normal Permission**

When setting up permissions for SPM, select the role StorageAdmin — Virtualization Domain. Figure 19 on page 90 and Figure 20 on page 90 show the dialog boxes.
The storage group selection is shown in Figure 21 on page 91 and in Figure 22 on page 91.
Communication between the vSphere Client and the SMC/SPM server uses SSL.

Trust is established between the vSphere Client and the SMC server initially through a password. After the first login of the client to the server by using the password, the client's certificate is stored on the SMC server. This is used to validate any further communications with the client.
The VMware administrator role possesses all the permissions it requires to use SPM. While that role is typically used in test, development, and lab environments by all users, production environments require tighter control. Many VMware administrators of production environments will create specialized roles in the vSphere Client for the users, perhaps based on the business unit, or the user’s function. In such cases, these users may own a single VM or even groups of VMs through resource pools. It may be desirable to allow these users to add RDMs to their own VMs through Storage Pool Management.

There are two sets of permissions a VMware user must have in order to use the SPM integration: Extension and Tasks. These privileges must be applied at the vCenter level and set to propagate through the entire environment. In Figure 23 on page 93 the user vmwareuser is assigned a new role called SPM which has the sets of privileges Extension and Tasks. Note that the setting Propagate to Child Objects in the red box is checked. If this is not checked, even a VMware user that has administrator privileges on a VM will not be able to use SPM to create the RDM.
Figure 23 Assign Extension Permission to a VMware user
SPM views and operations in EMC VSI

EMC VSI global view

The following is a detailed description of the functionality that is available in the EMC VSI global view. Figure 24 on page 94 shows the default global view that is presented upon navigating through Home > Solutions and Applications > EMC. By selection the navigation options on the left-hand panels under Settings or Features, the right-hand panel displays the choice.

Settings navigation panel

The settings navigation panel in Figure 25 on page 95 includes two options: Feature Manager and Logging.
Feature Manager

By choosing Feature Manager, the default selection, one is presented with a panel on the right displaying all current VSI features installed along with the version and whether they are enabled or disabled. From this panel seen in Figure 26 on page 95 one is able to disable or uninstall individual features.

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Vendor</th>
<th>Version</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path Management</td>
<td>EMC Corporation</td>
<td>4.0.0.140</td>
<td>Enabled</td>
<td>A VSI feature that allows users to change multi-path settings.</td>
</tr>
<tr>
<td>Storage Pool</td>
<td>EMC Corporation</td>
<td>4.0.0.134</td>
<td>Enabled</td>
<td>A VSI feature that allows users to manage storage pools.</td>
</tr>
<tr>
<td>Storage Viewer</td>
<td>EMC Corporation</td>
<td>4.0.0.131</td>
<td>Enabled</td>
<td>The Storage Viewer feature for EMC VSI for VMware vsphere.</td>
</tr>
</tbody>
</table>

Logging

The Logging option displays the available loggers, log files, and log levels. There are loggers available for each installed feature. Within the panel is an area where the current selected log entries are shown. This is shown in Figure 27 on page 96.
Figure 27  Logging

Each item in the Logging panel is described here:

- **Log Files combo box** — This box is used to select the log to show in the panel. The log files themselves are available on the local Windows client in: %APPDATA%\EMC\Virtual Storage Integrator\vSphere4\Logs.

- **Loggers combo box** — This box is used to select the log.

- **Log Levels combo box** — This box is used to select the log level to use for the selected log in the Loggers combo box. Possible values are off, fatal, error, warn, info, debug, all. The default value for each, when the plug-in is first loaded, will be info.

- **Open folder icon** — This action will open the folder %APPDATA%\EMC\Virtual Storage Integrator\vSphere4\Logs.

- **Log search icon** — This action allows the user to search through the logfiles.

- **WinZip icon** - This action allows the user to export all log files into a single zip file.

### Features navigation panel

The features navigation panel in Figure 28 on page 97 includes two features: Storage Pool Management and Storage Viewer.
Storage Pool Management

The Storage Pool Management servers panel, as shown in Figure 29 on page 97, displays all of the SMC servers with which VSI is currently registered. This list is configured by the user through various controls in this panel.
Each item in this panel is described here:

- **Register... button** — This button, when clicked, opens a wizard that allows the user to enter connection details for a new SMC server:
  
  - The first page, as shown in Figure 30 on page 99, accepts the hostname or IP address of an SMC server, the secure port for communication to SMC, a client ID, a password, and a certificate name. The port must be the secure (HTTPS) communication port configured for the SMC server by the SA. Values must be in the range 1 — 65535. The client ID is provided by an SA and may not contain the ’/’ character. The password should be supplied by the SA along with the client ID. The certificate name is used to select a certificate from the Windows certificate store to ensure integrity of all messages with the SMC server. The value provided is used to retrieve a certificate from the certificate store. This certificate’s Subject CN field contains the same value. If no certificate with this value exists, a self-signed certificate will be generated automatically. If a user certificate is to be used in the certificate store, such a one that is from a trusted certificate authority (CA), the user may input the CN value and that certificate will be used instead of the autogenerated certificate. The certificate name may not contain a slash (/). Figure 30 on page 99 shows a Test Connectivity button. If the connectivity test fails, the Next button is disabled until some of the connection settings have been modified.

**Note:** The Test Connectivity button is only testing network connectivity and is not validating the client id or whether SMC is installed.
Figure 30  Register with server settings dialog box

- The final page, as shown in Figure 31 on page 100, summarizes the inputs and when Finish is clicked begins an operation to register the SPM client with the SMC server.
For this button to be enabled, the VMware administrator must be granted the following permissions on the vCenter:

For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
- Task.Create
- Task.Update

- Remove context menu — This menu is available when registered server is right-clicked. When remove is chosen from the menu, the selected server is removed from the list and a warning message is displayed to warn the user about the change.

- Test Connectivity… context menu — This menu is available when registered server is right-clicked. When test connectivity is chosen, a test connection is made to the selected server to test connectivity to the server address. While connecting the status bar is updated. Upon error, an indicator will display below the server list along with a message describing the problem. The connection made does not test the registration with the server and is simply a test to ensure that the server is available and listening at the address and port provided.

- Refresh Configuration button — This button, when clicked, begins an operation to update each of the registered servers with the current VMware inventory hierarchy environment.
  - For this to execute, the VMware administrator must be granted the following permissions on the vCenter:
    - Task.Create
    - Task.Update

- Export Environment button — This button, which clicked, enables the export of various VMware environmental details to a file as seen in Figure 32 on page 102. A save file dialog box enables the user to choose where to export the file to and allows them to select the file format (XML or text). This file can be used by a storage administrator to acquire vCenter information and masking details for creating virtualization domains within SMC. This file is also required to be on the SMC server when using the Automated Virtualization Domain Setup task in SMC.
Storage Pool Management Feature in EMC Virtual Storage Integrator

Figure 32 SPM export file

Storage Viewer

The Storage Viewer navigation panel has a number of selections servers panel, as shown in Figure 28 on page 97. These are: Solutions Enabler, Symmetrix Arrays, CLARiiON Arrays, Celerra Systems, and VPLEX™ Systems. By choosing each of these selections, the right-hand panel is populated with the appropriate information.

Solutions Enabler

The Solutions Enabler panel contains the settings required to use Solutions Enabler in client/server mode. This is shown in Figure 33 on page 103.
If Solutions Enabler is installed, but there is no local connection to the storage, then Solutions Enabler can be configured to use a different server that does have a connection to the storage. That server must be running the Solutions Enabler Server service (named storsrvd). The user must enter the IP address and port number for that remote server, and then hit the Save Connection button. The plug-in will then utilize Solutions Enabler in client\server mode in order to perform the storage mapping. The connection to the Solutions Enabler server can be tested with the Test Connection button.

Each item in the panel is described here:

- **Remote Server Name Box** — Indicates the name or IP address of the remote server to use for Solutions Enabler in client\server mode.
- **Port Box** — Indicates the port number to use for communication with a remote instance of Solutions Enabler. This port number can be configured on the remote host before starting the Solutions Enabler service.
- **Local Solutions Enabler** — Shows the currently installed version of Solutions Enabler on the local host.

---

### Figure 33  Solutions Enabler Server dialog box

<table>
<thead>
<tr>
<th>Remote Server Name</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.12.129.92</td>
<td>2707</td>
</tr>
</tbody>
</table>

- **Test Connection**

- **Save Connection**

  - ✔ Successfully connected to the remote Solutions Enabler server.

- **Local Solutions Enabler**: 17.2.0.551-5102
- **Remote Solutions Enabler**: 17.2.0.565-1102
Remote Solutions Enabler — Shows the currently installed version of the remote Solutions Enabler if configured.

Test Connection button — This button, when clicked, will test Solutions Enabler in client\server mode. The plug-in will create a Solutions Enabler session with the remote host and gather the version of Solutions Enabler installed there, to prove that the connection is valid. The status of the test appears in a label below the button, such as in Figure 34 on page 104.

Save Connection button — Saves the settings for the remote Solutions Enabler connection. These settings remain in a flat configuration file and are subsequently reloaded with the plug-in.

Symmetrix Arrays

The Symmetrix Arrays selection displays all the Symmetrix arrays that are managed with Solutions Enabler. This is shown in Figure 35 on page 105.
Figure 35  Symmetrix Arrays

Each item in this panel is described here:

- Discover New Symmetrix button — This button, when clicked, will perform an in-band discovery of new Symmetrix storage array. To discover a new array using this button, Solutions Enabler (either local or remote) must have direct access to a LUN from that storage array. If a new storage array is discovered then it will appear in the Symmetrix Arrays panel.

- Refresh List button — This button, when clicked, will refresh the list of Symmetrix storage arrays. This button will not discover new storage arrays.

- Sync All Arrays button — This button, when clicked, will force Solutions Enabler to synchronize with each of the storage arrays in the Symmetrix Arrays panel. This operation will update Solutions Enabler with any changes that occurred on a given storage array, such as the addition of new disks, and the creation of new LUNs. This operation can be time-consuming. So if you suspect that only a single array has changed, then use the Sync Array button instead.
Symmetrix Arrays list — This list shows all of the Symmetrix arrays that Solutions Enabler has discovered. Each item in the list should have an icon that represents the model of Symmetrix array. And each item will have the following properties shown in its respective columns:

- Auto Sync — This column has a checkbox for each Symmetrix storage array. If selected every operation that requires an SE connection for that array will run a sync.
- ID column — This column shows the serial number (or ID) of the storage array.
- Model column — This column shows the model of the storage array.
- Firmware column — This column shows the version of firmware that is installed on the storage array.
- Attachment column — This column shows the attachment of the storage array, which indicates whether the array is locally discovered or remotely discovered (such as over an SRDF link).
- LUNs column — This column shows the number of LUNs that are currently configured on the storage array.
- Disks column — This column shows the number of disks that are installed in the storage array.
- Front-End Ports column — This column shows the number of front-end ports that exist within the storage array. These ports are those to which a host can connect, not RA ports, DA ports, and such.

Sync Array button — This button, when clicked, will force Solutions Enabler to synchronize with the currently selected Symmetrix storage array. This button will not be enabled until a storage array is selected. This operation will update Solutions Enabler with any changes that occurred on the selected storage array, such as the addition of new disks and the creation of new LUNs. Also, the properties of the array show in the columns should be updated after the sync is complete.

Status box — This box will contain any information that may be generated due to an action of the other buttons.
CLARiiON Arrays

The CLARiiON Arrays selection displays all the CLARiiON arrays that are managed with Solutions Enabler or that have been manually discovered. This is shown in Figure 36 on page 107.

Figure 36  CLARiiON Arrays

Each item in this panel is described here:

- Discover New CLARiiON Array button — This button, when clicked, will perform a discovery of new CLARiiON storage arrays based upon the information provided in the following fields:
  - SP-A Name or IP
  - SP-B Name or IP
  - Scope
  - Username
  - Password
  - Re-Type Password
Operation

- Refresh List button — This button, when clicked, will refresh the list of CLARiiON storage arrays. This button will not discover new storage arrays.

- Sync All Arrays button — This button, when clicked, will force Solutions Enabler to synchronize with the CLARiiON storage. This operation will update Solutions Enabler with any changes that occurred on a given storage array, such as the addition of new disks, and the creation of new LUNs. This operation can be time-consuming. So if you suspect that only a single array has changed, then use the Sync Array button instead.

- CLARiiON Arrays list — This list shows all of the CLARiiON arrays that Solutions Enabler has discovered or have been manually discovered. Each item in the list should have an icon that represents the model of CLARiiON array. And each item will have the following properties shown in its respective CLARiiON:
  - Auto Sync — This column has a checkbox for each Symmetrix storage array. If selected every operation that requires an SE connection for that array will run a sync.
  - Name column — This column shows the serial number (or ID) of the storage array. If a friendly name is configured for this storage array then that name will be shown instead.
  - Model column — This column shows the model of the storage array.
  - Firmware column — This column shows the version of firmware that is installed on the storage array.
  - Attachment column — This column shows the attachment of the storage array, which indicates whether the array is locally discovered or remotely discovered (such as over an SRDF link).
  - LUNs column — This column shows the number of LUNs that are currently configured on the storage array. This value includes snapshot LUNs. The value may differ from numbers shown in other tools (such as `symcfg list -clar`).
  - Disks column — This column shows the number of disks that are installed in the storage array.
  - Front-End Ports column — This column shows the number of front-end ports that exist within the storage array. These ports are those to which a host can connect, not RA ports, DA ports, and such.
Sync Array button — This button, when clicked, will force Solutions Enabler to synchronize with the currently selected CLARiiON storage array. This button will not be enabled until a storage array is selected. This operation will update Solutions Enabler with any changes that occurred on the selected storage array, such as the addition of new disks and the creation of new LUNs. Also, the properties of the array show in the columns should be updated after the sync is complete.

Status box — This box will contain any information that may be generated due to an action of the other buttons.

Celerra Systems

The Celerra Systems selection displays all the Celerra systems that have been manually discovered. This is shown in Figure 37 on page 110.

1. In addition to Celerra there is also a VNX Systems display in VSI 4.1 which is not detailed herein. Please see the VSI Product Guide for more information.
Each item in this panel is described here:

- **Discover New Celerra System button** — This button, when clicked, will perform a discovery of new Celerra storage systems based upon the information provided in the Celerra Control Station box:
  - Host Name or IP
  - Username
  - Password
  - Re-Type Password

- **Refresh List button** — This button, when clicked, will refresh the list of Celerra storage systems. This button will not discover new storage systems.

- **Celerra Systems list** — This list shows all of the Celerra systems that have been manually discovered. Each item in the list should have an icon that represents the model of Celerra system. And each item will have the following properties shown in its respective Celerra:
  - **Name column** — This column shows the IP of the Celerra storage system.
  - **ID column** — This column shows the serial number (or ID) of the storage system. If a friendly name is configured for this storage system then that name will be shown instead.
  - **Model column** — This column shows the model of the storage system.
  - **Firmware column** — This column shows the version of firmware that is installed on the storage system.
  - **Data Movers column** — This column shows the number of data movers in the system.
  - **File Systems column** — This column shows the number of file systems that are on the system.

- **Status box** — This box will contain any information that may be generated due to an action of the other buttons.
VPLEX Systems

The VPLEX Systems selection displays all the VPLEX systems that have been manually discovered. This is shown in Figure 38 on page 111.

![VPLEX Systems diagram]

Each item in this panel is described here:

- Discover New VPLEX Systems button — This button, when clicked, will perform a discovery of new VPLEX systems based upon the information provided in the VPLEX Management Station box:
  - Host Name or IP
  - Username
  - Password
  - Re-Type Password

- Refresh List button — This button, when clicked, will refresh the list of VPLEX systems. This button will not discover new storage systems.
◆ VPLEX Systems list — This list shows all of the VPLEX systems that have been manually discovered. Each item in the list should have an icon that represents the model of VPLEX system. And each item will have the following properties shown in its respective VPLEX:
  • Name - IP Address column — This column shows the IP of the VPLEX system.
  • ID column — This column shows the serial number (or ID) of the storage array. If a friendly name is configured for this VPLEX system then that name will be shown instead.
  • Model column — This column shows the model of the VPLEX system.
  • Firmware column — This column shows the version of firmware that is installed on the storage array.
  • Distributed Volumes column — This column shows the number of Distributed Volumes if the VPLEX System is a Metro Cluster.
  • Local Volumes column — This column shows the number of local volumes on the VPLEX system.
◆ Status box — This box will contain any information that may be generated due to an action of the other buttons.

vCenter view

The following is a detailed description of the functionality that is available in the context of a vCenter.

EMC VSI tab

The EMC VSI tab, as shown in Figure 39 on page 113, will be available when a vCenter is selected in the navigation tree of the vCenter inventory.
EMC VSI tab

This tab includes the following panels and views.

**Features Navigation Panel**

The following panel, Figure 40 on page 113, can be found along the left side of the EMC VSI panel. This design is similar to what VMware uses for the Configuration panel.

<table>
<thead>
<tr>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Storage Pool Management</td>
</tr>
<tr>
<td>- Assigned Pools</td>
</tr>
</tbody>
</table>

**Assigned Pools**

**Assigned Pools View**

This view is the only available one at the vCenter level. The goal of this view is to provide details about the storage currently available from the registered SMC servers.

The Assigned Pools view appears as shown in Figure 41 on page 114.
Figure 41  Assigned Pools

Each item in the view is described here:

- **Assigned Pools** — Shows each of the SMC servers and storage arrays the user can access:
  - Refresh button — This button when clicked, will force the Assigned Pools list to refresh its entries.
  - Total Assigned Pools label — This label shows the total number of Assigned Pools that the user has access to.
  - Server column — This column shows the network address of the SMC server providing the storage.
  - Array column — This column shows the name of the storage array providing the storage.
  - Product column — This column shows the model of the storage array providing the storage. Symmetrix, CLARiiON, and so on.
- **Storage types list** — This is a list of storage types, more commonly referred to in this document as a type list. This particular list shows each of the storage types that are provided by the selected assigned pool:

<table>
<thead>
<tr>
<th>Name</th>
<th>Available</th>
<th>Capacity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOLD</td>
<td>250.00 GB</td>
<td>250.00 GB</td>
<td>Flash disk</td>
</tr>
<tr>
<td>BRONZE</td>
<td>1000.00 GB</td>
<td>1000.00 GB</td>
<td>SATA disk</td>
</tr>
<tr>
<td>SLIVER</td>
<td>490.00 GB</td>
<td>490.00 GB</td>
<td>FC disk</td>
</tr>
</tbody>
</table>
Datacenter view

The following is a detailed description of the functionality that is available in the context of a Datacenter.

EMC VSI tab

The EMC VSI tab as shown in Figure 42 on page 115, will be available when a Datacenter is selected in the navigation tree of the vCenter inventory.

Figure 42 EMC VSI tab

This tab includes the following panels and views.

Navigation panel

The panel in Figure 43 on page 116, can be found along the left side of the EMC VSI panel. This design is similar to what VMware uses for the Configuration panel.
Storage Pool Management Feature in EMC Virtual Storage Integrator

**Operation**

Figure 43 Navigation panel

**Storage Types view**
This view appears by default in this tab. The goal of this view is to provide details about the storage currently available from the registered SMC servers.

The storage types view appears as shown in Figure 44 on page 116.

![Figure 43 Navigation panel](image)

<table>
<thead>
<tr>
<th>Storage Types</th>
<th>Available</th>
<th>Capacity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOLD</td>
<td>250.00 GB</td>
<td>250.00 GB</td>
<td>Flash disk</td>
</tr>
<tr>
<td>BRONZE</td>
<td>1600.00 GB</td>
<td>1000.00 GB</td>
<td>SATA disk</td>
</tr>
<tr>
<td>SILVER</td>
<td>450.00 GB</td>
<td>500.00 GB</td>
<td>FC disk</td>
</tr>
</tbody>
</table>

![Figure 44 Storage Types](image)

Each item in the view is described here:

- Storage Types list — This is a list of storage types, more commonly referred to in this document as a type list. This particular list shows each of the storage types that are available to the selected datacenter.
Storage Type Details panel — This panel shows additional details about the currently selected storage type:

- **Name label** — This label shows the name of the selected storage type.
- **Server label** — This label shows the name of the server that is providing the selected storage type.
- **Description label** — This label shows the description of the storage type.
- **Capacity pie graph** — This graph displays the total capacity and usage of the storage type in text and visually.
- **Usage list** — This list serves two purposes: it displays all the suballocations of the storage type to VMware entities below the selected VMware entity, and it displays all the LUNs provisioned from this storage type that are in use by the selected VMware entity:
  - **Name column** — This column shows two types of items: suballocations and LUNs provisioned from the selected storage type. If the item is a sub-allocation to a VMware entity, the name of that entity is displayed along with an icon indicating the VMware entity type. If the item is a LUN, the array id and device name are displayed along with an icon indicating that the item is a LUN.
  - **Capacity column** — This column shows the capacity of the suballocation that has been allocated to a VMware entity. This column shows the capacity of a LUN that has been provisioned from this storage type.

---

**Cluster view**

The following is a detailed description of the functionality that is available in the context of a cluster.

**EMC VSI tab**

The EMC VSI tab will be available when a Cluster is selected in the navigation tree of the vCenter inventory. Figure 45 on page 118 shows the tab.
Figure 45  EMC VSI tab

This tab includes the following panels and views.

**Navigation panel**

The following panel can be found along the left side of the EMC VSI panel. This design is similar to what VMware uses for the Configuration panel. *Figure 46 on page 118* shows the panel.

<table>
<thead>
<tr>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Storage Pool Management</td>
</tr>
<tr>
<td>• Storage Types</td>
</tr>
</tbody>
</table>

Figure 46  Navigation Panel

**Storage Types view**

This view appears by default in this tab. The goal of this view is to provide details about the storage currently available from the registered SMC servers.

The storage types view appears as shown in *Figure 47 on page 119*. 
Figure 47  Storage Types

Each item in the view is described here:

- **Storage Types list** — This is a list of storage types, more commonly referred to in this document as a type list. This particular list shows each of the storage types that are available to the selected datacenter.

- **Storage Type Details panel** — This panel shows additional details about the currently selected storage type:
  - Name Label — This label shows the name of the selected storage type.
  - Server Label — This label shows the name of the server that is providing the selected storage type.
  - Description Label — This label shows the description of the storage type.
  - Capacity Pie Graph — This graph displays the total capacity and usage of the storage type in text and visually.
Operation

- **Usage List** — This list serves two purposes: it displays all the sub-allocations of the storage type to VMware entities below the selected VMware entity, and it displays all the LUNs provisioned from this storage type that are in use by the selected VMware entity. Note: If a VMware entity that has an allocation on it is removed, the allocation will appear in this list with a name of ‘Unknown’. The allocation is not removed because it is not clear if the missing entity will appear again.
  - **Name Column** — This column shows two types of items: sub-allocations and LUNs provisioned from the selected storage type. If the item is a sub-allocation to a VMware entity, the name of that entity is displayed along with an icon indicating the VMware entity type. If the item is a LUN, the array id and device name are displayed along with an icon indicating that the item is a LUN.
  - **Capacity Column** — This column shows the capacity of the sub-allocation that has been allocated to a VMware entity. This column shows the capacity of a LUN that has been provisioned from this storage type.

---

**Host view**

The following is a detailed description of the functionality that is available in the context of an ESX host.

**EMC VSI tab**

The EMC VSI tab will be available when a host is selected in the navigation tree of the vCenter inventory. **Figure 42 on page 115** shows the tab. This tab includes the following panels and views.

**Navigation Panel**

The following panel as seen in **Figure 48 on page 121**, can be found along the left side of the EMC VSI panel. This design is similar to what VMware uses for the Configuration panel.
Each navigation link leads to a different view in the context of the selected host. When clicked, the link’s color should change to black so that it is obvious which link was selected. When the page first loads, the default view should be selected. For this navigation panel, the storage types view is the default.

**Storage Types view**

This view appears when the storage types link is selected. The goal of this view is to provide details about the storage currently available from the registered SMC servers.

**Note:** The empty figure below, Figure 49 on page 122, is the expected display when the host is part of a cluster. Storage types must be viewed at the cluster level.

The storage types view appears as follows.
Each item in the view is described in general here as the items are the same as in the Datacenter and Cluster views:

- **Storage Types list** — This is a list of storage types, more commonly referred to in this document as a type list. This particular type list shows each of the storage types that are available to the selected cluster.

- **Storage Type Details panel** — This panel shows additional details about the currently selected storage type:
  - **Name Label** — This label shows the name of the selected storage type.
  - **Server Label** — This label shows the name of the server that is providing the selected storage type.
  - **Description Label** — This label shows the description of the storage type.
  - **Capacity Pie Graph** — This graph displays the total capacity and usage of the storage type in text and visually.
• Usage List — This list serves two purposes: it displays all the sub-allocations of the storage type to VMware entities below the selected VMware entity, and it displays all the LUNs provisioned from this storage type that are in use by the selected VMware entity. Note: If a VMware entity that has an allocation on it is removed, the allocation will appear in this list with a name of 'Unknown'. The allocation is not removed because it is not clear if the missing entity will appear again.
  – Name Column — This column shows two types of items: sub-allocations and LUNs provisioned from the selected storage type. If the item is a sub-allocation to a VMware entity, the name of that entity is displayed along with an icon indicating the VMware entity type. If the item is a LUN, the array id and device name are displayed along with an icon indicating that the item is a LUN.
  – Capacity Column — This column shows the capacity of the sub-allocation that has been allocated to a VMware entity. This column shows the capacity of a LUN that has been provisioned from this storage type.

Status panel
The following panel can be found below the EMC VSI tab as seen in Figure 50 on page 123. This panel is used to communicate informational events, warnings, and failures to the user. Examples of operations that will be logged here are Solutions Enabler failures and successful rescans. In addition, the Status panel will also show the version of PowerPath/VE installed (if installed) on the ESX host. The panel can be hidden by double-clicking it.

Resource Pool view
The following is a detailed description of the functionality that is available in the context of a VMware resource pool.
EMC VSI tab

The EMC VSI tab will be available when a resource pool is selected in the navigation tree of the vCenter inventory, as seen in Figure 42 on page 115. This tab includes the following panels and views.

Navigation panel

The following panel can be found along the left side of the EMC VSI panel. This design is similar to what VMware uses for the Configuration panel as seen in Figure 46 on page 118.

Storage Types view

This view appears when the storage types link is selected. The goal of this view is to provide details about the storage currently available from the registered SMC servers.

The storage types view appears as shown in Figure 51 on page 124.

<table>
<thead>
<tr>
<th>Storage Type Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOLD</td>
</tr>
<tr>
<td>Serve: 10.11.125.65</td>
</tr>
<tr>
<td>Description: Flash disk</td>
</tr>
<tr>
<td>Used: 259.00 GB</td>
</tr>
<tr>
<td>Free: 0.00 GB</td>
</tr>
<tr>
<td>Name</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Figure 51  Storage Types

Each item in the view is described in general here as the items are the same as in the Datacenter and Cluster views:
◆ Storage Types list — This is a list of storage types, more commonly referred to in this document as a type list. This particular type list shows each of the storage types that are available to the selected cluster.

◆ Storage Type Details panel — This panel shows additional details about the currently selected storage type:
  • Name Label — This label shows the name of the selected storage type.
  • Server Label — This label shows the name of the server that is providing the selected storage type.
  • Description Label — This label shows the description of the storage type.
  • Capacity Pie Graph — This graph displays the total capacity and usage of the storage type in text and visually.
  • Usage List — This list serves two purposes: it displays all the sub-allocations of the storage type to VMware entities below the selected VMware entity, and it displays all the LUNs provisioned from this storage type that are in use by the selected VMware entity. Note: If a VMware entity that has an allocation on it is removed, the allocation will appear in this list with a name of ‘Unknown’. The allocation is not removed because it is not clear if the missing entity will appear again.
    – Name Column — This column shows two types of items: sub-allocations and LUNs provisioned from the selected storage type. If the item is a sub-allocation to a VMware entity, the name of that entity is displayed along with an icon indicating the VMware entity type. If the item is a LUN, the array id and device name are displayed along with an icon indicating that the item is a LUN.
    – Capacity Column — This column shows the capacity of the sub-allocation that has been allocated to a VMware entity. This column shows the capacity of a LUN that has been provisioned from this storage type.
The following is a detailed description of the functionality that is available when right-clicking a Datacenter.

**EMC context menu**

The EMC context menu, as seen in Figure 52 on page 126, will be available when a datacenter is right-clicked in the navigation tree of the vCenter inventory.

This includes the following submenus:

- **Configure Storage Allocations Context Menu** — This context menu, when clicked, opens a wizard for the user to configure the storage types allocated to the selected datacenter.
  - The first page, as shown in Figure 53 on page 127, displays all storage types that are available to the selected VMware entity. The storage types are set to 0 capacity by default. However, if the entity already has been allocated a storage type the current capacity will be populated. Capacity values are restricted to the maximum available and to a minimum if storage is in use by a lower item in the inventory, such as a LUN or a

1. All menus related to SPM are subject to checks for user permissions/privileges when they are accessed. If a particular menu is grayed out (disabled) then these permissions/privileges should be checked.
suballocation. If an invalid capacity is entered, it will be autocorrected to the nearest valid value and display a warning to the user.

Figure 53   Allocate Storage

- The final page seen in Figure 54 on page 128 summarizes the changes to the allocation and when Finish is clicked an operation to configure the allocations begins.
Figure 54  Allocate Storage Summary

- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the datacenter:
  - Task.Create
  - Task.Update
  - Host.Inventory.AddStandaloneHost.

**EMC VSI tab Storage Types context menu**

The EMC context menu, as seen in Figure 55 on page 129, will be available when a cluster or host is right-clicked in the Storage Type Details panel.
This includes the following submenus:

- Configure Storage Allocations Context Menu — This context menu, when clicked, opens a wizard for the user to configure the storage types allocated to the selected Cluster or Host.
- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the Cluster or Host:
  - Task.Create
  - Task.Update
  - Host.Inventory.EditCluster
  - Host.Inventory.AddHostToCluster
Cluster menus

The following is a detailed description of the functionality that is available when right-clicking a cluster.

EMC context menu

The EMC context menu will be available when a cluster is right-clicked in the navigation tree of the vCenter inventory as shown in Figure 56 on page 130.

![EMC context menu](image)

**Figure 56** EMC context menu

This includes the following submenus:

- Add Datastore… context menu — This context menu, when clicked, opens a wizard for the user to configure a new LUN to be provisioned and mapped to the selected inventory item as a VMFS datastore:
  - The first page displays a Type List for the classes available to the selected VMware entity. Figure 57 on page 131 is an example of this.
The second page allows for configuring the capacity of the LUN from the selected storage type. If precreated capacities are defined, then an option to select precreated LUN capacities is available on the screen. A capacity control is also available to allow for configuring custom capacities. The capacity control restricts capacity values based on the amount of storage available, the maximum LUN size policy, and the minimum LUN size policy. If an invalid capacity is entered, it will be autocorrected to the nearest valid value and a warning will be presented to the user. If a policy is enabled that allows only provisioning of precreated capacities, then the custom capacity options will be disabled. Figure 58 on page 132 is a view of this page.
The third page contains a text box to accept the name of the new datastore. The entered name is validated against a list of existing datastores to ensure that it is valid. Figure 59 on page 133 is a view of the third page.
**Figure 59 Add Datastore — Datastore Name**

- The fourth page contains the option to choose the block size of the datastore. **Figure 60 on page 134** is a view of the fourth page.
Figure 60  Add Datastore — Choose datastore formatting

- The final page summarizes the selected options and when Finish is clicked, an operation to create the datastore begins. Figure 61 on page 135 shows the final page.
Figure 61  Add Datastore — Summary

- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the Cluster:
  - Task.Create
  - Task.Update
  - Host.Inventory.EditCluster
  - Host.Config.Storage (for each host that is a member of the cluster)

- Update Storage Adapters context menu — This context menu, when clicked, causes an update to the list of Fibre Channel HBA ports in the cluster members to be sent to the SMC server.

- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the Cluster:
  - Task.Create
Operation

- Task.Update

- Configure Storage Allocations… context menu — This context menu, when clicked, opens a wizard for the user to configure the storage types allocated to the selected cluster.

  - For this context menu to be enabled, the VMware administrator must be granted the following permissions on the Cluster:
    - Task.Create
    - Task.Update
    - Host.Inventory.EditCluster
    - Host.Inventory.AddHostToCluster

EMC VSI tab Storage Types context menu

The EMC context menu, as seen in Figure 62 on page 137 and Figure 63 on page 138, will be available when a resource pool or LUN is right-clicked in the Storage Type Details panel.
EMC VSI tab Storage Types context menu — Resource Pool

This includes the following submenus:

- Configure Storage Allocations Context Menu — This context menu, when clicked, opens a wizard for the user to configure the storage types allocated to the selected resource pool.

  - For this context menu to be enabled, the VMware administrator must be granted the following permissions on the datacenter:
    - Task.Create
    - Task.Update
    - Host.Inventory.AddStandaloneHost.
Figure 63  **EMC VSI tab Storage Types context menu — LUN**

- **Expand LUN… context menu** — This context menu, when clicked, opens the Expand LUN wizard.
  - For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
    - Task.Create
    - Task.Update
    - Host.Config.Storage
- **Delete LUN… context menu** — This context menu, when clicked, begins the process of deleting the LUN.
• For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
  – Task.Create
  – Task.Update
  – Host.Config.Storage (for each host that mounts the datastore which is backed by the LUN)

Host menus

The following is a detailed description of the functionality that is available when right-clicking an ESX host.

EMC context menu

The EMC context menu will be available when a host is right-clicked in the navigation tree of the vCenter inventory. The tasks will only be available in a stand-alone host configuration. In a cluster the SPM related menu will be grayed out as is the case in Figure 64 on page 140.
This includes the following submenus:

- **Add Datastore...** context menu — This context menu, when clicked, opens a wizard for the user to configure a new LUN to be provisioned and mapped to the selected inventory item as a VMFS datastore.

- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the cluster:
  - Task.Create
  - Task.Update
  - Host.Inventory.EditCluster
  - Host.Config.Storage

- **Update Storage Adapters** context menu — This context menu, when clicked, causes an update to the list of Fibre Channel HBA ports in the host to be sent to the SMC server.
For this context menu to be enabled, the VMware administrator must be granted the following permissions on the Host:
- Configure Storage Allocations… Context Menu — This context menu, when clicked, opens a wizard for the user to configure the storage types allocated to the selected host.
- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the host:
  - Task.Create
  - Task.Update
  - Host.Config.Settings

Note: If an ESX host is a member of a cluster all SPM context menus to that host become disabled. To add a datastore or modify storage allocations to the host it is preferable to perform those operations on the entire cluster. This should ensure availability of resources should a member of cluster go down.

**EMC VSI tab Storage Types context menu**

The EMC context menu for a non-clustered host will essentially be the same as for a cluster as seen in Figure 62 on page 137 and Figure 63 on page 138. It will be available when a resource pool is right-clicked in the Storage Type Details panel.

**Resource Pool menus**

The following is a detailed description of the functionality that is available when right-clicking a resource pool.

**EMC context menu**

The EMC context menu will be available when a resource pool is right-clicked in the navigation tree of the vCenter inventory, as shown in Figure 65 on page 142.
Figure 65  EMC context menu

This includes the following submenus:

- Configure Storage Allocations… Context Menu — This context menu, when clicked, opens a wizard for the user to configure the storage types allocated to the selected resource pool.
  
  - For this context menu to be enabled, the VMware administrator must be granted the following permissions on the resource pool:
    - Task.Create
    - Task.Update
    - Resource.EditPool

EMC VSI tab Storage Types context menu

The EMC context menu, as seen in Figure 66 on page 143, will be available when a LUN is right-clicked in the Storage Type Details panel when the appropriate storage type is select in the storage types panel.
This includes the following submenus:

- **Expand LUN… context menu** — This context menu, when clicked, opens the Expand LUN wizard.
  - For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
    - Task.Create
    - Task.Update
    - Host.Config.Storage

- **Delete LUN… context menu** — This context menu, when clicked, begins the process of deleting the LUN.
  - For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
Virtual Machine menus

The following is a detailed description of the functionality that is available when right-clicking a virtual machine.

EMC context menu

The EMC context menu, as seen in Figure 67 on page 144, will be available when a virtual machine is right-clicked in the navigation tree of the vCenter inventory.

![EMC context menu](image)

**Figure 67  EMC context menu**

This includes the following submenus:

- **Add Storage... context menu** — This context menu, when clicked, opens a wizard for the user to configure a new LUN to be provisioned and mapped to the selected virtual machine as a Raw Device Mapping (RDM).
- The first page displays a type list for the classes available to the selected VMware entity, as shown in Figure 68 on page 145.

![Add Raw Device Mapping](image)

**Figure 68 Add Raw Device Mapping**

- The second page allows for configuring the capacity of a new LUN from the selected storage type as shown in Figure 69 on page 146.
The third page configures where the resulting RDM file is stored, either with the VM (default) or on a different datastore by selecting the datastore from a list. This is shown in Figure 70 on page 147.
Figure 70  Add Raw Device Mapping — Select Datastore

- The fourth page configures the compatibility mode of the new RDM as shown in Figure 71 on page 148.
The fifth page, as seen in Figure 72 on page 149, is dependent upon the previous page and configures two settings: Virtual Device Node where the RDM is mapped to the VM; and the mode of the RDM. SCSI device nodes may be selected for up to four virtual SCSI controllers, and if a controller does not exist it will be added to the VM at the same time as the RDM. IDE device nodes may be selected as well, however, hot-add of IDE devices is not permitted by VMware, so selection of IDE nodes is only allowed when the VM is powered off. If physical compatibility mode is selected on page four, mode selection is hidden. If virtual compatibility mode is selected, page five displays mode selection options.
Figure 72 Add Raw Device Mapping — Advanced Options

- The final page, Figure 73 on page 150, summarizes the options selected and when Finish is clicked an operation to create the RDM begins.
For this context menu to be enabled, the VMware administrator must be granted the following permissions on the virtual machine:

- Task.Create
- Task.Update
- Host.Config.Storage (on each ESX associated with the VM)
- VirtualMachine.Config.RawDevice

Configure Batch Storage...Context Menu — This context menu, when clicked, opens a wizard for the user to configure a batch of LUNs to be provisioned and mapped to the selected Virtual Machine as RDMs. LUNs of various storage types and capacities may be chosen and added to a ‘batch’, the batch LUNs are provisioned and then mapped as RDMs. The RDM settings chosen (such as compatibility and disk mode) are applied to all LUNs in the batch. Virtual device nodes are automatically assigned.
• The wizard consists of one page with two panels. The left panel describes the configuration of the LUNs added to the batch with the controls to add or remove entries. The right panel provides options similar to the Add Raw Device Mappings wizard, used to configure RDM settings. This is shown in Figure 74 on page 151.

![Add Raw Device Mappings Batch](image)

Figure 74  Add Raw Device Mappings Batch

• The first page, Figure 75 on page 152, displays a list of storage types from which to choose.
Figure 75  Add Raw Device Mappings Batch — Select Storage Type

- On the second page, Figure 76 on page 153, one selects the capacity of the LUNs — either a precreated or custom size — and then selects the number of LUNs to create.
Figure 76  Add Raw Device Mappings Batch — Select Capacity

- On the final page one can review the LUNs that will be created. As seen in Figure 77 on page 154, there are a total of three RDMS that are set to be created from two different storage types.
EMC VSI tab RDM context menu

The EMC context menu will be available when a RDM is right-clicked within the EMC VSI tab, Raw Device Mappings panel as seen in Figure 78 on page 155.
This includes the following submenus:

- Expand Raw Device Mapping… context menu — This context menu, when clicked, opens the Expand LUN wizard for the Raw Device Mapping wizard to configure how to increase the RDM capacity.

- Expand LUN Wizard — This wizard launches with a wait dialog box, as seen in Figure 79 on page 156, while determining if the RDM can be expanded, and then allows the user to configure a larger capacity based on the LUN’s usage and the expansion options available.

Figure 78  EMC VSI tab Storage Types context menu
After determining what type of extension is possible, if expanding the capacity of an RDM is possible, a wizard is launched to expand. The following conditions govern the extension:

- The wizard supports expanding LUNs using Symmetrix meta devices and is available on VMAX/VMAXe array running a minimum of Enginuity 5875 and managed by an SMC Server running a minimum version of 7.2.
- The wizard supports expanding LUNs in three states: Standalone LUNs mapped to an ESX; LUNs mapped to a VM as an RDM; a LUN backing a VMFS datastore which consists of a single extent.

The first page as seen in Figure 80 on page 157, allows for configuring the new capacity of the RDM. The RDM will be expanded using the same storage type from which it was provisioned. The capacity control restricts capacity values based on the amount available, the maximum LUN size policy, and the maximum size of a datastore extent. If invalid capacities are entered, it will be autocorrected to the nearest valid value and display a warning to the user.
Figure 80 Expand Raw Device Mapping—Capacity

- The final page, Figure 81 on page 158, summarizes the options selected and when finish is selected an operation to expand the RDM begins.
After determining what type of extension is possible, if expanding the capacity of the RDM is not possible, an error is displayed. This is shown in Figure 82 on page 158.

For this context menu to be enabled, the VMware administrator must be granted the following permissions on the virtual machine:
SPM views and operations in EMC VSI

- Task.Create
- Task.Update
- Host.Config.Storage (on each ESX associated with the VM)
- VirtualMachine.Config.RawDevice

- Remove Raw Device Mapping… context menu — This context menu, when clicked, begins the process of removing the RDM from the virtual machine. Figure 83 on page 159 is an example of the dialog box. If the RDM is not provisioned from an assigned pool, the RDM is simply removed. If the RDM is from a provisioned pool, a second dialog box, Figure 84 on page 160, offers to deallocate the RDM any the RDM will be unmasked, deleted, and the used capacity will become available again in for their storage type.

- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
  - Task.Create
  - Task.Update
  - Host.Config.Storage (on each ESX associated with the VM)
  - VirtualMachine.Config.RawDevice

![Figure 83 Remove Raw Device Mapping](image-url)
Datastore menus

The following is a detailed description of the functionality that is available when right-clicking a datastore.

EMC context menu

The EMC context menu as seen in Figure 85 on page 160, will be available when a datastore is right-clicked in the navigation tree of the vCenter inventory.

This includes the following submenus:

- Expand Datastore… context menu — This context menu, when clicked, opens the Expand LUN wizard for the Datastore wizard to configure how to increase the Datastore capacity.
• Expand LUN Wizard — This wizard launches with a wait dialog box, while determining if the LUN backing a datastore can be expanded, and then allows the user to configure a larger capacity based on the LUN’s usage and the expansion options available as seen in Figure 86 on page 161.

Figure 86  Expand Datastore — One Moment Screen

• After determining what type of extension is possible, if expanding the capacity of a LUN is possible, a wizard is launched to expand. The following conditions govern the extension:
  – The wizard supports expanding LUNs using Symmetrix meta devices and is available on VMAX/VMAXe array running a minimum of Enginuity 5875 and managed by an SMC Server running a minimum version of 7.2.
  – The wizard supports expanding LUNs in three states: Standalone LUNs mapped to an ESX; LUNs mapped to a VM as an RDM; a LUN backing a VMFS datastore which consists of a single extent.

• The first page as seen in Figure 87 on page 162, allows for configuring the new capacity of the LUN. The LUN will be expanded using the same storage type from which it was provisioned. The capacity control restricts capacity values based on the amount available, the maximum LUN size policy, and the maximum size of a datastore extent. If invalid capacities are entered, it will be autocorrected to the nearest valid value and display a warning to the user.
The final page, Figure 88 on page 163, summarizes the options selected and when finish is selected an operation to expand the LUN begins. When expanding a datastore extent, the VMFS filesystem will be expanded to utilize the new capacity of the LUN.
After determining what type of extension is possible, if expanding the capacity of the datastore extent is not possible, a wizard will be displayed that allows the user to configure a new LUN to use as a VMFS extent to the datastore.

The first page displays a list of storage types to choose from as seen in Figure 89 on page 164.
The second page allows for configuring the new capacity of the selected datastore using the selected storage type. If precreated capacities are defined, then a drop down box is available to select precreated LUN capacities, otherwise this drop down box is disabled. A capacity control is also available to allow for configuring custom capacities. The capacity control restricts capacity values based on the amount available, the maximum LUN size policy, and the minimum LUN size policy. If invalid capacities are entered, it will be autocorrected to the nearest valid value and display a warning to the user. If a policy is enabled that only allows provisioning of precreated capacities, then the custom capacity options will be disabled. To support extension of datastores with capacities greater than the maximum LUN size, the user is allowed to provide a capacity that will generate multiple LUNs and each LUN will be used as a datastore extent as shown in Figure 90 on page 165.
The final page summarizes the options selected and when finish is selected an operation to extend the Datastore begins. Note that the capacity value will indicate the number of LUNs that will be provisioned if more than one is required. The final page as seen in Figure 91 on page 166, summarizes the options selected and when finish is selected an operation to extend the datastore begins.
For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
- Task.Create
- Task.Update
- Host.Config.Storage (for each host that mounts the datastore)

Note: When extending a datastore, it is not possible to select a precreated device that is a metavolume.

- Remove Datastore… context menu — This context menu, when clicked, begins the process of removing the datastore from all hosts that mount it. Figure 92 on page 167 is an example of the dialog box. If the datastore does not have any extents that are provisioned from an assigned pool, the user is prompted to confirm that they wish to continue. If any extents are LUNs
provisioned from an assigned pool they will be unmasked, deleted, and their used capacity will become available again for their storage type.

- For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
  - Task.Create
  - Task.Update
  - Host.Config.Storage (for each host that mounts the datastore)

---

**Figure 92 Remove Datastore**

**Storage Viewer\LUNs menus**

The following is a description of the functionality that is available when right-clicking LUN from within the Storage Viewer\LUNs panel.

**EMC context menu**

The EMC context menu will be available when a LUN is right-clicked within the EMC VSI tab, Storage Viewer\LUNs as seen in Figure 93 on page 168.
This includes the following submenus:

- **Expand LUN… context menu** — This context menu, when clicked, opens the Expand LUN wizard.

- **Expand LUN Wizard** — This wizard launches with a wait dialog, as shown in Figure 94 on page 168, while determining if the LUN can be expanded, and then allows the user to configure a larger capacity based on the LUN’s usage and the expansion options available.
After determining what type of extension is possible, if expanding the capacity of a LUN is possible, a wizard is launched to expand. The following conditions govern the extension:

- The wizard supports expanding LUNs using Symmetrix meta devices and is available on VMAX/VMAXe array running a minimum of Enginuity 5875 and managed by an SMC Server running a minimum version of 7.2.
- The wizard supports expanding LUNs in three states: Standalone LUNs mapped to an ESX; LUNs mapped to a VM as an RDM; a LUN backing a VMFS datastore which consists of a single extent.

The first page as seen in Figure 96 on page 170, allows for configuring the new capacity of the LUN. The LUN will be expanded using the same storage type from which it was provisioned. The capacity control restricts capacity values based on the amount available, the maximum LUN size policy, and the maximum size of a datastore extent. If invalid capacities are entered, it will be autocorrected to the nearest valid value and display a warning to the user. If there is not enough capacity to expand, an error will appear as seen in Figure 95 on page 169.

Figure 95 Expand LUN — Insufficient capacity error
The final page, Figure 97 on page 171, summarizes the options selected and when finish is selected an operation to expand the LUN begins.
After determining what type of extension is possible, if expanding the capacity of the LUN is not possible, an error will appear as in Figure 98 on page 171.
• For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
  – Task.Create
  – Task.Update
  – Host.Config.Storage

◆ Delete LUN… context menu — This context menu, when clicked, begins the process of deleting the LUN. See Figure 99 on page 172 for an example of the dialog box to remove the LUN. Figure 100 on page 173 shows the error the user receives if the LUN is a non-SPM one. If there was a datastore associated with that LUN it is also removed. The LUNs will be unmasked, deleted, and their used capacity will become available again in for their storage type.

• For this context menu to be enabled, the VMware administrator must be granted the following permissions on the vCenter:
  – Task.Create
  – Task.Update
  – Host.Config.Storage (for each host that mounts the datastore which is backed by the LUN)
Figure 100  Delete LUN — Non-SPM LUN error
Each of the components that comprise the SPM functionality, SMC and VSI, has logging capabilities. The sections are divided by role.

Storage administrator

Logs are generated for SPM operations in the SMC log. These log entries include:

- All SPM operations that occur between the vSphere Client, SMC client, and the SMC server.
- All array configuration and control operations that occur during an SPM operation.
- Internal error conditions.

VMware administrator

SPM logs are generated in VSI. The Section “Feature Manager” on page 95 provides more detail on log levels and log locations.
This chapter contains use cases for Storage Pool Management.

- Use cases and functional details ............................................. 176
- Storage administrator (SA) functions ....................................... 177
- VMware administrator/user functions ..................................... 201
Use cases and functional details

The following chapter includes the “how-to” for the many functions available in Storage Pool Management. Each use case has step-by-step instructions for performing SPM tasks — from creating a virtualization domain to deleting an RDM. Where deemed necessary, the function is accompanied by a screenshot; however not all functions will include one.
Storage administrator (SA) functions

This section uses tables to describe common use cases and functional details related to operations that the storage administrator (SA) performs in Storage Pool Management including:

- Setting up the Storage Types
- Creating a virtualization domain
- Adding storage resources to the virtualization domain
- Setting policies for the storage resources

### Use cases

#### Table 1  Create Storage Type

<table>
<thead>
<tr>
<th>Use case</th>
<th>Create a Storage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Storage administrator (SA) creates a storage type from a previously defined Symmetrix tier definition or by a set of physical storage properties.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
### Use Cases

**The SA performs**

1. Accesses the **Storage Type creation** dialog box within SMC through: `Tasks/Administration/Operations/Virtualization Management/Manage Storage Types`. Figure 101 on page 179 shows the location in SMC of this task.
2. Selects **Create** and either selects an existing tier or creates a custom Storage Type.
3. Clicks the **OK** button.

**Exception Paths**

1. Storage type name already exists.

**Important considerations**

The following points should be considered for this use case:

- When creating a custom storage type it is possible to make 0, 1, or ‘x’ selections in a category.
- If FAST tiers are used to create a storage type then the tier name is used to create the storage type name.
- Even if a FAST tier is used to create a storage type, once the storage type is created it is independent of the tier. Changes to the tier do not affect the storage type and the storage type itself can be updated independent of the tier.
- Two different storage types can have exactly the same property set.
- Storage types can be created which do not have any settings for a particular property, for example, Disk type. In fact, a storage type can be created without any properties at all. In this case it can used to describe the storage in any storage resource. Storage types without any properties are required for FAST VP policy resources.
Use Cases

Figure 101 SMC Tasks — Manage Storage Types

Table 2 Delete Storage Type

<table>
<thead>
<tr>
<th>Use case</th>
<th>Delete Storage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator deletes a storage type through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
### Use Cases

**Table 3 Update Storage Type**

<table>
<thead>
<tr>
<th>Use case</th>
<th>Update Storage Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>The storage administrator updates a storage type including its name or description through SMC.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td><strong>Preconditions</strong></td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td><strong>The SA performs</strong></td>
<td>1. SA accesses the Storage Type creation dialog box within the SMC through: Tasks/Administration/Operations/Virtualization Management/Manage Storage Types. A list of storage types is displayed. 2. The SA highlights the storage type to update and selects Modify. 3. The SA can change the name, the description, or both. 4. The SA clicks OK.</td>
</tr>
<tr>
<td><strong>Exception Paths</strong></td>
<td>1. Updating the storage type name to one that already exists.</td>
</tr>
<tr>
<td><strong>Important considerations</strong></td>
<td>NA</td>
</tr>
</tbody>
</table>
### Create Virtualization Domain

<table>
<thead>
<tr>
<th>Use case</th>
<th>Create a virtualization domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator creates a virtualization domain through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td></td>
<td>2. The SA selects Create Virtualization Domain from the Virtualization Domain Management menu as shown in Figure 102 on page 182.</td>
</tr>
<tr>
<td></td>
<td>3. The SA selects a masking view to associate with the virtualization domain.</td>
</tr>
<tr>
<td></td>
<td>4. The SA then clicks OK.</td>
</tr>
<tr>
<td>The SA performs</td>
<td></td>
</tr>
<tr>
<td>1. The SA selects Create Virtualization Domain from the Virtualization Domain Management menu as shown in Figure 102 on page 182.</td>
<td></td>
</tr>
<tr>
<td>2. The SA uses a list box to choose virtualization domain name, the vCenter GUID, the minimum LUN size desired and the maximum LUN size. Both the minimum and maximum LUN size can be entered in manually rather than choosing the values in the list box. The SA also has the option of limiting the number of total LUNs in the virtualization domain, as well as enforcing the use of precreated LUNs. The dialog box is shown in Figure 103 on page 183.</td>
<td></td>
</tr>
<tr>
<td>3. The SA selects a masking view to associate with the virtualization domain.</td>
<td></td>
</tr>
<tr>
<td>4. The SA then clicks OK.</td>
<td></td>
</tr>
<tr>
<td>Exception Paths</td>
<td>1. The virtualization domain already exists.</td>
</tr>
<tr>
<td></td>
<td>2. There is already a virtualization domain for this array which contains storage for the vCenter.</td>
</tr>
<tr>
<td>Important</td>
<td>The following points should be considered for this use case:</td>
</tr>
<tr>
<td>considerations</td>
<td>- A virtualization domain can contain only storage resources from the same array.</td>
</tr>
<tr>
<td></td>
<td>- The virtualization domain name must be unique to the SMC server instance.</td>
</tr>
<tr>
<td></td>
<td>- More than one virtualization domain can be created per array, but they must be assigned to different vCenters.</td>
</tr>
<tr>
<td></td>
<td>- There is no validation of the vCenter GUID. Failure to enter the correct value will result in the vSphere Client being unable to see the storage.</td>
</tr>
</tbody>
</table>
Use Cases

Figure 102  Virtualization Domain Management — Create Virtualization Domain
Use Cases

**Use case:** Auto create a virtualization domain

**Description:** The storage administrator creates a virtualization domain from the existing storage resources on an array. Auto setup the masking and authorizations needed.

**Role:** Storage administrator (SA)

**Preconditions:**
1. The SA has access to the SMC server via a browser.
2. The storage resources, thin pools or FAST policies, have already been created.
3. The VMware configuration has been exported from VSI into an XML file.
### Use Cases

#### The SA performs

1. The SA accesses the **Automated Virtualization Domain Setup** dialog box within the SMC through: **Tasks/Operations/Virtualization Management/Automated Virtualization Domain Setup**. This is shown in [Figure 104](#) on page [185](#).
2. In the wizard the SA:
   a. Browses to the exported configuration file.
   b. vCenter to setup is selected (an export file can contain more than one vCenter).
   c. Once selected the vCenter name is displayed.
   d. A list of the clusters is shown. The port group to use for masking this cluster to the array can be selected. If no port group is selected then no masking is created for this cluster.
   e. Enters the provisioning policies for the virtualization domain.
   f. A table is shown with a row for each storage resource, FAST VP policy or thin pool.
   g. For each resource the user selects the storage type, capacity and an adopt LUNs flag to use for assigning the resource to the virtualization domain.
      i. There are 2 choices for storage type: select from a list of already created storage types or enter a new storage type name.
      ii. Capacity: This is the amount of subscribed storage from the storage resource that is to be committed to the vCenter.
      iii. Adopt LUNs flag: If set then the LUNs that can be are adopted into SPM for this resource, if not set then no LUNs are adopted. The default is not set.
3. The actions to be performed by the wizard are displayed.
4. The SA clicks Finish in the wizard.
5. All the actions necessary to setup and create the virtualization domain are completed.
6. The actions that were performed are displayed, and which, if any, failed.

#### Exception Paths

1. The SMC user does not have the Admin role.
2. SPM will abort the setup as soon as any error is encountered. Any failure will be reported to the user.

#### Important considerations

The following points should be considered for this use case:
- The SMC user must be an administrator since this includes permissions to both configure the Symmetrix and set authorizations, both of which the wizard does.
Figure 104  SMC Tasks — Automated Virtualization Domain Setup
### Use Cases

#### Table 6  Delete Virtualization Domain

<table>
<thead>
<tr>
<th>Use case</th>
<th>Delete a Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator deletes a virtualization domain through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td>The SA performs</td>
<td>1. The SA right-clicks an existing virtualization domain and selects <strong>Delete Virtualization Domain</strong> from the <strong>Virtualization Domain Management</strong> menu.</td>
</tr>
<tr>
<td></td>
<td>2. The SA selects <strong>Yes</strong>.</td>
</tr>
<tr>
<td>Exception Paths</td>
<td>1. There are still storage resources assigned to the virtualization domain. All storage resources must be removed first.</td>
</tr>
<tr>
<td>Important considerations</td>
<td>The following points should be considered for this use case:</td>
</tr>
<tr>
<td></td>
<td>• Deleting the virtualization domain removes all storage allocations for VMware resources that are associated with this virtualization domain; but all LUNs are left intact and still masked to the ESX servers.</td>
</tr>
</tbody>
</table>

#### Table 7  Update Virtualization Domain

<table>
<thead>
<tr>
<th>Use case</th>
<th>Update a Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Change some of the information about a virtualization domain. This includes the name, description, and vSphere server GUID.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
Use Cases

Table 8 Add a View to a Virtualization Domain

<table>
<thead>
<tr>
<th>Use case</th>
<th>Add a view to a Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator adds a view to a virtualization domain through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
</tbody>
</table>
| Preconditions     | 1. The SA has access to the SMC server via a browser.  
                     2. The vCenter has authorizations on the storage group in the view to be added. |
| The SA performs   | 1. The SA selects a virtualization domain in SMC, right-clicks it, and selects Modify Virtualization Domain from the Virtualization Domain Management menu.  
                     2. The SA selects a view from the table on the left and clicks the Add button to put it to the right. |
| Exception Paths   | 1. Adding a view will fail if there is already a view with the same initiator group in it.  
                     2. Adding a view will fail if the vCenter server does not have authorizations on the storage group in the view.  
                     3. The view does not exist on the array associated with the virtualization domain |
| Important considerations | The following points should be considered for this use case:  
                     • There can be multiple views attached to a virtualization domain. However, there can only be one view per virtualization domain per VMware cluster.  
                     • A view can be attached to multiple virtualization domains. |
### Use Cases

**Table 9  Remove a View from a Virtualization Domain**

<table>
<thead>
<tr>
<th>Use case</th>
<th>Remove a view from a Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator removes a view from a virtualization domain through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td>The SA performs</td>
<td>1. The SA selects a virtualization domain in SMC, right-clicks it, and selects Modify Virtualization Domain from the Virtualization Domain Management menu.</td>
</tr>
<tr>
<td></td>
<td>2. The SA selects a view from the table on the left and clicks the Remove button to put it to the left.</td>
</tr>
<tr>
<td>Exception Paths</td>
<td>NA</td>
</tr>
<tr>
<td>Important considerations</td>
<td>The following points should be considered for this use case:</td>
</tr>
<tr>
<td></td>
<td>• New LUNs cannot be created for the cluster serviced by the view that was removed.</td>
</tr>
<tr>
<td></td>
<td>• The masking view itself is not deleted or modified, so existing LUNs are left still masked to the cluster.</td>
</tr>
</tbody>
</table>

**Table 10  Add a Storage Resource to a Virtualization Domain**

<table>
<thead>
<tr>
<th>Use case</th>
<th>Add a storage resource to a Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator adds a storage resource, thin pool, or FAST VP policy to a virtualization domain through SMC. This makes all or part of the storage in the thin pool available for provisioning by VMware users.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td></td>
<td>2. The vCenter server has been given authorizations on the storage resources.</td>
</tr>
<tr>
<td></td>
<td>a. Thin pool storage resources require authorizations on themselves.</td>
</tr>
<tr>
<td></td>
<td>b. FAST VP policy storage resources require authorizations on all their associated thin pools and on a storage group associated with the FAST VP policy.</td>
</tr>
</tbody>
</table>
### Use Cases

| The SA performs | 1. The SA selects a virtualization domain in SMC, right-clicks it, and selects **Add Storage Resource** from the **Virtualization Domain Management** menu. A list of storage resources is shown.  
2. The SA chooses a storage resource to associate with a virtualization domain and then selects the appropriate storage type. The SA then supplies the capacity to use and selects **OK**. |
|-----------------|---------------------------------------------------------------------------------------------------------------|
| Exception Paths | 1. No storage types match the storage resource.  
2. The storage resource has no available capacity, e.g. all its capacity has been allocated to another virtualization domain(s).  
3. The storage resource matches a single storage type and another storage resource has already been placed in the virtualization domain using that storage type.  
4. The storage resource is not on the same array as the storage resources already in the virtualization domain.  
5. The vSphere server the virtualization domain is assigned to, does not have authorizations for this storage resource.  
6. The storage resource is a FAST VP policy and it does not have an associated storage group which is authorized to the vCenter and not in a masking view. |
| Important considerations | The following points should be considered for this use case:  
- The virtualization domain can only contain storage resources from the same array.  
- For each virtualization domain, a storage type can only be used once with a storage resource. Multiple storage resources cannot share the same storage type.  
- A storage resource can provide storage to more than one virtualization domain.  
- The amount of capacity added to a virtualization domain from a storage resource is subscribed capacity, not physical capacity. The total amount of subscribed capacity in a storage resource is determined by multiplying its enabled physical capacity by the maximum subscription percent (a thin pool property set by the SA) minus capacity already assigned to other thin pools and to other thin devices not in any virtualization domains. |
Use Cases

Table 11  Remove a Storage Resource from a Virtualization Domain

<table>
<thead>
<tr>
<th>Use case</th>
<th>Remove storage resource from Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator removes a thin pool from a virtualization domain through SMC. This dissolves the association between the virtualization domain and the thin pool. It leaves any LUNs in the thin pool in place, but removes the SPM reservation on them.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td>The SA performs</td>
<td>1. The SA selects a virtualization domain and clicks the Storage Resource tab in the right panel. 2. The SA right-clicks the storage resource to delete and selects Remove Storage Resource from the Virtualization Domain Management menu.</td>
</tr>
<tr>
<td>Exception Paths</td>
<td>NA</td>
</tr>
<tr>
<td>Important considerations</td>
<td>The following points should be considered for this use case:  • Devices provisioned from the removed storage resource will not be deleted or have their masking changed. Only the SPM reservation will be removed.  • Precreation policies for the virtualization domain that are for the storage type associated with the storage resource are deleted.  • All the storage for the storage type represented by this storage resource in the virtualization domain is removed. For example, if this storage resource contained the gold storage for virtualization domain A which is assigned to vCenter server ABC, the vSphere Client will no longer have any gold storage from virtualization domain A on vCenter server ABC.</td>
</tr>
</tbody>
</table>

Table 12  Update the Storage Resource Capacity in a Virtualization Domain

<table>
<thead>
<tr>
<th>Use case</th>
<th>Update the storage resource capacity in a Virtualization Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator changes the capacity assigned to a virtualization domain from a storage resource through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
Use Cases

Table 13: Adopt LUNs

<table>
<thead>
<tr>
<th>Use case</th>
<th>Adopt LUNs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>A storage resource that is being added to a virtualization domain may already have devices in it that users want to be controlled by the SPM. This could be because the Storage Pool Management meta-data has been corrupted or deleted, or the user wants to bring an existing VMware configuration under SPM control.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
The SA performs

1. The SA selects a virtualization domain and clicks the **Storage Resource tab** in the right panel.

2. The SA right-clicks the storage resource and selects **Modify Adopt LUNs** from the **Virtualization Domain Management** menu. The adopt LUN dialog box is displayed and is shown in Figure 105 on page 193. A list of the current devices in the thin pool matching the following criteria are displayed:
   a. Device is not reserved, or already reserved by SPM
   b. Is in a storage group, in a view, that has an initiator group that is in one of the views assigned to the virtualization domain.
   c. If the storage resource is a thin pool:
      i. The thin pool must be authorized to the vCenter
   d. If the storage resource is a FAST VP policy then:
      i. The device must be in a storage group associated with the FAST VP policy
      ii. The thin pool the device is in must be authorized to the vCenter
      iii. The storage group must be authorized to the vCenter
      iv. The storage group must not be in a masking view

3. The SA selects which of the devices to adopt and clicks **Add** or **Add All** to move them to the target side. The selected devices are adopted to be managed by SPM. They are placed in the virtualization domain, and their capacity is added to the virtualization domain’s total capacity.

**Exception Paths**

NA

**Important considerations**

The following points should be considered for this use case:

- The devices are added to the SPM reservation.
- A VMware user must now run refresh which determines the VMs each device is attached to and then straightens out the capacity accounting.
Use Cases

Table 14  Adopt an existing configuration

<table>
<thead>
<tr>
<th>Use case</th>
<th>Adopt an existing VMware configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>SPM is being deployed in an environment where there is an existing VMware configuration that already uses storage from a Symmetrix. The existing thin pools and thin LUNs need to be brought under SPM control.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
</tbody>
</table>
| Preconditions  | 1. The SA has access to the SMC server via a browser.  
2. The SA has both the storage administrator and security administrator role on the Symmetrix(es). |
Use Cases

The SA performs

1. The SA either creates new views to use to mask new LUNs to the VMware cluster, or decides to use the existing ones. Any newly created views use the existing initiator groups that contain the WWNs for the VMware cluster.

2. If authorization is being used on the Symmetrix, the SA enters the authorizations for the vCenter on the thin pools that contain the LUNs currently in use by the VMware cluster and for the storage groups in the views of the previous step.

3. The SA either decides to use some existing storage types, or create new ones. In either case there must be one per storage resource that is going to be put into the virtualization domain.

4. The SA creates a virtualization domain as explained in Table 4 on page 181 or Table 5 on page 183.

5. The SA selects storage resources to add to the virtualization domain as explained in Table 10 on page 188. These storage resources already contain the devices which are mapped to the VMware configuration.

6. The SA selects which LUNs to adopt. Table 13 on page 191 has details of this.

7. The VMAdmin does a refresh configuration from the vSphere Client as seen in Figure 106 on page 195.

Exception Paths

NA

Important considerations

The following points should be considered for this use case:

- This is only supported for thin devices.
Figure 106 Refresh Configuration in vSphere Client

Table 15 Set Client Security

<table>
<thead>
<tr>
<th>Use case</th>
<th>Set Up Client Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator sets the password that is used by vSphere clients to log in the SMC server.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
Use Cases

The SA performs

1. The SA opens the dialog box for **Manage Launch Clients** in SMC under Tasks as seen in Figure 107 on page 196.
2. The SA then either selects **Edit** to change the existing client-ID or **Add** to create a new client-ID. Figure 108 on page 197 is an example of this.

Exception Paths

1. Storage type name already exists.

Important considerations

The following points should be considered for this use case:
- The VMAdmin must supply the password when the first connection the vSphere Client to SMC. Once the first connection is made, the password is not used.

---

**Figure 107**  SMC Tasks — Manage Launch Clients
Figure 108  Manage Launch Clients

Table 16  Back up SPM data

<table>
<thead>
<tr>
<th>Use case</th>
<th>Back up SPM data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The storage administrator backs up the SPM data through SMC.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
<tr>
<td>The SA performs</td>
<td>1. The SA opens the dialog box for Manage SPM Metadata in SMC under Tasks as seen in Figure 109 on page 198.</td>
</tr>
<tr>
<td></td>
<td>2. The SA selects Action Backup and supplies a Backup Directory Name as seen in Figure 110 on page 199.</td>
</tr>
<tr>
<td></td>
<td>3. The SA clicks OK. The backup folder is created in the SMC directory path under .../WEB-INF/SPM_META_DATA/&quot;Backup Directory Name.&quot;</td>
</tr>
<tr>
<td>Exception Paths</td>
<td>1. The folder path does not exist or the SA does not have permissions to write to the folder.</td>
</tr>
<tr>
<td>Important considerations</td>
<td>The following points should be considered for this use case:</td>
</tr>
<tr>
<td></td>
<td>• If the folder does not exist, then it is created.</td>
</tr>
<tr>
<td></td>
<td>• If the folder does exist, the old data is deleted before the new data is placed there.</td>
</tr>
</tbody>
</table>
Use Cases

Figure 109 SMC Tasks — Manage SPM Metadata

Storage Pool Management Feature in EMC Virtual Storage Integrator
Use Case

Restore SPM data

<table>
<thead>
<tr>
<th>Use case</th>
<th>Restore the SPM data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This restoration causes the SPM data to replaced with SPM data that had previously been saved in a backup.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>
| The SA performs | 1. The SA opens the dialog box for Manage SPM Metadata in SMC under Tasks as seen in Figure 109 on page 198.  
   2. The SA selects Action Restore and uses the box to select the Directory Name as seen in Figure 110 on page 199.  
   3. The SA clicks OK. |
| Exception Paths | 1. The folder does not exist. |
| Important considerations | The following points should be considered for this use case:  
   • If the restored SPM Metadata refers to Symmetrix objects that no longer exist, the Metadata that refers to those objects is removed.  
   • A VMware user should run a Refresh Configuration after the restore as shown in Figure 106 on page 195. |
### Use Cases

#### Table 18 Delete SPM data

<table>
<thead>
<tr>
<th>Use case</th>
<th>Delete the SPM data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This deletion causes the backed-up SPM data to be deleted.</td>
</tr>
<tr>
<td>Role</td>
<td>Storage administrator (SA)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SA has access to the SMC server via a browser.</td>
</tr>
</tbody>
</table>

**The SA performs**

1. The SA opens the dialog box for Manage SPM Metadata in SMC under Tasks as seen in Figure 109 on page 198.
2. The SA selects the Action **Delete** and uses the list box to select the Directory Name as seen in Figure 110 on page 199.
3. The SA clicks **OK**.

**Exception Paths**

1. The folder does not exist.

**Important considerations**

NA
VMware administrator/user functions

This section uses tables to describe common use cases and functional details related to operations that the VMware administrator (VMAdmin), or in some cases the VMware user (VMUser) performs in Storage Pool Management including:

- Adding and removing SPM connections
- Allocating SPM storage
- Adding and removing RDMs
- Adding and removing datastores

Use cases

Table 19  Create an SPM server connection

<table>
<thead>
<tr>
<th>Use case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Registers an SPM Server with a client to perform SPM operations.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SPM feature of VSI is installed on the client where the vSphere client resides.</td>
</tr>
</tbody>
</table>
| The VMAdmin performs | 1. The user, through the vSphere Client, navigates to the EMC icon in the Solutions and Applications section of the Home screen. The SPM Configuration section displays a list of existing SPM server connection information. Figure 111 on page 202 is an example of this.  
2. The user selects Register New Server.  
3. The dialog box as seen in Figure 112 on page 202 asks the user to enter information about the new Server: Hostname/IP address, SMC Secure Port #, client ID (see Table 15 on page 195), and password. The Certificate Name will be the default. The user may choose to Test Connectivity at this point.  
4. The user clicks Next, and if the connection appears to be correct, clicks Finish. |
| Exception Paths | 1. Incomplete information entered in dialog.                                 |
| Important considerations | NA                                                                          |
Use Cases

Figure 111  Storage Pool Management — Servers Configuration

Figure 112  Storage Pool Management — Register With Server
### Use Cases

**Table 20  Remove an SPM Server connection**

<table>
<thead>
<tr>
<th>Use case</th>
<th>Remove an SPM server connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Unregisters an SPM Server from a client.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| **Preconditions** | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server. |
| **The VMAdmin performs** | 1. The user, through the vSphere Client, navigates to the EMC icon in the Solutions and Applications section of the Home screen. SPM Configuration section displays a list of existing SPM server connection information. Figure 111 on page 202 is an example of this.  
2. User selects a connection and selects Remove from the right-click menu. |
| **Exception Paths** | NA |
| **Important considerations** | NA |

**Table 21  Modify an SPM server connection**

<table>
<thead>
<tr>
<th>Use case</th>
<th>Modify an SPM server connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Modify SPM Server connection settings.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| **Preconditions** | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server. |
The VMAdmin performs

1. The user, through the vSphere Client, navigates to the EMC icon in the Solutions and Applications section of the Home screen. SPM Configuration section displays a list of existing SPM server connection information as seen in Figure 111 on page 202.
2. User selects a connection and selects Edit from the right-click menu.
3. The user updates the information, clicks Next, and if the connection appears to be correct, clicks Finish.

Exception Paths

1. Incomplete information entered in dialog.

Important considerations

NA

<table>
<thead>
<tr>
<th>Use case</th>
<th>Allocate storage for VMware object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>After an SA assigns a virtualization domain to a vCenter server a VMAdmin can allocate the storage in that virtualization domain to VMware objects including datacenters, ESX Servers, clusters or resource pools.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| Preconditions             | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server. |
### Use Cases

#### The VMAdmin performs

1. The VMAdmin selects the datacenter, ESX Server, cluster, or resource pool to which to allocate storage to and right-clicks the object, choosing Configure Storage Allocations from the EMC menu.
2. The VMAdmin receives the available storage, by storage type, from the parent of this VMware object. If the parent has not been explicitly allocated storage, then its parent is examined and so forth up through to the vCenter if necessary.
3. The VMAdmin enters the amount of storage he wants to allocate for each type of storage available. The children of this object may now allocate storage only from the amounts and types available in this object. The children cannot allocate storage available from parents of this object. Figure 53 on page 127 has the detail of this.

#### Exception Paths

1. If a clustered ESX server is selected no allocations can be made. Allocations can only be made to an ESX if it is not a member of a cluster.
2. The amount of requested allocation exceeds what is available from the parent object.
3. The amount of requested allocation is less than what is already in use at this object.

#### Important considerations

NA

---

### Table 23  
**Refresh cluster membership**

<table>
<thead>
<tr>
<th>Use case</th>
<th>Refresh cluster membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The server members of a VMware ESX cluster can change, or new HBAs may be added to an ESX server. When they change, the list of server FC ports for the cluster must be updated.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| Preconditions     | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server. |
## Use Cases

| The VMAdmin performs | 1. In the vSphere Client the VMAdmin selects the ESX server or Cluster whose membership has changed.  
2. The VMAdmin selects **EMC/Configure Storage Adapters** from the right-click menu. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exception Paths</td>
<td>NA</td>
</tr>
</tbody>
</table>
| Important considerations | The following points should be considered for this use case:  
• This action does not change the membership of any initiator groups.  
• The list of server ports recorded for that cluster is updated. When a new LUN is created for this cluster the virtualization domain’s views will be checked to make sure there is an initiator group that matches the members of the cluster. |

### Table 24 Refresh configuration

<table>
<thead>
<tr>
<th>Use case</th>
<th>Refresh configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Refresh configuration causes the SPM configuration data to be aligned with the VMware configuration. The SPM configuration data can become out of sync with the VMware configuration when changes are made to VMware configuration, for example creating or deleting a resource pool.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| Preconditions    | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server. |
| The VMAdmin performs | 1. In the Storage Pool Management tab in the vSphere Client, the VMAdmin selects Refresh Configuration as seen in Figure 106 on page 195.  
2. SPM configuration is updated with:  
   a. Used and available storage for each VMware object.  
   b. The LUNs that are mapped to the VMs or clusters.  
   c. Any changes to the VMware hierarchy such as resource pool and VM migration from one resource pool to another. |
| Important considerations | |

---

206  
Storage Pool Management Feature in EMC Virtual Storage Integrator
### Table 25 Create RDM for VM

<table>
<thead>
<tr>
<th>Use case</th>
<th>Create RDM for VM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Creates a thin device and maps it as an RDM for an existing VM.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>VMware administrator (VMAdmin) or VMware user (VMUser)</td>
</tr>
</tbody>
</table>
| **Preconditions** | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server.  
3. Storage has been allocated to the VMware object or one of its parents that the VM is a child of.  
4. vCenter server has authorizations on the thin pool and storage group that will be used.  
5. SAN is zoned correctly. |
| **The VMAdmin or VMUser performs** | 1. The user does the following (this function is stepped through in Chapter 2, under “Virtual Machine menus” on page 144):  
a. Navigates in the vSphere Client.  
b. Clicks the appropriate VM.  
c. Selects EMC/ Add Storage or Configure Batch Storage from the right-click menu.  
2. The user selects the appropriate storage type that is available based upon the VM's VMware parent object, and then clicks Next.  
3. The user sets the size of the LUN by either selecting one of the precreated sizes, or by entering a custom size. If doing a batch add, the user selects the number of disks.  
4. The RDM creation continues in typical fashion. If doing a batch add, the user can then add more RDMs before finally selecting OK. |
| **Exception Paths** | 1. There is not enough available capacity for the storage type selected.  
2. Creating the LUN violates one of the provisioning policies put in place on the virtualization domain by the SA, e.g. maximum number of LUNs. |
| **Important considerations** | The following points should be considered for this use case:  
• If the SA has set the policy that indicates that only precreated LUN sizes may be used, then the user will not be able to create custom-sized LUNs.  
• If the size selected was a precreated size, and if there is an existing, free, thin device, then it is used. Otherwise, a new thin device is created.  
• If creating the LUN violates one of the provisioning policies put in place on the virtualization domain by the SA such as maximum number of LUNs, the task will fail. |
### Table 26 Remove RDM from VM

<table>
<thead>
<tr>
<th>Use case</th>
<th>Remove RDM from VM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Unmaps an RDM from a VM and deletes the LUN.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin) or VMware user (VMUser)</td>
</tr>
</tbody>
</table>
| Preconditions  | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
                           2. The vSphere client has access to the SPM/SMC server.  
                           3. An RDM has been mapped to a VM.  
                           4. vCenter server has authorizations on the thin pool and storage group that will be used. |
| The VMAdmin or VMUser performs | 1. User selects the VM in the vSphere Client.  
                           2. User selects the **EMC VSI tab** and Raw Device Mappings. A list of existing RDMs on a VM's EMC VSI tab appears.  
                           3. User right-clicks an RDM and selects Remove Raw Device Mapping to remove the RDM.  
                           4. If the device is an SPM device, the user is asked whether to destroy the device and return storage to the pool, or to leave the device mapped to the cluster as seen in Figure 113 on page 209.  
                           5. VMware automatically updates the capacities of the objects. |
| Exception Paths | NA                                                                                |
| Important considerations | The following points should be considered for this use case:  
                           • If the device was a non-SPM device, the RDM is removed but the device is still presented to the cluster.  
                           • If the LUN is to be deleted, the capacity of the LUN is checked against the precreation policies for the virtualization domain. If the capacity does not match any of the policies the device is deleted.  
                           • If the capacity matches a policy, the device storage is reclaimed and the device is kept for a future LUN creation of that size. |
Figure 113 Remove Raw Device Mapping or RDM

Table 27 Create a VMFS datastore for a cluster

<table>
<thead>
<tr>
<th>Use case</th>
<th>Create a VMFS datastore for a cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Creates a thin device and formats it as a VMFS datastore.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin)</td>
</tr>
<tr>
<td>Preconditions</td>
<td>1. The SPM feature of VSI is installed on the client where the vSphere client resides.</td>
</tr>
<tr>
<td></td>
<td>2. The vSphere client has access to the SPM/SMC server.</td>
</tr>
<tr>
<td></td>
<td>3. Storage has been allocated to the VMware object or one of its parents that the VM is a child of.</td>
</tr>
<tr>
<td></td>
<td>4. vCenter server has authorizations on the thin pool and storage group that will be used.</td>
</tr>
<tr>
<td></td>
<td>5. SAN is zoned correctly.</td>
</tr>
</tbody>
</table>
### Use Cases

#### Table 28  Delete a VMFS datastore from a cluster

<table>
<thead>
<tr>
<th>Use case</th>
<th>Delete a VMFS datastore from a cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Deletes the datastore and optionally the device on which the datastore was created.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| **Preconditions** | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server.  
3. Storage has been allocated to the VMware object or one of its parents.  
4. A VMFS datastore is mapped to a cluster.  
5. vCenter server has authorizations on the thin pool and storage group that will be used. |
Table 29 Expand a VMFS datastore

<table>
<thead>
<tr>
<th>Use case</th>
<th>Expand a VMFS datastore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Expand or extend a VMFS datastore. This use case is valid for VMFS datastores composed of SPM or non SPM LUNs. This is covered extensively in Chapter 2 in the section “Datastore menus” on page 160.</td>
</tr>
<tr>
<td>Role</td>
<td>VMware administrator (VMAdmin)</td>
</tr>
</tbody>
</table>
| Preconditions  | 1. The SPM feature of VSI is installed on the client where the vSphere client resides.  
2. The vSphere client has access to the SPM/SMC server.  
3. Storage has been allocated to the VMware object or one of its parents.  
4. A VMFS datastore is mapped to a cluster.  
5. vCenter server has authorizations on the thin pool and storage group that will be used. |
### Use Cases

| The VMAdmin performs | 1. The user right-clicks a datastore and selects **EMC Expand Datastore** from the menu.  
| | 2. After a short analysis, the user is presented with a dialog box to either select a new size of the datastore in the existing storage type (SPM LUN), or to select a new extent size from an available storage type.  
| | 3. The user then follows through the appropriate wizard. A new device will be provisioned and appended to the datastore as a new extent or the existing SPM LUN will be converted to a meta or have a meta member added if it is already a meta. VMware automatically updates the capacities of the objects.  |
| Exception Paths | NA |
| Important considerations | The following points should be considered for this use case:  
| | • The VMware LUN concatenation facility will be used to extend the datastore as opposed to any array facility. |
This chapter provides a walk-through of a typical setup of Storage Pool Management in a customer environment.

- Introduction ........................................................................................................... 214
- The Storage administrator — Joe............................................................................ 215
- VMware administrator and VMware user — Judy and Jack .............................. 252
- Conclusion .................................................................................................................. 284
Introduction

The purpose of this chapter is to guide a user through a Storage Pool Management (SPM) setup that details the tasks appointed to the Storage Administrator (SA) and the tasks appointed to the VMware Administrator (VMAdmin). The use case here attempts to mimic how a customer would approach SPM in their production environment. This, of course, represents only a single use case of how SPM can be configured in a VMware environment. It covers most features of SPM and how a customer can take advantage of the benefits.

Rather than speak generically as in the other chapters, a customer model will be used and the chapter will follow in first person plural. Our customer is Acme with Joe as their SA, Judy as their VMAdmin, and Jack as a VMware user in the environment. Acme’s VMAX array is running with Enginuity 5875 and their versions of SMC and Solutions Enabler are both 7.2. In addition, their ESX Servers, vCenter, and vSphere Clients are all version 4.1.

Due to Acme’s current software versions, the automated virtualization domain creation is not available. The chapter is based upon the manual creation of the virtualization domain. An example of what the automated setup would look like, however, is provided so those customers who are at the appropriate level for automated virtualization domain creation have an idea of the step-by-step process involved.¹

¹ The manual process may still be used in the most current version of SMC, 7.3.
The Storage administrator — Joe

The first part of SPM configuration is undertaken by the SA, Joe.

Initiator and port groups

Before beginning the configuration of Storage Pool Management, there are a few required steps that Joe must perform. These tasks may already have been completed by Joe since they relate to constructs within the storage environment that exist with or without SPM: thin pools, initiator, port, and storage groups, and masking views. In a new implementation of VMware, Joe would have to start from scratch, and work with Judy to configure these things; but Acme has been using VMware for some time and therefore Joe can use the existing environment if he chooses. After reviewing the SPM documentation, Joe decides to split the difference: create some new components but also utilize existing ones.

Let’s start, therefore, by reviewing Joe’s existing storage components in SMC. The first stop is Auto-provisioning groups. For Judy’s VMware environment there is currently a single masking view which presents storage to the ESX hosts. Like all masking views, this one is comprised of a storage group, an initiator group, and a port group. Joe decides that rather than use this masking view, he can simply create a new one with a new storage group that will contain the thin devices created through SPM. Fortunately he can use the same initiator group and port group from the other masking view since SPM will be masked to the same ESX servers.
Joe logs in to SMC and looks at the existing port group, dt_licof29-32_pg, in Figure 114 on page 216. Everything looks in order so he moves on to the initiator group.

Figure 114  Existing port group for Judy’s VMware environment

He looks at the existing initiator group for Judy’s ESX cluster, dt_licof29-30_ig. Figure 115 on page 217 is what Joe saw.
The initiator group contains 8 initiators which represent 2 HBAs on each ESX server, each with 2 ports. When Joe created the initiator group he put all of the initiators into the group despite the fact that only 2 of the ports are active on each host. Joe knows the Linux administrator plans on cabling the other 4 ports at some point so he wanted to have them available ahead of time. It does no harm to include all the initiators in an initiator group. In fact it is fortunate that Joe has configured it this way because SPM requires that all initiators be included, even if they are inactive. If it is not configured in this manner, then when Judy or Jack attempt to provision storage, the operation will fail.

Before Joe creates his new masking view, however, he wants to be sure nothing has changed in the ESX clusters since he does not administer the hardware. Perhaps another HBA has been added, or even one replaced. In either case he would need to modify his initiator group which would impact both his masking views. Normally, Joe would go directly to the Linux administrator but he is out today. Fortunately there is another way for Joe to check on the HBAs in the cluster: the EMC Virtual Storage Integrator (VSI). Judy recently installed the newest version of the VSI in anticipation of
enabling SPM functionality. When Joe tells Judy he has to wait for the Linux administrator to get back tomorrow to check on the HBAs, Judy tells Joe that she has been reading the documentation on the new VSI and can get the information for him. Joe readily accepts.

**EMC Virtual Storage Integrator export environment**

Judy returns to her desk and logs in to the vSphere Client which attaches to her vCenter called PARTNER. The storage plug-in is loaded as she can see the EMC VSI tab in many views. Judy then uses the address bar to navigate to Home where she sees the icon for EMC as in Figure 116 on page 218.
She clicks it and then clicks the new tab, Storage Pool Management, as shown in Figure 117 on page 219.

Figure 117  Storage Pool Management tab

Now Judy has read that there is functionality in this tab that enables her to retrieve the information that Joe needs. She sees under Tasks, Export Environment. Judy clicks this and is given the option to save the exported information in an XML file. She instead chooses to format it as a text file so it is easier for Joe to read. Figure 118 on page 220 and Figure 119 on page 221 detail what Judy saw.
Figure 118  Save SPM Export File
The Storage administrator — Joe

Armed with this information, Judy sends Joe an email with the file. Joe double-checks that initiators listed in Judy’s file match those in the existing initiator group for the VMware environment. The values in Figure 119 on page 221 match those in Figure 115 on page 217 and Joe is able to move forward in the storage-side configuration for SPM.

**Storage group and masking view**

Having confirmed that his existing auto-provisioning components are ready to go, Joe’s next step is to create a storage group. As he is running the latest version of SMC, Joe can create an empty storage group, but without a device in the group he will be unable to create a
masking view. He therefore adds a small gatekeeper device to the storage group which will not be used. Figure 120 on page 222 is Joe’s SPM storage group.

![Figure 120 SPM Storage Group](image)

With the new storage group, the final component is in place and Joe can create the new masking view for SPM. Through SMC, Joe creates a new view called SPM_mv which is made up of the storage group dt_licof029-30_sg, the initiator group dt_licof29-30_ig, and the port group dt_licof29-32_pg. The new masking view is shown in Figure 121 on page 223.
Thin pools

With the autoprovisioning part of the SPM setup complete, Joe now moves to thin pools. Once again, Joe takes advantage of the existing objects in the VMware environment. There are three thin pools that Joe set up for Judy and that she continues to require. Being practical, Joe named the thin pools for the type of disks that support them: FLASH, FC, and SATA. The details of these pools can be reviewed in the following figures: Figure 122 on page 224, Figure 123 on page 225, and Figure 124 on page 226.
Figure 122  FLASH thin pool with Flash disk DATA devices
Figure 123 FC thin pool with Fibre Channel disk DATA devices
These thin pools can be used by Joe in the SPM configuration without any further modification. There are two values that Joe knows are important to take note of: Free Capacity and Maximum Subscription%. These two values will dictate how much storage is presented to Judy’s environment. Joe knows, for instance, that though his thin pool, FC, has 400 GB of free capacity, because the Maximum Subscription is set to 200%, Judy will actually see and be able to provision 800 GB of disk. Joe will need to keep an eye on the Allocated Capacity and Allocated% since those values are based on the actual free capacity in the thin pool. Because the VMware environments have data that will grow over time, Joe knows that Judy will not need
Storage Types

Storage types are something that must be configured in SMC before Joe ties the thin pools to a virtualization domain. As Joe has three thin pools that are in use in Judy’s VMware environment, each representing a different tier of storage, he decides to create three storage types that will reflect this. Joe discusses this with Judy. They agree that this will be very beneficial for Judy and her VMware users. Prior to SPM, Joe would create devices in one of his thin pools. He would then inform Judy of the size and type of disk (Flash, FC, SATA) it was so that when she rescanned the HBAs from within vSphere, she would know what to look for in the storage screens. Now, Joe figures that by assigning storage types that match his thin pools, Judy will be able to know exactly what type of disk she has access to and how much of it.

Creating storage types is done through the task of Manage Storage Types which is shown in Figure 125 on page 228.
While Joe named his thin pools to match the type of disk in them, he realizes it is not practical to use those same names for the storage types. Judy might be savvy enough to understand the name FC, but certainly her VMware users would not be. For Joe, Judy is not his only customer. His customers are all those business units that make up the company and each of those units pay for storage. Simply presenting storage with names Flash, FC or SATA will not mean much to those customers. They need to understand both the speed and cost of the disk with which they are presented. Joe decides that if he uses some common understanding of value, and pairs it with a description of the type of disk, most users will be able to comprehend what they are provisioning to their VMs. Joe settles on using types of metal: GOLD, SILVER, and BRONZE. His storage types are shown in Figure 126 on page 229, Figure 127 on page 230, and Figure 128 on page 230. Inherently his customers will know gold is more valuable than silver and that silver is more valuable than bronze. Joe is quite sure that his users will deduce from this that the GOLD type is the best, and hence will provide the best performance albeit at the
highest cost; while the BRONZE type is not as fast but less costly. With the help of Judy to allocate to specific VMware resource pools, Joe thinks he has his bases covered. He sets his storage types to match his thin pools, for example he sets GOLD to be RAID type RAID 5, and disk type EFD (SSD or Flash) because he knows the data devices that are in his FLASH thin pool have this configuration. He does the same for his SILVER and BRONZE storage types.

![Figure 126 GOLD Storage Type for Flash disks](image)
**Figure 127**  SILVER Storage Type for FC disks

**Figure 128**  BRONZE Storage Type for SATA
When Judy first approached Joe about using Storage Pool Management, Joe had his misgivings. After all, to hand over the ability to allocate storage to a VMAdmin, or a VMware user, was not a comforting thought to him. Could the VMware users provision any type of storage in any type of amount they wanted? Could a VMware user with only minimal access within the vCenter environment provision storage? These questions led to Joe to ask the most important question, How would security be handled?

After Joe read through the VSI and SMC documentation, he was reassured that indeed there is strong security on both sides of SPM, namely in both vCenter and in SMC. Joe learns that he will need to set up security in SMC for the thin pools he will provide to Judy and the storage group that will contain the thin devices created in vSphere through SPM. Joe also reads about a password that will act as security he must set when registering vCenter with SMC. So now Joe needs to set up this first security. He will set up a second security later (the Section “Client ID - connection” on page 249 covers this topic).
Here is what Joe did. In the Tasks section of SMC, he navigated to the Security area and clicked on Manage Roles. This action displayed a familiar box to Joe, as shown in Figure 129 on page 232, as he had previously set up security roles for another Symmetrix VMAX under his administration, 000192601665:

![Figure 129 Manage Roles](image)

Figure 129  Manage Roles

Per SPM instructions, Joe configures the role StorageAdmin - Virtualization Domain first for the storage group, dt_licof029-30_sg as seen in Figure 130 on page 233. Then he configures the role for all 3 thin pools which is seen in the following figures: Figure 131 on page 233, Figure 132 on page 234, and Figure 133 on page 234. The specialized role in every authorization requires the virtualization domain name which must be obtained from Judy. Fortunately this information is easily gathered by Judy because it is kept in the export file she previously generated to show Joe the initiators as previously shown in Figure 119 on page 221. Judy lets Joe know the name is PARTNER. Judy also tells Joe he must use this name or she will be unable to provision storage when everything is configured because this name is checked against the roles he is about to create. Now that Joe is ready he proceeds as shown in the following figures.
Figure 130  Adding the Virtualization Domain Role for the Storage Group

Figure 131  Adding the Virtualization Domain Role for Thin Pool FLASH
Figure 132  Adding the Virtualization Domain Role for the Thin Pool FC

Figure 133  Adding the Virtualization Domain Role for the Thin Pool SATA
Virtualization Domain — manual setup

With storage types in place and authorizations, Joe believes he is ready to create the container within SMC that is the driver behind SPM: the virtualization domain. He already has the name given that he supplied it when creating the roles. That name will be available to him within a list box in the dialog box for the Virtualization Domain Name field. He will take the following two steps:

1. Create the virtualization domain, attaching the new SPM view, SPM_mv.
2. Attach each thin pool and assign the correct storage type of GOLD, SILVER, or BRONZE.

Joe brings up the dialog box for creating a virtualization domain by right-clicking the Virtualization Domains folder. He then enters all the information required, using the list boxes where appropriate, such as for the virtualization domain itself. This list box gets pre-populated after an authorization role is setup for the vCenter, in this case PARTNER. For the vCenter GUID, Joe would have been at a loss, save his conversation with Judy and that she showed him the SPM export file again (view Figure 119 on page 221 for this example). This export file, under the heading of ID, contains the GUID. He inputs the GUID, the name which is also in that export file, a minimum and maximum LUN size, which are values that he and Judy agreed upon ahead of time based on the business units’ requirements, and adds the SPM masking view he created. His values are in Figure 134 on page 236. Note that the virtualization domain
restricts the minimum LUN size to at least 5 GB, but allows a large maximum LUN size of 1 TB so that Judy is able to create a large datastore if needed.

![Virtualization Domain Management - Create Virtualization Domain](image)

Now Joe moves to the second step, adding the thin pools. Remember that Joe has three thin pools: FLASH, FC, and SATA. When he adds the thin pools to the virtualization domain he will be required to select the appropriate storage type. Joe does not need to be an expert at SPM to do this since SMC will match his thin pools to the storage types he created previously. And as we mentioned in Section “Storage Types” on page 227, Joe was careful to match his storage type configurations to his data devices that support his thin pools.
Figure 135  Adding of Thin Pools to Virtualization Domain PARTNER

Entering the menu by right-clicking on the Virtualization Domain and choosing Add Thin Pool as in Figure 135 on page 237, Joe begins the process. Again, he follows the order of FLASH, FC, and then SATA. He chooses FLASH, and the storage type of GOLD automatically fills in for him. Now, remember that on this thin pool Joe set a maximum subscription rate of 250%. So although there is only 100 GB of actual disk space supporting that thin pool, the capacity available to add to the virtualization domain is 250 GB. Figure 136 on page 238 demonstrates this.
Since Joe uses those three thin pools for the VMware environment and has configured it specifically for that purpose, including the maximum subscription, he provides all of the capacity to the virtualization domain. Joe follows by adding the thin pools FC and SATA in similar fashion as shown in Figure 137 on page 239 and Figure 138 on page 239.
**Figure 137** Adding Thin Pool FC to Virtualization Domain PARTNER

**Figure 138** Adding Thin Pool SATA to Virtualization Domain PARTNER

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The Storage administrator — Joe
Virtualization Domain — automated setup

The complexity involved in manually creating the virtualization domain can be eliminated by using the automated process whenever possible. To do so, Acme would require SMC version 7.3 and Enginuity 5875 Q2 2011 SR operating environment version. What follows is an example of the step-by-step wizard Acme would use in such a case. The setup is also based upon their environment presented in this chapter.

The automated setup, like the manual one, relies on some objects already in Acme’s storage environment. Before beginning the wizard there is a prerequisite that must be completed. In the manual setup, Judy exported the environment to be used with SPM through the vSphere Client, explained in the section “EMC Virtual Storage Integrator export environment” on page 218. For the automated wizard this environment file is critical and is also known as the Virtualization Data File. It is what the wizard will use to generate all the objects related to the virtualization domain. This file needs to be copied to the SMC server and placed in a directory of the administrator’s choosing. Joe’s SMC implementation is on Linux so he places the spm-export.xml file in the /tmp directory as once the wizard is complete he will no longer require the file.

The other objects that the wizard will need are storage resources (thin pools, FAST VP policies) to assign to the virtualization domain and a port group. While the wizard can create initiator and storage groups, the wizard cannot determine the zoning of the servers and relies on the administrator to provide the proper ports through the port group. Joe will be using the existing port group seen in Figure 114 on page 216, just as in the manual process.

Once logged into SMC, Joe navigates to the Tasks/Operations/Automated Virtualization Domain Setup as seen in Figure 139 on page 241.
Figure 139 Automated Virtualization Domain Setup task

Selecting this starts the wizard with the welcome screen displayed in Figure 140 on page 242.
The welcome screen provides the outline of the steps Joe will be taking to create the virtualization domain. Joe selects “Next” and begins the first step which is to select his Symmetrix from the list provided. In Figure 141 on page 243 Joe sees his Symmetrix which ends in 540. If his “spm” user had privileges on more than one Symmetrix, they would be available for selection in the drop-down box. Joe selects “Next” and moves along to step 3.
In step 3, Joe will need to load the spm-export.xml file which he copied over to his SMC server in the /tmp directory. As there is no browse capability, Joe needs to type in the exact location of the file, including the file name itself, and then select the “Load” button which is highlighted in green in Figure 142 on page 244. SMC reads the information in the file and populates the following fields: Virtualization Management Server; Cluster/Server Name; and Details which contain the WWNs of the HBAs of the ESX hosts in the cluster. The only field that Joe is required to complete is the Port Group which he can do by selecting the previously created dt_licof029-32_pg from the drop-down box, again as in Figure 142 on page 244.
Once the Port Group is selected, Joe chooses “Next” to move on to the final configuration in step 4.

In step 4 Joe needs to supply the remaining configuration components of his virtualization domain. In this screen, many of the steps that previously were completed manually only after the creation of the virtualization domain, are now automated - tasks such as adding a thin pool. Joe also can take advantage of configuring Storage Pool Management to use a FAST VP policy as a storage resource. This will simplify the provisioning of storage for Judy, the VMAdmin, since FAST VP will be able to make all the decisions about where her data should be placed on the Symmetrix. A few of Acme’s business divisions, however, require that their virtualized applications use FC only, so Joe must take this into account when configuring the storage resources. Because of this, he selects two storage resources: a thin pool and a FAST VP policy. For the thin pool he selects a Fibre Channel (FC) thin pool, and for the FAST VP policy
he selects a previously created one that is configured with SATA and EFD disks. As the majority of Acme’s business applications do not have specific disk requirements, and since only a small percentage of the data for each application is accessed with any frequency, they can best be serviced with a mix of EFD and SATA. Joe’s FAST VP policy calls for EFD to hold a maximum of 10% of the data while SATA is permitted to contain all 100%. Without any user intervention, any devices that Judy provisions from the FAST VP pool of storage will be capable of having their data moved seamlessly between the disk tiers as access patterns demand. This takes all the guesswork out for both Joe and Judy.

In Figure 143 on page 246, we see that Joe checks the thin pool resource FC, and the FAST VP policy FASTVP_for_SPM. He assigns the storage type FC_Storage to the thin pool and the storage type FASTVP_Storage to the FAST VP policy by simply typing in the names. If, by chance, there were existing storage types created but not in use, he could use the drop-down box to select one, assuming it matched the Storage Resource. Those storage type names will be the ones that Judy will see in the vSphere client in VSI, making it clear to her what pool of storage is FC and what is FAST VP. Joe also assigns a capacity for each resource. Recall that the available capacity listed is based upon the subscription policy of the thin pool(s) and may not be the actual amount of physical storage. Joe has not set the maximum subscription for the thin pools in this case. For FC he presents 5 TB to Judy and for the FAST VP policy, 10 TB.
Now that Joe has completed this configuration he chooses “Next” and is brought to a summary screen which details all the steps that SMC will take to complete the request. This will include creating any necessary autoprovisioning objects and all necessary authorizations. The entire list of actions is delineated in Figure 144 on page 247.

Figure 143  Automated Virtualization Domain — Storage Resource selection
Figure 144  Automated Virtualization Domain — Summary of actions
Joe selects “Finish” and SMC proceeds to create the virtualization domain. The final screen will appear and will mark each successful step with a green check mark as it completes. The three completed steps are seen in Figure 145 on page 248. At this point Joe also has the option of selecting the “Show Details” button which will display a detailed explanation of all the steps taken. This is most useful when an error has occurred since the details will show exactly on what step the wizard failed.

Figure 145  Automated Virtualization Domain — Progress indicator

The virtualization domain is now ready for presentation to the vCenter environment. The remaining setup of SPM proceeds just as the manual process does, beginning with the Client ID creation in the next section.
Note: If Joe wishes to add other storage resources to his virtualization domain in the future, he will need to follow the manual process of setting up an authorization and storage type for each storage resource.

Client ID - connection

Joe is ready now to undertake the last step in his part of the configuration of Storage Pool Management and allow Judy and her team to complete the configuration. This could be considered the most important part of the setup, though certainly the quickest and easiest to undertake. It answers the question How does vCenter communicate with SMC? The answer is by registering a client-ID that Judy will use in her configuration in vCenter. This client-ID is just a name by which VSI performs a handshake with SMC and retrieves all storage types information about the virtualization domain.
And so Joe begins by selecting another task called Manage Launch Clients under the Administration panel as in Figure 146 on page 250.

![Figure 146 Manage Launch Clients task](image)

Joe selects to add a client and enters in the information. He uses the box to change the client type to SPM. He then enters in two pieces of information, a client-ID and a password. Although Joe could use any ID, he uses the name PARTNER to make things simple, and matches it with the virtualization domain name. He finishes with the password spm and confirms it before hitting OK as in Figure 147 on page 251.
With this complete, we see a finished configuration on the SMC side. Joe tells Judy she now can complete her portion of the configuration and begin taking advantage of SPM.
VMware administrator and VMware user – Judy and Jack

We now see the configuration turned over to Judy. Judy has been involved each step of the way. She is totally informed and ready to begin.

vCenter registration with SMC for SPM

The first step Judy will need to take is in direct correlation with the last step that Joe took. She needs to register the vCenter environment with SMC and needs to do so with the client ID that Joe set up in Section “Client ID - connection” on page 249.

Judy starts the vSphere Client in Figure 148 on page 252 and logs in as Administrator.

She then follows the same path she took when she presented Joe with the SPM export file, as shown in Figure 116 on page 218. This time instead of exporting the environment, Judy selects Register New Server as in Figure 149 on page 253.
Judy is presented with the registration screen. There are five fields that require an entry. Two of those fields, Secure Port and Certificate Name, default automatically for Judy. The other entries are from Joe. Just as Judy could supply Joe with initiators from the SPM export file for his configuration portion, Joe supplies Judy the values for her portion of the configuration: SMC IP Address, Client-ID, and Client-ID password. She put them in the appropriate fields as in Figure 150 on page 254.
After completing the dialog box, Judy sensibly chooses to test the connectivity and finds that the information is correct and the connection is made. A new entry is shown in the Storage Pool Management Servers panel, as seen in Figure 151 on page 255, once Judy clicks through the remaining screen and a task is listed for the registration. Although only one entry is listed, Judy is aware that if required, future registrations could be made to other Symmetrix VMAX arrays under Joe’s administration.
Figure 151  Registration entry in SPM tab and associated task

**Note:** Acme’s environment is set up so that both Judy and Jack use the same Windows client in which to run the vSphere Client along with the Virtual Storage Integrator plug-in. In the future, if Jack wants to run the vSphere Client from his PC for instance, he would need to install the VSI plug-in with the SPM feature, and ensure that Judy runs the registration steps. Joe could also perform the steps himself. More details are provided in the Section “vCenter registration with SMC for SPM” on page 252. However once registered, Jack will see the same information as if he were using the centralized vSphere Client.
Customer Example

### vCenter assigned pools

The registration is complete. Judy now has access to the thin pools that Joe configured for her environment. She accesses the vCenter at the top level, PARTNER, and thin pools are presented by the storage types previously created by Joe as shown in Figure 152 on page 256.

![Figure 152 Assigned Pools and Storage Types in Judy’s vCenter PARTNER](image)

**Note:** Due to its pool size, BRONZE is displayed in TB rather than GB in Figure 152 on page 256. Since Joe allocated 2000 GB of SATA in SMC, it does not convert to exactly 2 TB, but rather about 1.95 TB.

Again, if another Symmetrix VMAX were configured, Judy would see two entries in the Assigned Pools window on the right. Each Assigned Pool represents a registration as seen in Figure 149 on page 253, and each registration in turn may contain multiple thin pools in the form of storage types. Judy examines the storage types for her registration and notes that the available storage is currently the same as the capacity. As Judy begins the allocation process, the available capacity begins to decrease, but the overall capacity at the
vCenter level will remain the same. Unless Joe allocates more storage (data devices) to one of the supporting thin pools and then adjusts the amount available in the virtualization domain, the capacity number will not change. Additionally, if he did make a change like that, Judy knows she would need to issue a Refresh Configuration from the SPM tab, as highlighted in Figure 153 on page 257. As we go lower on the tree (datacenter, cluster, resource pool) both capacity numbers will decrement appropriately.

![Figure 153 Refresh Configuration after SMC storage change](image)

There are any number of changes Joe that could make that would impact the storage presented to Judy. However, Judy need only refresh her environment to see those changes.

**Judy’s datacenter**

Judy is ready to begin allocating the storage available to her. In a high-level view of her environment, as shown in Figure 154 on page 258, Judy has a datacenter named SPM which contains a single cluster SPM_Cluster comprised of two ESX hosts. Judy’s environment is only partially presented. There are three resource pools highlighted in the figure, although Judy has many more. Each resource pool shows a single VM, while in actuality each pool has
tens of VMs. Fortunately the process demonstrated through Judy’s configuration does not change whether in this pared down environment, or in her much larger actual environment. The process is made more clear by using a simple example. Extrapolation to a larger environment can easily be undertaken by the reader.

Figure 154  Judy’s Datacenter, SPM

Looking deeper into the figure, the items circled in blue show us how the display has changed by dropping down a level from the vCenter to the datacenter. When Judy gets to the datacenter level, the storage types, not the assigned pools now populates the upper-right panel. The lower right-hand panel contains the detail of whatever storage type is selected. Here the storage type is the GOLD, or the Flash disk. The datacenter automatically inherits the allocated storage from the vCenter. The displayed detail is always from the child of the object.
we selected on the left. So as Judy highlights the datacenter, the storage detail is of the cluster, SPM_Cluster. This indicates that the capacity of the GOLD storage type is 0 for the SPM_Cluster. This makes perfect sense since Judy has yet to allocate any storage to the children of the datacenter. If SILVER or BRONZE were selected, 0 would appear in the bottom panel.

Storage resource pools

At the cluster level, Judy is presented with the details of her resource tools on the bottom-right panel as seen in Figure 155 on page 259. Once again, as she has not begun allocation of storage, the resource pools register 0 as their capacity for the GOLD storage type.
Now the advantages to using SPM become even more clear. Judy and Joe have always worked closely together. Their roles absolutely necessitated it. You see, Judy was constrained by her inability to allocate storage herself. She relied entirely on Joe’s role as an SA to enable her to provide storage to her customers. In turn, Judy’s VMware users had to rely on her to get them disk for their VMs. They could add the RDMs once she gave them the disk information, but it was easier to let her do the whole process. It eliminated a step for them, and got them the disk quicker. This increased Judy’s workload. She needed to micromanage VMs when what she really needed to be working on was virtual architectures and better ways to utilize available resources. The constant need to request disk from Joe caused invariable delays. She was not Joe’s only customer, and Joe needed to balance her requests with those requests of other customers.

Now enters Storage Pool Management. Judy is going to be able to pool her storage resources just as she pools her CPU and memory resources. Not only will she be able to create datastores from the disk up, but she will be able to allow her VMware users to do the same for RDMs on their VMs. Moreover, she can control the type of storage available to the VMware users. No more issues where a test environment is presented with Flash disk or a production environment mistakenly given a SATA device. Because of how Joe set it up, these storage types make it clear to both Judy and her users what type of storage they are using and what performance they can expect from it. Essentially she will have storage resource pools. And as much as Judy likes talking to Joe, their need to communicate about storage allocation to her VMware environment will now be just once a month. Plus, she now has the opportunity to speak to him about bigger virtual projects.

Storage allocations

Cluster

All things being ready, Judy starts the storage allocations. Beginning at the Cluster level, Judy allocates storage from the storage types to the SPM_Cluster in Figure 156 on page 261:
Judy decides not to allocate all the storage available to her at this time. She has multiple clusters and may be adding a second datacenter and wishes to keep some storage aside. Her allocations are in Figure 157 on page 262 and Figure 158 on page 263.
Figure 157  Cluster_SPM Storage Type Allocation
When the allocation is complete, view the result from the datacenter (SPM) level. The available capacities are decremented for the allocations, but the capacity remains the same. If Judy highlights a particular storage type, such as GOLD as in Figure 159 on page 264, the bottom panel shows how much capacity is available to the cluster.

**Note:** Judy is showing an additional cluster, VSTORAGE here but has not allocated any storage to it. This explains why she has reserved some capacity. Also note that the amounts in the highlighted Capacity column have not changed. This is due only to the fact that at this time Judy does not have a second datacenter to which she has allocated storage.
Customer Example

The allocations complete to the cluster, Judy can now consider her users like Jack. As hinted at earlier (the Section “Storage resource pools” on page 259 provides more detail), Judy wants to create pools of storage for her users. To do this, Judy will match the pool of storage with the resource pool. In other words, if she has a resource pool where Jack has all his production VMs, Judy will be sure to create pools of storage that contain storage types that meet that need: GOLD. Similarly, she can assign FC to a test/QA resource pool and SATA to say an archive resource pool. The VMs in those resource pools would only have access the “storage pool” allocated to them. This solves Judy’s problem of occasional having the wrong storage go to the wrong environment.
Judy will also be handing over more control of her customers’ VMs to them. Jack will now be able provision his own RDMs and make decisions on how to use the storage allocated to him. If Jack depletes his allocation, he can make a request to Judy to have additional capacity added to his pool of storage. Before SPM, he would have to ask Judy to go through the process of asking Joe for storage, then having her discovering it in ESX Server and then presenting it to his VM. Any of these steps were error prone or time consuming. Review this example of allocating this “storage pool” to the Archive_ResourcePool.

**Allocating to Resource Pools**

Just like the allocation to the cluster, Judy right-clicks the ArchiveResourcePool, as in Figure 160 on page 265, and follows the EMC menu to “Configure Storage Allocations”.

![Figure 160 Configuring the “storage pool” for the ArchiveResourcePool](image)

Judy is presented with the three storage types that she previously allocated to the cluster. As this resource pool contains VMs that are specifically for archiving purposes, Judy is providing capacity from the BRONZE storage type, or SATA disk. The business owners of
these VMs need lots of storage at reasonable prices, but what they do not require is performance. BRONZE is therefore the right choice. These steps are seen in Figure 161 on page 266 and Figure 162 on page 267.

**Figure 161** Allocating the BRONZE Storage Type to the ArchiveResourcePool
Figure 162 Completing BRONZE allocation

Once the allocation is complete, Judy highlights the ArchiveResourcePool to see that indeed while 150 GB has been allocated to the resource pool, the other storage types, GOLD and SILVER, still register 0. Figure 163 on page 268 is what Judy sees.
Customer Example

Figure 163 ArchiveResourcePool with BRONZE allocation

Judy continues to allocate the storage capacities to each of the resource pools in turn until all of the capacity she planned on distributing is complete. In the end Judy allocates all storage from the storage types save 300 GB from the BRONZE storage type for a datastore that will hold her ISO images. In Figure 164 on page 269 shows the final view. Notice that the SILVER storage type is highlighted. It indicates 150 GB has been allocated to two different resource pools since there are some production VMs that do not need the level of performance that Flash offers.
The previous process was quite quick and easy for Judy. What normally would have taken days or more between her and Joe, was completed in a very short time. Judy has a couple more tasks and then she can return the environment to her users.

The BRONZE datastore

With the reserved 300 GB of BRONZE storage type, Judy is ready to create an ISO datastore for the cluster environment through SPM. While it is possible for Judy to delegate this task to one of her users, that would require more VMware permissions on the host than Judy is comfortable with so she has decided she will handle all datastore creation. Now that she has all this extra time because of SPM, she is more than willing to keep that responsibility.
Once again, Judy right-clicks the SPM_cluster but this time selects Add Datastore from the EMC menu as seen in Figure 165 on page 270.

Figure 165  Add the BRONZE Datastore from the EMC menu

Judy then selects from the available storage, in this case of course there is only BRONZE to choose from, just as she planned it. Figure 166 on page 271 shows the selection.
Next Judy selects a size. She intends to use all 300 GB which will create a metavolume on the VMAX and provide for easy expansion if she requires it. However, notice that not only could she put in any custom size of 50 GB or less, but that she could also select a precreated LUN size. Figure 167 on page 272 shows the detail.
Customer Example

Figure 167  Select Datastore size — Precreated or Custom

The next screen requires the datastore name as seen in Figure 168 on page 273.
Finally, Judy takes the default block size, Figure 169 on page 274, and finishes the task shown in Figure 170 on page 275.
Figure 169  Select block size for datastore
After the datastore creation, Judy returns to the cluster view to see the allocation of the storage. From Figure 171 on page 276 Judy is able to see the LUN that she provisioned when creating the datastore. The detail here goes down to the device number, 00EC. Should Joe care to look at SPM from within vSphere, he would be able to map back that LUN to the thin pool of the BRONZE storage type. This might be beneficial, if say, there was a performance problem and Judy needed Joe to investigate.
Customer Example

Figure 171  The complete allocation of the GOLD Storage Type

With that Judy has only one thing left to do. She needs to assign permissions to Jack so he can provision storage to his own VMs.

VMware user permissions for SPM

By default, only VMware administrators can provision storage with Storage Pool Management. From the start, though, Judy felt that SPM would only be truly effective if the business users/owners of the resource pools could provision their own RDMs. She did, however, have many of the same types of concerns that Joe expressed in Section “Authorizations” on page 231. Chief among these was: “How could she grant access to her users without outright giving them administrator privilege?” The answer is simple. There are two sets of permissions that someone like Jack must possess to use SPM.
integration to provision storage: Extension and Tasks. These privileges must be applied at the vCenter level (PARTNER) and set to propagate through the entire environment.

Judy begins, therefore, by creating a role called SPM in the vSphere Client which has all the Extension and Tasks privileges as in Figure 172 on page 277.

She then assigns the role to Jack at the vCenter level as seen in Figure 173 on page 278.
Figure 173  Add Role SPM to Jack

Note that the setting Propagate to Child Objects in the red box is checked. If this is not checked, even if Jack has administrator privileges on a VM, he will not able to use SPM to create an RDM.

Since Jack already has administrator privileges on his resource pools, he is now ready to provision storage for his VMs. Jack needs a single RDM added to a particular VM fairly quickly. He logs into the vSphere Client and chooses the ProductionVM, in his ProductionResourcePool. From the right-click menu, Figure 174 on page 279, Jack now sees the EMC menu to Add Storage.
Customer Example

Figure 174  VMUser Jack adds storage through SPM

Like Judy, Jack first chooses the type of storage to provision. In this case he will select from the GOLD storage type seen in Figure 175 on page 280.
Figure 175  Jack selects Storage Type GOLD

Following this selection Jack needs a capacity for his RDM. Figure 176 on page 281 shows this. Fortunately, Judy came to him before Joe configured SMC for SPM and asked what size RDM disk he used most frequently. Jack indicated that he uses many 10 GB LUNs for his databases. Therefore Judy asked Joe to set a pre-create policy of 10 GB on the thin pool that is associated with the GOLD storage type. By doing this, Jack can be fairly confident that he will be able to add the RDM quickly as most likely there will be one or more 10 GB LUNs waiting to be provisioned. So rather than waiting for the LUN to be created, the adding of the RDM happens very quickly.
Figure 176  Capacity Selection — Jack chooses Precreated

Jack accepts defaults on the remaining screens until he clicks Finish at the final screen in Figure 177 on page 282.
Figure 177  Jack completes the RDM

Jack views the RDMs associated with the VM and refreshes the screen a few times until his LUN appears. By using VSI he can see the RDM as in Figure 178 on page 283, and all the storage detail associated with it, including: device ID, RAID configuration, known capacity, and even the storage type from which the LUN was created - GOLD.
Figure 178  EMC Virtual Storage Integrator showing Jack’s RDM
Joe, Judy, and Jack were able to present their company, Acme, a new paradigm of how to think about storage. By using “pools of storage”, much like VMware uses resource pools, the team has given their company the ability to intelligently manage storage tasks. In so doing, they are able to free up more of their time to concentrate on the business of the company.