

Provisioning with VPLEX™ INTEGRATED ARRAY SERVICES

Planning, Implementation, and Best Practices

Abstract

This paper is intended to give guidance to the planning, implementation, and best practices for using VPLEX Integrated Array Services (VIAS) and SMI-S Provider functionality in your VPLEX environment.

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Executive summary

Business Case

The **DELL EMC® VPLEX™** family removes physical barriers within, across, and between data centers. VPLEX Local provides simplified management and non-disruptive data mobility across heterogeneous arrays. VPLEX Metro provides data access and mobility between two VPLEX clusters within synchronous distances. With a unique scale-up architecture, VPLEX's advanced data caching and distributed cache coherency provide workload resiliency, balancing, plus enables both local and remote data access with predictable service levels.

Solution Overview

This white paper is designed to give technology decision-makers a deeper understanding of the VPLEX Integrated Array Services in terms of the overall solution, planning, design, and features & functionality. The key technical considerations for implementing VPLEX Integrated Array Services for provisioning in VPLEX and how to provision storage from Storage Pools provided from VMAX, VNX, and XtremIO arrays. VIAS provisioning will create new virtual volumes on demand, with the required service levels, and do this provisioning across multiple arrays in five easy steps.

Audience

This white paper is intended for technology architects, storage administrators, and system administrators who are responsible for architecting, creating, managing IT environments that utilize EMC VPLEX technologies. The white paper assumes the reader is familiar with VPLEX, VMAX, VNX, and XtremIO technologies.

1 VPLEX Integrated Storage Provisioning

The VPLEX Integrated Array Service (VIAS) feature enables VPLEX to provision storage for EMC VMAX, VNX, and XtremIO storage arrays directly from the VPLEX CLI, UI, and REST API. VPLEX uses Array Management Providers (AMPs) to streamline provisioning, and allows you to provision a VPLEX virtual volume from a pool on the array.

The VIAS feature uses the Storage Management Initiative -Specification (SMI-S) provider to communicate with VMAX and VNX arrays while using the REST provider to communicate with XtremIO arrays to enable storage provisioning. An SMI-S provider must be installed and configured on the same storage area network (SAN) as the VPLEX, and both the VPLEX and the SMI-S provider must be configured for same arrays. After the SMI-S Provider has been configured, use AMP to register the backend arrays with VPLEX. This is accomplished using either the VPLEX CLI or Unisphere for VPLEX GUI. After the registration has completed, the managed arrays are visible to VPLEX and are provisioning of virtual volumes can be accomplished using Disk Groups or Pools visible from each array. VIAS will see **all** Disk Groups and Pools created on the managed array(s). There is no limit to the scope of pools used by VPLEX VIAS due to role-based access limitations within SMI-S

Provisioning in VPLEX has been streamlined and enhanced to provide a more efficient way to provision storage for EMC arrays. Simplified provisioning uses a wizard to create new virtual volumes on demand, with the service levels needed, in five steps:

1. Select consistency groups and add storage
2. Select VPLEX protection services to apply to the production volume (none, local RAID-1, and distributed mirroring), number of volumes and capacity per volume
3. Select the underlying storage array pools from which to draw storage
4. Expose storage to hosts – See Figure 1 below
5. Review and finish

Simplified provisioning enhances productivity by dramatically reducing the amount of operational steps required to provision storage. To leverage VIAS-based functionality, you must register an Array Management Provider (AMP). An Array Management Provider is an external protocol endpoint used to execute array management operations on individual arrays. In this release, VIAS uses the Storage Management Initiative - Specification (SMI-S) provider and the REST provider to communicate with the arrays that support integrated services to enable provisioning.

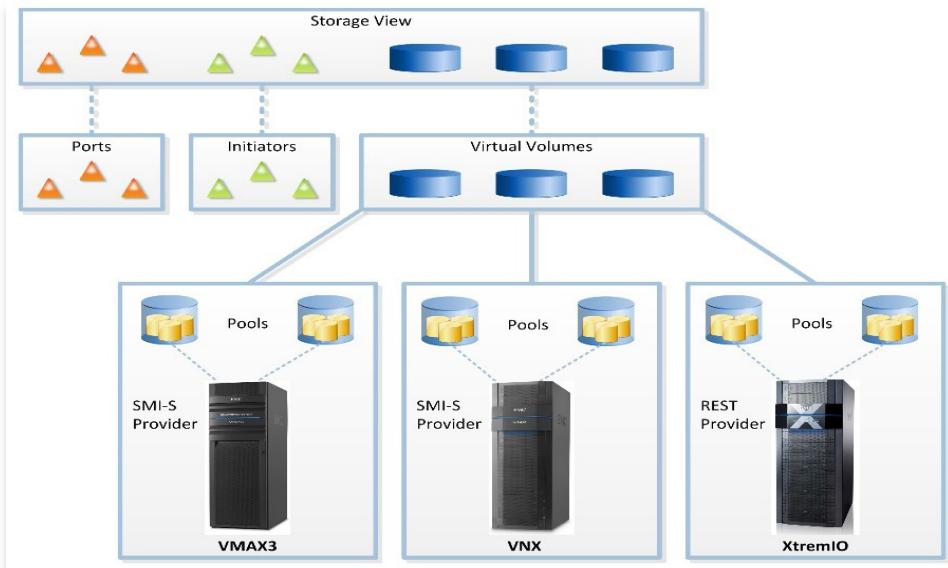


Figure 1 Architectural Overview

Integrated storage refers to storage created through the VPLEX Integrated Services feature. This feature requires the use of Array Management Providers (AMPs) to leverage functionality on the array, specifically, storage pools. If your EMC array configuration includes storage pools and the array is supported for use with VPLEX, you can integrate the array with VPLEX and provision storage from pools on the array through VPLEX.

In Figure 2, the SMI-S Providers are configured to see the same array VPLEX has already been connected to. Once this configuration is done a user can register a SMI-S provider using AMP on the VPLEX. This is done by running the CLI or GUI wizard. You will provide the SMI-S Provider's IP Address and credentials, then the registration will be completed. At this point the managed arrays with its disk groups and pools for provisioning will be visible in the VPLEX UI.

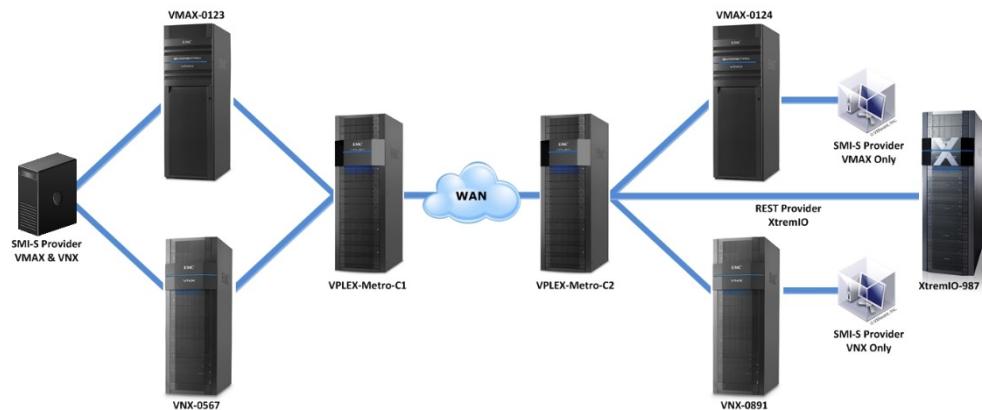


Figure 2 SMI-S Providers

1.1 VIAS REQUIREMENTS

Table 1 Array and Provider Requirements

Array Requirements			Provider Requirements	
Array	Code Family	Target Code	Solutions Enabler	SMI-S Provider
VMAX	5784 - 5876	5876.272.177	7.62	5876.272.17
	5977	5977.596.583	8.02	n/a
VNX	7.1	7.1.79.8	7.62	5876.272.17
	8.1	8.1.6.101	7.62	5876.272.17
	5.32	5.32.000.5.218	7.62	5876.272.17
	5.33	5.33.006.5.102	7.62	5876.272.17
XtremIO	3.0	3.0	n/a	n/a

For the 5.5 GeoSynchrony release, the max number of jobs that may be queued is 100. This does not include cancelled or completed jobs. The maximum number of virtual volumes per request is 10. After one request is complete, the next request can be initiated. During a provisioning request, it might take several minutes for the job ID to be returned. In the GUI, the provisioning wizard will display an in progress icon until the job ID is ready. The same is applicable for the CLI, it might take several minutes for the job ID to be displayed. This behavior has been greatly enhanced since the 5.3 and 5.4 versions of GeoSynchrony.

1.2 VIAS Recommendations

- As a best practice, do not use the RESTful interface to poll the pools on a managed array. This can be very expensive resource consuming operation. EMC recommends that you limit the number of times you query pools from any of the interfaces. (CLI, GUI, and RESTful API)
- Avoid having redundant array providers managing the same arrays. It is possible to add many array providers. Additional providers that are not used to actively manage an array must be removed.
- Listing pools is expensive on the SMI-S provider. While a provisioning request is in progress, try to limit the number of times you list pools. This request can be synchronous and can cause delays in the response time for listing pools.
- Know the SMI-S provider health. Before executing a provisioning request you might want to check the health of the provider. This is best done by looking for the ECOM thread or service. There have been some cases where the SMI-S provider can have a CPU that is taking up a percentage of the CPU (25%) when there is no interaction. In such cases, the provider is having an issue.
- If there are multiple masking views, VPLEX will place the provisioned LUNs in the masking view with the least number of devices. In other words, provisioning is deterministic in terms of the masking view with the least number of devices.
- The minimum capacity that may be provisioned is 150MB.
- The automatic provisioning job deletion only deletes completed and failed jobs. The jobs are automatically deleted after seven days. In-progress and canceled jobs must still be deleted manually.
- Local jobs will be executed even if the remote jobs fail on the remote cluster.
- In a scenario where one cluster fails, the distributed RAID1 provisioning requests will remain queued until the other cluster is reachable.

- There are different timers that are executed at each level of a provisioning request. When a cluster fails or an AMP becomes unreachable, a timeout occurs. In the event of a timeout, provisioning requests will fail with the message: "futures timeout"
- The provisioning job status will persist through any SMS failures or reboots.
- If a provisioning job is in progress, and there is a VPN or SMS failure, the job listing on the remote cluster will not be visible. If the jobs are executed on the remote cluster, then the provisioning job listings will remain empty until the VPN is re-established or the remote cluster is again reachable.
- For VMAX, if a LUN is provisioned from a pool that has a specific policy, then the storage group in the masking view must also have the same policy. During provisioning, when a LUN was created from a pool with a specific policy that the masking view configured to VPLEX did not have, the LUN was created. However, the LUN could not be added to the masking view and was not exposed to VPLEX.
- Before provisioning from storage pools, you must first register the AMP that manages the array. Your VPLEX system can include AMPs that manage some or all of the arrays in your environment. An array must be integrated with VPLEX in order to provision storage from pools on the array. Note that you can also provision from storage volumes as well on an integrated array.

Note: VIAS uses the Storage Management Initiative - Specification (SMI-S) provider to communicate with the VMX and VNX arrays. Please validate your versioning requirements with the EMC Simple Support Matrix for VPLEX.

1.3

Pools and VIAS interaction

It is important to remember for the end user of VIAS to ensure they have some insight into the pools they will be provisioning from. The VPLEX VIAS functionality will show all the non-restricted pools on the array. VIAS has implemented capabilities that try to reduce the possibility of showing invalid pools but there are scenarios that can arise with unsupported array configurations that may prevent provisioning. A user should know how the VPLEX is configured to the array and the types of pools that should be used. The following is an example of different types of pools:

- **Primordial Storage Pool:** A primordial Storage Pool is a type of Storage Pool that contains unformatted, unprepared, or unassigned capacity. Storage capacity is drawn from the primordial Storage Pool to create concrete Storage Pools. A primordial Storage Pool is not shown after registering with VPLEX AMP because provisioning is not permitted from these types of pools.
- **Concrete Storage Pool:** A concrete Storage Pool is comprised of VMAX Disk Groups or VNX RAID Groups. They may aggregate the capacity of one or many these Disk and/or RAID groups. Concrete Pools are shown after VPLEX AMP registration.
- **Reserved Disk Pools:** These are Storage Pools reserved by the storage array for hot sparing.
- **Reserved LUN Pools:** These are Storage Pools reserved by the storage array for Snaps and Clone technologies.

Provisioning requests from VPLEX may fail with generic ECOM errors that are due to limitations and restrictions on the array. If the provisioning request fails with an error please check the pool configuration and how VPLEX is configured. The generic ECOM error messages are displayed when provisioning fails and are usually due to array configuration issues and need to be investigated on the SMI-S provider and the log files. The log files are located here: "C:\Program Files\EMC\ECIM\ECOM\log"

2 Installing The SMI-S Provider

The SMI-S provider is a key component of the VIAS service. It is used by VPLEX to communicate with VNX and VMAX arrays to enable storage provisioning. An SMI-S provider needs to be installed and configured correctly on the SAN that is going to interact with the arrays that VPLEX also is connect to. The assumption is that the SMI-S set up and configuration has already been done by an administrator that has knowledge on how to configure the SMI-S provider.

The screenshot shows a web-based download interface for the SMI-S Provider. At the top, there's a navigation bar with links to Product Overview, Documentation, and Advisories. Below this, a sidebar lists 'Browse Products' under 'SMI-S Provider' with versions 4.6, 4.5, and 4.4. The main area displays a list of 48 results, sorted by 'Download Type'. A filter for 'FULL RELEASE (36)' is applied. The first item in the list is highlighted with a red oval: 'SMI-S Provider 4.6.2.27 for SMI-S 1.5 for Windows x86'. This item includes a download icon, a brief description, and download details: '4.6.2 | July 06, 2015 | Windows | 130.0 MB | Checksum'. Below it are two more items: 'SMI-S Provider 4.6.2.27 for SMI-S 1.5 for Linux' and 'SMI-S Provider 4.6.2.27 for SMI-S 1.5 for Windows x64'.

Figure 3 Downloading SMI-S Provider

2.1 SMI-S Configuration Suggestions

The following are some best practices for the installation and configuration of the SMI-S providers:

- Validate your VNX, VNX2, VMAX and VMAX3 requirements with the ESSM prior to installation
- Each generation of array may require different versions of SMI-S
- The gatekeepers should NOT be shared between hosts, instead they should be unique per host.
- Ensure that the SMI-S Provider server does not lose connectivity to the Symmetrix system(s) under management
- Make sure that the SMI-S provider can be IP reachable on port from VPLEX. Firewalls and other network security systems need to be configured to allow access from VPLEX to the SMIS-S provider and vice versa
- Before registering a provider to manage an array it is a good practice to make sure that both VPLEX and the SMI-S provider can access the managed array(s)

Note: SMI-S is not used for XtremIO arrays. The XtremIO uses the REST provider to communicate.

2.2 SMI-S Post-Installation Steps For VIAS

This section explains the post-installation tasks that you must complete.

VMAX Arrays: When using the SMI-S Provider to manage Symmetrix arrays, it is recommended that you configure six gatekeepers for each Symmetrix array accessed by the provider. Only set up these gatekeepers for the host on which the SMI-S Provider is running. When started, the SMI-S Provider automatically discovers all Symmetrix storage arrays connected to the host on which the Array Provider is running. No other action is required, such as a running the symcfg discover command.

SYMAPI_DB.BIN Database Sharing: When the SMI-S Provider is installed on the same host as the ECC Symmetrix agent and/or the Unisphere for VMAX 1.0, you may see the following memory allocation errors in the syampi log file:

```
EMC:SMBASE __iload_db_osl pdsDbRecRead() failed : OSL:CONN_INFO ([PDS/DB]
(Unable to allocate memory)
EMC:SMBASE emcSymDBLoad Error encountered while reading from DB file
[C:\Program Files\EMC\SYMAPI\db\syampi_db.bin] (SYMAPI_C_MEMORY_ALLOC_ERROR)
```

The factors determining these memory allocation errors are governed by the amount of physical memory on the host as well as the number and size of the array configurations. Because it is difficult to predict how much memory is required for this type of installation scenario, perform the following steps to prevent the above errors from occurring:

- Instruct SMI-S Provider to use its own syampi database by editing the following file:

C:\Program Files\EMC\ECIM\ECOM\providers\oslsprovider.conf

- Change the following line in oslsprovider.conf:

```
#OSLSProvider/com.emc.cmp.osls.se.array.StorApi.database.filename =
```

to:

```
OSLSProvider/com.emc.cmp.osls.se.array.StorApi.database.filename = c:/program
files/emc/syampi/db/syampi_smi_db.bin
```

- Stop ECOM, the ECC Symmetrix agents, Unisphere for VMAX 1.0, and the Solutions Enabler daemons
- Remove the existing syampi_db.bin file, then restart ECOM, the ECC Symmetrix agents, Unisphere for VMAX 1.0, and the Solutions Enabler daemons

VNX Arrays:

SMI-S Provider discovers CLARiiON and VNX storage arrays using one of the following discovery methods:

In-band discovery: This is conceptually the same as the Symmetrix SMI-S Provider-based discovery. If the correct information is in place, SMI-S Provider can automatically discover a CLARiiON array or VNX storage system during its startup. For SMI-S Provider to automatically discover locally-attached CLARiiON or VNX arrays, you must add authorization information for its storage processors. A locally-attached storage array is one in which at least one CLARiiON or VNX LUN is visible to the host on which the SMI-S Provider is running. Use the SYMCLI symcfg command, as shown in the following syntax example, to add the username and password for each storage processor:

```
symcfg authorization add -host <HostName> -username <UserName> -password
<PassWord>
```

Out-of-band discovery: You can add a VNX array to the SMI-S Provider without a VNX LUN being present on the host on which SMI-S Provider is installed. Typically, this method is preferred over in-band discovery. SMI-S Provider has a programmatic interface that provides management applications integrated with the provider the ability to discover VNX storage arrays out of band. This discovery method only requires an IP connection to the storage array.

2.2.1 Modify PATH Environment Variable:

```
set PATH=%PATH%;"C:\Program Files\EMC\SYMCLI\bin;C:\Program
Files\EMC\ECIM\ECOM\bin"
```



```
C:\Program Files\EMC\ECIM\ECOM\bin>testsmiprovider
Connection Type (ssl,no_ssl,native) [no_ssl]:
Host [localhost]:
Port [5988]:
Username [admin]:
Password [#1Password]:
Log output to console [y/n <default y>]:
Log output to file [y/n <default y>]:
LogFile path [Testsmiprovider.log]:
Connecting to localhost:5988
Using user account 'admin' with password '#1Password'

#####
## EMC SMI Provider Tester
## This program is intended for use by EMC Support personnel only.
## At any time and without warning this program may be revised
## without regard to backwards compatibility or be
## removed entirely from the kit.
#####
slp      - slp urls          slpv     - slp attributes
cn       - Connect            dc       - Disconnect
disco    - EMC Discover      rc       - RepeatCount
addsys   - EMC AddSystem     remsys  - EMC RemoveSystem
refsys  - EMC RefreshSystem

ec       - EnumerateClasses   ecn      - EnumerateClassNames
ei       - EnumerateInstances  ein      - EnumerateInstanceNames
ens     - EnumerateNamespaces miner   - Mine classes

a        - Associators       an       - AssociatorNames
r        - References         rn       - ReferenceNames

gi      - GetInstance         gc       - GetClass
ci       - CreateInstance     di       - DeleteInstance
mi       - ModifyInstance     eq       - ExecQuery
gp       - GetProperty        sp       - SetProperty

tms     - TotalManagedSpace tp       - Test pools
ecap   - Extent Capacity    pd       - Profile Discovery

im      - InvokeMethod       active  - ActiveControls
ind    - Indications menu   tv       - Test views

st      - Set timeout value lc       - Log control
sl      - Start listener     dv       - Display version info
ns      - NameSpace           vtl     - UTL menu

chp    - consolidated host provider menu

q      - Quit                h      - Help

Built with EMC SMI-S Provider: U4.6.1
Namespace: root/emc
repeat count: 1
<localhost:5988> ? addsys
```

Figure 4 Using TestSMIProvider to Add VNX Systems

Installing The SMI-S Provider

```
#####
Built with EMC SMI-S Provider: U4.6.1
Namespace: root/emc
repeat count: 1
<localhost:5988> ? addsys
Add System <y/n> [n]: y
ArrayType (1=Clar, 2=Symm) [1]:
One or more IP address or Hostname or Array ID

Elements for Addresses
IP address or hostname or array id 0 (blank to quit): 10.5.44.110
IP address or hostname or array id 1 (blank to quit): 10.5.44.111
IP address or hostname or array id 2 (blank to quit):
Address types corresponding to addresses specified above.
(1=URL, 2=IP/Nodename, 3=Array ID)
Address Type (8) [default=2]:
Address Type (1) [default=2]:
User Inulll: nasadmin
Password Inulll: nasadmin
++++ EMCAddSystem +++
OUTPUT : 0
Legend:0=Success, 1=Not Supported, 2=Unknown, 3=Timeout, 4=Failed
5=Invalid Parameter
4096=Job Queued, 4097=Size Not Supported
Note: Not all above values apply to all methods - see MOF for the method.
System : //10.5.44.232/root/emc:Clar_StorageSystem.CreationClassName="Clar_StorageSystem",Name="CLARiON+APM00074601930"

In 15.022953 Seconds
Please press enter key to continue...
```

Figure 5 Discovering VNX Systems

After connecting to the SMI-S Provider, you may issue the “dv” (display view) command to list all of the basic provider information and each storage array that has been attached or remotely registered as seen below.

```
#####
Built with EMC SMI-S Provider: U4.6.1
Namespace: root/emc
repeat count: 1
<localhost:5988> ? dv
++++ Display version information +++
CIM ObjectManager Name: EMC:10.5.44.232
CIMOM Version: EMC CIM Server Version 2.7.3.1.0.5
SMI-S qualified version: 1.5.0
SMI-S Provider version: U4.6.1.3
SMI-S Provider Location: Proxy
SMI-S Provider Server:
Windows_NT WIN2012-N2 6.2.9200 x86_64 (64bit Libraries)
Solutions Enabler version: U7.6-1755 1.12
Firmware version information:
<Remote> CLARiON Array APM00074601930 <Rack Mounted CX3_10> : 3.26.10.5.031
<Remote> Symmetrix Array 000187910051 <8000-M2> : 5671.82
<Remote> Symmetrix Array 000190301146 <CDMX4-6> : 5773.198
<Local> Symmetrix Array 000194900688 <UMAX-1SE> : 5876.268.174

Retrieve and Display data - 1 Iteration(s) In 0.312008 Seconds
Please press enter key to continue...
```

Figure 6 TestSMIProvider Display View

3 SMI-S Firewall Considerations For VIAS

This section explains the required firewall ports that must be opened for SMI-S to communicate with VPLEX VIAS. If a firewall exists between the SMI-S Provider installation and a VNX array, port 443 must be opened in both directions in the firewall for management communications to occur with the array. By default, the ECOM server listens on ports 5988 (for HTTP) and 5989 (for HTTPS) and must be able to communicate both directions as well as port 443. This may be done by opening Server Manager in Windows and selecting “Advanced Firewall Settings.” From there create both an inbound and outbound TCP/UDP rules for ports 5988 and 5989 as seen in Figure-7.

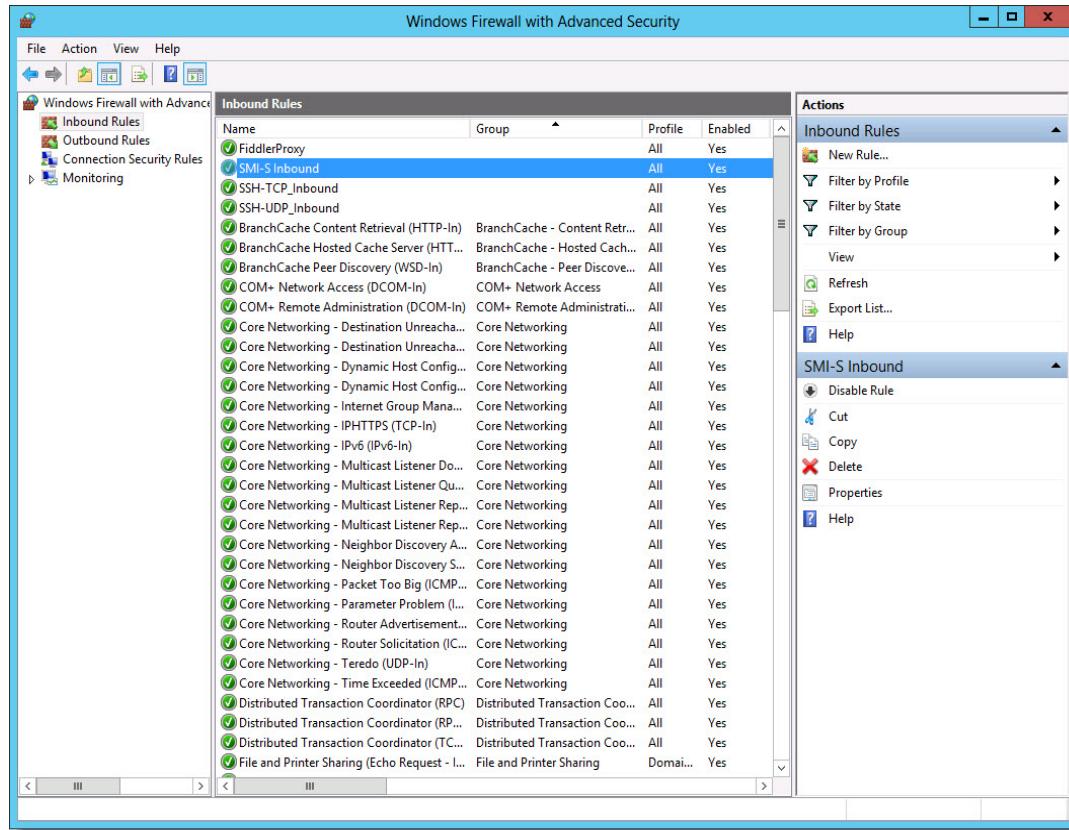


Figure 7 Advanced Firewall Settings

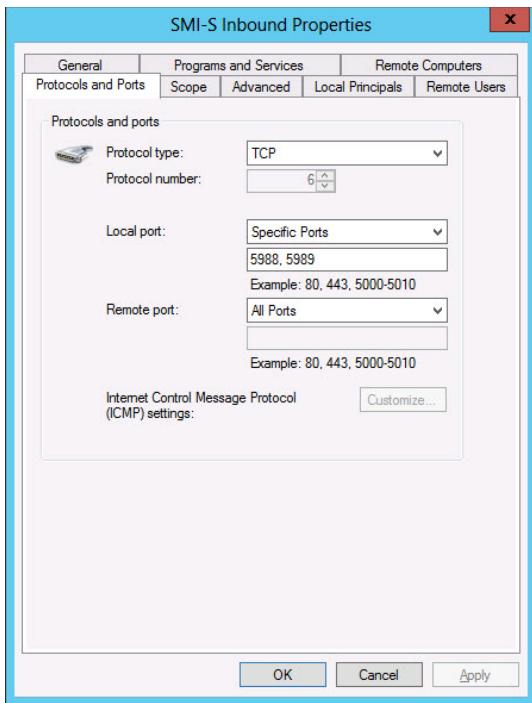


Figure 8 Creating Inbound TCP Firewall Rules

3.1 Setting ECOM Security

The EMC provider security can be configured through a webpage. Go to https://<sms-i_provider>:5989/ecomconfig and login with the default account (admin) and password (#1Password).

Welcome to the ECOM Administration Web Server. Please log in.
ECOM Version 2.7.3.1.0.5 (Build Date & Time: Jul 26 2013, 20:27:12)

Username:

Password:

Figure 9 ECOM Login Screen

The screenshot shows the ECOM Administration interface. At the top, it displays "ECOM Administration", "ECOM Version 2.7.3.1.0.5 (Build Date & Time: Jul 26 2013, 20:27:12)", and "Logged in as admin".
Logging:
[Display Log File](#)
[Logging Options](#)

Security:
[Add User](#)
[Modify User](#)
[Change Password](#)
[Set Password quality](#)
[Delete User](#)
[List Users](#)
[Display Security Log File](#)
[Client IP Filtering](#)
[Local IP Filtering](#)
[SSL Certificate Management](#)
[LDAP Configuration](#)
[OSLogin Configuration](#)

[Dynamic Settings](#)
[Windows Authentication Protocol Configuration](#)

[Logout](#)

Figure 10 ECOM Administration Page

Next, proceed to change the password, add an additional user or make any other changes to the security as desired. Note the user name and password since you will need this when you register the provider for use with the Storage Service.

There is one more change that we will need to make. Click on the Dynamic Settings link from the ECOM Administration Page and locate the setting for SSLClientAuthentication. Select “None” and check the “Persist” box, then “Apply” these settings. This avoids a potential problem with SSL negotiations without lowering the security level. You will need to restart the ECOM service if you modify parameters on this page. (“***net stop ecom*** –and– ***net start ecom***”)

4 Array Management Provider (AMP)

VPLEX's Integrated Array Services feature uses array management providers (AMPs) to expose functionality on supported arrays. Specifically, AMPs allow VPLEX to provision storage from predefined storage pools on the arrays. To use the Integrated Array Services feature in VPLEX, you must register the AMP with VPLEX and then use the CLI or the Provision from Pools wizard in the GUI to provision virtual volumes from pools on the managed arrays. For an AMP to manage an array, the array must be visible to the AMP and to the VPLEX cluster on which you are registering the AMP. An AMP can manage multiple arrays and is registered to the specific cluster.

VPLEX supports two types of AMPs:

- VPLEX RESTful Interface (REST) — Manages XtremIO arrays
- SMI-S — manages all other arrays

There is no restriction on the type of SMI-S AMP that can be registered. If the username, password, IP address and port are accepted during the registration process, then the AMP can be registered with VPLEX. Once the AMP is successfully registered, it appears on the Array Management Provider view of the cluster. Select an AMP to see the arrays that it manages, as well as the storage pools and storage groups available from each of the managed arrays.

Additional resources

- For a list of arrays supported for use with VPLEX's Integrated Array Services, refer to the EMC VPLEX and GeoSynchrony Simple Support Matrix document, available on EMC Online Support
- To correctly install and configure a SMI-S Provider, refer to the EMC SMI-S Provider Release Notes, available on EMC Online Support
- To configure and use the REST provider, refer to the VPLEX Element Manager API Guide

To use VIAS in VPLEX, you must register an array management provider, and then use the GUI provisioning wizard or the CLI to provision virtual volumes. In our example, we will use the VPLEX GUI to show the following tasks needed to provision storage:

- Register the array management provider
- Register the initiators that access VPLEX storage
- Create a storage view that include virtual volumes, initiators, and VPLEX ports
 - Select the storage array and storage volumes to create virtual volumes

Security_settings.xml

Persist	Name	Value
<input type="checkbox"/>	CIMRequest_AuthenticationEnabled	<input checked="" type="checkbox"/>
<input type="checkbox"/>	NonCIMRequest_AuthenticationEnabled	<input type="checkbox"/>
<input type="checkbox"/>	SecurityLoggingEnabled	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	SSLClientAuthentication	<input type="button" value="None"/> <input type="button"/>
<input type="checkbox"/>	SendSSLClientCertificate	<input checked="" type="checkbox"/>
<input type="checkbox"/>	HTTPRealmIdentifier	<input type="text" value="ECOM_SERVER"/> (string)
<input type="checkbox"/>	GenerateCertificate	<input checked="" type="checkbox"/>
<input type="checkbox"/>	WSTrustSessionTimeout	<input type="text" value="300"/> (uint32)
<input type="button" value="Apply"/>		

Figure 11 SSLClient Authentication

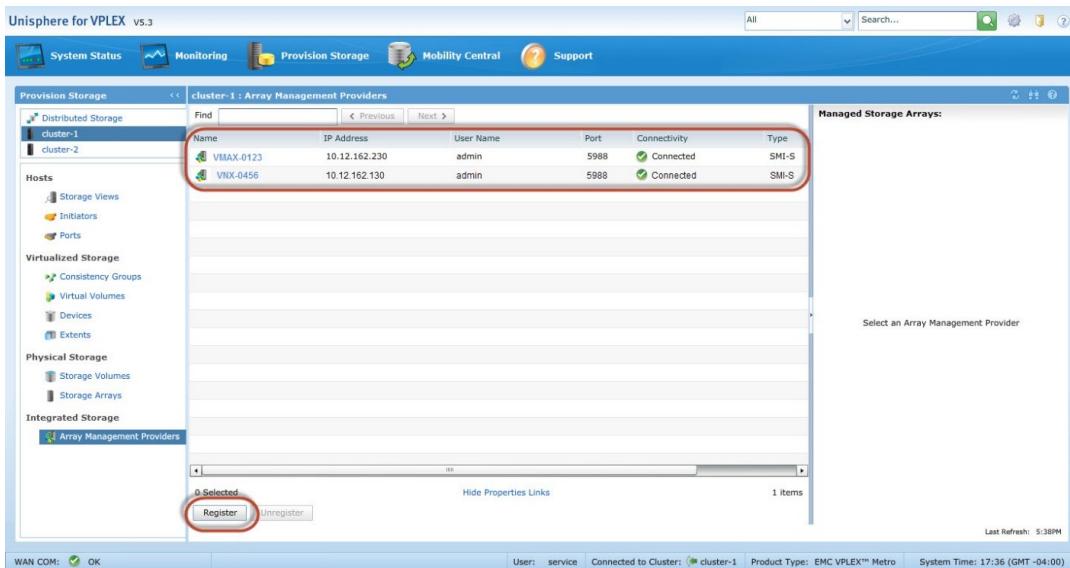


Figure 12 Registering the AMP

After the array management provider is registered, VPLEX correlates the arrays to identify which arrays it is connect to and which arrays that VPLEX can also manage. There is no restriction on the number of SMI-S providers that can be registered. If the credentials passed during registration are valid and the provider is IP reachable the AMP can be successfully registered. The username, password, IP, and port all must be valid in order to register the amp. It is best to validate that the credential are correct using the ECOM Explorer before registering a provider. This way you can ensure the SMI-S configuration is correct. If the registration fails the AMP is not persisted and password is not saved.

- Passwords are stored in the lockbox on each management server
- Passwords are not stored in any log file or in capture logs
- A provider can be registered from either management server

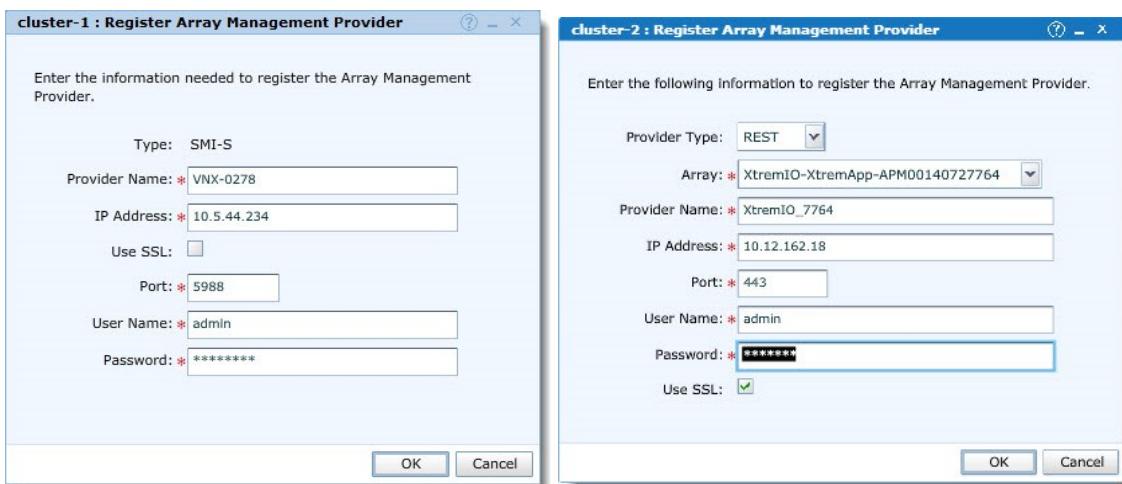


Figure 13 Registering AMP with SMI-S or REST

A managed array is an array that is both visible by SMI-S and registered with VPLEX. If an array is visible by the SMI-S provider and not registered with VPLEX, it will not be considered managed. You do not need to un-register and re-register your SMI-S provider to force updates when adding new arrays. If the configuration is setup correctly, the GUI will poll every 3 minutes and automatically discover when new arrays are added.

Each managed array has a list of pools associated with it. In order to provision, you must know the pool you want to provision from. Once AMP has been registered, the SMI-S provider will list all Disk Groups and Pools from your VMAX and VNX arrays so it's a good idea to create a naming convention that will make it easy to identify your tiered storage pools which are intended for VPLEX provisioning.

The screenshot shows a user interface for managing storage arrays. At the top, there is a header "Managed Storage Arrays:" followed by a section titled "c1_smis1". Below this, under "Storage Arrays", there are two entries: "EMC-SYMMETRIX-194900874" and "EMC-CLARiiON-APM00112301957". The second entry is highlighted with a blue background. Below this, there is a table titled "Pools" with columns "Pools", "Free", and "Total". The table lists four pools:

Pools	Free	Total
VPLEX_Gold_Tier	1.05 TB	22.00 TB
VPLEX_Silver_Tier	85.50 GB	100.00 GB
VPLEX_Bronze_Tier	4.04 GB	100.00 GB
VPLEX_Backup_Tier	18.80 GB	100.00 GB

Figure 14 AMP Naming Conventions

Unregistering an AMP

Before unregistering an AMP, ensure that all arrays associated with the provider are no longer in use and are unregistered. After the AMP is unregistered, VPLEX removes all references. The only restriction is that the AMP cannot be unregistered if there is a provisioning or de-provisioning action taking place.

Registering Redundant AMPs

You cannot register the same AMP on a cluster. It is possible to register an AMP that is managing the same arrays as an AMP already registered. This means you would essentially have two AMPs that are managing the same arrays. VIAS will only list managed arrays for one of the two AMP's. Therefore whichever AMP was registered first will have the list of managed arrays. The other provider will have no arrays listed under managed arrays.

Updating Provider Credentials

There is no specific action to update the array management provider's credentials if they change on the back end array. The user will have to unregister and then register the AMP again.

Listing SMI-S Pools

Not all the pools from the array may be listed. Only pools that are unrestricted and are capable of provisioned LUN's from. This means that the AMP will only try and list the pools that are capable for provisioning. There are some pools on the arrays that are not possible to provision a LUN from and these pools we try to prevent from being displayed in the list. For example primordial pools. Primordial storage refers to unallocated storage capacity on a storage device. Storage capacity can be allocated from primordial pools to create storage pools (TDATs/SAV). This means that primordial and restricted pools are disk/device sources for allocation of storage pools and will not be listed because they cannot have LUNs directly provisioned from them.

5 VIAS Provisioning

Provisioning is available through both the CLI and the GUI. Please see <http://support.emc.com> for the most current VPLEX Administration Guide and VPLEX CLI Guides.

5.1 General Provisioning LIMITS

When a provisioning is performed there are a few details that are worth noting.

- Maximum number of Virtual Volumes that can be provisioned on a single request is 10
- The minimum capacity that is capable of being provisioned is 150 MB
- An array rediscovery is needed to make the LUNs visible to VPLEX. The rediscovery is a targeted rediscovery on the array and only done once on each array after all LUNS have been created
- One can have multiple storage groups/masking views on the underlying arrays. Placement will be done automatically, determined by the lowest volume count at the time the provisioning request is processed. A subsequent provisioning request may result in a different storage group/masking view being used
- Cascaded storage groups for VMAX are not supported at this time
- For VMAX If a LUN is provisioned from a pool that has a specific policy then the storage group in the masking view needs to also have the same policy
- In order to enforce HA a different array for each cluster is enforced
- When provisioning a virtual volume greater than 240 GB on VMAX, ensure that the auto Meta configuration flag is set on the array. For internal testing the value was set to concatenate. Please use the VMAX admin guide to determine the best value for the environment that the VMAX is in
- For VNX, the LUN will only be thickly provisioned. VIAS currently does not support provisioning thin LUNs even though the pool indicates both thick and thin

Distributed Storage Views

Distributed storage refers to storage objects (consistency groups, virtual volumes, devices) that are created by using storage from both clusters. All distributed storage objects can be conveniently accessed from the Distributed menu option in the Provision Storage hover menu. This menu option opens the Distributed storage section in the navigation pane on the left. From this section you can view a grouping of all distributed consistency groups, distributed virtual volumes and distributed devices.

Creating Virtual Volumes

You can use the VPLEX GUI or the CLI to provision virtual volumes. However, it is easier to provision using the GUI.

There are a few considerations:

- Only one provisioning request can be executed at a time on a VPLEX cluster
- The maximum number of virtual volumes that can be provisioned using a single request is 10
- The minimum capacity that can be provisioned is 150 MB

5.2 Provisioning From Pools

Using the VPLEX GUI to Provisioning Storage from the “Provision from Pools” wizard.

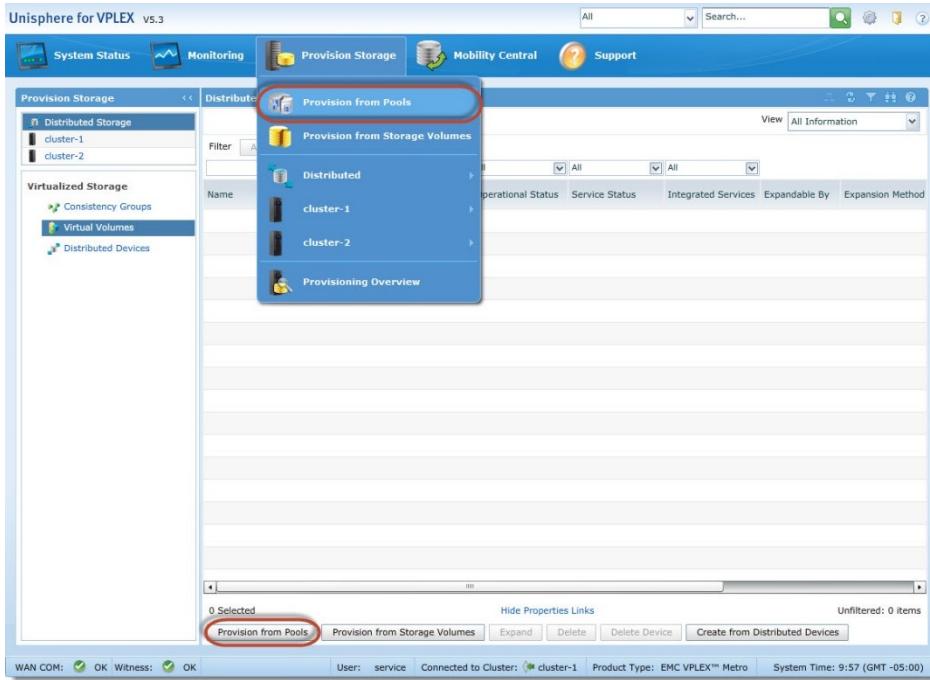


Figure 15 Provision from Pool Wizard

Using the VPLEX GUI to Provisioning Storage from the “Provision from Pools” wizard.

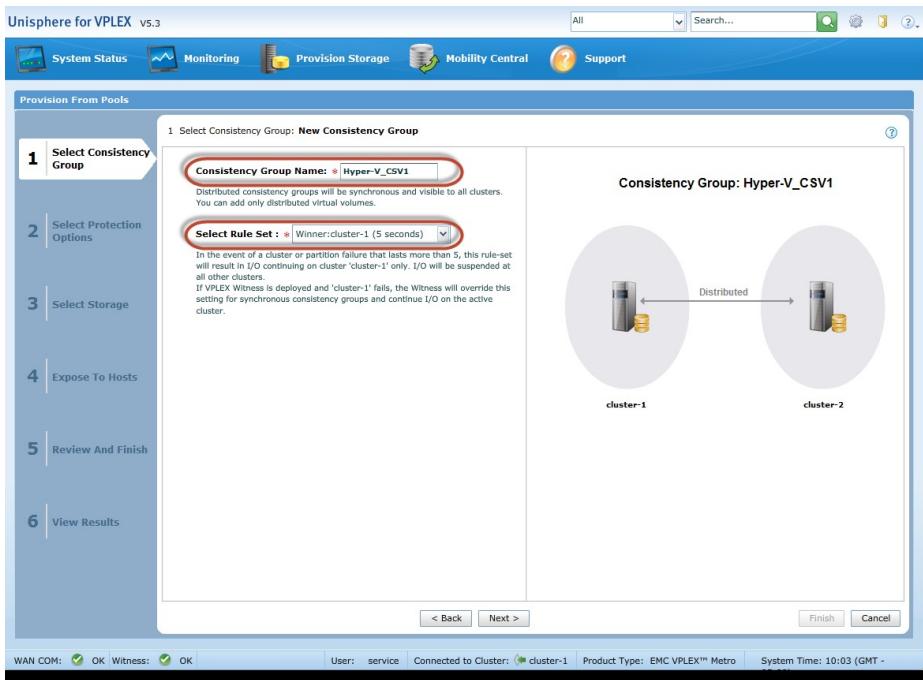


Figure 16 Step One, Select a Consistency Group

Step One: For the volume to be created, select an existing consistency group or create a new one. To add the virtual volume to an existing consistency group, select the Add storage to existing consistency group radio button and then select the consistency group in the list. To filter the list of consistency groups by name, type the full or partial name of the consistency group in the Filter text box. To filter by storage location, click the

drop down box to the right of the Filter text box, and then select the storage location. To create a new consistency group for the virtual volume, select the Create new consistency group radio button.

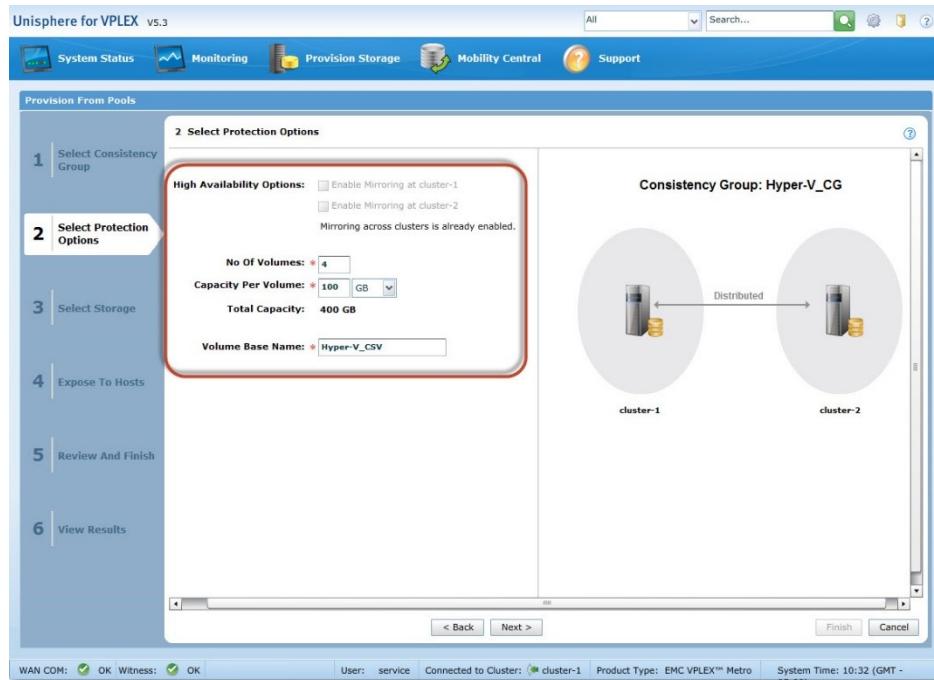


Figure 17 Step Two, Select Protection Options

Step Two: Select mirroring on the cluster where the virtual volumes will be created (optional), and then enter the quantity, size and base name for the virtual volumes.

- **High Availability Options:** Select the check box to enable mirroring at the cluster indicated. The option to mirror at a cluster is disabled if you have less than two arrays in the cluster.
 - For a local consistency group, select the check box to enable mirroring at the local cluster.
 - For a distributed consistency group, select the appropriate check box to enable mirroring at one cluster or both clusters, or leave the check boxes unselected to disable mirroring.
- **Number of Volumes:** The number of volumes to create. You can create a maximum of 10 volumes at a time. Each volume will have the same RAID geometry.
- **Capacity per Volume:** The size of each volume. Select the size in MB, GB or TB. The minimum size is 150MB. Each volume will have the same capacity.
- **Total Capacity:** The total capacity of all the virtual volumes to be created.
- **Volume Base Name:** Type a base name for the virtual volumes. A number will be added to the base name for each volume created. For example, using the base name Test, volumes will be named Test_1, Test_2, Test_3, and so forth.

Note: If a base name has been previously used with a VIAS Provisioning job, then it cannot be re-used when you desire to provision additional LUNs to a Storage View or set of Hosts.

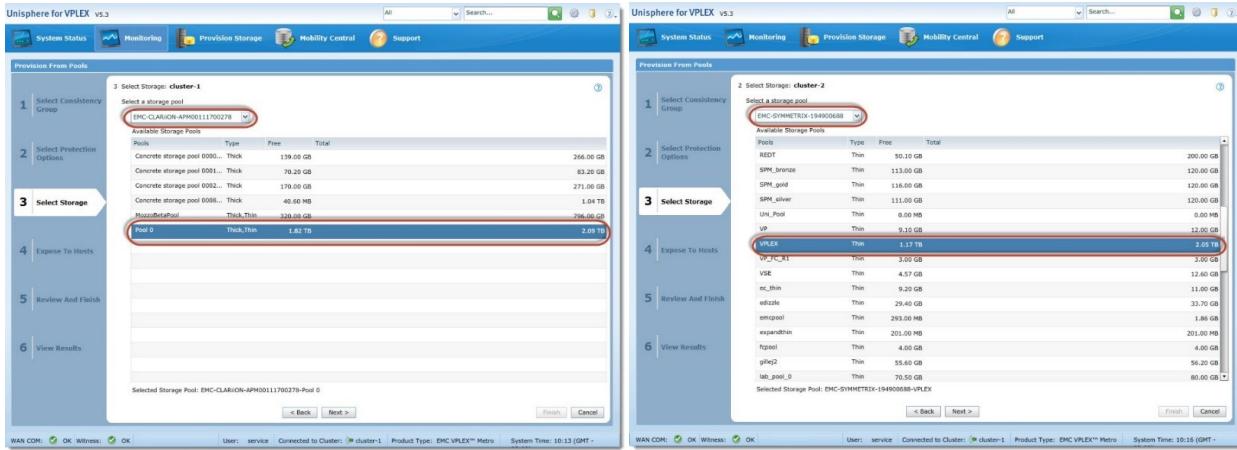


Figure 18 Step Three, Selecting Storage

Step Three: Select a storage pool to provide storage for the virtual volumes to be created. Click the drop down box and select an array, and then select a pool from the list of available pools on the array. The following information is shown for each available pool:

- **Pools:** The name of the pool on the array.
- **Type:** Indicates if the pool is thickly- or thinly-provisioned on the array. If you select a thin pool, a thin rebuild will be automatically set for the storage volume that is created during the provisioning process.
- **Free:** The amount of storage available for provisioning from the pool.
- **Total:** The total amount of storage available from the pool.

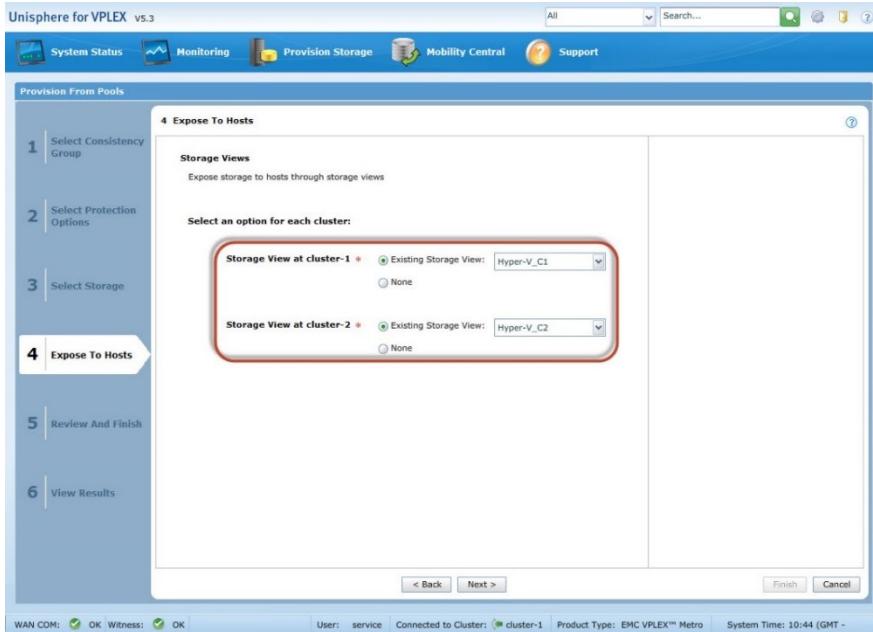


Figure 19 Step Four, Expose Storage to Host

Step Four: In Figure-19 we select a storage view for the virtual volume, or select “None” to continue and select a storage view later. If you select an active storage view, the virtual volume is added to that storage view and automatically becomes visible to hosts with access to the storage view. In some cases a rescan of

the host may be required (depending on hba and multipathing versions) If the storage view is inactive, go to the Storage Views screen and ensure that the components necessary to activate the storage view (hosts initiators, vplex fe-ports, storage volumes). Should you select “None”, you must manually add the virtual volume to a storage view when ready.

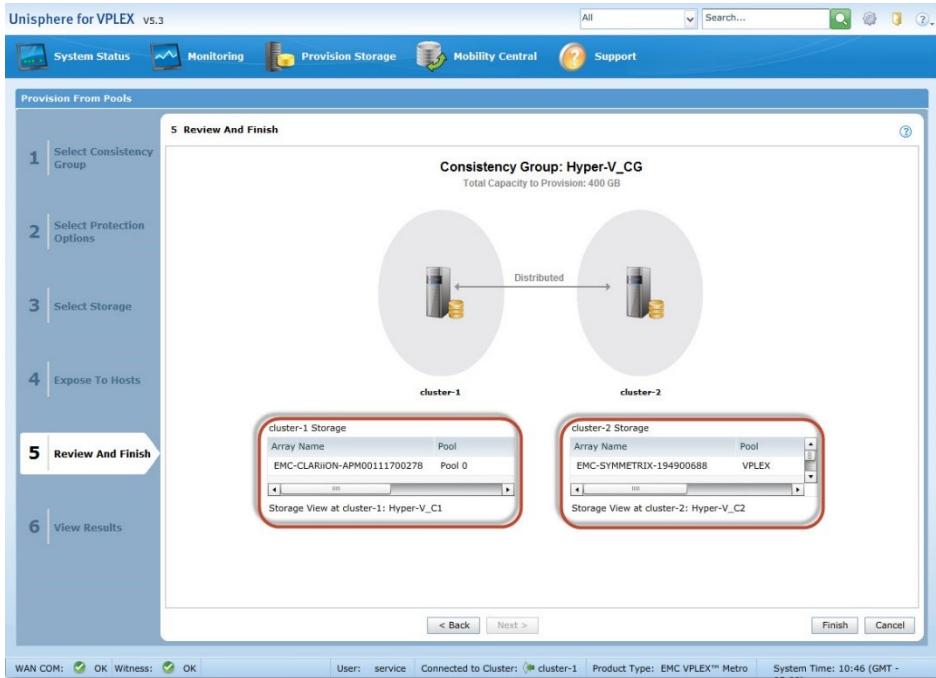


Figure 20 Step Five, Review and Finish

Step Five: In Figure-20 we will Review and Finish our selections. This page shows a summary of your selections in the wizard and a topology map of the volume to be created. Review your selections, and if satisfied, click Finish to submit the provisioning request. To make changes, click Back to go back to a previous step and make the necessary changes.

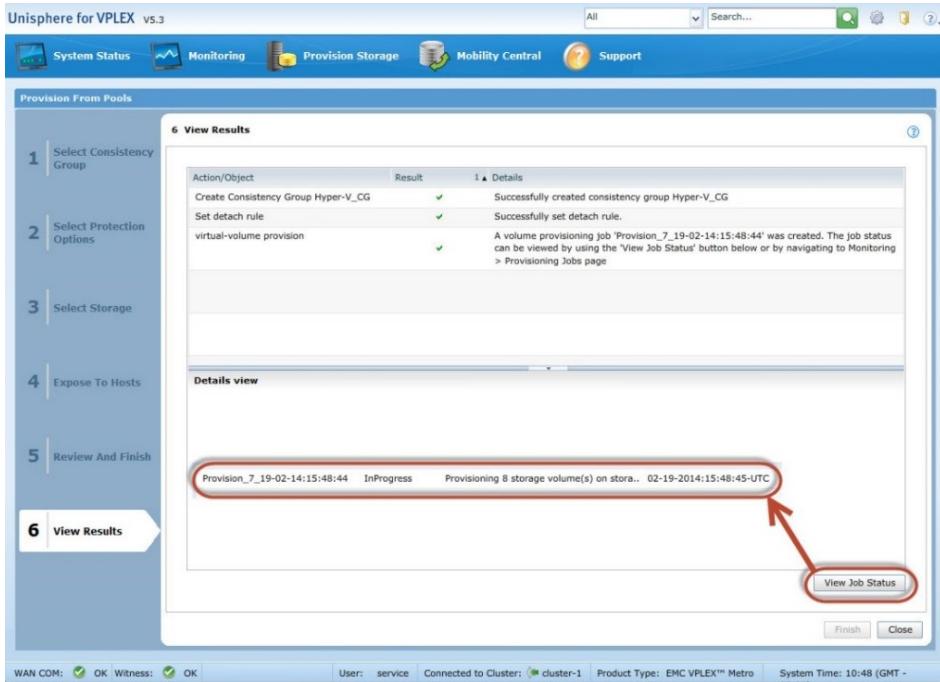


Figure 21 Step Six, Review the Results

Step Six: Reviewing the Results. This page shows the results of the provisioning request. Each provisioning request creates a provisioning job that runs in the background. To monitor the job, click View Job Status in the lower-right corner of the screen to go to the Provisioning Jobs page. Otherwise, click Close to close the wizard.

5.3

Provisioning From Storage Volumes

The Provision from Storage Volumes wizard allows you to provision a virtual volume directly from a storage volume or preserve data on an existing storage volume that you want to expose to hosts. The wizard simplifies the provisioning process by automatically claiming storage (if not already claimed) and creating all of the underlying storage objects (extents and devices), and then creating a local or distributed virtual volume that is the total capacity of the selected storage volume. When provisioning from storage volumes, you can create only one virtual volume at a time. Each virtual volume created maps to a storage volume on the array. You can provision from storage volumes using integrated or non-integrated storage arrays. Refer to Provisioning Overview for more information on integrated and non-integrated storage.

Creating a new virtual volume is as simple as selecting or creating a consistency group for the volume, selecting mirroring options (optional), and then selecting an available storage volume from an array on the cluster on which you want to create the virtual volume. You do not need to claim the storage volume before you begin to provision, and you can select claimed or unclaimed storage volumes from the selected array.

You may launch the Provision from Storage Volumes wizard from any of the below listed locations. Depending on where you launch the wizard, you are presented with the option to create specific types of consistency groups.

- Provisioning storage hover menu (Local or distributed)
- Distributed Virtual Volumes screen (Distributed only)
- Virtual Volumes screen on a specific cluster (Local only)

- Storage Volumes screen on a specific cluster (Local only)

The Provision from Storage Volumes wizard consists of the following steps:

1. Select an existing consistency group for the volume or create a new consistency group
2. Select mirroring options, synchronization options, and provide a name for the virtual volume
3. Select a storage volume to use to create the virtual volume
4. Expose the virtual volume to hosts by selecting a storage view
5. Review your selections and submit the provisioning request
6. View the results of the operation

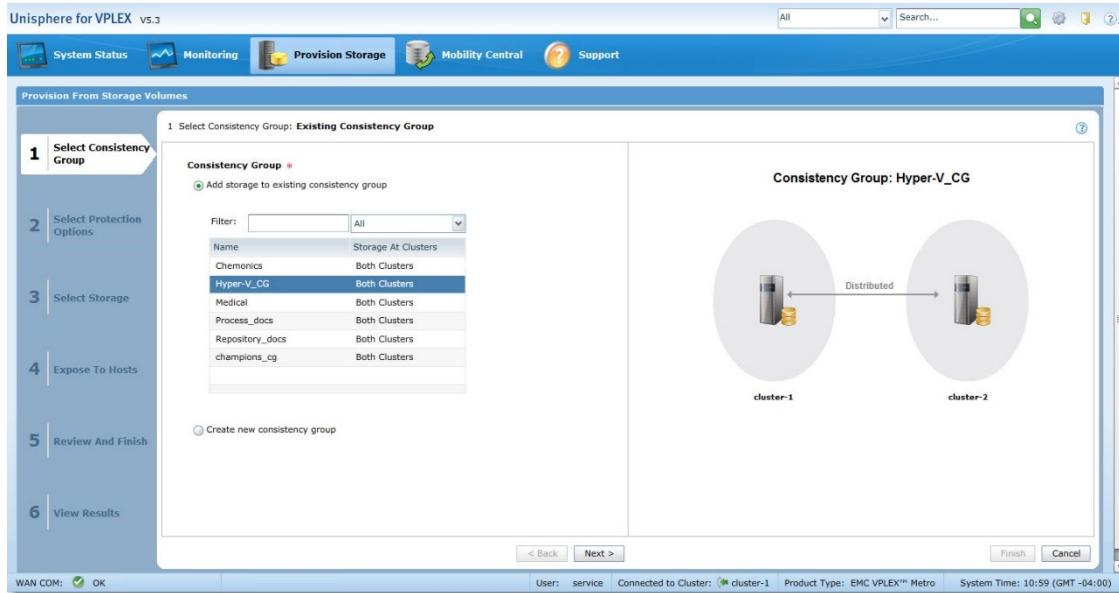


Figure 22 Step One, Select a Consistency Group

Step One: Select a consistency group for the virtual volume. For the volume to be created, select an existing consistency group or create a new one. To view the topology of a consistency group, select the group in the list. In the map that displays to the right, the storage icon and blue shading around a cluster indicate that the selected consistency group uses storage from that cluster.

- To add the virtual volume to an existing consistency group, select the Add storage to existing consistency group radio button and then select the consistency group in the list
- To filter the list of consistency groups by name, type the full or partial name of the consistency group in the Filter text box. To filter by storage location, click the drop down box to the right of the Filter text box, and then select the storage location
- To create a new consistency group for the virtual volume, select the Create new consistency group radio button

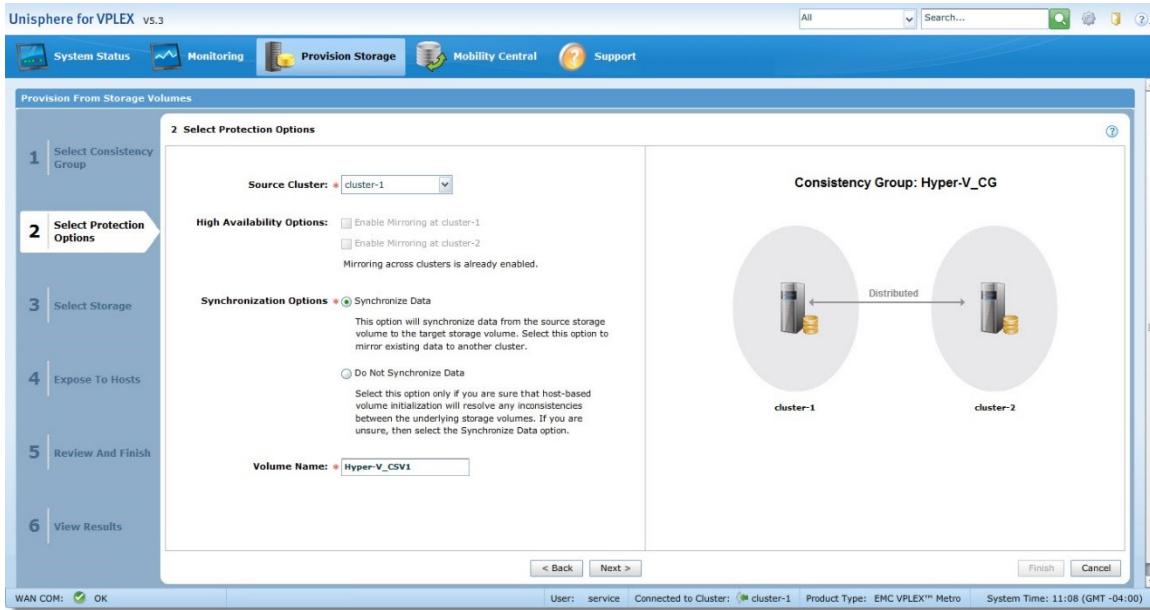


Figure 23 Step Two, Selecting Protection Options

Step Two: Select protection options. Select high availability options, synchronization options, and enter a name for the volume. If a cluster has only one array, the ability to mirror is disabled for that cluster.

- **Source Cluster:** Select the cluster where you want to create the virtual volume
- **High Availability Options:** Select a check box to enable mirroring at the cluster indicated. You can select a single cluster, both clusters, or leave both check boxes unselected to disable mirroring at both clusters. When you select the check box to enable mirroring at a cluster, Local Mirroring appears above the cluster in the map
- **Synchronization Options:** Select the appropriate option to indicate whether or not you want to synchronize data from the source storage volume to the target storage volume
- **Volume Name:** Type a name for the virtual volume

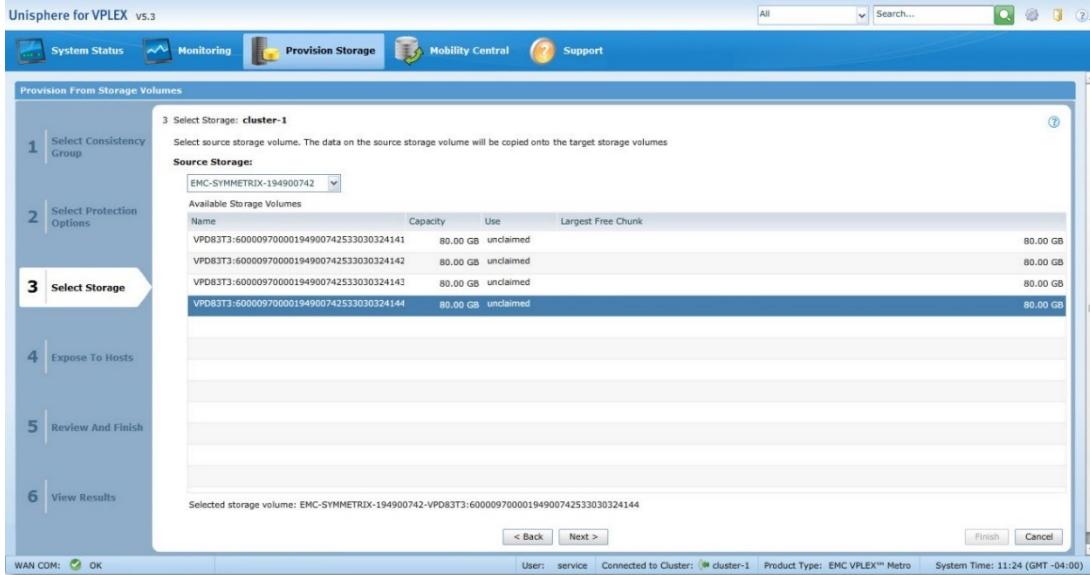


Figure 24 Step Three, Select Storage

Step Three: Select source storage from cluster-1 and cluster-2 volumes to create the virtual volume. Select a single storage volume to create the virtual volume. The virtual volume will use the entire capacity of the selected storage volume. You can select claimed or unclaimed storage volumes. To select the source storage on cluster-1, select an array in the drop down box, and then select a storage volume from the list of available storage volumes on the array. Repeat process for cluster-2.

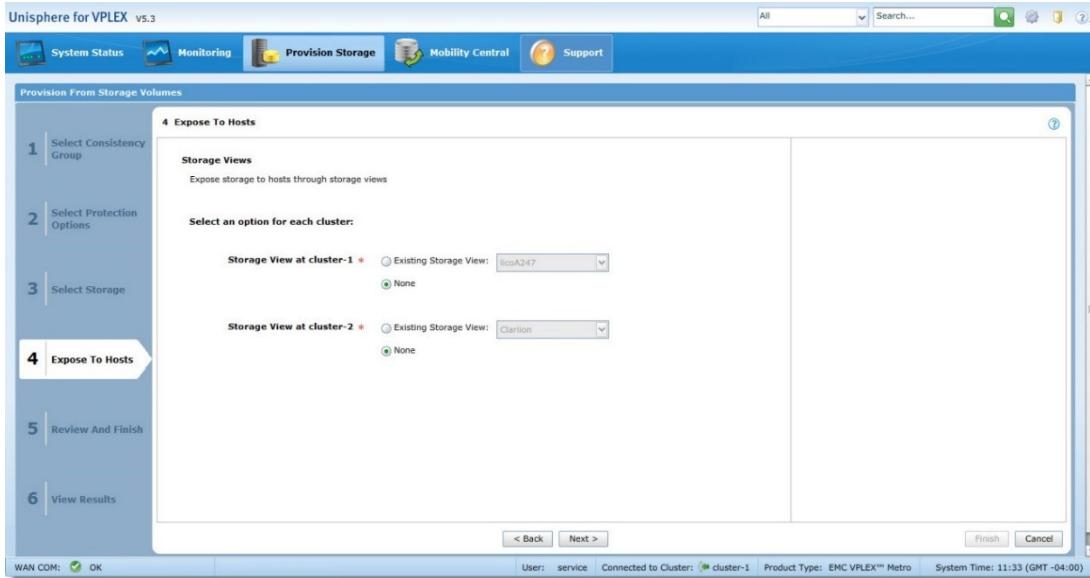


Figure 25 Step Four, Exposing Storage to Host

Step Four: Expose the virtual volume to hosts. Select a storage view for the virtual volume, or select “None” to continue and select a storage view later. If you select an active storage view, the virtual volume is added to that storage view and automatically becomes visible to hosts with access to the storage view. In some cases a rescan of the host may be required. If the storage view is inactive, go to the Storage Views screen and add the components necessary to activate the storage view. For more information, refer to Creating a storage view. If you select “None”, when you are ready to expose the virtual volume to hosts, you must manually add the virtual volume to a storage view.

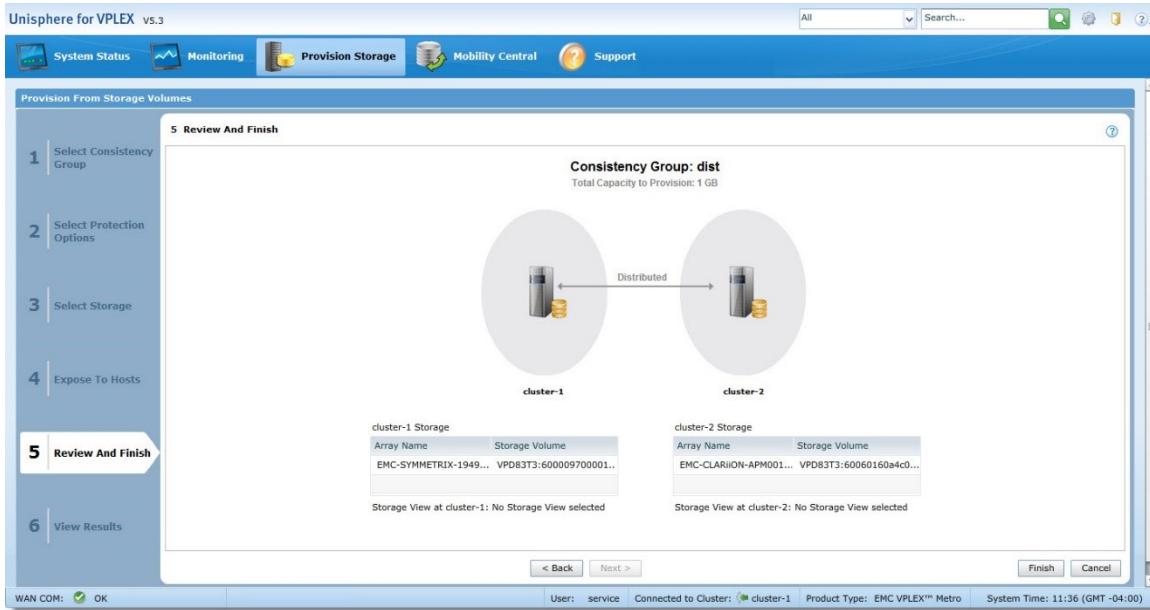


Figure 26 Step Five, Review and Finish

Step Five: Review your selections and finish. This page shows a summary of your selections in the wizard and a topology map of the volume to be created. Review your selections, and if satisfied, click Finish to submit the provisioning request. To make changes, click Back to go back to a previous step and make the necessary changes.

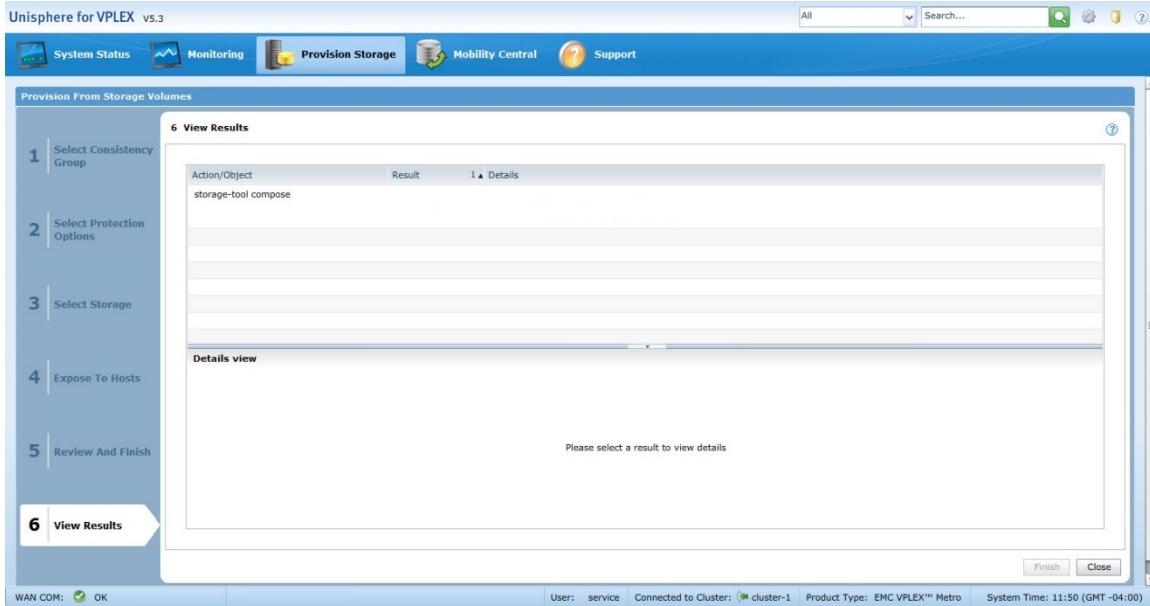


Figure 27 Step Six, Reviewing the Results

Step Six: View results. This page shows the results of the provisioning request. The top portion of the page shows the success or failure of the operation and the details. Select the row in the top portion of the page to see the expanded details in the Details view at the bottom of the page. You can scroll through the detailed information and cut and paste information if needed. Click Close to close the wizard when done.

5.4 Provisioning with the VPLEX CLI

The “storage-tool compose” command will create virtual-volumes on top of the specified storage-volumes, building all intermediate extents, local, and distributed devices as necessary.

Syntax:

```
storage-tool compose
[-n|--name] name
[-g|--geometry] {raid-0|raid-1|raid-c}
[-d|--storage-volumes] storage-volume [, storage-volume...]
[-s|--source-storage-volume] storage-volume
[-h|--help]
[--verbose]
```

Optional Arguments:

[-n|--name] name - * Specifies the name for the new virtual volume. Must be unique across the system.

[-g|--geometry] {raid-0|raid-1|raid-c} - * Specifies the desired geometry to use for the local devices at each cluster. Valid values are raid-0, raid-1, or raid-c.

[-d|--storage-volumes] storage-volume [, storage-volume...] - * Specifies a list of storage volumes from which to build the virtual volume. These may be claimed, but must be unused.

[-s|--source-storage-volume] storage-volume - Specifies the storage volume to use as a source mirror when creating local and distributed devices.

Note: If specified, **--source-storage-volume** will be used as a source-mirror when creating local and distributed RAID 1 devices. This will trigger a rebuild from the source-mirror to all other mirrors of the RAID 1 device (local and distributed). While the rebuild is in progress the new virtual volume (and supporting local and/or distributed devices) will be in a degraded state, which is normal. This option only applies to RAID 1 local or distributed devices. The **--source-storage-volume** may also appear in **--storage-volumes**.

[-h|--help] - Displays command line help.

[--verbose] - Provides more help during command execution. This may not have any effect for some commands.

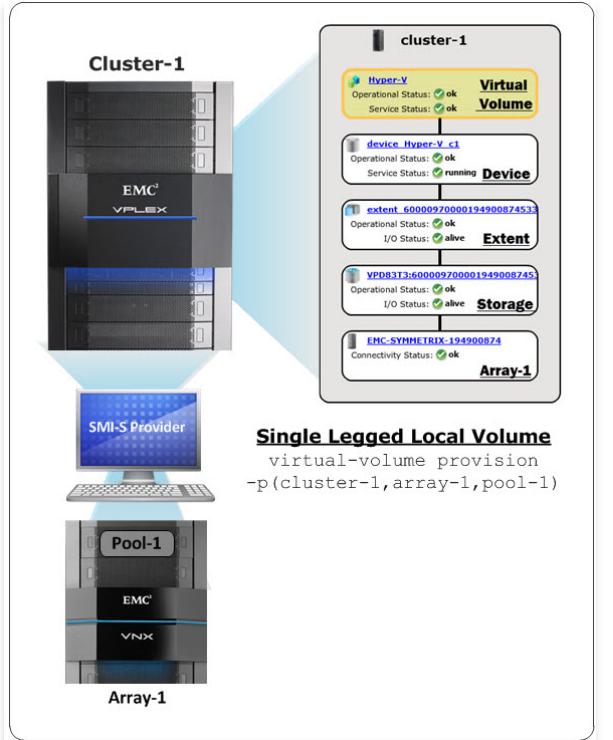


Figure 28 Provisioning Single Legged Local Volumes

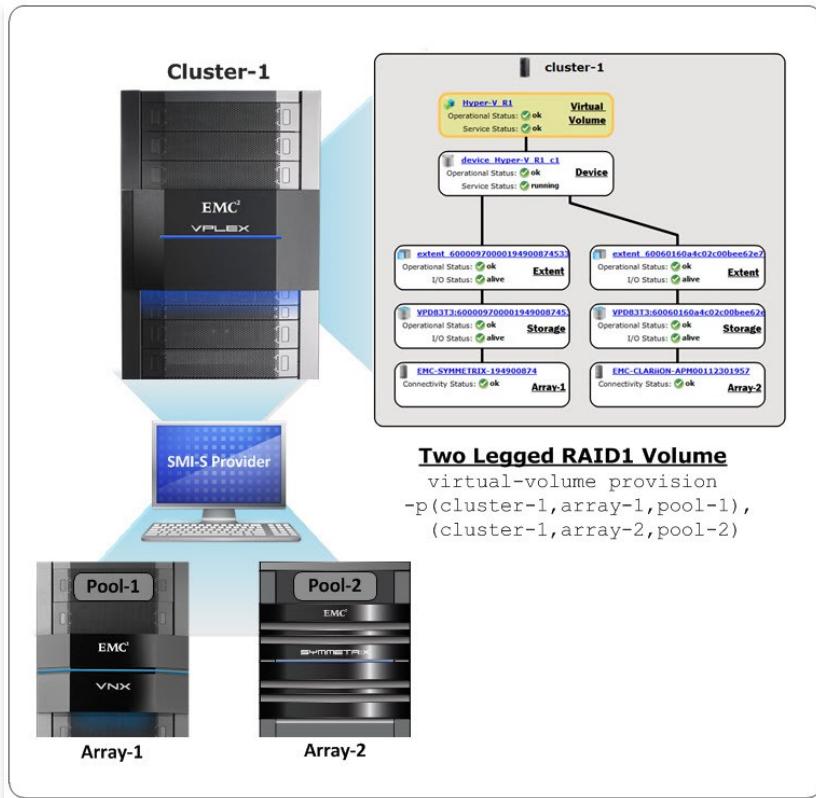


Figure 29 Provisioning Two Legged RAID-1 Volumes

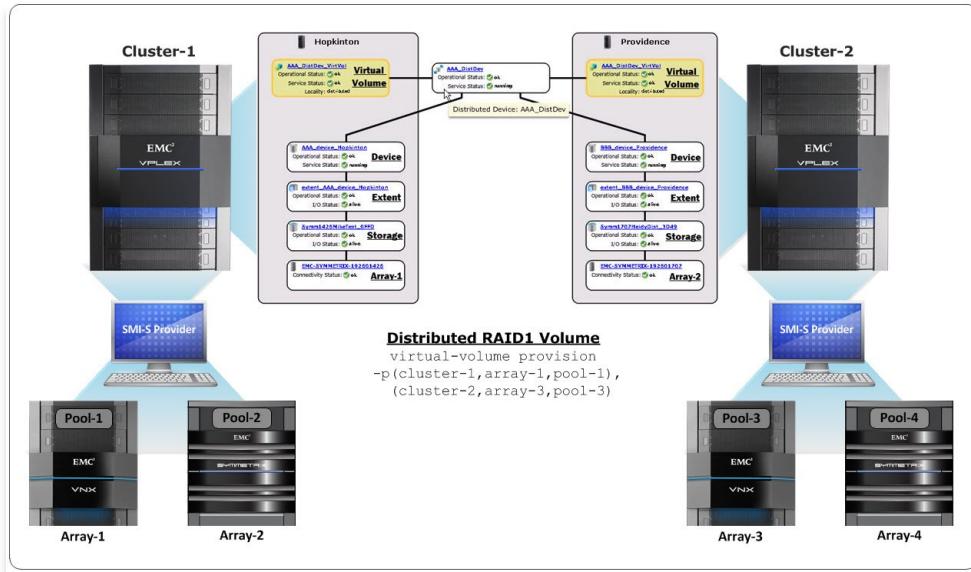


Figure 30 Distributed RAID-1

5.5 Provisioning requests Jobs

Provisioning requests will be executed as a job. Since provisioning can take some time a provisioning request is executed in an asynchronous manner. The command prompt will return direct to the CLI so the user can continue to perform administrative tasks. The provisioning job and its status will be updated by a job id. The job id will be returned after a provisioning command is executed. Note about provisioning jobs:

- Jobs are not persisted. If the SMS fails or is rebooted all of the jobs and their status will not be restored
- Any job regardless of the state will be removed after 48 hours
- Jobs are read-only, they cannot be started or stopped

5.6 Monitoring Provisioning Jobs

The Provisioning Jobs Status page allows you to view the status of a provisioning job. The Provision from Pools wizard allows you to create multiple virtual volumes which can take some time. Therefore, when you make a provisioning request through the wizard, a provisioning job is automatically created and runs in the background while you continue to perform other tasks. You cannot perform any actions on the job except to monitor its progress. The status page shows the Job name, status, description, cause of failure when applicable, and the last status update time for each job. A provisioning job can be in one of the following states:

- **In Progress:** The job is in progress.
- **Completed:** The job has completed.
- **Failed:** The job has failed. Depending on which step in the process that the failure occurred, you may need to take action to manually rollback any components that were created. Refer to when a provisioning job fails for more information. The job status is automatically updated every 10 seconds. However, you can manually refresh the job status at any time by clicking the refresh icon in the upper right corner of the screen. When the job completes, a record of the job stays on the Provisioning Jobs Status page for 48 hours, after which time it is automatically deleted.

A single provisioning job is created for each provisioning request, regardless of the number of volumes being provisioned. When a provisioning job starts, the job is given a name that includes information about the job such as job number and the date and time the job started. The following is the format and description of a job name:***"Provision_#_dd-mm-yy:time"***

Breakdown of Name:

"Provision_" is a prefix added to all job names.

"#" is the job number. This number increments with each provisioning job.

"dd-mm-yy" is the date the job started.

"time" is the time the job started.

5.7 Using Hierarchy Maps

Storage hierarchy maps allow you to select a storage object whether provisioned by VIAS (or not) and view a graphical display of all other objects connected to the selected object. This includes underlying objects, as well as top level objects that use the selected object. You can then drill down further to see the health and properties of each connected object. When a map is displayed, you can print, export, or search for objects.

Distributed devices and distributed virtual volumes appear outside of both clusters because they are not associated with a specific cluster, but instead spans both clusters. A virtual volume on top of a distributed device appears in both clusters and may appear in different storage views depending on the view membership on either cluster.

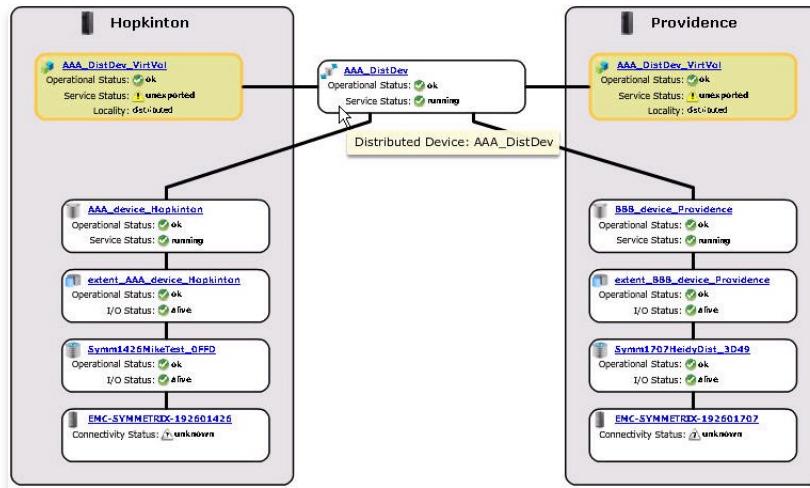


Figure 31 Distributed Device Map

5.8 Unclaiming Storage Volumes Created with VIAS

When unclaiming storage volumes created with VIAS, you have the additional option to delete the storage volume from the array and return the allocated storage volume capacity to the storage pool on the array.

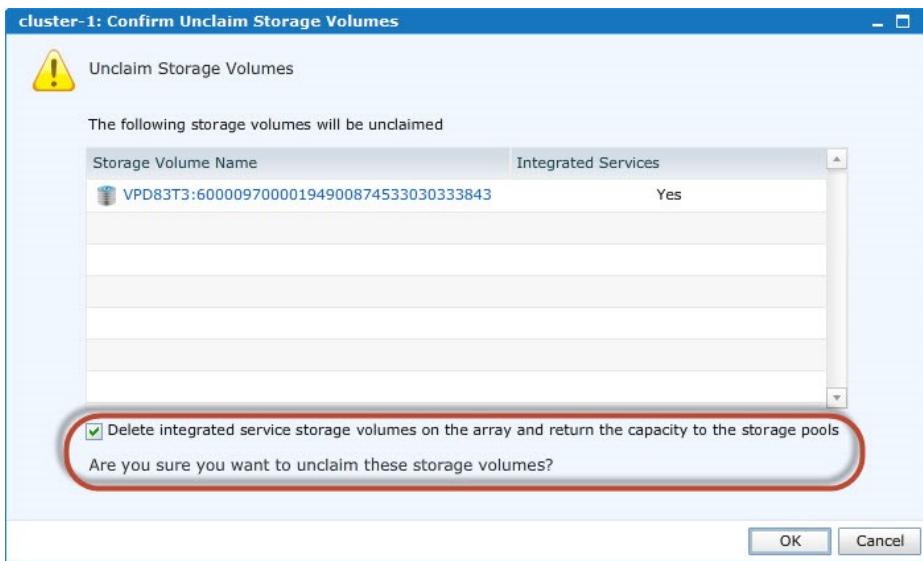


Figure 32 Unclaiming Wizard for VIAS

6 Appendix:

Business Communication Layer Service (BOLE)

The new array aware provisioning and registration commands use a new service that communicates across the clusters. This service is started by default and intended to be a zero touch service. When the SMS starts up the business communication layer service (BOLE) will be started automatically.

The BOLE Service commands:

```

Duluth Lab - VPLEX Metro-IP_C1

VPlexcli:/> bole
bole request      simple bole client
bole route add    add a bole route
bole route list   list the bole routes
bole route remove remove a bole route
bole server restart restart the bole server.
bole server start  start the bole server
bole server status determine if the bole server is 'running' or 'not running'
bole server stop   stop the bole server

VPlexcli:/> bole route list
cluster1 = ('128.221.253.33', 22552, '/user/boleServer')
cluster2 = ('128.221.253.65', 22552, '/user/boleServer')

VPlexcli:/> bole server status
running

VPlexcli:/>

```

Figure 33 The BOLE Command Set

Log Files for VIAS

There are two additional log files that are created. The bole.log and via.log files are located with all the other VPLEX log files in the “/var/log” location. These log files contain additional information about the VIAS capability.

- BOLE log will have log information regarding the business layer and its interaction
- VIA log will have specific information about the SMIS provider and direct calls to it from AMP

Please keep in mind that some errors will happen during provisioning that are due to array restrictions and configurations that VIAS may not enforce. This means that the native log files on the array may need to be looked at to identify issues.

VPLEX 5.3.0.00.00.10 Limitations

- Provisioning restricted to single job at a time additional requests will be accepted and then fail.
- VMAX & VNX support only
- DMX not supported
- VNX requires FLARE 32 or higher
- SMI-S / Solutions Enabler 4.6.1.2 (Provider)/ 7.6-1755 (SE)
- Pool listing (GUI/CLI/REST) can be impacted by ongoing provisioning task.

