

PS Series Template Volumes and Thin Clones: How and When to Use Them

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Table of contents

Revisions.....	2
Executive summary.....	4
1 Introduction.....	5
2 Configuring template volumes and thin clones	6
2.1 Creating template volumes and thin clones	6
3 Use cases for template volumes and thin clones.....	7
3.1 Hyper-V virtual machine deployment using thin clones.....	7
3.2 SQL Server database distribution using template databases	7
3.3 Providing a powerful VMware test environment using thin clones	12
4 Summary	19
A Technical support and resources	20
A.1 Related resources.....	20

Executive summary

This document shows how to configure Dell EMC PS Series template volumes and thin clones and discusses possible use cases including Microsoft® SQL Server®, Microsoft Hyper-V™, and VMware® vSphere®.

1 Introduction

Data growth continues to increase exponentially and as result, technology companies are continually trying to develop new ways to reduce data storage consumption. In most cases, these technology developments are specific or are the best fit for certain applications. One example of these specific solutions is the use of template volumes and thin clones for Dell EMC PS Series arrays.

In the PS Series array architecture, a template volume acts as a read-only gold image copy of a volume from which writeable thin clones can be created. The thin clones initially consume little to no storage space on the array and as data is written to the thin clone, only new writes to a thin clone are recorded to storage space, thus reducing the amount of storage consumption.

This technology is ideal for environments that use many copies or images of like data. This document discusses a few common application environments in which PS Series template volumes and thin clones can play an important role in simplifying and reducing storage consumption.

2 Configuring template volumes and thin clones

Thin clones are sub-volumes of template volumes in which the template is a read-only version of volume at a specific point in time. Thin clones can be created from the template and are considered attached to the template volume but act as individual differencing disks that initially consume minimum volume reserve. As new writes are written to the thin clone, storage space is consumed and associated with the thin clone while reads continue to come from the template. At any point, a thin clone can be separated from the template volume and act as a new volume. In addition, snapshots can be taken of these thin clones and act as standard volumes to the OS.

For more information and a complete list of options and restrictions on template volumes and thin clones, refer to the *Dell EqualLogic Group Manager Administrator's Guide* available on eqsupport.dell.com (login required).

2.1 Creating template volumes and thin clones

Creating a template volume from a standard PS Series volume is fairly simple depending on the application for the template. Start with a PS Series volume that will serve as the base for the thin clone deployment. This volume can be cloned from existing data or an existing volume can be turned into a template. This volume should already be populated with the data that will be used because the base image for all thin clones spawned from this template.

To convert a volume to a template volume:

1. Set the volume offline.
2. Convert the volume to a template volume by using the **Activities** panel in the PS Series Group Manager.

Note: Template volumes are read-only. You will not be able to write to this volume again while it is a template.

3. Set the template volume online.

The new template volume will show up as volume with a blue icon in the Group Manager. The option to create thin clones will now show up in the Activities panel when the template volume is selected.

Thin clones can be created from any template volume and can only belong to the template volume from which they were created. To create a thin clone, simply select the template volume and use the Activities panel to create the thin clone. Each thin clone will be listed under the template volume they were created from.

3 Use cases for template volumes and thin clones

PS Series thin clones can be used in a number of ways, ranging from gold image deployments to object distribution. The simplest use for thin clones is to distribute like volume data to many locations or business units by creating copies from a template. This allows each location or business unit to use the data without multiplying out the space requirements.

Some other more advanced uses for thin clones are discussed in this section as well as possible use cases and how to configure them using template volumes and thin clones.

3.1 Hyper-V virtual machine deployment using thin clones

One common use case for template volumes and thin clones is rapid OS deployment. In a virtual environment, thin clones can be used for virtual machine distribution based off boot images. This is possible in Hyper-V environments by using the import/export operations in conjunction with template volumes and thin clones. Using the following steps, it is very easy to distribute VMs based on a single or multiple gold VM images.

1. Create two PS Series volumes and add them to the Hyper-V host.
2. Create a VM and build the gold image on one of the volumes.
3. Once the image is in the desired state, power down the VM and export it to the second volume.
4. Use Disk Manager to set the second volume offline in the host. Optionally, log off the volume from the iSCSI initiator (logging off will make sure not to confuse the template with the thin clone copies).
5. Make the second volume a template volume in the Group Manager. This will make it read-only and serve as the gold master image for the VM deployment. It is recommended to remove the access control on the template volume so that it does not show up in the host initiator.
6. Create thin clones from the template and give each thin clone access control to the Hyper-V host.
7. Refresh the iSCSI initiator in the Hyper-V host and log into the thin clone.
8. Use Disk Manager to give the newly attached thin clone a drive letter.
9. Using Hyper-V manager, import the VM on the thin clone to the Hyper-V host.
10. Repeat steps 6–9 for as many VM copies as needed.

Note: These procedures can be included for use with VHDs hosting multiple VMs as well as CSVs in a Hyper-V cluster although the operations required in these environments are more difficult to manage and maintain and not ideal for thin clone use cases.

3.2 SQL Server database distribution using template databases

In a SQL Server world, template volumes and thin clones can be useful to quickly distribute large numbers of database copies to test and development teams without consuming valuable storage space. Thin clones utilize the read-only data of the template volume and new writes get written to thin clone space. In a test and development environment, this would mean any new builds or tests on a thin clone database will take up very minimal storage space and if a build does not work or breaks, the database can be easily reverted back to the state of the template database.

Figure 1 shows the process flow to create database thin clones using the PS Series Auto-Snapshot Manager/Microsoft Edition (ASM/ME) and the PS Series Group Manager.

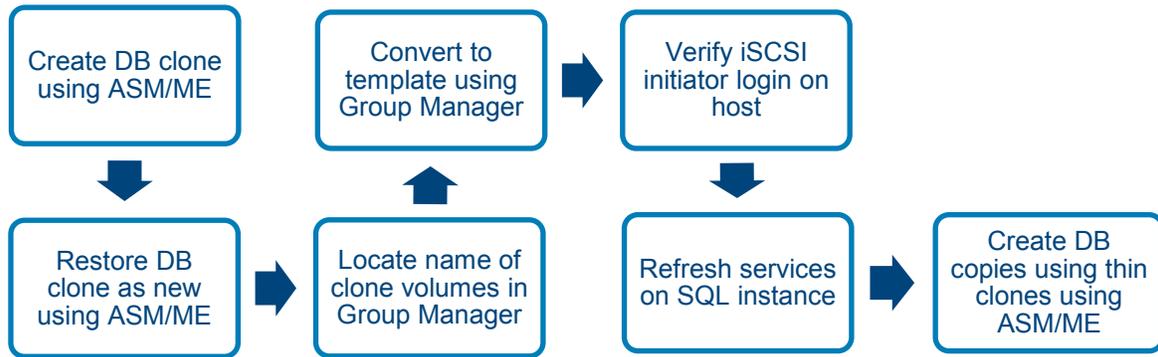


Figure 1 Thin clone database process flow

First, prepare the database copy for template volumes. The following steps accomplish database distribution using template databases:

1. Create a clone type smart copy of the SQL database being used.
2. Restore the clone smart copy using the **Restore All as New** method.
3. Check the box, **Make database READ-ONLY after attach**.

The database should show up as a read-only copy of the database in SQL Server Management Studio, as shown in Figure 2.

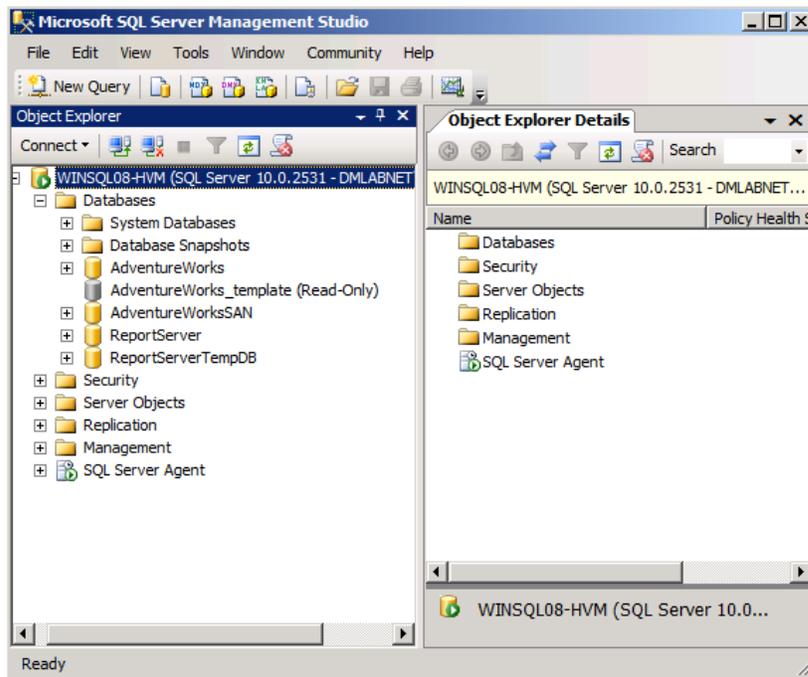


Figure 2 Read-only database in management studio

Now the database volumes can be converted to template volumes using the PS Series Group Manager GUI.

1. Select the smart copy used for the read-only copy of the database and locate the names of the volumes that were created in the properties window of ASM/ME shown in Figure 3.

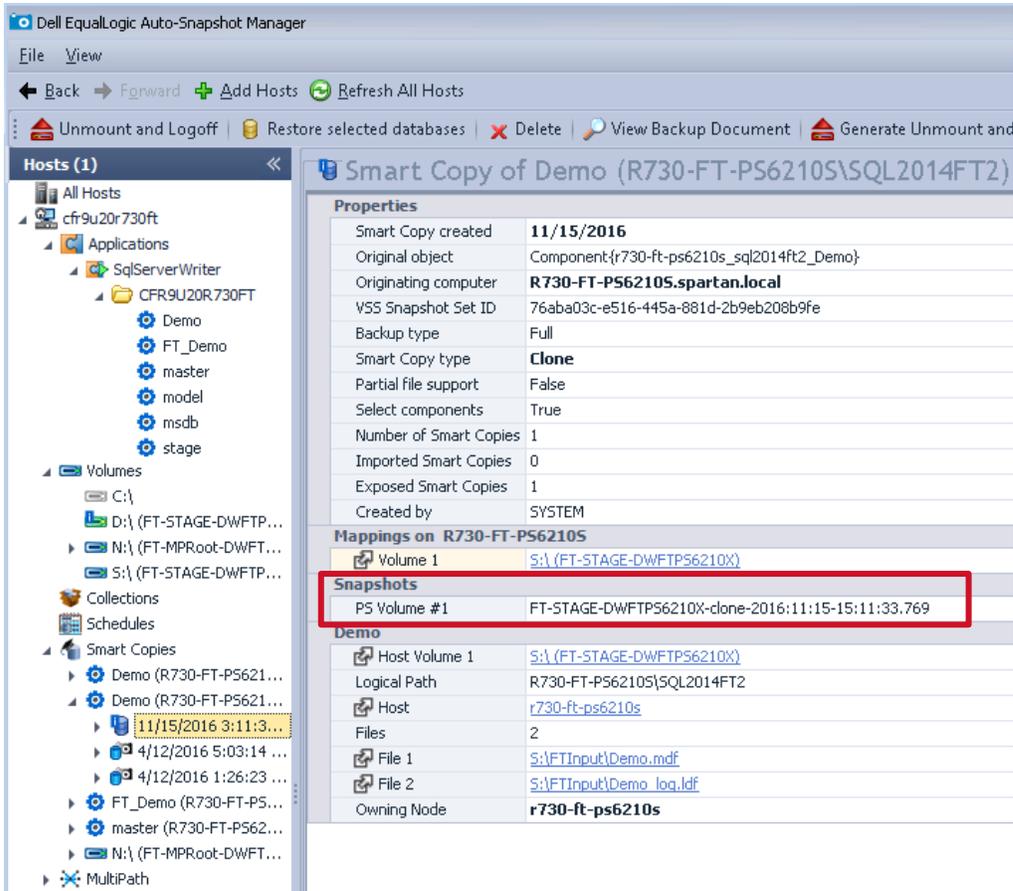


Figure 3 PS Series volume names of the smart copy

2. Log into the PS Series Group Manager and locate the **Smart Copy Clones** in the Group Manager **Volumes** view. Select the smart copy clones, and using the **Activities** pane of Group Manager, select the **Convert to template** option shown in Figure 4.

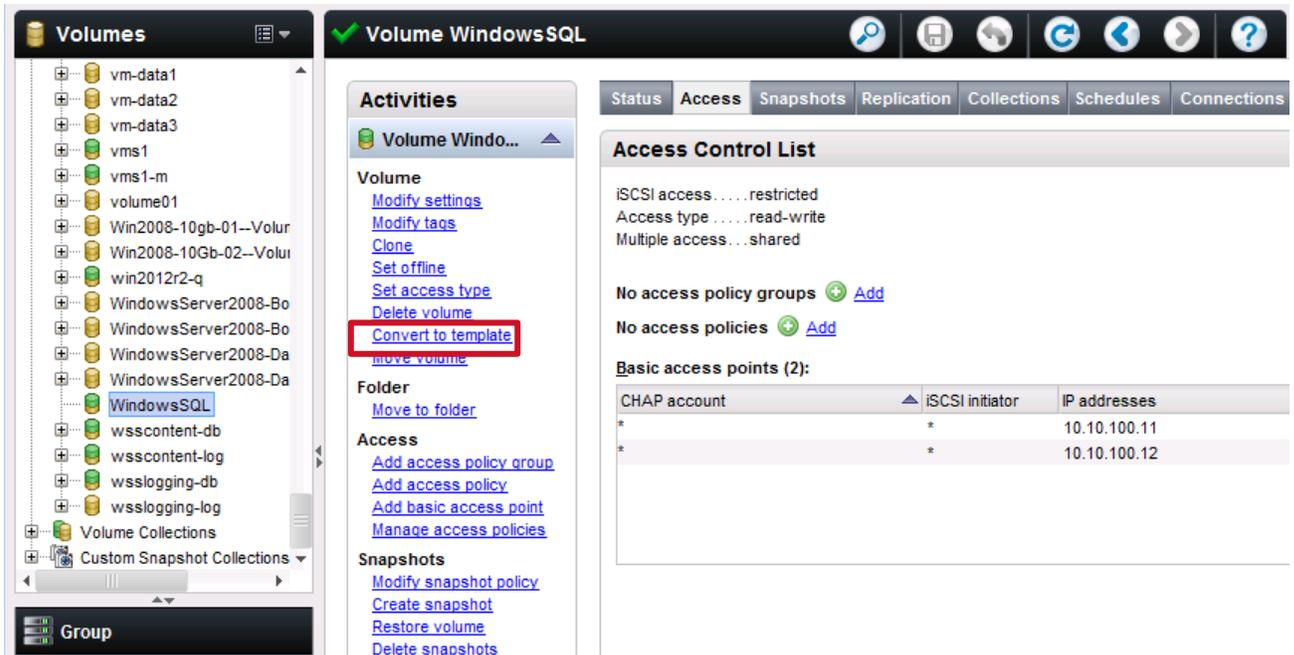


Figure 4 Locate volumes used for template volumes

3. Repeat this process for each clone volume in the database Smart Copy.
4. The volumes will be set offline and converted into template volumes. Once in template form, set the template volumes online using the **Activities** pane in Group Manger.

Now that the volumes have been converted to template volumes in the PS Series Group Manager, services need to be refreshed (but not restarted) on the SQL Server host to recognize the template database.

1. Refresh the **Microsoft iSCSI initiator – Targets** list and make sure the template volumes are logged in (connected). Log into the template volumes if necessary.
2. Refresh the SQL Server instance.
3. Bring the database online in the SQL Server instance. If the database fails to online, refresh the SQL instance again.
4. Refresh Auto-Snapshot Manager to recognize the changes.

5. Use ASM/ME to create thin clones of the created template database (see Figure 5).

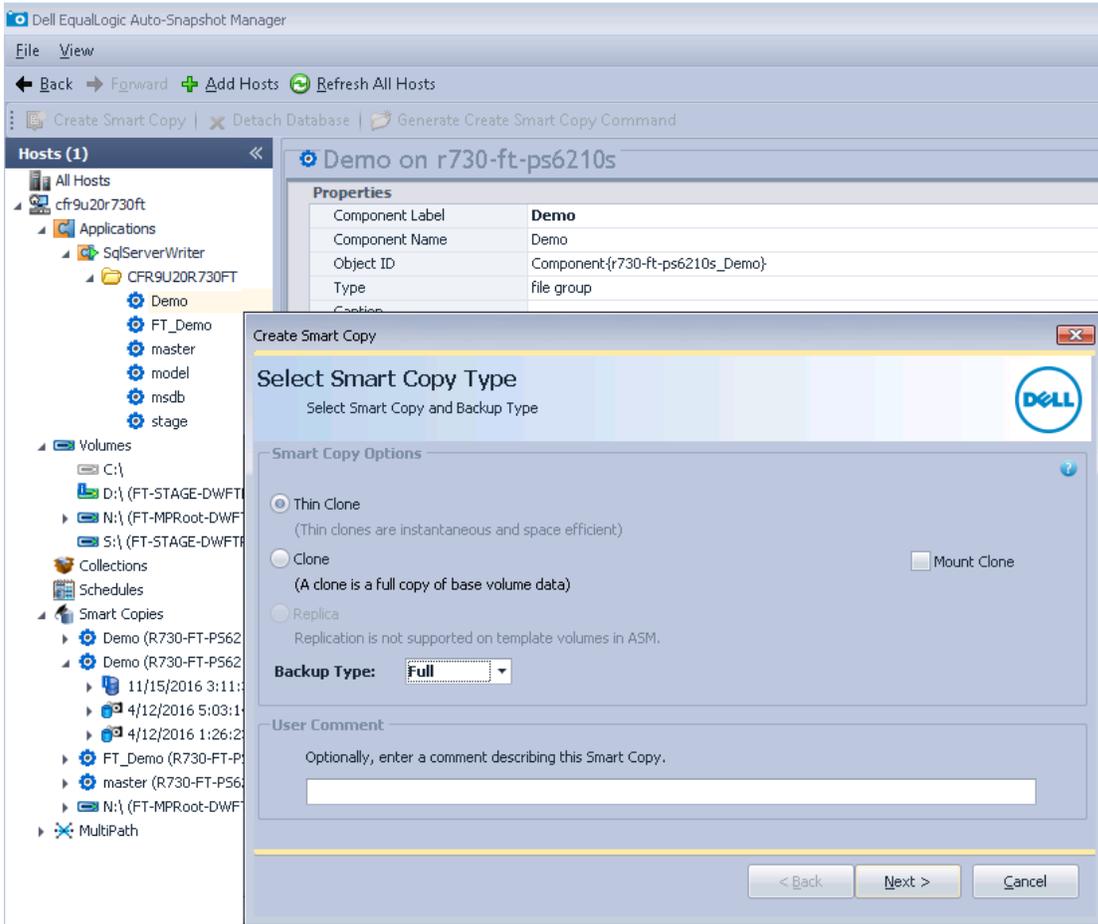


Figure 5 Create a thin clone using ASM/ME

3.3 Providing a powerful VMware test environment using thin clones

Thin clones can bring huge value to a virtualized environment. In a VMware vSphere environment, all virtual machines are encapsulated into data files. These files allow the PS Series arrays, in combination with thin clones, to provide space-efficient copies of these environments allowing administrators to build out huge development and test farms.

For example, an environment may have ten separate developers who all work on software programs. Each developer needs to work on a large environment that is as close to production as possible. With virtual machines, this can amount to hundreds of GB of data or more. Now, each developer needs to work on the same installation including service pack and OS level. This is where thin clones can really help. Instead of each developer having to create their own environment, which may or may not be identical to their colleagues, they can all work from the same base template environment which can contain clones of the actual production data. Not only do they save on space for creating this environment, but since the clones can be actual production data, they will have a reasonable expectation as to what effects their changes will have in the running data center.

This example assumes proficiency in both VMware vSphere and PS Series administration and uses some advanced administration techniques to provide these space-efficient test environments. There are also some caveats to keep in mind. Because this example uses thin clones of virtual machines, each virtual machine will be an identical copy in the environment. This means care needs to be taken to network isolate these machines, especially if these are clones of existing production machines. Because of this isolation and the fact that each machine is identical, iSCSI in the guest VM is not allowed in this example. It is possible to create a scenario in which VMs receive thin clones of volumes that are presented to the iSCSI initiator in the VM, but that is outside the scope and depth of this example. Also, for ease of configuration, in this example the environment will reside on a single datastore. This makes it easy to deploy. It is possible, however, to combine multiple thin clone environments and isolate them for the developers.

Step 1: Configure developer environments

The first step for this example is to prepare the VMware vCenter environment for the developers. This example creates three developers: Developer1, Developer2, and Developer3. Each of these developers is given a thin clone environment to work with. These environments will be clones of actual production systems, so they have to be isolated from each other but the VMs must be allowed to communicate with each other inside the development network bubble. Here are the example steps to create these isolated bubble environments for the developers. See the VMware administration guides for more in-depth steps.

1. Create new users for the developers: **Developer1, Developer2, Developer3**.
2. Create folders in vCenter to isolate the test environments: **Developer1, Developer2, Developer3**.
3. Create isolated vSwitches for the test environments to live on — **Developer1, Developer2, Developer3** — and assign no physical NICs to them. When the test environments are created from the thin clone, the virtual NICs of the VMs will be associated with the vSwitch of the developer environment. This will isolate them and make sure they cannot impact production systems or other thin clone systems but can still work together in their own environment.

Note: If you are not using vDS switching, DRS and vMotion of virtual machines across different hosts will impact the ability of these VMs to communicate inside the isolated test environment. Once the VMs are configured, change the DRS rules so that all of the VMs in a single the developer environment must reside on the same ESXi host.

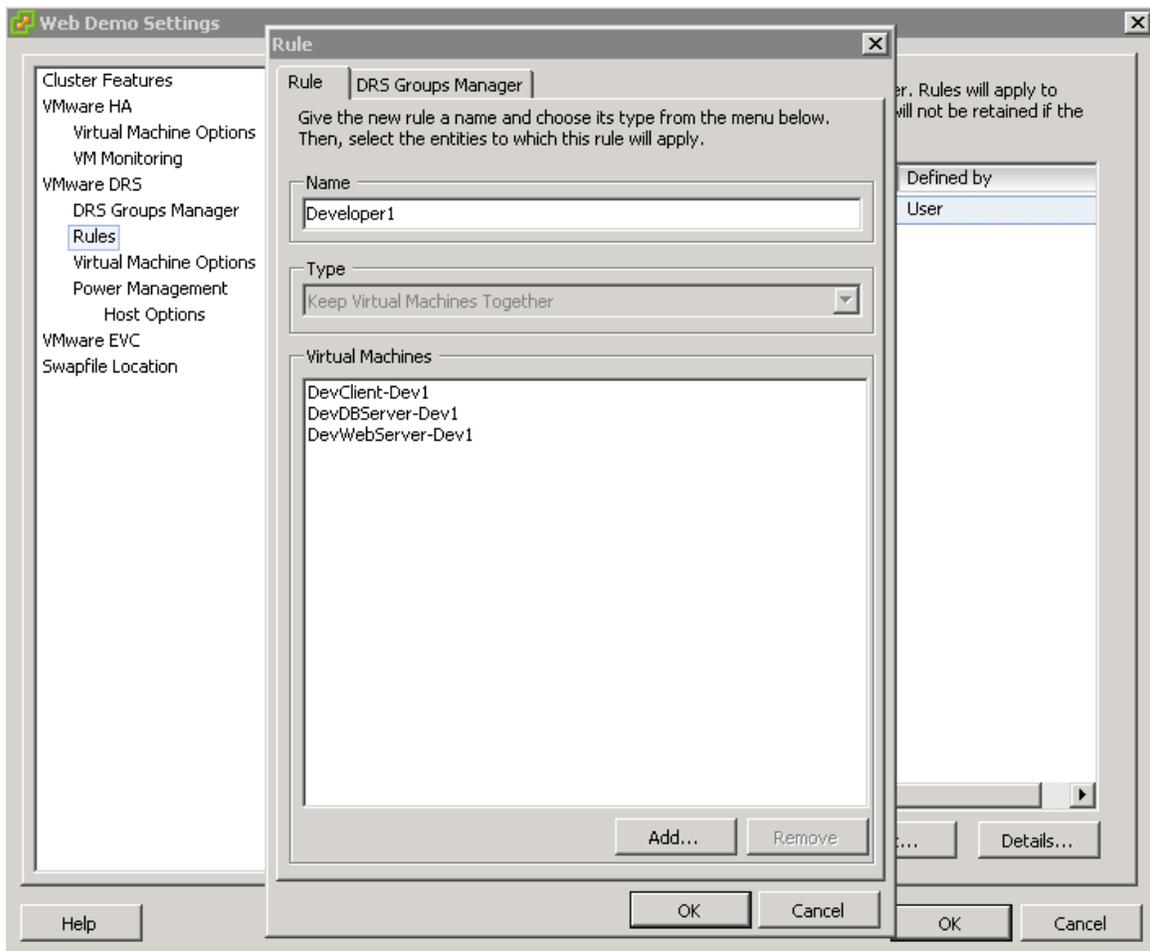


Figure 6 DRS rule configuration

4. Assign users to folders. Different environments will have different permission structures, but in this example, each developer is only given permissions to their folder. This way, when a developer launches the vSphere client UI and logs in, as Developer1 for example, they will only see the folder and VMs that are in Developer1 folder and this will keep them segmented from the other developers. The virtual machine power user for the folder will allow the developer to power on and power off the VM as well as change settings.

Step 2: Configure thin clone on SAN

Now that the vSphere environment is prepared, it is time to create the thin clone environment. This example has a client VM, a web server VM, and a database server VM on a single datastore. This is the production environment that will be thin cloned and then provisioned out to the developer environments.

This example assumes the developers want to work on production data. We can create a clone of the production datastore in one of two ways:

- From the Group Manager UI, select the volume that has the VMs and clone it.
- Use Dell Virtual Storage Manager (VSM) to create a clone of the datastore. If using VSM to create a clone of the environment, remove the cloned VMs from inventory before moving to the next step.

Once the volume with the production virtual machines on it is cloned, follow the instructions in this document to convert it into an offline template volume (see section 2). Once the volume is offline and is a template volume, verify that there are no static connections to the volume in the iSCSI initiator on the ESXi servers and rescan to prevent error messages showing up on the SAN.

You can also follow these same instructions by creating a new volume, presenting it to ESXi as a new Datastore, populating it with VMs, then offlining the volume and turning it into a thin clone template.

Step 3: Provision thin clones

Now that the volume has been converted into a thin clone template, it is time to provision the thin clones. It is important to note that ESXi will only resignature one clone or snapshots of a volume. If provisioning more than one thin clone (for example, to support multiple developers), the process must be performed one thin clone at a time.

1. Provision one thin clone as described in section 2.
2. Perform a rescan of the storage adapter from ESXi, and select **Add Storage** from the **Storage** tab.
3. When presented with the **Mount Options** dialogue shown in Figure 7, select **Assign a new signature**.

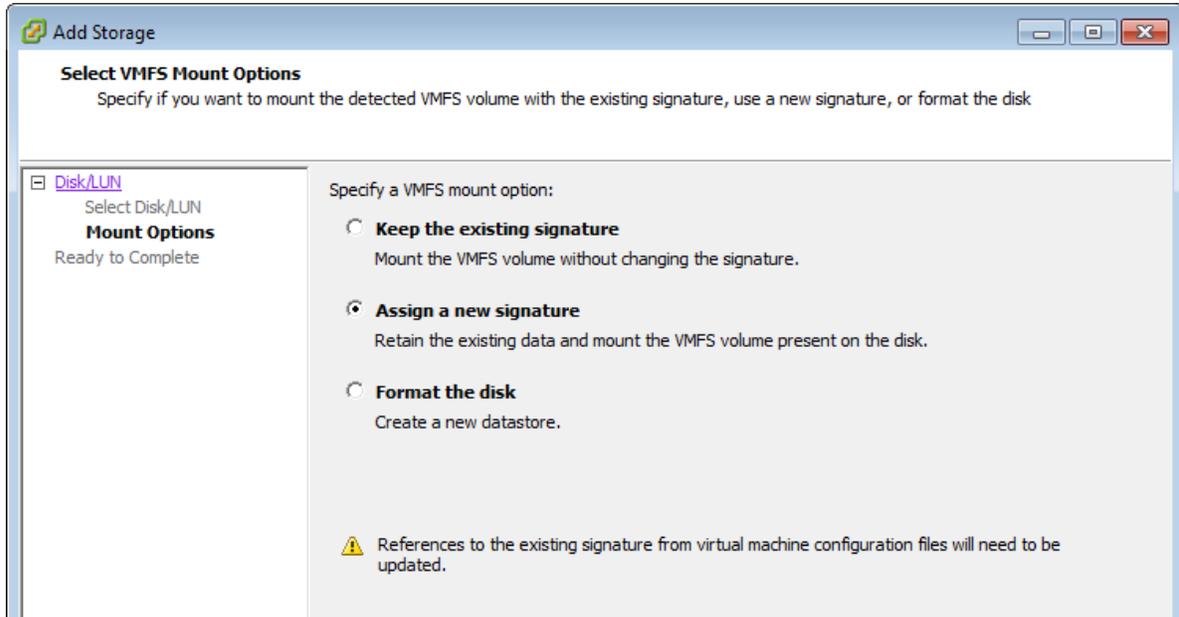


Figure 7 Select the **Assign new signature** option

4. Once the datastore has been mounted and resignedatured, it will have the same datastore label, but with **snap-** prefixed. Rename the datastore clone to a more suitable name, like **Developer#**.
5. Repeat this process for each thin clone that is needed.

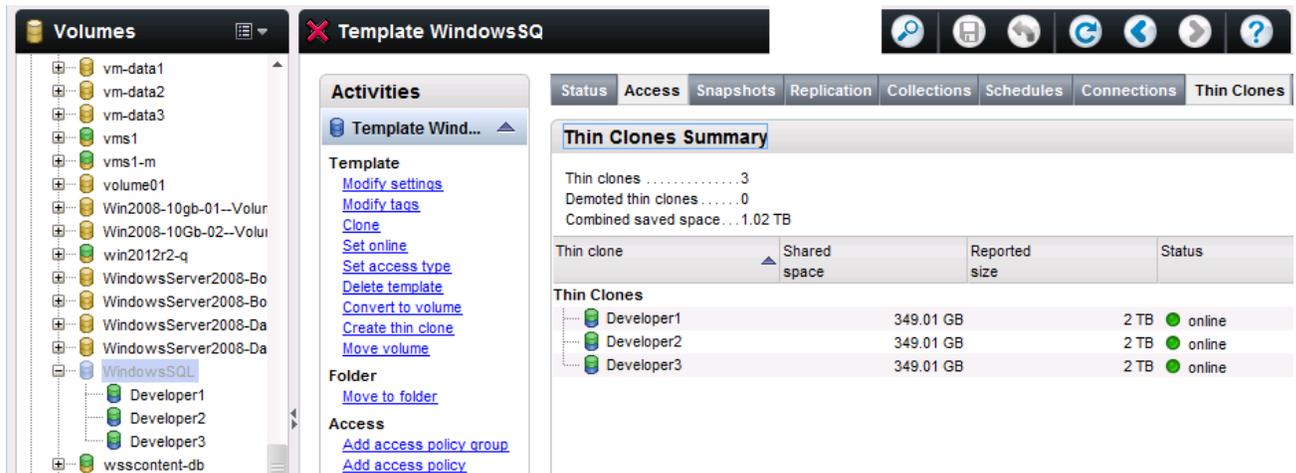


Figure 8 View of resignedatured and renamed thin clones

Note: Multiple snapshots can be mounted at once, however, this involves setting an advanced ESXi configuration setting that is now deprecated. Its use in a production environment is not recommended as a storage disruption while this setting is enabled, and can cause volumes to be resignatured. This can cause virtual machines to become unavailable.

To enable the discovery and mounting of multiple clones at once, from one ESXi host command line, run the following command:

```
esxcfg-advcfg --set 1 /LVM/EnableResignature
```

Scan the ESXi host storage adaptors. After the rescan, each of the thin clones show up under **Datstores** with a **snap-** prefix. You can rename these in vCenter to match the naming scheme of the volume. Then, disable this capability by running the following command:

```
esxcfg-advcfg --set 0 /LVM/EnableResignature
```

Step 4: Register virtual machines

Now that the thin clones have been seen by the ESXi farm, it is time to register the developer environments.

1. From the vCenter UI, select a host and click the **Configuration** tab.
2. Right-click a thin clone datastore and select **Browse Datastore**. This shows all the VMs that were cloned.
3. Open each folder, right-click the .vmx file, and select **Add to Inventory**.
4. Rename the VM based on what developer environment it is going to be and select the correct folder for it to live in.

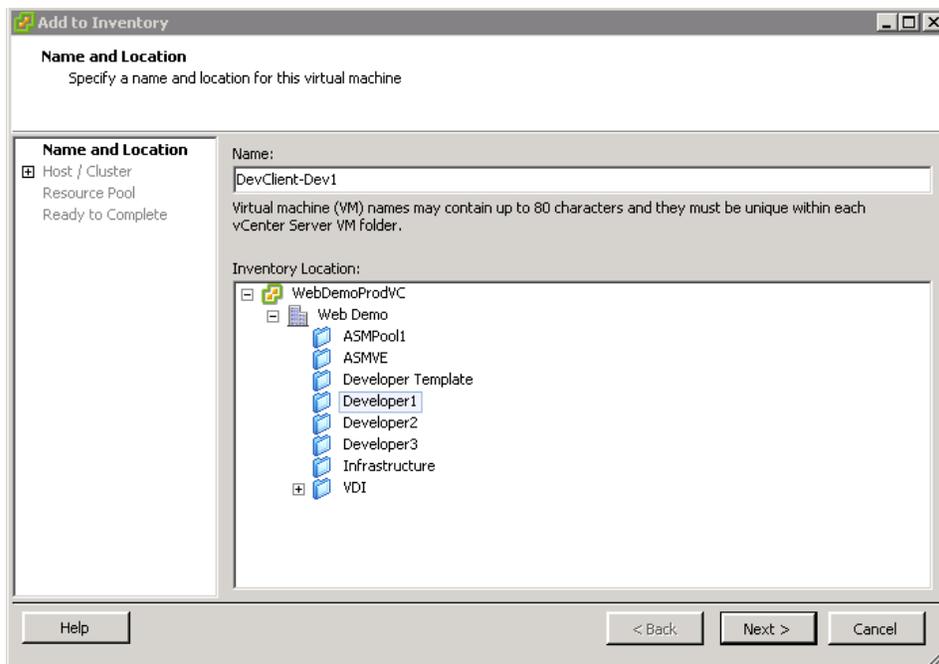


Figure 9 Registering VM from thin clone datastore

Once each of the VMs is registered in the appropriate folder, you also need to change the network settings so that they are isolated. These are exact copies of the production VMs including hostname, MAC address, and IP address. Failure to isolate these VMs from the network can have severe implications. Select a VM and click **Edit Properties**. Click the **Network Adapter** and change the **Network Label** to one of the isolated vSwitches created earlier.

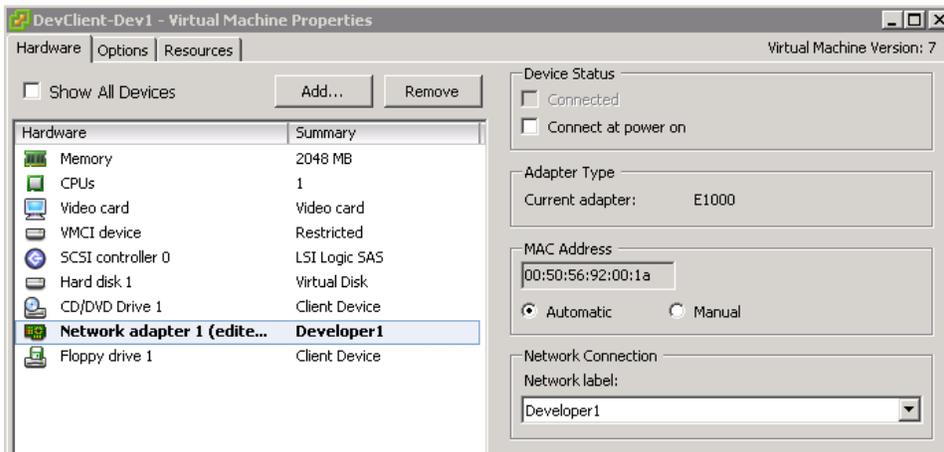


Figure 10 Changing network connections

Once all of the VMs are registered and configured, each of the developers now has an environment which they can change and utilize.

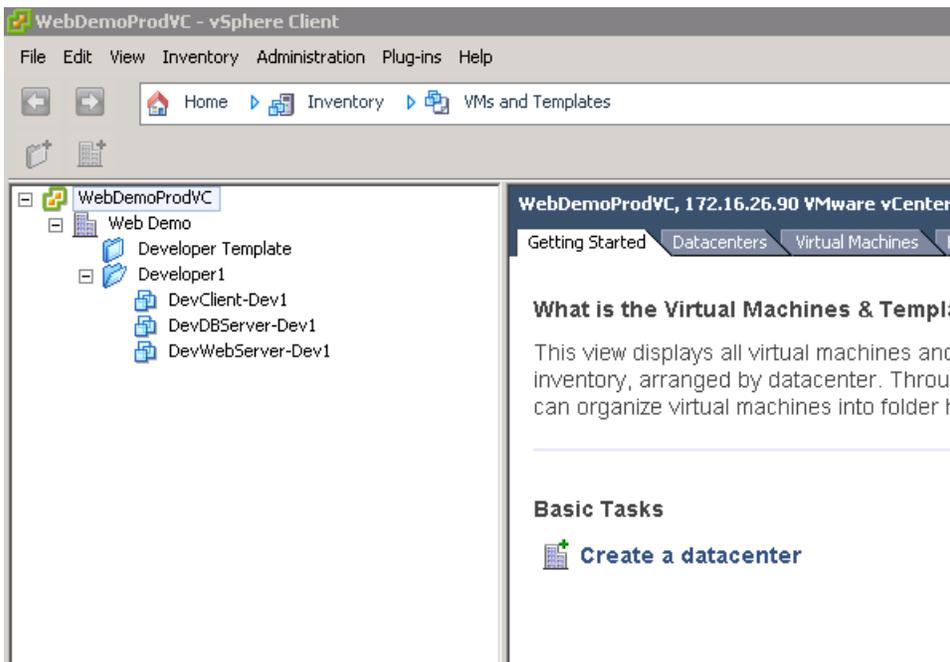


Figure 11 Developer1 isolated environment

There are a variety of other things that can be done to these environments that are beyond the scope of this document, for example:

- Assign a second network adapter, assign new IP addresses to it, and have it residing on a reachable switch so that developers can remote into the environment or copy files across a network share.
- Take advantage of snapshots and allow developers to roll back their own test environments.
- Detach the thin clone into a full set of volumes and bring those virtual machines into production.

Administrators can also use these same concepts and apply them to sys-prepped virtual machines or virtual desktops to provide space-efficient, thin-cloned environments based on the various needs they have. This is just an example of some of the powerful ways that thin clones can be used in a VMware environment.

4 Summary

PS Series template volumes and thin clones can be very valuable tools when applied in the right environments. They serve as space-efficient copies for environments that require high numbers of the same image on disk. These cases vary but can include test environments that change often and need to be reverted back to a base image, OS deployments, and data distribution. Whatever the case may be, template volumes and thin clones are an easy solution to meet challenging data-center needs.

A Technical support and resources

Dell.com/support is focused on meeting customer needs with proven services and support.

[Dell TechCenter](#) is an online technical community where IT professionals have access to numerous resources for Dell software, hardware and services.

[Storage Solutions Technical Documents](#) on Dell TechCenter provide expertise that helps to ensure customer success on Dell EMC storage platforms.

A.1 Related resources

The following list includes documents referred to in this paper:

- *Dell EqualLogic Group Manager Administrator's Guide* available on eglsupport.dell.com (login required)
- *EqualLogic Host Integration Tools for Windows* documentation available on eglsupport.dell.com (login required)
- [Microsoft SQL Server Database Protection Using Dell EqualLogic Auto-Snapshot Manager / Microsoft Edition](#) (see section, Advanced Operations with SQL Server Databases)