Remote Command line Management of PCIe SSD devices in VMware ESXi

A Dell Technical White Paper

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**Introduction to PCIe SSD**

The Dell PowerEdge Express Flash PCIe SSD provides high IOPs and sequential read/write speeds. The Express Flash device is designed to deliver sequential throughput on reads and writes of up to 1.8-1.2 GB/s speed. Refer to [data sheet](#) of Dell_PowerEdge_Express_Flash_PCIe_SSD for more details.

This white paper focuses on command line methods of managing PCIe SSD devices in VMware ESXi environment. This document is useful for administrators to automate the configuration of PCIe SSD device(s) in an efficient manner.

**Audience and Scope**

The scope of this white paper is limited to management of PCIe SSD devices in ESXi using PowerCLI cmdlets. This is intended towards IT administrators and normal ESXi users working on the virtualized infrastructure using PCIe SSD. The document provides insight into the usage of PCIe SSD in VMware ESXi. The document is categorized into three major sections out of which the first section focuses on configuring the PCIe SSD as a VMFS datastore followed by command line options to configure PCIe SSD as a Host Swap Cache. The last section of the document details about automating the creation of a vFlash resource out of the PCIe SSD.

**Dell PCIe SSD devices support in ESXi**

Dell provides support for Micron RealSSD P320h PCIe Controller. This device is supported from Dell customized ESXi 5.1 U1 onwards. Refer to Dell [VMware ESXi documentation page](#) to check out the driver versions incorporated in Dell customized image.

**PCIe SSD support matrix for Dell PowerEdge servers and VMware ESXi**

Refer to the [blog](#) for the support matrix of PCIe SSD for various Dell PowerEdge models. It also details about the different VMware ESXi versions supported for PCIe SSD device. Dell customized VMware ESXi builds is bundled with the necessary drivers to support the PCIe SSD device for PowerEdge servers.
Pre-requisites

This white paper details about remote command line management of PCIe SSD devices. The main pre-requisite is installing the latest version of VMware PowerCLI on supported windows platform. Refer the section 'Installing vSphere PowerCLI' at PowerCLI documentation for detailed steps. For additional details on PowerCLI, refer to release notes.

Use Cases of PCIe SSD in VMware ESXi

Currently there are three possible use-cases for PCIe SSD in VMware ESXi. Refer to the blog for a brief summary of the use cases.

PCIe SSD as a VMFS datastore

The first use case is all about configuring PCIe SSD as a VMFS datastore. The detailed PowerCLI cmdlets used to configure PCIe SSD as a VMFS datastore are as follows:

1. The first step is to connect ESXi server from PowerCLI as follows. Once the cmdlets Connect-VIServer <ESXi IP> is invoked, it prompts for the ESXi username and password.

The connection is established once the credentials of ESXi host are provided. Once the connection is established, the response code would be seen as below.
2. Once the connection to ESXi server is established successfully, execute `Get-ScsiLun` command to get the available LUNs present in the system.

```
PowerCLI C:\Program Files \x86\VMware\Infrastructure\vSphere PowerCLI> Get-ScsiLun
CanonicalName ConsoleDeviceName LunType CapacityGB MultipathPolicy
----------------------------------------------- ----------- --------- ----------
mpx.vmhba5d.../vmfs/devices/cdrom/mpx.vmhba5d... cdrom Unknown Fixed
mpx.vmhba5d.../vmfs/devices/cdrom/mpx.vmhba5d... cdrom Unknown Fixed
t10.ATA.../vmfs/devices/disk/t10.ATA... disk 163.022 Fixed
naa.6d4.../vmfs/devices/disk/naa.6d4... disk 930.500 Fixed
```

Here the lun begins with t10.ATA (highlighted) is termed as PCIe SSD device.

3. Now, parse the PCIe SSD LUN alone from the available SCSI LUNs

```
PowerCLI C:\Program Files \x86\VMware\Infrastructure\vSphere PowerCLI> Get-ScsiLun -CanonicalName t10.*
CanonicalName ConsoleDeviceName LunType CapacityGB MultipathPolicy
-------------- ----------- --------- ----------
t10.ATA.../vmfs/devices/disk/t10.ATA... disk 163.022 Fixed
```

```
PowerCLI C:\Program Files \x86\VMware\Infrastructure\vSphere PowerCLI>
```

4. Format the selected PCIe SSD as a VMFS datastore using `New-Datastore` cmdlet.

```
PowerCLI C:\Program Files \x86\VMware\Infrastructure\vSphere PowerCLI> New-Datastore -Name PCIeSSD-Datastore -Path $PCIeSSD -Vmdf -FileSystemVersion 5
Name                 FreeSpaceGB  CapacityGB
------------------- ----------- -----------
PCIeSSD-Datastore   162.051     163.000
```

Where `-Path` parameter accepts the full path of the device and `-FileSystemVersion` designates the VMFS filesystem version in which the device to be formatted.

With VMFS filesystem created on the PCIe SSD device, it’s now possible to host the virtual machines on this datastore. Refer [Micron website](http://micron.com) to know the different performance comparison they have performed.
PCIe SSD as a Host Swap Cache

The second use case is PCIe SSD as a Host Swap Cache. Refer to VMware documentation to know more about Host Swap Cache. In this paper, we provide a sample code snippet which can be used to configure a portion of PCIe SSD as a host swap cache. Courtesy to Joe Keegan who has made this code available in his website. The below is a modified version of the Powershell script which is changed to suit the environment where PCIe SSD is tested for HostSwapCache via PowerCLI.

$DataStore = Get-Datasstore -Name “PCIeSSD” # Here PCIeSSD is the VMFS datastore created in earlier step

# The below section is to create the HostCacheConfigurationSpec spec as per VMware API doc

$HostCacheConfigurationSpec = New-Object VMware.Vim.HostCacheConfigurationSpec
$HostCacheConfigurationSpec.datastore = New-Object VMware.Vim.ManagedObjectReference
$HostCacheConfigurationSpec.datastore.type = ”Datastore”;
# As per the spec, the type of datastore should be set to ”Datastore”
$HostCacheConfigurationSpec.datastore.Value = ($DataStore.id).substring(10, 35)
# The Value field for datastore object should be the ID of the VMFS datastore that is created in Step 4 above. The values 10 and 35 are derived by printing $DataStore.id variable. The ID begins with Datastore-<ID>. We just need the ID of the VMFS volume so begin from character 10 till the end. In the test system, the ID length was 25, so the substring of (10,35) was extracted for ‘Value’ field of datastore Managed Object.

$HostCacheConfigurationSpec.swapSize = 2048;
# Setting an arbitrary value in MB. Refer to the API description.
$HostCacheConfigurationManager_ID = "HostCacheConfigurationManager-ha-cache-configuration-manager"

$HostCacheConfigurationManager = Get-View -Id $HostCacheConfigurationManager_ID
$HostCacheConfigurationManager.ConfigureHostCache_Task($HostCacheConfigurationSpec) | Out-Null

## PCIe SSD as a vFlash Device

Configuration of vFRC through command line using PowerCLI cmdlets. For PowerCLI installation and importing vFRC cmdlets please refer to the [vFRC blog](#).

Steps for enabling vFRC cmdlets for PowerCLI are as follows:

1. Download VMware.VimAutomation.Extensions from [here](#).
2. Extract the downloaded ZIP file to your Powershell modules directory
   
   Path - C:\Windows\System32\WindowsPowerShell\v1.0\Modules
3. Now execute the Windows Powershell as Import System Modules option.
4. After all modules are imported, open PowerCLI and run below command.
   
   # Import-Module VMware.VimAutomation.Extensions

After importing the vFRC cmdlets, PCIe SSD can be added as a Flash resource. The detailed steps are outlined below

1. Get the Canonical Names of Luns present on ESXi using the command and then identify the PCIe SSD using *Get-ScsiLun* cmdlet.
Here the lun begins with t10.ATA (highlighted) is termed as PCIe SSD device.

2. Create an object for getting specific ESXi host configuration as below.

3. Create an object for getting PCIe SSD configuration

4. Execute the below command for adding PCIe SSD as a vFlash Resource

5. PCIe SSD is now added as vFlash Resource. Set up the reservation for HostSwapCache say 20 GB, using below syntax:
Where t10* is the Canonical name of the PCIe SSD drive shown in step 2.

Now once the vflash resource and HostSwap cache configured, Virtual Flash Read Cache vFRC can be enabled for VMs.

**Note: Before proceeding, upgrade the VM to hardware version 10 (VMX-10)**

**Configuring vFRC for VMs**

1. Create an object to get the specific VM configurations

2. Create an object to get the details of the specific disk of VM( .vmdk) on which vFRC is enabled

3. Execute the following command to check the vFRC configurations for a specific vmdk.
4. To verify the enablement of vFlash cache with a specified size on a specified hard disk

5. Create object $conf to get the vFRC current configuration, use the above command to create this object.

6. Now specify the size of the vFRC on the specified vmdk, say 10GB

**NOTE**: If the above command execution is throwing an error during setting up the vFRC, open a new window and connect to your VCenter server and run all the given commands from Step 4 (configure vFRC for VMs). The error can occur if the host is managed by some VCenter server.

In the above screen, it’s clear that the cache size of vFRC on the specific vmdk is set to 10 GB
7. Now to disable the **vFlash Read cache** on a specified hard disk, then set the CacheSizeGB to 0.

Now the CacheSize is 0 Gb and vFRC is not active or disabled on the specific vmdk.

8. Similarly to remove the **Host Swap cache** on the host, below is the command:

```
VMware vSphere PowerCLI 5.5 Release 1
PowerCLI C:"Program Files (x86)\VMware\Infrastructure\vSphere PowerCLI> Set-VMHostFlashConfiguration -t10* -SwapCacheReservationGB 0
```

Where t10* is the Canonical name of the PCIe SSD drive shown in step 2, you can also get this by running either `esxcfg-mpath -l` or `esxcli storage core path list` on ESXi host shell prompt.

9. The last step is the removal of Virtual Flash Resource from the Virtual flash Capacity bucket.

**NOTE:** Before removing Virtual Flash resource from the vFlash bucket, verify that no resource should be allocated to Host Swap cache or Swap cache to VM.
Now the SSD has been removed from the Vflash resource bucket.

**VMotion with vFlash configured**

When choosing to vMotion a VM which disks are configured to use vFlash Read cache function, two options are prompted to migrate the cache content. The destination host must also have the vFlash resource enabled in order to move a powered on VM. VSphere Web Client, provide the ability to migrate or discard the virtual machine’s Virtual Flash Read Cache content during migration events. The two options are

- Always migrate the cache contents – Virtual machine migration proceeds only if all of the cache contents can be migrated to the destination host.
- Do not migrate the cache contents – Drops the write-through cache. Cache is rewarmed on the destination host.

For more information on vFRC enabled VMs vMotion, please refer to the Blog for more details.

**Conclusion**

This document helps administrators and end users to configure and manage PCIe SSD programmatically using VMware PowerCLI. It helps users to identify the use cases of PCIe SSD in VMware ESXi and manage the device for all possible use cases via PowerCLI.

**References**

- VMware API Reference
- Dell support for PCIe SSD