



Concerto™ Best Practices Guide for Windows 2012®

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Introduction

The Violin Flash Storage Platform (FSP) with Concerto OS 7 provides robust Enterprise Data Services for a comprehensive solution with optimum performance. The FSP consists of high performance storage integrated with Enterprise Data Services, including business continuance, data safety, data scale and data reduction.

The primary goal of this document is provide the user with steps to configure both the FSP as well as a Windows 2012/2012 R2 client for optimal connectivity.

This document should be used along with the applicable application (Hyper-V, SQL Server, etc.) best practices.

Reference Documents

The following documents are available for download from the Violin Memory Support site at <http://www.violin-memory.com/support/>

- *7300 Flash Storage Platform Best Practices Guide*

General 7300 Best Practices

See the *7300 Flash Storage Platform Best Practices Guide* for general recommendations on configuring and connecting the Violin 7300 Flash Storage Platform.

General BIOS Recommendations

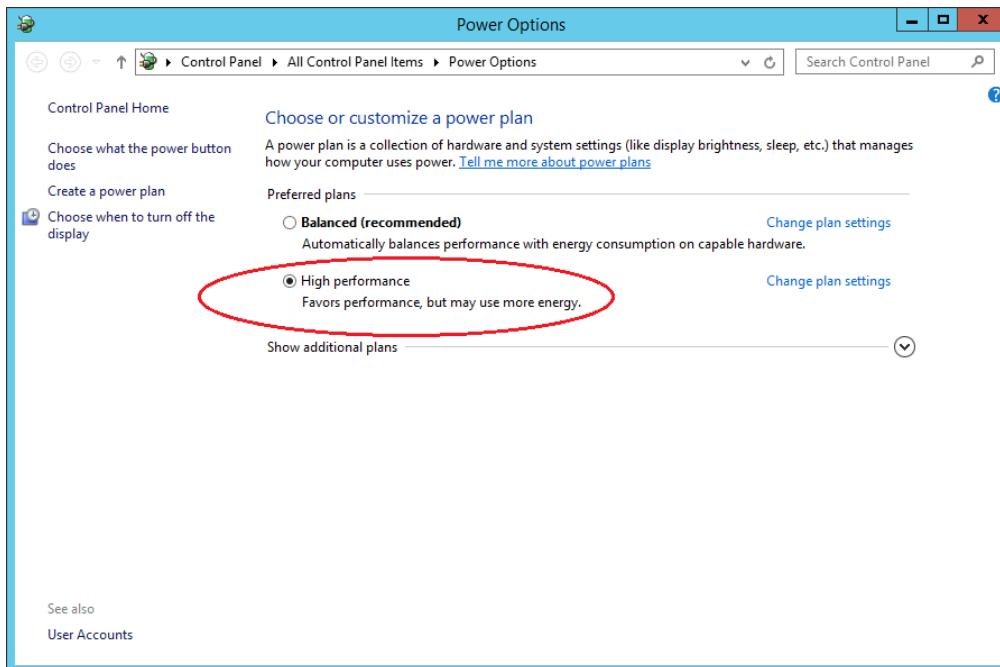
BIOS settings can have a significant effect on both overall performance and performance stability. There are many manufacturers of motherboards, feature names used, default settings applied by vendors and various levels of server classes such that not all of the below features may be included in every server. However, the following are recommended settings for optimal performance in the BIOS:

- Hyperthreading: Enabled
- C-State: Disabled
- Turbo Boost: Enabled
- Memory clock speed: Set to maximum
- QPI Speed: Set to maximum
- Memory Optimizer Mode: Optimizer
- Node Interleaving: Disabled (NUMA on)

General Windows 2012 Best Practices

Power Plan

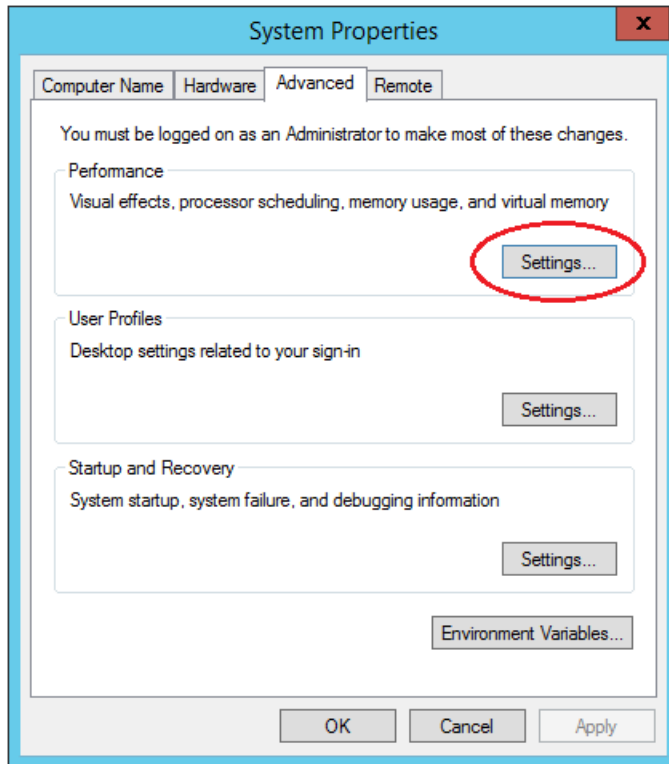
For optimal performance it is recommended that you set the Power Plan to High Performance. This will consume more power than if left in the default of Balance and energy consumption should be considered when choosing a plan.



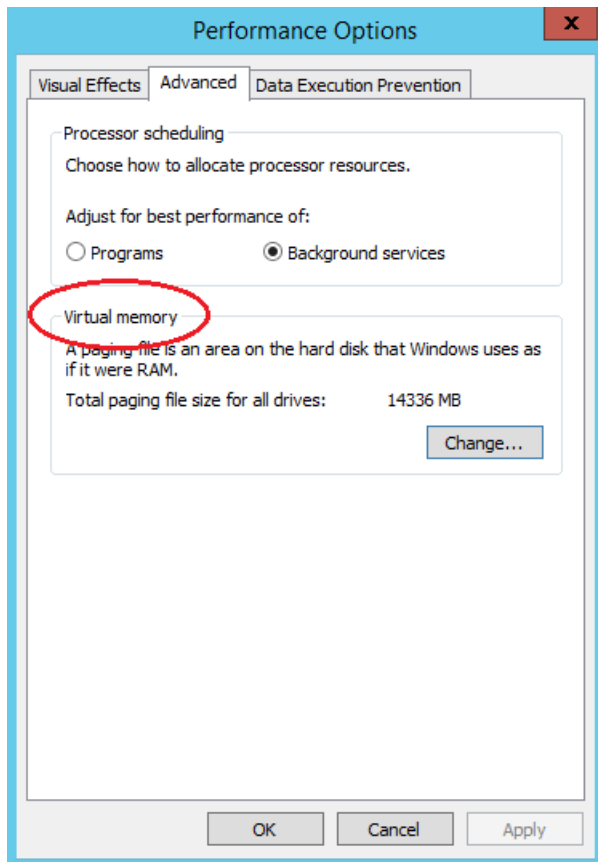
PageFile – Virtual Memory

Upon install, Windows creates a page file with a size relative to the amount of system memory. If large amounts of system memory (DRAM) are installed and SAN LUNs are presented to the host, it is possible for the page file to migrate onto a SAN LUN.

For ultra-performance systems it is recommended that you put the page file on a high performance SAN LUN like Violin Memory arrays. In this scenario, it is recommended that you use a thick or thin LUN as performance is the ultimate goal and the size of the virtual memory file would be relatively small compared to an enterprise SAN.



You can find the virtual memory's settings by choosing the **Advanced Systems Settings** on the Systems properties menu and then clicking the **Settings** button under the Performance section of the Advanced tab.



File System

NTFS Format

With random based storage like Violin Memory arrays, the NTFS format is less of a performance concern than with legacy hard disk drive based storage. As a best practice, it is recommended that you format LUNs at 4k for optimal performance. The older 64k recommendation was based upon hard disk drive technology.

Starting with Windows 2008 R2, the operating system automatically aligns new Volumes to 4k boundaries. It is best practice to review LUNs and Volumes being migrated from older SANs and hosts to validate that they are 4k aligned, as 4K alignment of the file systems is critical to high performance. The easiest way to determine if a partition is out of 4KB alignment is to look at a partition table. Divide the starting sector of a partition by 8. If you end up with a number that has remainder (a number after the decimal point other than 0), that partition is not aligned correctly.

The array does not cause misalignment; it needs to be investigated at the host side. For example, LVM layout, striping, or database pre-allocation can magnify the misaligned write issue.

To check a listing of the physical details of attached storage:

```
C:\wmic diskdrive list /format:list
```

```
C:\wmic partition get BlockSize, StartingOffset, Name, Index BlockSize  
IndexName StartingOffset
```

```
512 0 Disk #0, Partition #0 1048576
```

Windows NUMA tuning tips are at <http://support.microsoft.com/kb/2506384>

Number of LUNs

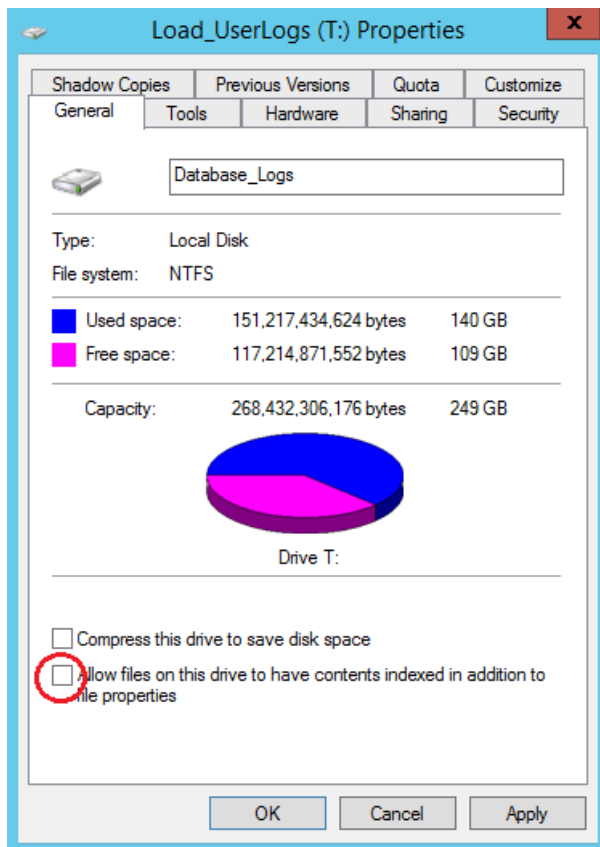
Windows natively manages IO to/from each LUN with a single thread. This means that performance can bottleneck enterprise workloads if too few LUNs are utilized. It is recommended that at least two LUNs are allocated to each workload at a minimum and up to eight LUNs are allocated for workloads requiring the best possible performance.

Volumes

While Windows Server allows for several types of Volumes, there is no performance gain when utilizing Striped, Spanned or Mirrored LUNs. It is optimal to let the Violin Memory arrays handle data protection and LUN management.

Content Indexing

Microsoft Windows' built in file content indexing will significantly slow down write performance if enabled on a Volume. It will act like a virus scanner in that it will lock the files during writes in order to update its internal search database. This is not required for most applications and is highly performance-draining. Content Indexing is recommended to be turned on for systems drives like the C:\ volume but is recommended to be turned off for all other volumes that do not need document searching.



Networking / Transport

Queue Depths

It is a best practice for high performance configurations to increase the default queue depths to at least 128. Optimal performance requires enabling enough IO requests to be in flight in parallel so that the transportation tier is not the bottleneck. It is common for architectures to have relatively few LUNs and/or physical ports so queue depth becomes a requirement to increase. For architectures with many ports or LUNs this may not be a setting that requires change. Having the overall queue sizes too large will not negatively affect applications so having the setting higher than needed is better than not having it high enough. Thus, the recommendation is to increase queue depths above the defaults.

Drivers and Firmware

It is highly recommended that you make sure that HBA drivers are up to date and running the most recently approved versions. Also, make sure that the same driver version is running on all ports.

MPIO

Multi-path IO, or MPIO, is the feature that ties all HBA ports together to work as one when interacting with high performance storage. Windows MPIO will create up to 32 paths between the host server and the storage array per LUN. More paths allow for more outstanding IO packets and more parallelism, which increases overall throughput and can lower packet latency.

It takes a minimum of four paths to saturate a physical link, and performance increases up to 16 paths per LUN, so it is important to make sure that enough paths are being created. Windows will create the paths on boot based upon the physical number of ports on the host and the array. Check the “Ports and Paths section” below to learn more.

Paths and Ports

The number of paths depends on how many ports on the SAN can be seen by the ports on the host. As such, it is recommended that at least two physical ports are available for lighter to medium performance hosts and four or more physical ports for larger, heavier working host servers.

The number of ports on the host is especially important when two switches are utilized for redundancy. This reduces the ports on the array that each port on the host can see and thus divides the number of paths in half. A minimum of four paths is recommended per physical port in order to achieve optimal utilization of the physical links.

After running SAN based benchmark testing, if the performance over the links does not reach saturation then it is recommended that you add more LUNs. By spreading the workload over more LUNs, Windows will create more paths and increase the overall in-flight IOs leading to better application performance.

Path State

MPIO path states should be “Active/Optimized”. Another common Policy is Least Queue Depth. Both should be tested for the best effect on the highest priority workloads on the host.

Policy

For most workloads it is recommended that the MPIO Policy to be set to Round Robin.

MPIO DSM

Violin Memory does not require a vendor-specific DSM to be installed. Violin Memory arrays work with the native MPIO driver that ships with all versions of Windows, starting with Windows Server 2008 R2.

Installation of Hotfixes

Violin Memory recommends the following Hotfixes on Windows 2012. There are no recommended hotfixes for Windows 2012 R2.

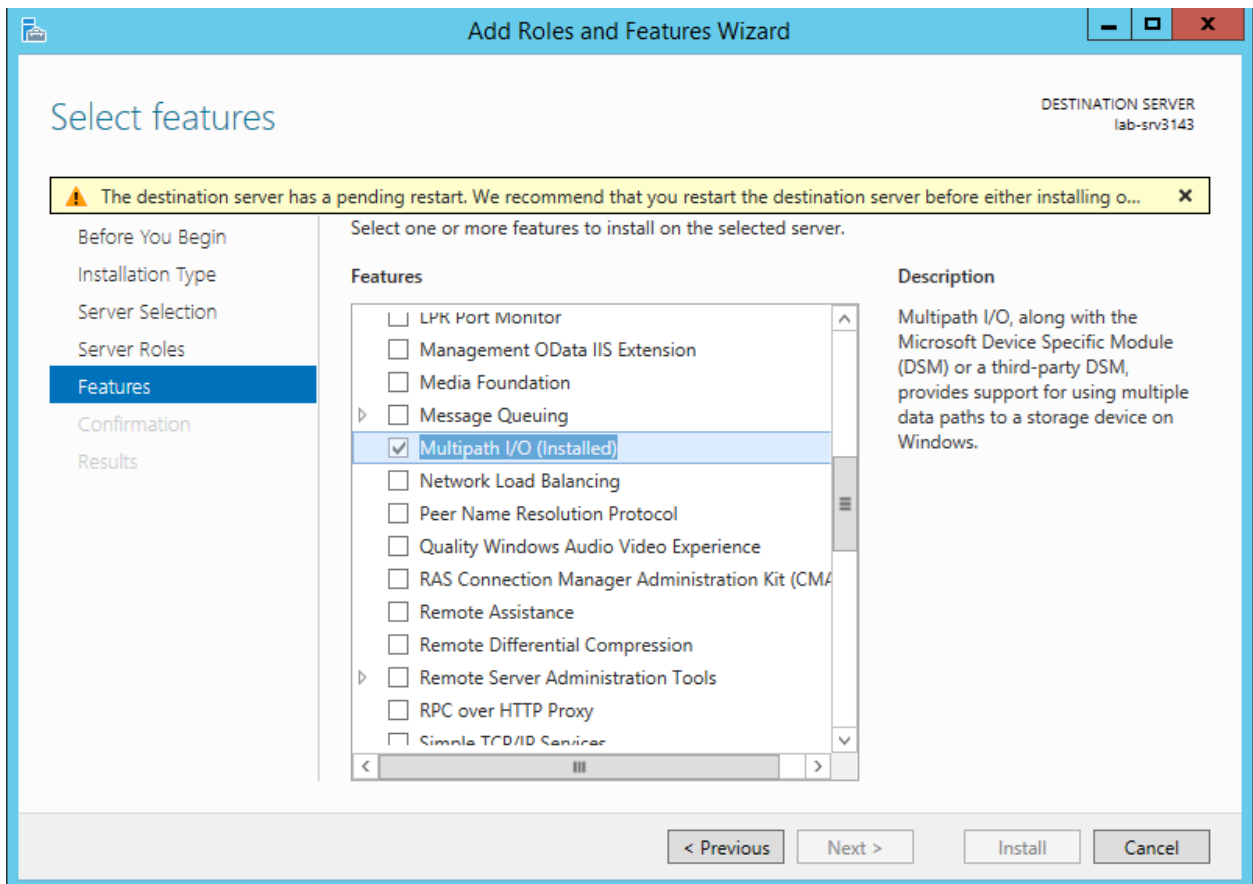
- KB2784679

To verify the patches that are installed:

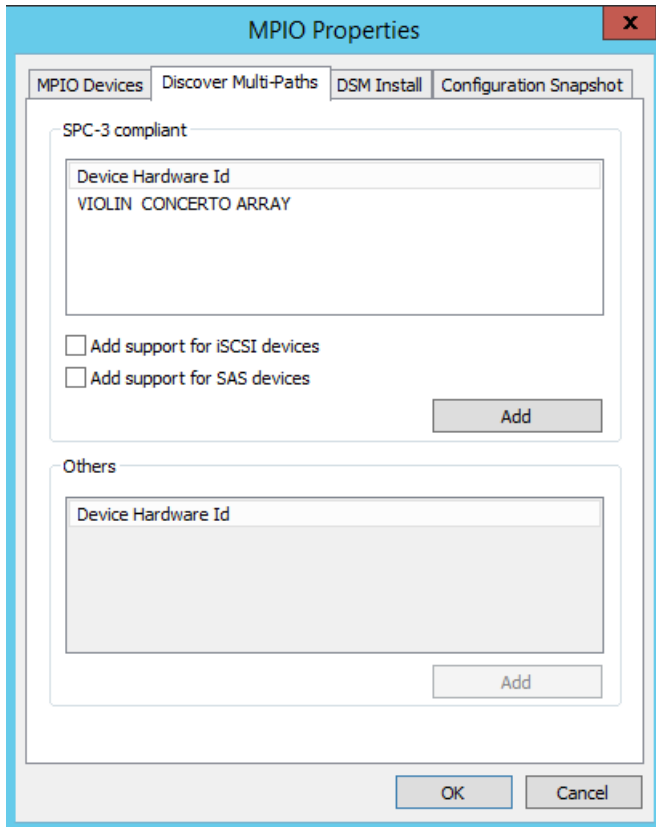
```
C:\wmic mic:root\cli>qfe
```

Installation of MPIO

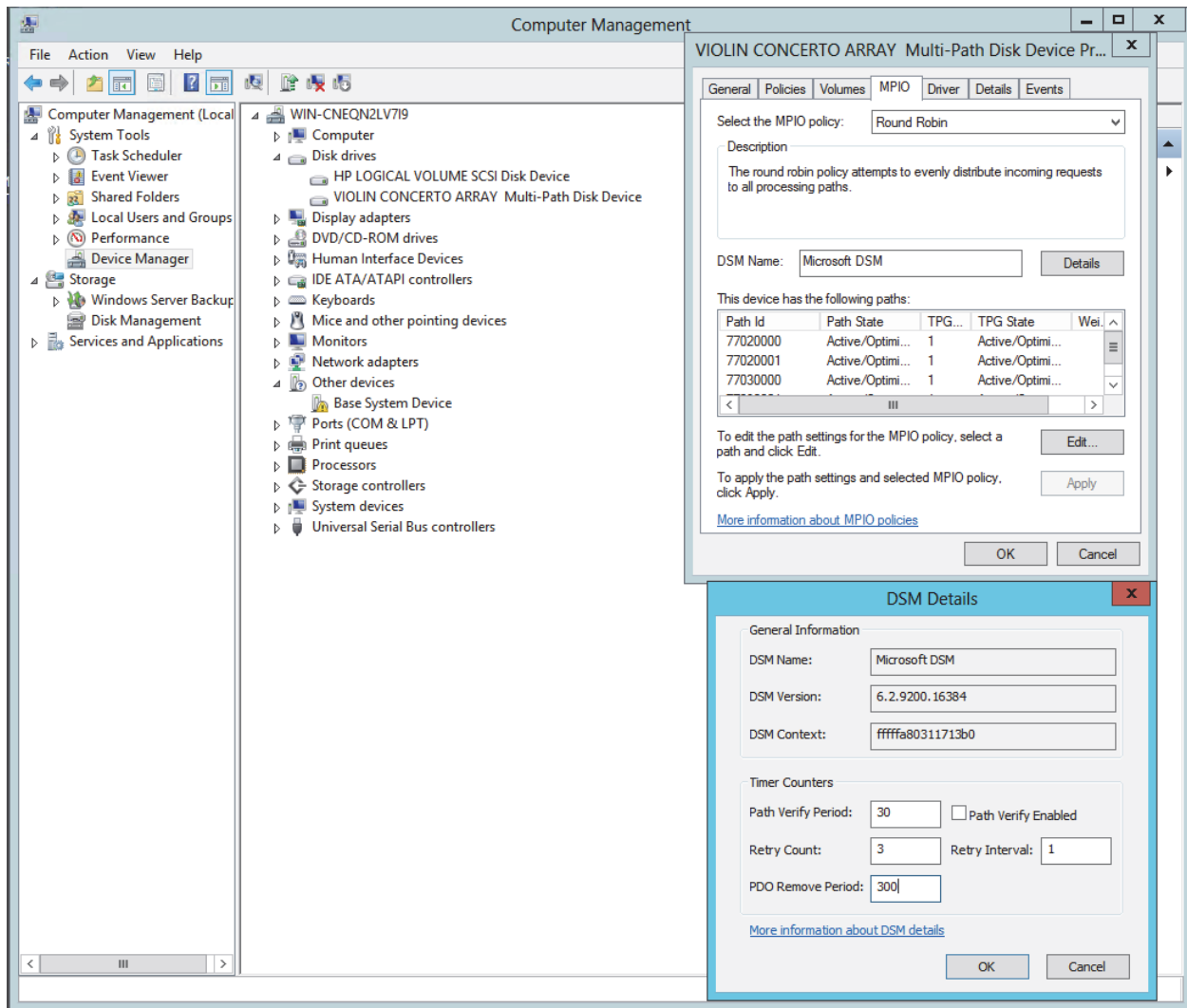
1. Go to **Add Roles and Features** under Server Manager.
2. Select **Features** and then select **Multipath I/O**.
3. Click **Next** to complete the MPIO installation.



4. After MPIO is installed, go to the Windows Control Panel, open Administrative Tools and open the MPIO Properties window.
5. Do the following:
 - a. In the MPIO Properties window, click the **Discover Multi-Paths** tab.
 - b. Under SPC-3 compliant Device Hardware ID, select VIOLIN CONCERTO ARRAY. (You must first export a Concerto LUN to the Windows host.)



6. Select **VIOLIN CONCERTO ARRAY** and then click **Add**. Other storage devices might be present.
7. Reboot the server for the changes to take effect.
After reboot, the DSM PDO remove period needs to be changed from the default value 20 to 300.
8. When the server is back up, navigate to **Computer Management**.
9. Under Device Manager, expand Disk Drives and right-click the **VIOLIN CONCERTO ARRAY Multi-Path Disk**.



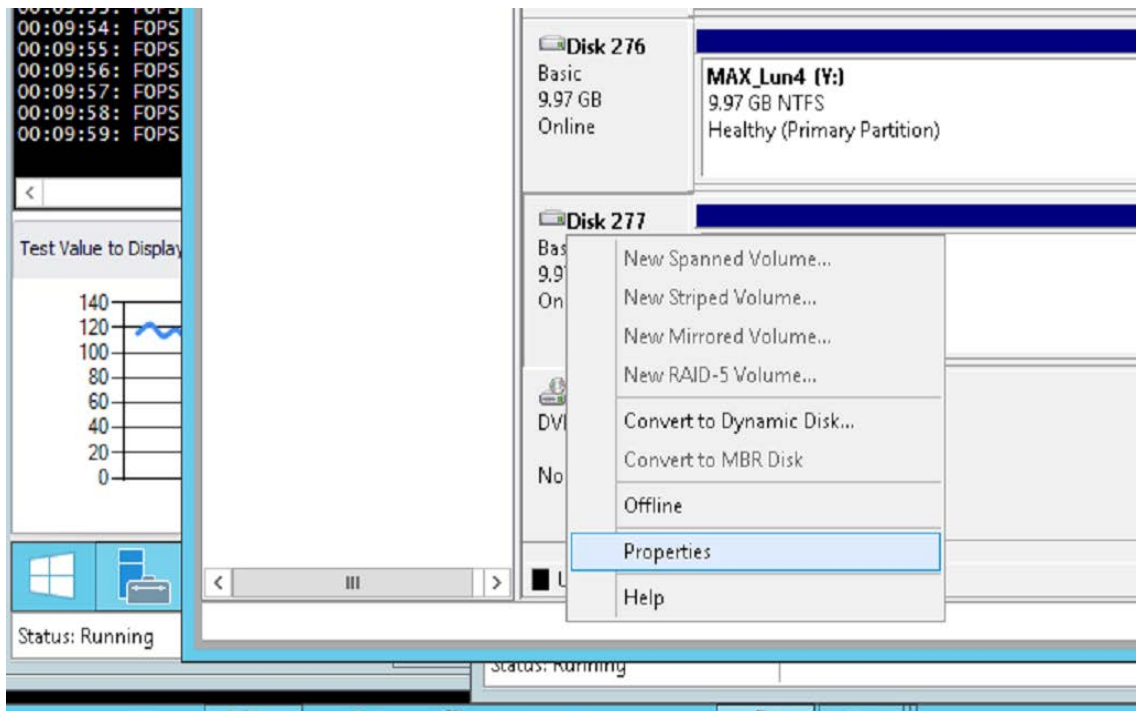
10. Click the MPIO tab, and then click **Details**.

11. Change the PDO Remove Period parameter to 300, then click **OK** and then **OK** again.

You only need to change this parameter for one Concerto disk, and it will be changed for all the Concerto disks.

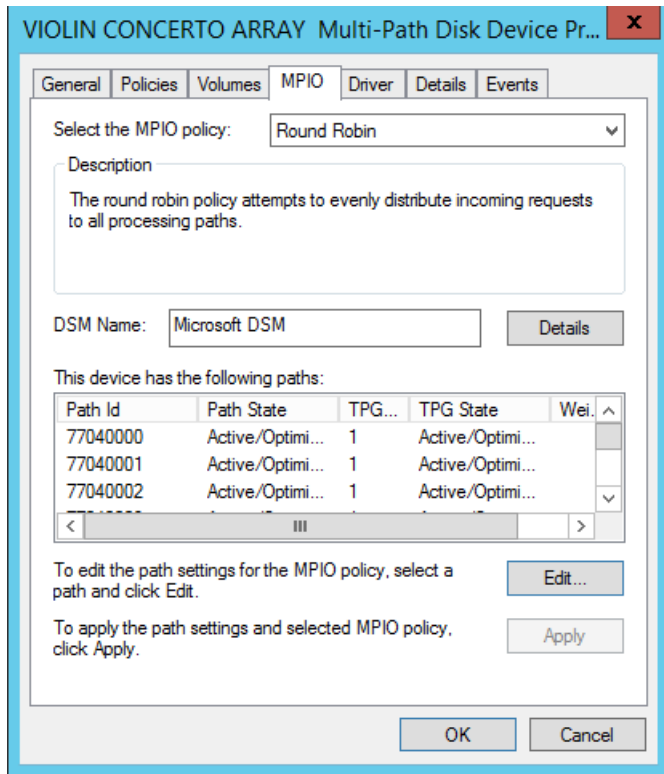
Verify MPIO Settings

1. Verify the MPIO settings and the paths by navigating to Disk Management.
2. Right-click the left side of the disk label and choose **Properties**.



Path checking for the exported LUN should look like the screenshot below.

3. Verify that the number of paths are correct. The MPIO policy recommended by Violin Memory is a "Round Robin" policy.
4. Leave everything else as default.



To check the MPIO paths for the volumes on Windows, open a command prompt and then type
`C:\ mpclaim -s -d`