



Windows

SAN hosts and cloud clients

NetApp
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Windows

Using Windows Server 2022 with ONTAP

Booting the OS

There are two options for booting the operating system: by using either local boot or SAN boot. For local booting, you install the OS on the local hard disk (SSD, SATA, RAID, and so on). For SAN booting, see instructions below.

SAN booting

If you opt to use SAN booting, it must be supported by your configuration. You can use the NetApp Interoperability Matrix Tool to verify that your OS, HBA, HBA firmware and the HBA boot BIOS, and ONTAP version are supported.

1. Map the SAN boot LUN to the host.
2. Verify multiple paths are available. Remember, multiple paths will only be available after the host OS is up and running on the paths.
3. Enable SAN booting in the server BIOS for the ports to which the SAN boot LUN is mapped. For information on how to enable the HBA BIOS, see your vendor-specific documentation.
4. Reboot the host to verify the boot is successful.

Installing Windows hotfixes

We suggest the use of **latest cumulative update** to be installed on the server.



Go to the [Microsoft Update Catalog 2022](#) website to obtain and install the required Windows hotfixes for your version of Windows.

1. Download hotfixes from the Microsoft support site.



Some hotfixes are not available for direct download. In these cases, you will need to request a given hotfix from Microsoft support personnel.

2. Follow the instructions provided by Microsoft to install the hotfixes.



Many hotfixes require a reboot of your Windows host, but you can opt to wait to reboot the host until *after* you install or upgrade the Host Utilities.

Installing the Windows Unified Host Utilities

The Windows Unified Host Utilities (WUHU) are a set of software programs with documentation that enables you to connect host computers to virtual disks (LUNs) on a NetApp SAN. We recommend downloading and installation of the latest Utility Kit. For WUHU configuration information and instructions, please refer to [WUHU 7.1 Documentation](#).

Multipathing

You must install MPIO software and have multipathing set up if your Windows host has more than one path to the storage system. Without MPIO software, the operating system might see each path as a separate disk, which can lead to data corruption. The MPIO software presents a single disk to the operating system for all paths, and a device-specific module (DSM) manages path failover.

On a Windows system, the two main components to any MPIO solution are a DSM and the Windows MPIO. MPIO is not supported for Windows XP or Windows Vista running in a Hyper- V virtual machine.



When you select MPIO support, the Windows Unified Host Utilities enables the included MPIO feature of Windows Server 2022.

SAN configuration

Non-ASA configuration

For non-ASA configuration there should be two groups of paths with different priorities.

The paths with the higher priorities are Active/Optimized, meaning they are serviced by the controller where the aggregate is located.

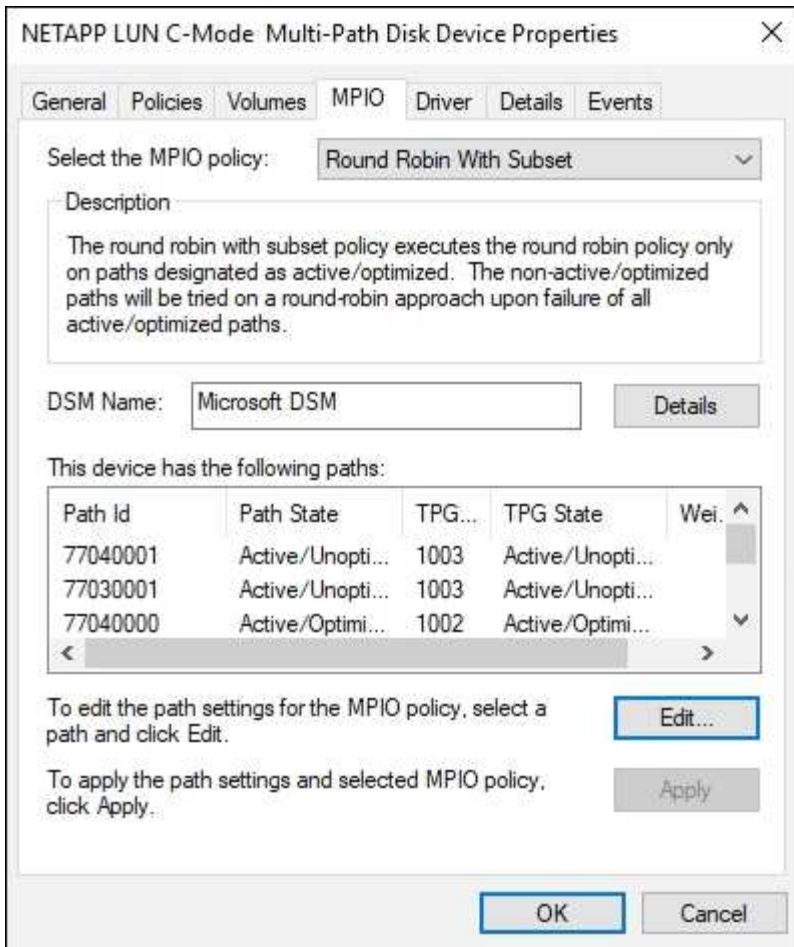
The paths with the lower priorities are active but are non-optimized because they are served from a different controller.



The non-optimized paths are only used when no optimized paths are available.

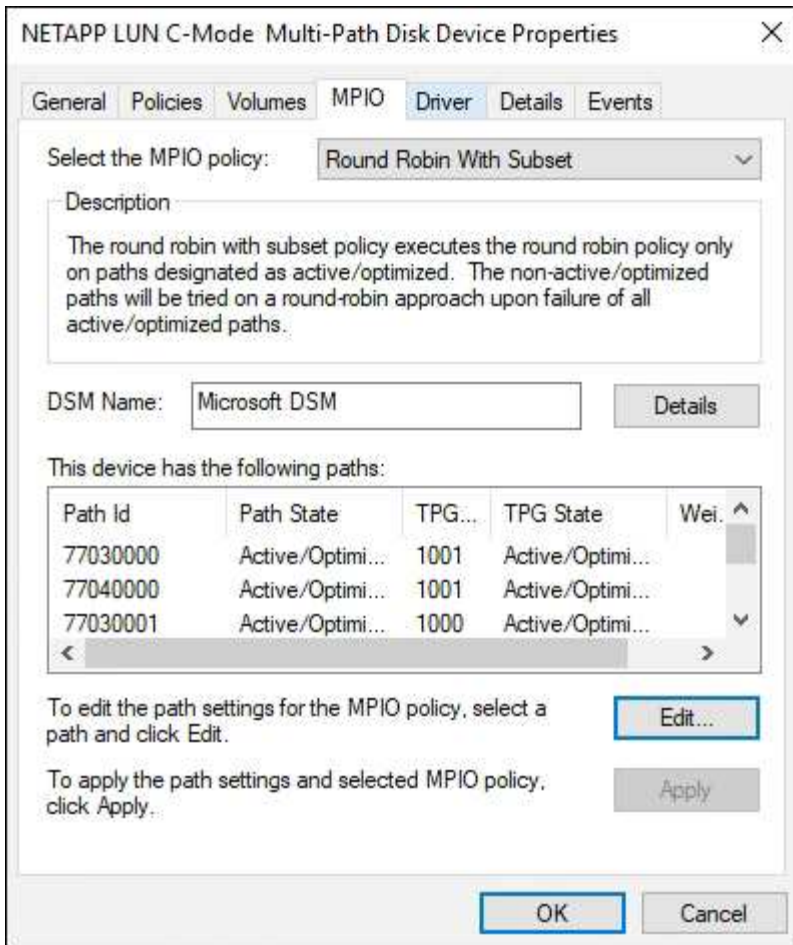
Example

The following example displays the correct output for an ONTAP LUN with two active/optimized paths and two active/non-optimized paths.



All SAN array configuration

For All SAN Array (ASA) configuration, there should be one group of paths with single priorities. All paths are active/optimized; that is, they are serviced by the controller and that the I/O is sent on all the active paths.



Do not use an excessive number of paths to a single LUN. No more than four paths should be required. More than eight paths might cause path issues during storage failures.

Recommended settings

On systems using FC, the following timeout values for Emulex and QLogic FC HBAs are required when MPIO is selected.

For Emulex Fibre Channel HBAs:

Property type	Property value
LinkTimeOut	1
NodeTimeOut	10

For QLogic Fibre Channel HBAs:

Property type	Property value
LinkDownTimeOut	1
PortDownRetryCount	10



Windows Unified Host Utility will set these values. For detailed recommended settings, refer to the [Windows 7.1 Host Utilities Installation Guide](#).

Known limitations

There are no known issues for Windows Server 2022.

Using Windows Server 2019 with ONTAP

Booting the OS

There are two options for booting the operating system: by using either local boot or SAN boot. For local booting, you install the OS on the local hard disk (SSD, SATA, RAID, and so on). For SAN booting, see instructions below.

SAN booting

If you opt to use SAN booting, it must be supported by your configuration. You can use the NetApp Interoperability Matrix Tool to verify that your OS, HBA, HBA firmware and the HBA boot BIOS, and ONTAP version are supported.

1. Map the SAN boot LUN to the host.
2. Verify multiple paths are available. Remember, multiple paths will only be available after the host OS is up and running on the paths.
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4. Reboot the host to verify the boot is successful.



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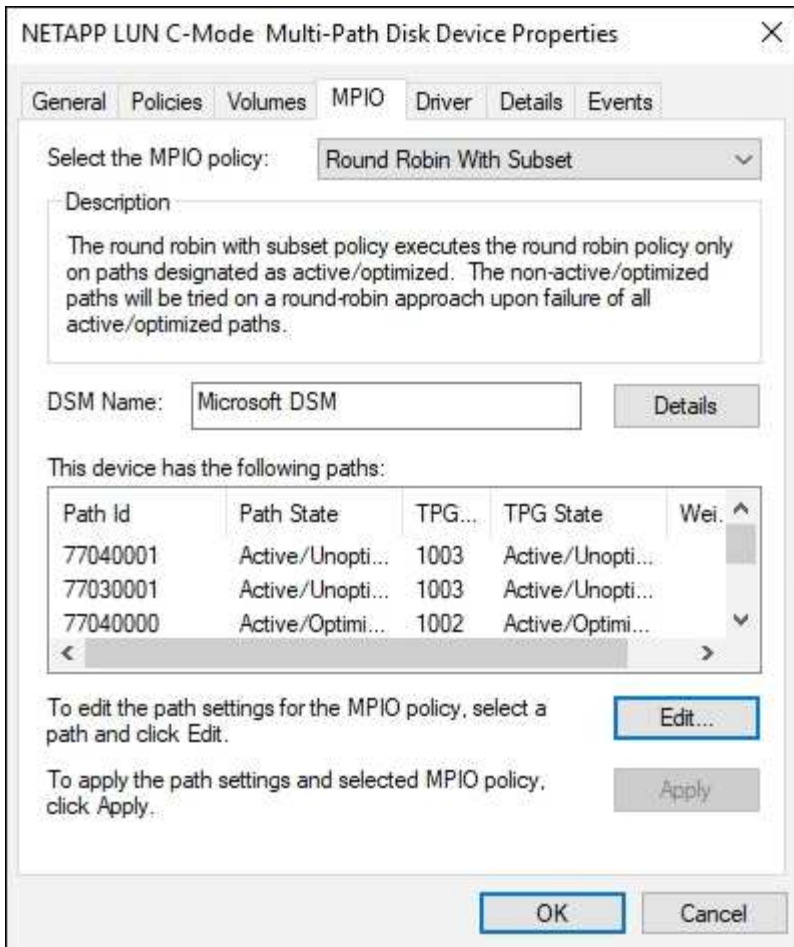
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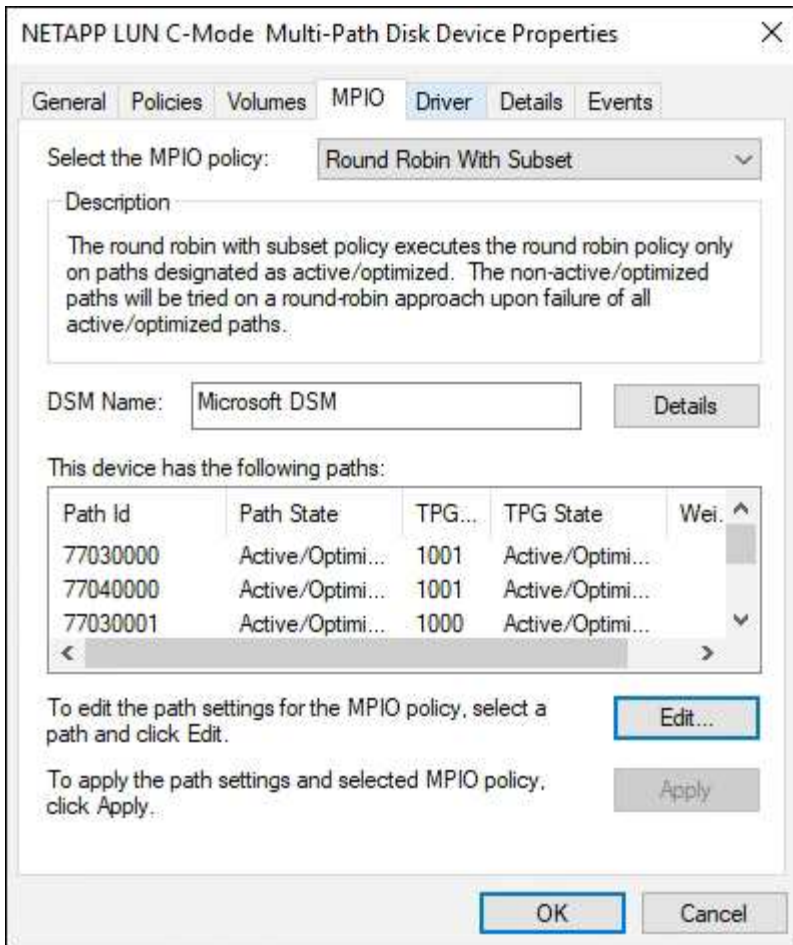
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Known limitations

There are no known issues for Windows Server 2019.

Using Windows Server 2016 with ONTAP

Booting the OS

There are two options for booting the operating system: by using either local boot or SAN boot. For local booting, you install the OS on the local hard disk (SSD, SATA, RAID, and so on). For SAN booting, see instructions below.

SAN booting

If you opt to use SAN booting, it must be supported by your configuration. You can use the NetApp Interoperability Matrix Tool to verify that your OS, HBA, HBA firmware and the HBA boot BIOS, and ONTAP version are supported.

1. Map the SAN boot LUN to the host.
2. Verify multiple paths are available. Remember, multiple paths will only be available after the host OS is up and running on the paths.
3. Enable SAN booting in the server BIOS for the ports to which the SAN boot LUN is mapped. For information on how to enable the HBA BIOS, see your vendor-specific documentation.
4. Reboot the host to verify the boot is successful.



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Installing Windows hotfixes

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On a Windows system, the two main components to any MPIO solution are a DSM and the Windows MPIO. MPIO is not supported for Windows XP or Windows Vista running in a Hyper- V virtual machine.



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SAN configuration

Non-ASA configuration

For non-ASA configuration there should be two groups of paths with different priorities.

The paths with the higher priorities are Active/Optimized, meaning they are serviced by the controller where the aggregate is located.

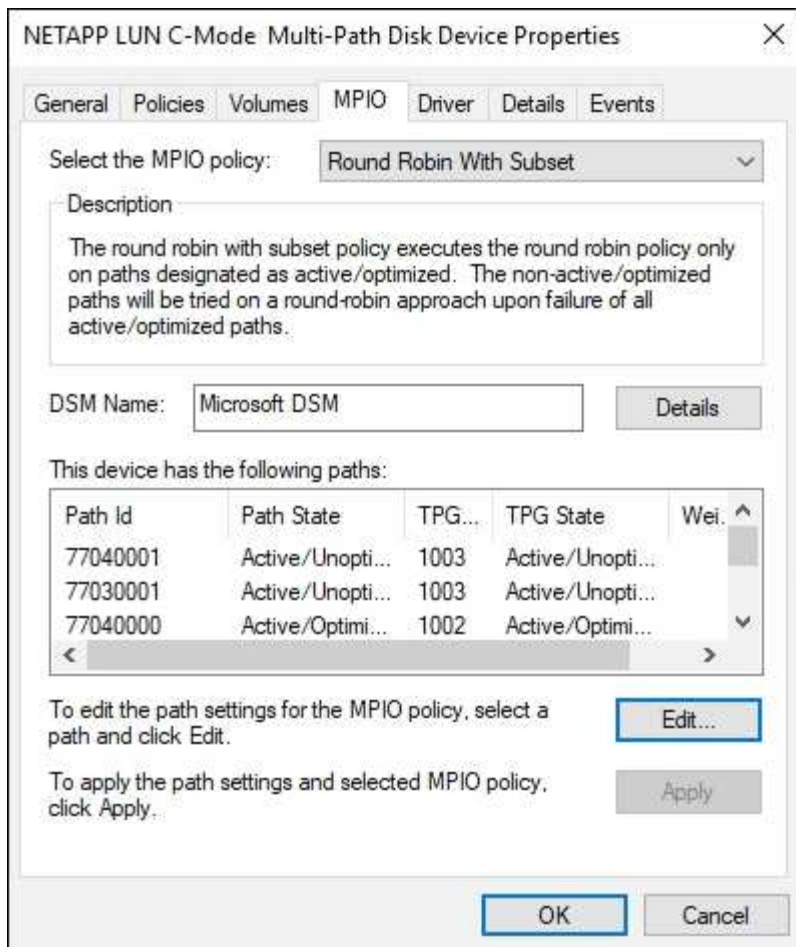
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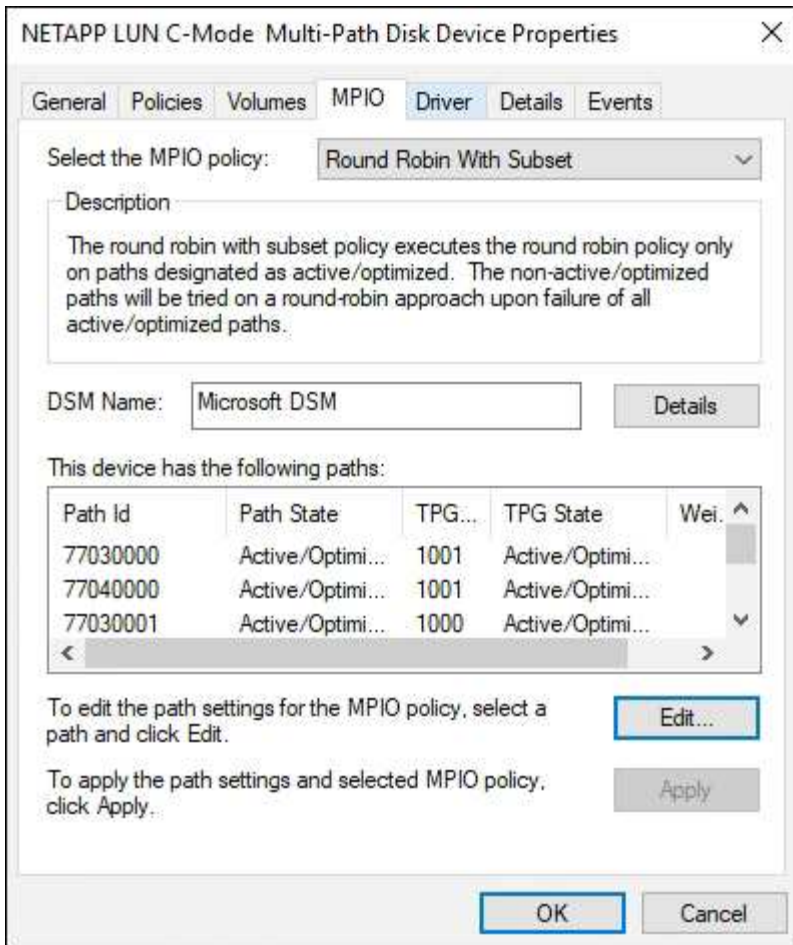
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The following example displays the correct output for an ONTAP LUN with two active/optimized paths and two active/non-optimized paths.



All SAN array configuration

For All SAN Array (ASA) configuration, there should be one group of paths with single priorities. All paths are active/optimized; that is, they are serviced by the controller and that the I/O is sent on all the active paths.



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For QLogic Fibre Channel HBAs:

Property type	Property value
LinkDownTimeOut	1
PortDownRetryCount	10



Windows Unified Host Utility will set these values. For detailed recommended settings, refer to the [Windows 7.1 Host Utilities Installation Guide](#).

Known limitations

There are no known issues for Windows Server 2016.

Using Windows Server 2012 R2 with ONTAP

Booting the OS

There are two options for booting the operating system: by using either local boot or SAN boot. For local booting, you install the OS on the local hard disk (SSD, SATA, RAID, and so on). For SAN booting, see instructions below.

SAN booting

If you opt to use SAN booting, it must be supported by your configuration. You can use the NetApp Interoperability Matrix Tool to verify that your OS, HBA, HBA firmware and the HBA boot BIOS, and ONTAP version are supported.

1. Map the SAN boot LUN to the host.
2. Verify multiple paths are available. Remember, multiple paths will only be available after the host OS is up and running on the paths.
3. Enable SAN booting in the server BIOS for the ports to which the SAN boot LUN is mapped. For information on how to enable the HBA BIOS, see your vendor-specific documentation.
4. Reboot the host to verify the boot is successful.



You can use the configuration settings provided in this document to configure cloud clients connected to [Cloud Volumes ONTAP](#) and [Amazon FSx for ONTAP](#).

Installing Windows hotfixes

We suggest the use of **latest cumulative update** to be installed on the server.



Go to the [Microsoft Update Catalog 2012 R2](#) website to obtain and install the required Windows hotfixes for your version of Windows.

1. Download hotfixes from the Microsoft support site.



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2. Follow the instructions provided by Microsoft to install the hotfixes.



Many hotfixes require a reboot of your Windows host, but you can opt to wait to reboot the host until *after* you install or upgrade the Host Utilities.

Installing the Windows Unified Host Utilities

The Windows Unified Host Utilities (WUHU) are a set of software programs with documentation that enables you to connect host computers to virtual disks (LUNs) on a NetApp SAN. We recommend downloading and installation of the latest Utility Kit. For WUHU configuration information and instructions, please refer to [WUHU 7.1 Documentation](#).

Multipathing

You must install MPIO software and have multipathing set up if your Windows host has more than one path to the storage system. Without MPIO software, the operating system might see each path as a separate disk, which can lead to data corruption. The MPIO software presents a single disk to the operating system for all paths, and a device-specific module (DSM) manages path failover.

On a Windows system, the two main components to any MPIO solution are a DSM and the Windows MPIO. MPIO is not supported for Windows XP or Windows Vista running in a Hyper- V virtual machine.



When you select MPIO support, the Windows Unified Host Utilities enables the included MPIO feature of Windows Server 2012 R2.

SAN configuration

Non-ASA configuration

For non-ASA configuration there should be two groups of paths with different priorities.

The paths with the higher priorities are Active/Optimized, meaning they are serviced by the controller where the aggregate is located.

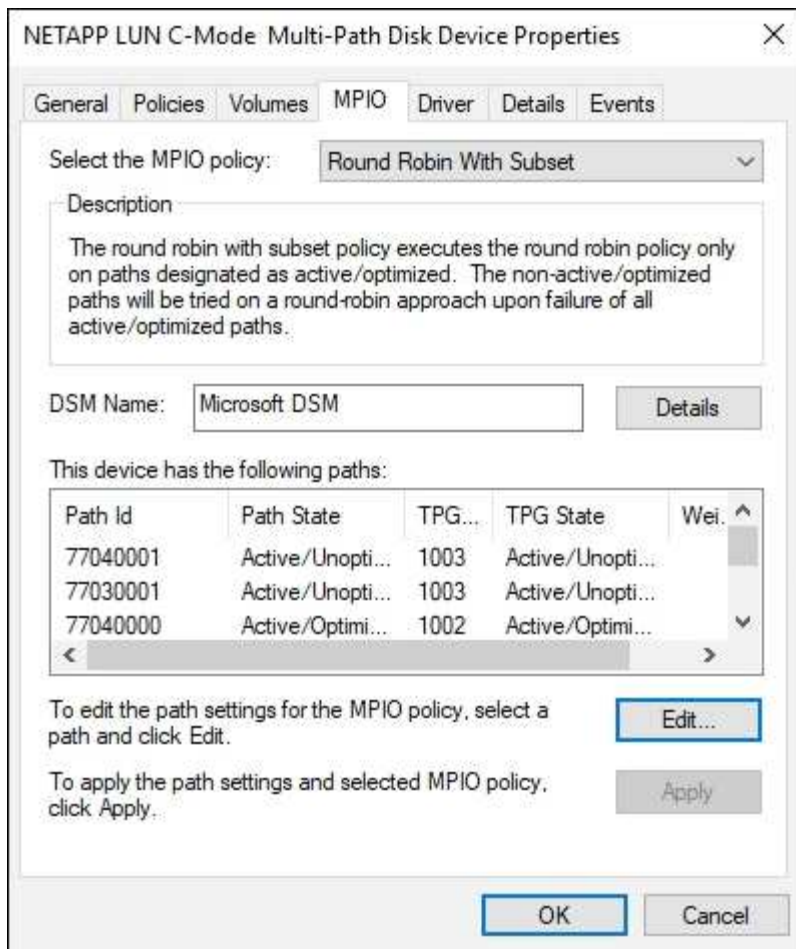
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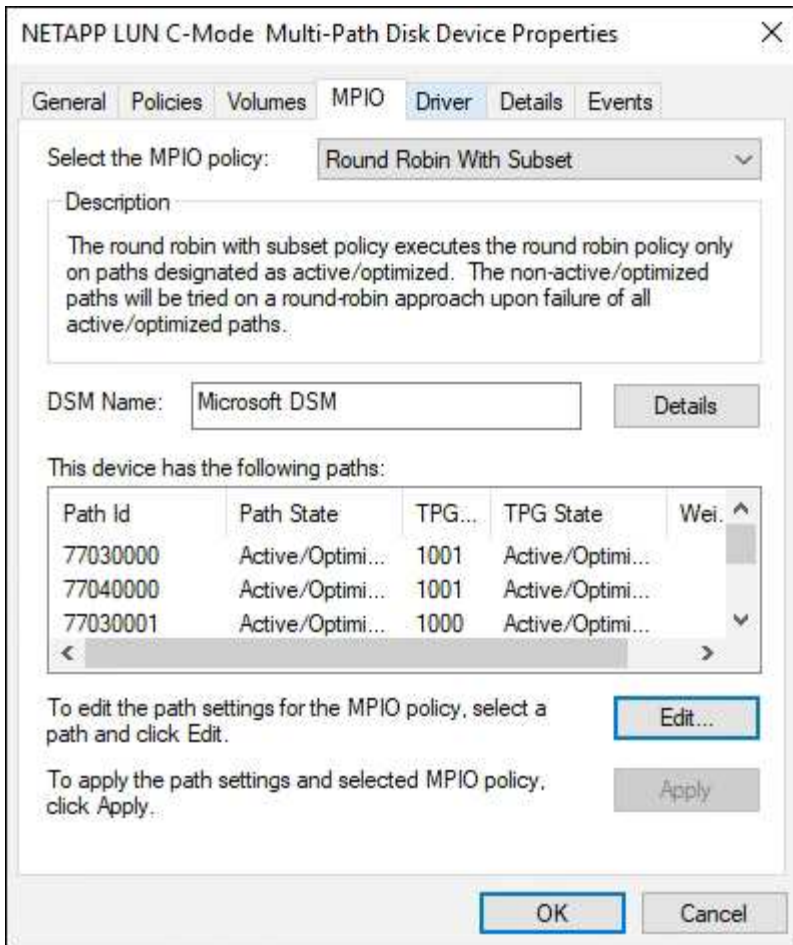
Example

The following example displays the correct output for an ONTAP LUN with two active/optimized paths and two active/non-optimized paths.



All SAN array configuration

For All SAN Array (ASA) configuration, there should be one group of paths with single priorities. All paths are active/optimized; that is, they are serviced by the controller and that the I/O is sent on all the active paths.



Do not use an excessive number of paths to a single LUN. No more than four paths should be required. More than eight paths might cause path issues during storage failures.

Hyper-V VHD requires alignment for best performance

If the data block boundaries of a disk partition do not align with the block boundaries of the underlying LUN, the storage system often has to complete two block reads or writes for every operating system block read or write. The additional block reads and writes caused by the misalignment might create serious performance problems.

Misalignment is caused by the location of the starting sector for each partition defined by the master boot record.



Partitions created by Windows Server 2016 should be aligned by default.

Use the `Get-NaVirtualDiskAlignment` cmdlet in the ONTAP PowerShell Toolkit to check whether partitions are aligned with underlying LUNs. If the partitions are incorrectly aligned, use the `Repair-NaVirtualDiskAlignment` cmdlet to create a new VHD file with the correct alignment. This cmdlet copies all of the partitions to the new file. The original VHD file is not modified or deleted. The virtual machine must be shut down while the data is copied.

You can download the ONTAP PowerShell Toolkit at NetApp Communities. You must unzip the `DataONTAP.zip` file into the location specified by the environment variable `%PSModulePath%` (or use the `Install.ps1` script to do it for you). Once you have completed the installation, use the `Show-NaHelp` cmdlet to get help for the cmdlets.

The PowerShell Toolkit supports only fixed-size VHD files with MBR-type partitions. VHDs using Windows dynamic disks or GPT partitions are not supported. In addition, the PowerShell Toolkit requires a minimum partition size of 4 GB. Smaller partitions cannot be correctly aligned.



For Linux virtual machines using the GRUB boot loader on a VHD, you need to update the boot configuration after running the PowerShell Toolkit.

Reinstalling GRUB for Linux guests after correcting MBR alignment with PowerShell Toolkit

After running `mbralign` on disks for correcting MBR alignment with PowerShell Toolkit on Linux guest operating systems using the GRUB boot loader, you must reinstall GRUB to ensure that the guest operating system boots correctly.

The PowerShell Toolkit cmdlet has completed on the VHD file for the virtual machine. This topic applies only to Linux guest operating systems using the GRUB boot loader and `SystemRescueCd`.

1. Mount the ISO image of Disk 1 of the installation CDs for the correct version of Linux for the virtual machine.
2. Open the console for the virtual machine in Hyper-V Manager.
3. If the VM is running and hung at the GRUB screen, click in the display area to make sure it is active, then click the **Ctrl-Alt-Delete** toolbar icon to reboot the VM. If the VM is not running, start it, and then immediately click in the display area to make sure it is active.
4. As soon as you see the VMware BIOS splash screen, press the **Esc** key once. The boot menu displays.
5. At the boot menu, select **CD-ROM**.
6. At the Linux boot screen, enter: `linux rescue`
7. Take the defaults for Anaconda (the blue/red configuration screens). Networking is optional.
8. Launch GRUB by entering: `grub`
9. If there is only one virtual disk in this VM, or if there are multiple disks, but the first is the boot disk, run the following GRUB commands:

```
root (hd0,0)
setup (hd0)
quit
```

If you have multiple virtual disks in the VM, and the boot disk is not the first disk, or you are fixing GRUB by booting from the misaligned backup VHD, enter the following command to identify the boot disk:

```
find /boot/grub/stage1
```

Then run the following commands:

```
root (boot_disk,0)
setup (boot_disk)
quit
```



Note that `boot_disk`, above, is a placeholder for the actual disk identifier of the boot disk.

10. Press **Ctrl-D** to log out.

Linux rescue shuts down and then reboots.

Recommended settings

On systems using FC, the following timeout values for Emulex and QLogic FC HBAs are required when MPIO is selected.

For Emulex Fibre Channel HBAs:

Property type	Property value
LinkTimeOut	1
NodeTimeOut	10

For QLogic Fibre Channel HBAs:

Property type	Property value
LinkDownTimeOut	1
PortDownRetryCount	10



Windows Unified Host Utility will set these values. For detailed recommended settings, refer to the [Windows 7.1 Host Utilities Installation Guide](#).

Known limitations

There are no known issues for Windows Server 2012 R2.

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