

IBM System Storage N series



# Data ONTAP DSM 4.0.1 for Windows MPIO Release Notes



---

# Contents

<b>Data ONTAP DSM 4.0.1 for Windows MPIO Release Notes</b>	<b>1</b>
<b>Important cautions</b>	<b>3</b>
DSM 4.0.1 disables the SCSI UNMAP command on Windows Server 2012 hosts for specific Data ONTAP versions.	3
Installing Windows Host Utilities after installing the DSM resets the persistent reservation timeout value incorrectly.	4
iSCSI driver parameters not set for the Emulex OCE10102 CNA	4
Setting the iSCSI driver parameters for the Emulex OCE10102 CNA	4
Windows Server 2008 R2 upgrade issues.	5
Do not manually create files on Windows Server 2008 R2 CSV	5
Windows crashes after setting Chelsio 10 Gb NIC MTU to 9000	5
Enabling ALUA might require a Windows reboot.	6
Emulex FC HBA timeouts not set by DSM installation program	6
Do not mix 10 Gb and 1 Gb iSCSI sessions to a LUN	6
<b>Known problems and limitations</b>	<b>7</b>
Installation issues	7
Error when installing hotfixes	7
Installing or uninstalling DSM takes a long time in MSCS configurations.	7
Internal Error: Access is Denied during installation	8
GUI and CLI issues.	9
Errors when opening GUI and running cmdlets on Windows Server 2012 host with disconnected network drive	9
LUN paths remain in Failed state after a communication disruption to the storage system	9
DSM does not display virtual disks	10
DSM GUI displays 0.0.0.0 for initiator address	10
Full DSM feature set not available using Microsoft user interfaces.	10
New LUNs do not appear in DSM GUI or CLI	10
Interoperability issues	11
Windows iSCSI sessions do not automatically reconnect to the target after a giveback	12
QLE8240 and QLE8242 adapters not configured automatically	12
Raw pass-through SCSI disks on a guest OS are not available when running MPIO on the guest	14
Windows Server 2008 cluster node hangs and takeover of disk resources fails when both ISLs are down in MetroCluster configuration.	14
Windows Server 2008 R2 cluster node takes about 7 minutes to establish persistent reservation during startup	15
I/O errors during repeated connectivity disruptions of iSCSI connections	15
iSCSI sessions do not reconnect after reboot with mixed IPv4 and IPv6	15
Configuring pass-through disks for Windows Server 2008 R2 or Windows Server 2012 Hyper-V.	16
Cluster Shared Volume not accessible from one node in a Windows 2008 failover cluster	17
Hyper-V live migration and quick migration fail after converting a CSV LUN to non-CSV	17
Cannot add SCSI pass-through disk to SUSE Hyper-V guest using IDE controller	18
Uninstalling SP2 from SAN-booted Windows Server 2008 prevents host from booting	18
Bidirectional CHAP limitation for Itanium hosts.	18

Raw (pass-through) disks on a guest OS are not available when running MPIO on the guest . . .	19
Guest OS install on SCSI disk fails . . . . .	19
Hyper-V virtual machine files do not work on CIFS share . . . . .	19
Hyper-V guest does not boot or loses pass-through disk . . . . .	19
SUSE Hyper-V guest loses network when moved to another cluster node . . . . .	19
Configuration fails when attempting to add a virtual machine to a Failover Cluster . . . . .	20
Unable to add another virtual machine to a failover cluster . . . . .	21
Virtual machine does not work after being removed from a failover cluster. . . . .	21
Unable to SAN boot with Emulex FC HBA . . . . .	21
Microsoft iSCSI SW Initiator takes a long time to reconnect to the storage system after disruption	21
LUN identifier range 0-254 . . . . .	23
Wait between iSCSI logout and login . . . . .	23
<b>Fixed issues in this release . . . . .</b>	<b>25</b>
<b>Websites . . . . .</b>	<b>27</b>
<b>Where to find additional information . . . . .</b>	<b>29</b>
<b>Copyright and trademark information . . . . .</b>	<b>31</b>
Trademark information . . . . .	32
<b>Notices . . . . .</b>	<b>35</b>

---

## Data ONTAP DSM 4.0.1 for Windows MPIO Release Notes

These release notes describe new features, enhancements, and known issues for Data ONTAP DSM 4.0.1 for Windows MPIO.

Release notes might be updated between product releases. You should periodically check online for updated Release Notes on the IBM N series support web site, located at: [www.ibm.com/storage/support/nseries/](http://www.ibm.com/storage/support/nseries/)

- “DSM overview”
- “New features in this DSM release”
- “Information on finding system requirements”

### DSM overview

The Data ONTAP DSM for Windows MPIO enables you to manage multiple Fibre Channel (FC) and iSCSI paths between an IBM N series storage system and a Windows host computer.

You can have one or more active paths and zero or more passive paths, depending on the load balance policy. The DSM automatically selects paths for I/O as needed, maximizing throughput and maintaining the host's access to its storage.

The DSM has both graphical and command line management interfaces. You can install the DSM interactively or from a Windows command prompt.

### New features in this DSM release

The Data ONTAP DSM 4.0.1 has been updated to include support for Windows Server 2003. Support for Windows Server 2003 is the only new feature added in DSM 4.0.1 since 4.0.

### Information on finding system requirements

For the latest information about the system requirements, see the N series Interoperability Matrices website, accessed and navigated as described in Websites.



---

## Important cautions

Before deploying this release of Data ONTAP DSM for Windows MPIO, make sure that you read the following items to identify and resolve issues that might affect the operation of your systems.

- “DSM 4.0.1 disables the SCSI UNMAP command on Windows Server 2012 hosts for specific Data ONTAP versions”
- “Installing Windows Host Utilities after installing the DSM resets the persistent reservation timeout value incorrectly” on page 4
- “iSCSI driver parameters not set for the Emulex OCe10102 CNA” on page 4
- “Windows Server 2008 R2 upgrade issues” on page 5
- “Do not manually create files on Windows Server 2008 R2 CSV” on page 5
- “Windows crashes after setting Chelsio 10 Gb NIC MTU to 9000” on page 5
- “Enabling ALUA might require a Windows reboot” on page 6
- “Emulex FC HBA timeouts not set by DSM installation program” on page 6
- “Do not mix 10 Gb and 1 Gb iSCSI sessions to a LUN” on page 6

---

### **DSM 4.0.1 disables the SCSI UNMAP command on Windows Server 2012 hosts for specific Data ONTAP versions**

The SCSI UNMAP command can degrade performance on storage systems connected to Windows Server 2012. To prevent this issue, Data ONTAP DSM 4.0.1 disables the SCSI UNMAP command on Windows Server 2012 hosts for specific Data ONTAP versions.

On Windows Server 2012 hosts, NTFS uses the SCSI UNMAP command to reclaim storage when files are deleted. The UNMAP command can degrade performance on storage systems connected to a Windows Server 2012 host, if that host uses a LUN as an NTFS-formatted disk.

To prevent performance degradation, DSM 4.0.1 periodically checks the version of Data ONTAP on the target system. The DSM disables the SCSI UNMAP command on the Windows Server 2012 host if it detects that any target is running the following:

- Data ONTAP 8.1.2 or earlier operating in 7-Mode

The DSM runs the check when you load the GUI. If you do not use the GUI (for example, if you use Windows Server Core), you can turn off UNMAP by running the `get-sandisk` PowerShell cmdlet with the `-turnOffUnmap` parameter.

Use SnapDrive for Windows to manage storage efficiency in these configurations.

**Note:** DSM 4.0.1 re-enables the UNMAP command if all targets are running a 7-Mode version of Data ONTAP later than 8.1.2. or if all targets are running clustered Data ONTAP 8.2 or later.

You should not re-enable the SCSI UNMAP command on the Windows Server 2012 host after it has been disabled by DSM 4.0.1.

---

## **Installing Windows Host Utilities after installing the DSM resets the persistent reservation timeout value incorrectly**

The persistent reservation timeout value is reset incorrectly to 30 seconds when you install Windows Host Utilities 6.0 or later after installing DSM 4.0.1. You need to reset this value to 60 seconds.

You can reset the persistent reservation timeout value by repairing the DSM installation using the Windows repair option, or by editing the persistent reservation timeout parameter on the **Data ONTAP DSM** tab of the **Data ONTAP DSM Properties** window.

**Note:** You should not change the timeout value from 60 seconds unless directed to by your storage system support representative.

---

## **iSCSI driver parameters not set for the Emulex OCE10102 CNA**

The Data ONTAP DSM does not set the iSCSI driver parameters for the Emulex OCE10102 converged network adapter (CNA).

You need to manually set the driver parameters.

### **Setting the iSCSI driver parameters for the Emulex OCE10102 CNA**

The Data ONTAP DSM installer does not set the iSCSI driver parameters for the Emulex OCE10102 CNA. You need to manually set the parameters.

### **About this task**

A reboot is required after you set the parameters.

### **Procedure**

1. Load the Windows Registry Editor.
2. Navigate to **HKLM\SYSTEM\CurrentControlSet\services\be2iscsi\Parameters\Device\DriverParameters**.
3. Enter the following value for the **ldto** parameter:



- 1 (REG\_DWORD)
- 4. Enter the following value for the **eto** parameter:
  - 10 (REG\_DWORD)
- 5. Reboot your Windows host.

---

## Windows Server 2008 R2 upgrade issues

Upgrades to Windows Server 2008 R2 require you to address certain issues.

Be sure to read the upgrade information provided by Microsoft. The following issues are especially important.

- Be sure to upgrade to DSM 3.3.1 or later before upgrading to Windows Server 2008 R2.
- You cannot upgrade to Windows Server 2008 R2 while the host is part of a Windows cluster. Remove the host from the cluster before upgrading.
- After clustering a Windows host running Windows Server 2008 R2, run the Repair option of the Data ONTAP DSM for Windows MPIO installation program to set the required value of the \HKLM\Cluster\ClusSvcHangTimeout parameter.
- For iSCSI-booted Windows Server 2008 hosts, there is no way to upgrade to Windows Server 2008 R2. You must do a fresh installation of Windows Server 2008 R2. This is a Microsoft limitation.

---

## Do not manually create files on Windows Server 2008 R2 CSV

Manually creating or copying files to a Windows Server 2008 R2 cluster shared volume (CSV) can corrupt the data on the volume.

The only files allowed on a CSV are the files written by the Hyper-V administrative tools. This includes any user or application data stored under the C:\ClusterStorage directory on every node.

---

## Windows crashes after setting Chelsio 10 Gb NIC MTU to 9000

Enabling jumbo frames (MTU = 9000) on a Chelsio 10 Gb NIC can crash Windows Server 2008 R2.

Do not enable jumbo frames on the Chelsio 10 Gb NIC on Windows Server 2008 R2.

This problem has been reported to Microsoft and Chelsio, and is expected to be fixed in a future version of the Chelsio driver.

---

## **Enabling ALUA might require a Windows reboot**

In some situations, you must reboot Windows after enabling ALUA on LUNs mapped to that Windows host.

A reboot is required if ALUA is enabled on an igroup and the host has already discovered LUNs from that igroup. A disk rescan of the host does not set the load balance policies or the target portal group properties correctly. Rescan does not cause a stack tear down and rebuild of MPIO LUNs, so the new ALUA property is not detected.

If you enable ALUA on a new igroup and then map LUNs to that igroup, no reboot is needed.

---

## **Emulex FC HBA timeouts not set by DSM installation program**

The DSM installation program runs the fcconfig program to set timeouts for Fibre Channel (FC) host bus adapters (HBAs). However, for some Emulex FC HBAs, the correct timeouts are not set, which can cause failover problems.

After installing or repairing the Data ONTAP DSM, you should use the Emulex OneCommand Manager to verify, and if necessary, set the required LinkTimeOut and NodeTimeOut values.

For DSM, LinkTimeOut must be set to 1 and NodeTimeOut must be set to 10.

---

## **Do not mix 10 Gb and 1 Gb iSCSI sessions to a LUN**

Mixing 10 Gb and 1 Gb iSCSI sessions to the same LUN is not supported.

To avoid multipathing problems with iSCSI sessions, use either all 10-Gb sessions or all 1-Gb sessions to a given LUN.

---

## Known problems and limitations

Some unexpected and potentially undesired behaviors, as well as, in some cases, workarounds to avoid these behaviors, have been identified in this release.

- “Installation issues”
- “GUI and CLI issues” on page 9
- “Interoperability issues” on page 11

---

### Installation issues

You might encounter the following issues when you install Data ONTAP DSM for Windows MPIO.

- “Error when installing hotfixes”
- “Installing or uninstalling DSM takes a long time in MSCS configurations”
- “Internal Error: Access is Denied during installation” on page 8

#### Error when installing hotfixes

When installing required Windows hotfixes, you might get an error message saying the hotfix does not apply to your system.

Some hotfixes have a dependency on other hotfixes. Install the hotfixes in numerical order to ensure they are accepted.

Many hotfixes prompt you to reboot your system. You can wait until all hotfixes are installed before rebooting. If you are installing Data ONTAP DSM immediately after the hotfixes, you can wait and reboot when prompted by the DSM installation program.

#### Installing or uninstalling DSM takes a long time in MSCS configurations

Installing or uninstalling the Data ONTAP DSM for Windows MPIO can take a long time on Windows hosts in a Microsoft cluster (MSCS) configuration.

The long install and uninstall times are a result of the way multipathing works with MSCS. In large production environments, times of one hour have been observed.

You can simply choose to let the process run, with the understanding that it might take a long time to complete.

Another option is to shut down one node in the cluster, install or uninstall the DSM software on the running node, shut down the first node, and repeat the process on the second node.

### **Internal Error: Access is Denied during installation**

On Windows Server 2008 or later, you might receive an Internal Error: Access is Denied message if User Access Control is enabled and installation is attempted from a user account other than Administrator.

You can do one of the following to resolve this issue:

- Installing from an elevated command prompt
- Disabling User Access Control.

For more information about User Access Control, see the Microsoft TechNet article: [User Account Control Step-by-Step Guide](#).

### **Installing from an elevated command prompt**

Run the installation from an elevated command prompt to avoid the Internal Error: Access is Denied error.

#### **Before you begin**

An elevated command prompt is required to install the DSM when User Access Control (UAC) is enabled. The elevated command prompt overrides the UAC restrictions.

#### **Steps**

1. Click **Start**.
2. Right-click **Command Prompt** and then click **Run as Administrator**.
3. Run the installation program by navigating to the directory containing the installation package and entering the package name at the command prompt.

### **Disabling User Access Control**

Disable User Access Control to avoid the Internal Error: Access is Denied error.

#### **Steps**

1. Log in as an administrator.
2. Select **Control Panel > User Accounts > Turn User Account Control on or off**.

3. Clear the **Use User Access Control (UAC)** to help protect your computer check box and then click **OK**.
4. Run the installation program again.

---

## GUI and CLI issues

You might encounter the following issues as you use the Data ONTAP DSM for Windows MPIO GUI and CLI.

- “Errors when opening GUI and running cmdlets on Windows Server 2012 host with disconnected network drive”
- “LUN paths remain in Failed state after a communication disruption to the storage system”
- “DSM does not display virtual disks” on page 10
- “DSM GUI displays 0.0.0.0 for initiator address” on page 10
- “Full DSM feature set not available using Microsoft user interfaces” on page 10
- “New LUNs do not appear in DSM GUI or CLI” on page 10

### **Errors when opening GUI and running cmdlets on Windows Server 2012 host with disconnected network drive**

The Data ONTAP DSM GUI and cmdlets might display errors on a Windows 2012 host if the host has a disconnected network drive.

For example, you might see the following error messages when you try to load the DSM GUI:

- Failed to get disk information from the driver.
- Failed to get I/O stats information from the driver.
- Snapin is not responding.

You might see an error message similar to the following when you run a cmdlet:

Get-sandisk: An unexpected Error occurred while executing Get-Disk.

To fix this issue, delete the disconnected network drive and then restart the Microsoft Management Console.

### **LUN paths remain in Failed state after a communication disruption to the storage system**

On Windows Server 2008 hosts, a path can stay in the Failed state when it fails and comes back online, but has not encountered an I/O error. The failed paths are caused by an inconsistency in the LUN path state between the Windows MPIO component and the Data ONTAP DSM.

A path marked as Failed by Data ONTAP DSM is only recovered when the MPIO component performs a successful path verification on that path. Because the MPIO component does not believe that the path is failed (no I/O error), it does not perform the verification and the path is stuck in the failed state.

You can do one of the following to resolve this issue:

- Use the Data ONTAP DSM graphical user interface (GUI) to identify the Fibre Channel or IP network interface that is used for the failed path. Disable that interface for 30 seconds and then enable it. After you enable the interface, the LUN paths are discovered and usable again.
- Reboot the Windows host to recover the failed paths.

### **DSM does not display virtual disks**

A Windows Server 2003 or Windows Server 2008 host running Data ONTAP DSM fails to display virtual disks (LUNs) that are created.

The virtual disks work correctly, but cannot be viewed or managed using the DSM GUI or CLI.

Contact technical support for assistance on this issue.

### **DSM GUI displays 0.0.0.0 for initiator address**

When you are viewing the paths for a virtual disk in the DSM GUI, the iSCSI initiator address is displayed as 0.0.0.0.

This problem occurs only when the iSCSI session is created and the initiator address is allowed to retain its default setting in the Microsoft iSCSI initiator.

To avoid the problem, when creating an iSCSI session, manually select the initiator address.

### **Full DSM feature set not available using Microsoft user interfaces**

All management functions of the Data ONTAP DSM are not available through the native Microsoft user interfaces, such as the Microsoft iSCSI GUI.

Use the GUI or CLI supplied with the Data ONTAP DSM for management. The DSM GUI is available from Windows Computer Management. For more information, see the *Data ONTAP DSM for Windows MPIO Installation and Administration Guide* for instructions.

### **New LUNs do not appear in DSM GUI or CLI**

When you add new LUNs to your storage system, the new virtual disks are not automatically discovered by the Windows host. You must manually rescan disks.

## Steps

1. On the Windows host, select **Start > Administrative Tools > Computer Management**.
2. Select **Storage > Disk Management** in the navigation pane.  
The Initialize and Convert Disk wizard starts.
3. If the wizard does not start, select **Action > Rescan Disks**.
4. Follow the prompts to initialize the disks, but do not convert them to dynamic disks.
5. Partition and format the disks, if required.

## After you finish

Refresh the DSM GUI display.

---

## Interoperability issues

You might encounter the following issues with your host's configuration.

- “Windows iSCSI sessions do not automatically reconnect to the target after a giveback” on page 12
- “QLE8240 and QLE8242 adapters not configured automatically” on page 12
- “Raw pass-through SCSI disks on a guest OS are not available when running MPIO on the guest” on page 14
- “Windows Server 2008 cluster node hangs and takeover of disk resources fails when both ISLs are down in MetroCluster configuration” on page 14
- “Windows Server 2008 R2 cluster node takes about 7 minutes to establish persistent reservation during bootup” on page 15
- “I/O errors during repeated connectivity disruptions of iSCSI connections” on page 15
- “iSCSI sessions do not reconnect after reboot with mixed IPv4 and IPv6” on page 15
- “Configuring pass-through disks for Windows Server 2008 R2 or Windows Server 2012 Hyper-V” on page 16
- “Cluster Shared Volume not accessible from one node in a Windows 2008 failover cluster” on page 17
- “Hyper-V live migration and quick migration fail after converting a CSV LUN to non-CSV” on page 17
- “Cannot add SCSI pass-through disk to SUSE Hyper-V guest using IDE controller” on page 18
- “Uninstalling SP2 from SAN-booted Windows Server 2008 prevents host from booting” on page 18
- “Bidirectional CHAP limitation for Itanium hosts” on page 18

- “Raw (pass-through) disks on a guest OS are not available when running MPIO on the guest” on page 19
- “Guest OS install on SCSI disk fails” on page 19
- “Hyper-V virtual machine files do not work on CIFS share” on page 19
- “Hyper-V guest does not boot or loses pass-through disk” on page 19
- “SUSE Hyper-V guest loses network when moved to another cluster node” on page 19
- “Configuration fails when attempting to add a virtual machine to a Failover Cluster” on page 20
- “Unable to add another virtual machine to a failover cluster” on page 21
- “Virtual machine does not work after being removed from a failover cluster” on page 21
- “Unable to SAN boot with Emulex FC HBA” on page 21
- “Microsoft iSCSI SW Initiator takes a long time to reconnect to the storage system after disruption” on page 21
- “LUN identifier range 0-254” on page 23
- “Wait between iSCSI logout and login” on page 23

### **Windows iSCSI sessions do not automatically reconnect to the target after a giveback**

After a giveback, the Windows iSCSI initiator might not reconnect to the target. The iSCSI initiator GUI lists the connection state as Inactive.

When the iSCSI service on the target is stopped during a giveback, the iSCSI initiator tries to reconnect. This re-login request is incorrectly sent to the partner node, which causes the target to reject the login. The initiator marks the session as Inactive.

The workaround is to manually reconnect the session using the iSCSI initiator GUI.

### **QLE8240 and QLE8242 adapters not configured automatically**

The QLogic converged network adapter (CNA) models QLE8240 and QLE8242 are supported in specific Windows host configurations. You must manually install the QLogic software packages and set the adapter timeout if you have driver level 9.1.9.19 or later.

The IBM N series interoperability matrix (accessed and navigated as described in “Websites” on page 27) lists the supported Windows configurations and required driver and firmware versions for these adapters when using the iSCSI offload and FCoE functionality.



When using the adapter as a simple 10 GbE NIC, special configuration is not needed. The interoperability matrix does not list Ethernet NICs. If the adapter is used for standard iSCSI or NAS traffic, then it is supported with IBM N series storage systems.

The Data ONTAP DSM installation program does not automatically configure the required settings for the QLE8240 and QLE8242 if you have driver level 9.1.9.19 or later. The following manual steps are required:

1. Install the QLogic software packages (driver/firmware, host agents, and management CLI).
2. Set the adapter timeouts using the QConvergeConsole CLI.

## Installing the QLogic software packages

Download and install the QLogic software packages to load the supported firmware and driver on the adapter. Also download and install the management software to configure and manage the adapter.

### Steps

1. Check the N series interoperability matrix for the required driver and firmware versions.
2. Download the software packages from the QLogic download page.  
You need the following packages:
  - Windows Superinstaller (x86/x64) package
  - Optional QConvergeConsole (x86/x64) GUI management tool
3. Install the packages according to the QLogic documentation.

## Setting the adapter timeouts using QConvergeConsole

The adapter requires specific timeout settings that are not set by the current host software.

### Before you begin

The QConvergeConsole CLI must already be installed on the Windows host computer.

### Steps

1. Using the QConvergeConsole CLI, enter the following command to set the adapter LinkDownTimeout to 1:  

```
qauccli -pr fc -n port_number lt 1
```

port\_number is the number of the port on a multi-port adapter. The setting must be made to each port of a multi-port adapter.

2. Enter the following command to set the adapter PortDownRetryCount to 10:

```
gauccli -pr fc -n port_number pd 10
```

port\_number is the number of the port on a multi-port adapter. The setting must be made to each port of a multi-port adapter.

### **Raw pass-through SCSI disks on a guest OS are not available when running MPIO on the guest**

If you run MPIO software on a guest OS (for iSCSI directly from the guest), and you also configure raw pass-through disks as SCSI physical disks from the parent, the guest is unable to use the raw disks.

This issue occurs with the Data ONTAP DSM for Windows MPIO and the Veritas DMP DSM.

When you are running MPIO on the guest, map raw drives as IDE physical disks.

### **Windows Server 2008 cluster node hangs and takeover of disk resources fails when both ISLs are down in MetroCluster configuration**

In a MetroCluster storage configuration, when both the front-end and back-end Inter-Switch Links (ISLs) are down and a group move is attempted between local sites, the move is unsuccessful and the Windows cluster nodes hang.

The root cause for this cluster hang is the enumeration of the disks that causes a READ command to be sent to the disk in the remote storage site. The READ command is attempted across the ISL which is down, but the command fails because there is no path to the remote disk.

Even though the disk from the remote storage site is not part of the resource group being moved, because the remote disk is part of the node's storage resources and is mounted in both the local and remote sites, the disk enumeration tries to access the remote disk to match its device ID.

Before doing a group move in the local site when the MetroCluster ISLs are down, you should manually disable the disks belonging to the remote sites using the Windows Device Manager or Windows Disk Management.

After disabling the remote disks, the group move succeeds. Because the remote disks are disabled, when Windows cluster does a disk enumeration, the READ commands are not sent to the remote site.

It is important to note that the remote disks must be disabled on BOTH the nodes (source and destination) in the LOCAL site before doing the group move.

## Windows Server 2008 R2 cluster node takes about 7 minutes to establish persistent reservation during bootup

You can reduce the bootup time for a Windows Server 2008 R2 host in a failover cluster configuration by changing the cluster service startup setting.

The delay in establishing the persistent reservation is caused by the cluster service terminating unexpectedly while the Data ONTAP DSM is performing device discovery after the reboot. The cluster service recovers automatically by restarting after about 5 minutes and establishes reservations.

To improve bootup time, you can set the Cluster service **Startup Type** value to **Automatic (Delayed Start)** in the Windows Services Microsoft Management Console (MMC) snap-in. This reduces the time to establish the persistent reservation to about 1 minute.

## I/O errors during repeated connectivity disruptions of iSCSI connections

Windows hosts with fewer than four iSCSI paths to the storage system might experience I/O errors when the iSCSI connections have repeated connectivity disruptions.

Ongoing testing has identified a potential problem when a host running the iSCSI software initiator has a small number of iSCSI paths and the iSCSI connections are repeatedly disrupted. This issue has not been seen with systems that have four or more iSCSI paths.

There are two workarounds for this issue:

- Create additional iSCSI paths to the storage controllers. The best practice is to have multiple subnets using independent Ethernet switches.
- Change the value of the LinkDownTime parameter in the Windows registry. This value is set by the Host Utilities installation program based on your configuration.

The LinkDownTime parameter is set in the *HKLM\SYSTEM\CurrentControlSet\Control\Class\{iSCSI\_driver\_GUID}\instance\_ID\Parameters\LinkDownTime* parameter.

## iSCSI sessions do not reconnect after reboot with mixed IPv4 and IPv6

In a multipath I/O (MPIO) configuration or multiple connections per session (MCS) configuration that has both IPv4 and IPv6 endpoints, some iSCSI sessions might fail to reconnect after rebooting the Windows host.

To ensure that all of your iSCSI paths return after a reboot, use either all IPv4 endpoints or all IPv6. Do not mix IPv4 and IPv6.

## Configuring pass-through disks for Windows Server 2008 R2 or Windows Server 2012 Hyper-V

There are two procedures for configuring pass-through disks for Windows Server 2008 R2 or Windows Server 2012 Hyper-V virtual machines in an HA configuration.

Select the appropriate configuration depending on whether the virtual machine already belongs to a cluster.

### Configuring a pass-through disk for a VM not yet in the cluster

Use this procedure to configure a pass-through disk for a Windows 2008 R2 Hyper-V HA virtual machine (VM) if the VM is not yet added to the failover cluster.

#### Steps

1. Verify that the disk being added is not configured to be managed by the cluster. If it is a cluster resource, delete it from the cluster.
2. Add the disk as a pass-through disk to the VM, using Hyper-V Manager.
3. After verifying that the pass-through disk is working with the VM, shut down the VM.
4. Add the disk to the failover cluster.  
The disk appears in **Available Storage** in Failover Cluster Manager.
5. Add the VM to the cluster using Failover Cluster Manager.

### Configuring a pass-through disk for a VM already in the cluster

Use this procedure to configure a pass-through disk for a Windows 2008 R2 Hyper-V HA virtual machine (VM) if the VM is already added to the failover cluster.

#### Steps

1. In Failover Cluster Manager, verify the disk that will be the pass-through disk is listed in **Available Storage**. Take the disk offline, but do not delete from the cluster.
2. Using Failover Cluster Manager, shut down the VM to which you are adding the disk.
3. Using Hyper-V Manager, add the pass-through disk to the VM.
4. In Failover Cluster Manager, select the VM, and then select **Refresh virtual machine configuration** in the Action pane.

The pass-through disk is added to the group that the VM is in and brought online automatically.

5. Start the VM.

The pass-through disk is available.

### **Cluster Shared Volume not accessible from one node in a Windows 2008 failover cluster**

From a node in a Windows Server 2008 failover cluster, if a CSV volume is accessed, an error message CSV Volume not accessible is displayed.

The event log contains an error message similar to *Cluster service failed to create a cluster identity token for Cluster Shared Volumes*.

This error is caused by a configuration error such as inability of the node to contact a domain controller, authentication issues, or the cluster IP address being incorrect. If you fix these issues, the volume should be accessible.

### **Hyper-V live migration and quick migration fail after converting a CSV LUN to non-CSV**

Hyper-V live migration and quick migration do not work after converting a cluster shared volume (CSV) LUN to a non-CSV LUN. You need to follow special procedures to convert a CSV to a non-CSV for successful live migration or quick migration.

When a LUN is used as a CSV, you cannot change the Windows drive letter of the virtual hard drive (VHD) to enable live migration or quick migration. Attempting live migration or quick migration with a CSV fails. If you simply remove the LUN from the CSV, the migration also fails.

Follow the special procedure for converting a CSV LUN to enable live and quick migrations.

### **Converting a Hyper-V CSV LUN to enable live and quick migration**

Hyper-V live migration and quick migration do not work after cluster shared volume (CSV) LUNs have been converted to non-CSV. This procedure removes the LUN from the CSV and enables migration of the virtual machine.

#### **Steps**

1. Shut down the Hyper-V virtual machine (VM).
2. Export the VM configuration.

This does not copy the virtual hard drive (VHD), just the VM configuration information.

3. Delete the VM from the Windows cluster and from Hyper-V.

**Note:** Do not import the VM configuration until you are instructed to do so below.

4. Remove the LUN from the CSV and assign an available Windows drive letter.
5. Import the VM you exported. In the VM settings, change the VHD location to point to the drive letter you assigned to the LUN.
6. Add the VM back as an HA resource.

### **Cannot add SCSI pass-through disk to SUSE Hyper-V guest using IDE controller**

If you add a SCSI pass-through disk using the virtual IDE controller to a Hyper-V virtual machine running SLES 10 SP2, you cannot create a file system on the disk.

Disk commands such as `fdisk` also fail.

The problem has been observed in both clustered and non-clustered configurations.

The workaround is to use the virtual SCSI controller for pass-through disks on SLES 10 virtual machines.

### **Uninstalling SP2 from SAN-booted Windows Server 2008 prevents host from booting**

If you need to remove service pack 2 from a SAN-booted Windows Server 2008 host, remove MPIO first.

When SP2 is removed, the registry entries needed for successful SAN booting in an MPIO configuration are also removed. If you first remove MPIO, you can remove SP2 and still reboot the host successfully.

For more information, see the Technical Report 967752: Microsoft support article.

### **Bidirectional CHAP limitation for Itanium hosts**

The Microsoft iSCSI initiator cannot create more than one session using bidirectional (mutual) CHAP on Itanium hosts.

On Windows hosts with Itanium (IA64) processors, you cannot use bidirectional (mutual) CHAP with either multipath I/O (MPIO) or multiple connections per session (MCS). The first session or connection is established successfully, but you are unable to create additional sessions or connections.

This problem is fixed in Windows Server 2008 R2.

For earlier versions of Windows, do not use CHAP on IA64 systems if you want to create more than one iSCSI session.

### **Raw (pass-through) disks on a guest OS are not available when running MPIO on the guest**

If you run MPIO software on a guest OS (for iSCSI directly from the guest), and you also configure raw (pass-through) disks as SCSI physical disks from the parent, the guest is unable to use the raw disks.

This issue occurs with the Data ONTAP DSM for Windows MPIO and the Veritas DMP DSM.

When you are running MPIO on the guest, map raw drives as IDE physical disks.

### **Guest OS install on SCSI disk fails**

You cannot boot a Hyper-V virtual machine from a SCSI-mapped disk.

Use an IDE-mapped disk for the virtual machine boot disk.

### **Hyper-V virtual machine files do not work on CIFS share**

You cannot use a CIFS share on the storage system to store the virtual hard disk (.vhd file) or virtual machine configuration files for a Hyper-V virtual machine.

Store the .vhd file and virtual machine configuration files on a FC or an iSCSI LUN mapped to a drive on the Hyper-V parent system.

### **Hyper-V guest does not boot or loses pass-through disk**

If the disk numbers on the Hyper-V parent change so that they no longer match the virtual machine configuration, the guest operating system can fail to boot or the guest can lose access to a pass-through disk.

The disk number might change if you delete a LUN mapped to the parent and then reboot the parent.

You can fix the problem by modifying the virtual machine configuration to match the new disk identifiers.

### **SUSE Hyper-V guest loses network when moved to another cluster node**

SUSE guest operating systems on Hyper-V systems lose their network connections when the guest is moved to another node in the Windows cluster.

The network loss occurs when the guest uses a dynamic MAC address for its virtual network adapters. Dynamic MAC addresses are the default setting.

The workaround is to always select a static MAC address in the virtual machine **Network Adapter** settings for SUSE guest operating systems.

This problem has been reported to Microsoft.

## **Configuration fails when attempting to add a virtual machine to a Failover Cluster**

Adding a virtual machine to a failover cluster fails because the hidden available storage resource group belongs to a different node in the cluster.

### **Correcting a failed virtual machine addition**

If adding a virtual machine to a failover cluster fails because the hidden available storage resource group belongs to a different node in the cluster, add the new virtual machine's disk to the correct resource group.

#### **Steps**

1. Move the disk to the proper node by using the Failover Cluster Management Console.
2. Add the disk to the proper resource group created by the Virtual Machine Resource Wizard.
3. Manually add a dependency of the Virtual Machine on the Virtual Machine Configuration files.
4. Add a dependency of the Virtual Machine Configuration Files on the Physical Disk.
5. Start the Virtual Machine Resource Group.

### **Ensuring virtual machines can be added to a failover cluster**

To ensure new virtual machines can be added to a failover cluster, move the available storage group to the node on which you are creating and adding virtual machines.

#### **Steps**

1. On the cluster node, enter the following command at a Windows command prompt:  

```
C:\cluster group "Available Storage" /move:"node_name"
```

node\_name is the host name of the cluster node from which you are adding virtual machines.

#### **After you finish**

Run the virtual machine wizard to create the virtual machines and then add them to the failover cluster.



### **Unable to add another virtual machine to a failover cluster**

You can successfully add one virtual machine to a failover cluster, but attempts to add other virtual machines stored in the same LUN fail.

This problem applies only to configurations with more than one virtual machine (configuration files and boot .vhd file) stored on the same LUN.

Move all of the virtual machine resources to the same failover cluster resource group. Then add the virtual machines to the cluster. Be sure that the resources for all virtual machines are configured as dependent on the disk mapped to the LUN.

### **Virtual machine does not work after being removed from a failover cluster**

A Hyper-V virtual machine no longer works after being removed from a failover cluster. Adding a virtual machine to a failover cluster and then removing it from the cluster removes the virtual machine configuration.

Recreate the virtual machine reusing the original boot .vhd file.

### **Unable to SAN boot with Emulex FC HBA**

SAN booting might fail with Emulex Fibre Channel HBAs in one of several ways.

The following symptoms might occur while SAN booting a Windows host with an Emulex Fibre Channel HBA:

- The server boots once, but does not boot on subsequent attempts. The SAN boot is performed from a storage system LUN using FC. The HBA firmware is on the support matrix and the required storeport miniport driver is installed.
- After configuring the Emulex boot BIOS and rebooting the Windows host, the Emulex boot BIOS is not installed. The message Emulex BIOS is not installed!!! is displayed during the POST. This prevents configuring SAN booting.

Enable the Start Unit Command option in the Emulex HBA BIOS to resolve this issue.

### **Microsoft iSCSI SW Initiator takes a long time to reconnect to the storage system after disruption**

In a storage system configuration with multiple physical networks or multiple VLANs, the Microsoft iSCSI software Initiator can take several minutes to reconnect to the storage system.

During initial target discovery (Add Target), the Microsoft iSCSI software initiator uses the iSCSI SendTargets command to retrieve a list of IP addresses at which the target can be accessed.

In a storage system configuration with multiple physical networks or multiple VLANs, it is possible that some of the storage system's addresses are not accessible to a given host. In this situation, the SendTargets response sent by the storage system will advertise some addresses which are not accessible by that host.

When the Microsoft iSCSI initiator loses connectivity to the target (such as during storage system reboot, takeover, and giveback), the initiator attempts to reestablish connectivity to the target using the following default algorithm, which Microsoft calls "port-hopping":

- Attempt to reconnect over the same IP address which was being used before the disruption.
- Cycle through the other IP addresses from the SendTargets response, attempting to reconnect, until connectivity is reestablished.

Each inaccessible IP address in the list can add a delay of 15-20 seconds, which is the TCP connection establishment timeout. If there are many inaccessible IP addresses in the list, it may take a long time for the iSCSI initiator to cycle through the list before successfully reconnecting to the target. If the total reconnect time exceeds the timeout configured on the host (PDORemovePeriod for MPIO), the Windows applications experience I/O errors.

This long reconnect time can be minimized by disabling the use of the Microsoft "port-hopping" algorithm by using a specific target IP address for each connection in the iSCSI Initiator.

## Disabling the Microsoft iSCSI port-hopping algorithm

Disable the Microsoft iSCSI port-hopping algorithm in the iSCSI Initiator to minimize the recovery time in configurations with many iSCSI target ports.

### Steps

1. Open the Microsoft iSCSI initiator applet and select the **Targets** tab.
2. Click **Log On**.
3. In the **Logon to target** dialog box, click **Advanced**.
4. In the **Target Portal** list, change the value from Default to one of the storage system IP addresses specified in the **Target Portals** list on the **Discovery** tab.

### Result

After a disruption occurs, the Microsoft initiator uses only the IP address specified to reconnect to the storage system and does not try other IP addresses advertised in the SendTargets response.

**Note:** If the specified IP address is unreachable, no failover occurs.

### **LUN identifier range 0-254**

The Windows operating system only recognizes LUNs with identifiers from 0 to 254, regardless of the number of LUNs mapped.

Be sure that your LUNs are mapped to identifiers in this range.

### **Wait between iSCSI logout and login**

If you use the iSCSI software initiator GUI to log out the last session with an iSCSI target and then immediately log back in to the target, the Windows host does not connect to the iSCSI LUNs.

Wait at least 150 seconds after logging out of the last session with an iSCSI target before logging back in.



---

## Fixed issues in this release

Some known issues fixed in this release of Data ONTAP DSM are as follows:

- Limit on number of installed adapters for systems operating in 7-Mode.
- Windows Server hosts might take a long time to boot.



---

## Websites

IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. The following web pages provide N series information:

- A listing of currently available N series products and features can be found at the following web page:  
[www.ibm.com/storage/nas](http://www.ibm.com/storage/nas)
- The IBM System Storage N series support website requires users to register in order to obtain access to N series support content on the web. To understand how the N series support web content is organized and navigated, and to access the N series support website, refer to the following publicly accessible web page:  
[www.ibm.com/storage/support/nseries/](http://www.ibm.com/storage/support/nseries/)  
This web page also provides links to AutoSupport information as well as other important N series product resources.
- IBM System Storage N series products attach to a variety of servers and operating systems. To determine the latest supported attachments, go to the IBM N series interoperability matrix at the following web page:  
[www.ibm.com/systems/storage/network/interophome.html](http://www.ibm.com/systems/storage/network/interophome.html)
- For the latest N series hardware product documentation, including planning, installation and setup, and hardware monitoring, service and diagnostics, see the IBM N series Information Center at the following web page:  
[publib.boulder.ibm.com/infocenter/nasinfo/nseries/index.jsp](http://publib.boulder.ibm.com/infocenter/nasinfo/nseries/index.jsp)





---

## Where to find additional information

The following table describes documents with the most current information about host and storage system requirements and additional documentation.

If you want...	Go to...
The latest supported configurations	<a href="http://www.ibm.com/storage/support/nseries/">www.ibm.com/storage/support/nseries/</a>
Configuring and managing the storage system	<p>The following documents for your Data ONTAP release in the Data ONTAP information library:</p> <ul style="list-style-type: none"><li>• The <i>Data ONTAP Software Setup Guide</i></li><li>• The <i>Data ONTAP SAN Administration Guide (formerly the Data ONTAP Block Access Management Guide for iSCSI and FC) for your version of Data ONTAP.</i></li><li>• <i>Data ONTAP Release Notes</i></li><li>• The <i>Data ONTAP Commands: Manual Page Reference, Volume 1</i></li><li>• The <i>Data ONTAP Commands: Manual Page Reference, Volume 2</i></li><li>• The <i>Data ONTAP Upgrade Guide</i></li></ul>
Supported Fibre Channel SAN topologies	The <i>Data ONTAP SAN Configuration Guide (formerly the FC and iSCSI Configuration Guide)</i> for your version of Data ONTAP.
Configuring your host for the Host Utilities	<p>The <i>HP-UX Host Utilities Installation and Setup Guide</i></p> <p>The <i>Linux Host Utilities Installation and Setup Guide</i></p> <p>The <i>AIX Host Utilities Installation and Setup Guide</i></p> <p>The <i>Windows Host Utilities Installation and Setup Guide</i></p>



---

## Copyright and trademark information

This section includes copyright and trademark information, and important notices.

### Copyright information

Copyright ©1994 - 2013 Network Appliance, Inc. All rights reserved. Printed in the U.S.A.

Portions copyright © 2013 IBM® Corporation. All rights reserved.

US Government Users Restricted Rights - Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

No part of this document covered by copyright may be reproduced in any form or by any means - graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

References in this documentation to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM product, program, or service is not intended to state or imply that only IBM's product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any of IBM's or NetApp's intellectual property rights may be used instead of the IBM or NetApp product, program, or service. Evaluation and verification of operation in conjunction with other products, except those expressly designated by IBM and NetApp, are the user's responsibility.

No part of this document covered by copyright may be reproduced in any form or by any means - graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT,

INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S.A. patents, foreign patents, or pending applications.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

---

## Trademark information

IBM, the IBM logo, and [ibm.com](http://www.ibm.com)<sup>®</sup> are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. A complete and current list of other IBM trademarks is available on the Web at <http://www.ibm.com/legal/copytrade.shtml>

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

NetApp, the NetApp logo, Network Appliance, the Network Appliance logo, Akorri, ApplianceWatch, ASUP, AutoSupport, BalancePoint, BalancePoint Predictor, Bycast, Campaign Express<sup>®</sup>, ComplianceClock, Cryptainer, CryptoShred, Data ONTAP, DataFabric, DataFort, Decru, Decru DataFort, DenseStak, Engenio, Engenio logo, E-Stack, FAServer, FastStak, FilerView,

FlexCache, FlexClone, FlexPod, FlexScale, FlexShare, FlexSuite, FlexVol, FPolicy, GetSuccessful, gFiler, Go further, faster, Imagine Virtually Anything, Lifetime Key Management, LockVault, Manage ONTAP, MetroCluster, MultiStore, NearStore, NetCache, NOW (NetApp on the Web), Onaro, OnCommand, ONTAPI, OpenKey, PerformanceStak, RAID-DP, ReplicatorX, SANscreen, SANshare, SANtricity, SecureAdmin, SecureShare, Select, Service Builder, Shadow Tape, Simplicity, Simulate ONTAP, SnapCopy, SnapDirector, SnapDrive, SnapFilter, SnapLock, SnapManager, SnapMigrator, SnapMirror, SnapMover, SnapProtect, SnapRestore, Snapshot, SnapSuite, SnapValidator, SnapVault, StorageGRID, StoreVault, the StoreVault logo, SyncMirror, Tech OnTap, The evolution of storage, Topio, vFiler, VFM, Virtual File Manager, VPolicy, WAFL, Web Filer, and XBB are trademarks or registered trademarks of NetApp, Inc. in the United States, other countries, or both.

All other brands or products are trademarks or registered trademarks of their respective holders and should be treated as such.

NetApp, Inc. is a licensee of the CompactFlash and CF Logo trademarks.

NetApp, Inc. NetCache is certified RealSystem compatible.



---

## Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe on any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing to: IBM Director of Licensing IBM Corporation North Castle Drive Armonk, N.Y. 10504-1785 U.S.A.

For additional information, visit the web at:

[www.ibm.com/ibm/licensing/contact/](http://www.ibm.com/ibm/licensing/contact/)

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM web sites are provided for convenience only and do not in any manner serve as an endorsement of those web sites. The materials at those web sites are not part of the materials for this IBM product and use of those web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

If you are viewing this information in softcopy, the photographs and color illustrations may not appear.







NA 210-06231\_A0, Printed in USA

GC27-2054-16

