IBM ioMemory VSL 3.2.3

USER GUIDE FOR ESX AND ESXi

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IBM

IBM ioMemory VSL 3.2.3 User Guide for VMware ESX and ESXi

Legal Notices

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Introduction

Overview

Congratulations on your purchase of an IBM solid-state storage device. This guide explains how to install, troubleshoot, and maintain the software for your IBM High IOPS Adapters.

NOTE Throughout this manual, when you see a reference to an **IBM High IOPS Adapter**, you may substitute your particular device(s), such as an IBM High IOPS Adapter or each of the two IBM High IOPS Adapters of an IBM High IOPS Duo Adapter.

Attention **Products with Multiple Devices**: Some products, such as an IBM High IOPS Duo Adapter, are actually comprised of **multiple IBM High IOPS Adapters**. If your product consists of multiple IBM High IOPS Adapters, you will manage each IBM High IOPS Adapter as an independent device.

For example, if you have an IBM High IOPS Duo Adapter, you can independently attach, detach, and/or format each of the two IBM High IOPS Adapters. Each of the two devices will be presented as an individual device to your system.

About the IBM High IOPS Platform

The IBM High IOPS platform combines ioMemory VSL software with IBM High IOPS hardware to take enterprise applications and databases to the next level.

Performance

The IBM High IOPS platform provides consistent microsecond latency access for mixed workloads, multiple gigabytes per second access and hundreds of thousands of IOPS from a single product. The sophisticated IBM High IOPS architecture allows for nearly symmetrical read and write performance with best-in-class low queue depth performance, making the IBM High IOPS platform ideal across a wide variety of real world, high-performance enterprise environments.

The IBM High IOPS platform integrates with host system CPUs as flash memory to give multiple (and mostly idle) processor cores, direct and parallel access to the flash. The platform's cut-through architecture gives systems more work per unit of processing, and continues to deliver performance increases as CPU power increases.

Endurance

The IBM High IOPS platform offers best-in-class endurance in all capacities, which is crucial for caching and write-heavy databases and applications.

Reliability

The IBM High IOPS platform eliminates concerns about reliability like NAND failures and excessive wear. The all-new intelligent, self-healing feature called Adaptive Flashback provides complete, chip-level fault tolerance. Adaptive Flashback technology enables an IBM High IOPS product to repair itself after a single chip or a multi-chip failure without interrupting business continuity.

System Requirements

Please read the *IBM ioMemory VSL Release Notes* for more information on this release.

Hardware Requirements

- **Hardware Requirements**: These depend on your device (including device capacity, generation, and configuration). Please see the *IBM High IOPS Hardware Installation Guide* for requirements on the following:
  - PCIe Slot
  - Cooling
  - Power
- **Supported Devices**: Also see the *IBM High IOPS Hardware Installation Guide* for a list of supported IBM High IOPS Adapters.
- **RAM Requirements**: The *IBM ioMemory VSL Release Notes* contains memory (RAM) requirements for this version of the software.

For specific IBM High IOPS System x server configuration information and requirements, refer to the following URL: *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=SERV-IOPS*

Supported Operating Systems

- ESX 4.0 Update 4
- ESX 4.1 Update 3
- ESXi 4.0 Update 4
- ESXi 4.1 Update 3
- ESXi 5.0 Update 1
- ESXi 5.1

The page Overview does not exist.s are only compatible with operating systems that are 64-bit x86 architecture. This means the following scenarios are supported:

1. Using the The page Overview does not exist. as VMFS datastore within the hypervisor, and then sharing that storage with guest operating systems. Guest operating systems can be 32-bit or 64-bit because they are not directly using the The page Overview does not exist..

2. Using VMDirectPathIO, allow a virtual machine to directly use the The page Overview does not exist.. In this case, only supported operating systems can use the device.

   NOTE VMDirectPathIO is currently supported on Windows and Linux operating systems that are supported by The page Overview does not exist..

   See either the *ioMemory VSL User Guide for Linux* or the *ioMemory VSL User Guide for Windows* for installation instructions.

   Attention If you are using VMDirectPathIO, you do not need to install the ioMemory VSL on the ESXi system. Instead, install the driver on the guest system. Only install the ioMemory VSL if you plan on creating a VMFS on the device(s). For more information on using VMDirectPathIO, see the VMDirectPathIO appendix in the *ioMemory VSL User Guide* for ESX or ESXi

Upgrading Legacy Adapters (IMPORTANT)

Please read these IBM High IOPS Adapter compatibility considerations.

Multiple High IOPS adapters are installed in a single system:

When multiple High IOPS Adapters are installed in the same server, all devices must operate with the same version of software. High IOPS adapters require matching firmware, drivers and utilities. This is a very important consideration when adding a new Second Generation High IOPS Adapter in a server where Legacy Adapters are deployed.

When Upgrading Legacy Adapters operating with a previous generation of software (1.2.x or v2.x), you must back up the data on the adapter before upgrading to prevent data loss. After upgrading the ioMemory VSL to version 3.x, the legacy adapters will not logically attach to the system until the firmware is also updated. Detailed instructions for upgrading software is provided in Appendix B- Upgrading Devices from VSL 2.x to 3.x of this user guide.

Upgrading from version 1.2.x or 2.x software to 3.x:

Upgrading Legacy adapters from 1.2.x software to version 3.1.1 offers a number of significant changes and improvements, however there are some important considerations

When performing an upgrade from 1.2.x to 3.x, you must perform a staged upgrade (upgrade to the 2.x software and firmware before upgrading to 3.x). The device driver name has also changed from fio-driver (version 1.2.x) to iomemory-vsl (2.x and above).

The upgrade process from 2.x to 3.x will require the adapter to be formatted. Formatting will remove all existing data from the card and the data must be restored after the update completes. Users must back up their data before proceeding with the upgrade process to version 3.x.

The firmware upgrade process updates and modifies important hardware settings that are not compatible with 1.2.x or 2.2.3 versions of software. Once updated, the card cannot be black-leveled to the previous versions of software. Please see the "change history" documentation for a complete list of new features, enhancements, and fixes.

Replacing a failed legacy High IOPS card and "mandatory" update requirements:

As the supply of legacy adapters diminishes from inventory, it becomes more likely that warranty replacement cards will transition to the newer versions of the High IOPS adapters. Replacement High IOPS cards and may require firmware updates to support the new or existing cards in the server.

Any situation when mixing the flash NAND technology occurs, the minimum version of software supported by the latest generation of hardware prevails. A mandatory upgrade of software is required to support the latest generation of hardware with backward compatibility to legacy cards in the server.

Change History's Update Recommendations:

Change histories files provide an ongoing list of changes to a series of software compatible with a family of hardware. Please review the change histories using the following guidelines as to how IBM recommends or suggests updates to code levels at the website below:

http://www.ibm.com/support/entry/portal/docdisplay?brand=5000008&lndocid=HELP-FIX

Software Installation

NOTE After you install this version of the ioMemory VSL software, you may need to upgrade the firmware to enable operation. See *Upgrading the Firmware* later in this section for more information

Attention IBM High IOPS Adapters cannot be installed as part of an ESX installation.

VMDirectPathIO

The ESX(i) ioMemory VSL software is only required if you plan to use the device as a VMFS Datastore. If, however, you are passing the device(s) through (using VMDirectPathIO – also known as PCI passthrough), you do not need to install the VSL software on the ESX(i) system. Instead, install the VSL software on the guest operating system. For example, you would pass the device through to a Windows VM and then install the Windows ioMemory VSL software on that VM (consult the *IBM ioMemory VSL User Guide for Windows* for installation and user instructions).

There are special considerations when passing through an IBM High IOPS Adapter, for more information, see *Appendix D- Working with IBM High IOPS Devices and VMDirectPathIO* in this user guide before proceeding with passing through the device.

Command-Line Installation

Unless you use VUM, you will need to use a command-line interface to install the ioMemory VSL software. In order to manage the IBM High IOPS Adapters and VSL software, you **must** use a Command-Line Interface (CLI).

ESX Command Line

ESX includes the Console Operating System (COS). This CLI is available on the host, or through an SSH connection. The VMware **vCLI** (vSphere Command-Line Interface) also works with ESX.

ESXi Command Line

VMware provides the **vCLI** (vSphere Command-Line Interface) to run against your ESXi system. You should install a vCLI package on a physical machine running Linux or Windows. For more information on VMware's vCLI, see *http://www.vmware.com/support/developer/vcli/*

Attention We do not recommend using the vCLI within a virtual machine that is hosted on your ESXi system. The ioMemory VSL software installation and configuration processes involve putting the ESXi host into maintenance mode and rebooting the host.

You may choose to use the **TSM** (Tech Support Mode), also known as **Shell** or **SSH** (when used remotely), instead of

the vCLI to install the ioMemory VSL software. The TSM/Shell may be required for managing/troubleshooting your device with the command-line utilities.

Attention VMware suggests that the TSM only be used "for the purposes of troubleshooting and remediation." VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more information visit VMware's Knowledge Base article on using this mode: *http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1017910*.

Installation Overview

1. If needed, uninstall previous versions of the ioMemory VSL software and the utilities. Instructions for uninstalling current and previous versions of the software are available in the *Common Maintenance Tasks* section. Once you have uninstalled the software, return to this page.
2. Install the latest version of the ioMemory VSL software and the command-line utilities.
3. Reboot the ESX(i) system; this will load the ioMemory VSL software driver and attach the IBM High IOPS Adapter(s).
4. Optional: Install and setup an SMI-S remote management solution. See *Installing Optional Remote Management Software* for details.
5. *Upgrade the Firmware* to the latest version, if needed (recommended).
6. *Configure the Device to Support VM Disks*.
   Attention The IBM High IOPS Adapter is meant to be used as a data storage disk or caching device. Installing an ESX(i) operating system and booting from the IBM High IOPS Adapter is not supported.

   ESX(i) installers may permit you to install the ESX(i) OS on an IBM High IOPS Adapter. This is not supported, and the installation will fail on reboot.

Downloading the Software

Download the installation packages to a remote machine (preferably one that has the vCLI and/or vSphere client installed).

The ioMemory VSL software is available as an offline bundle from *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**). Navigate to the appropriate folder for your operating system. Example:

- `iomemory-vsl_<version>.offline-bundle.zip`
- `cross_vmware-esx-drivers-block-iomemory-vsl_<version>-offline-bundle.zip`

Attention The offline bundle may be within a .zip archive: `iomemory-vsl-<version>.zip`

Also download the firmware archive file, for example:

- `highiops_<version>-<date>.fff`

Transferring the ioMemory VSL files to the ESX(i) Server

You will need to transfer the firmware file to the ESX(i) host. Also, depending on your ESX(i) version and your preferred installation method, you may need to transfer the two bundle installation files to the host as well. We recommend transferring all the files at this point, and then choosing the installation method later.

Whichever method you choose for transferring the file(s), we recommend saving the file(s) to a datastore on the host. The example paths to the bundles and firmware in this guide will show them located in a `bundles` directory on a datastore:

```
/vmfs/volumes/<datastore>/bundles/
```

Where `<datatstore>` is the name of the datastore.

Transfer Methods

You may transfer the file(s) using one of many methods, including:

- vSphere Client
- vCLI `vifs` command
- SCP (using SSH)

The file(s) can be copied to the host from your remote machine, or from an NFS share.

vCLI Example

Described below are the steps for transferring files to the ESX(i) host using vCLI

1. On your remote machine, make sure you have downloaded the appropriate files, and take note of their location.
2. Choose an available datastore (with at least 200MB of available storage) on the hypervisor that you will use to temporarily store the bundles.

3. Create a directory in the datastore named `bundles` using the `vifs` remote command:

```
vifs --server <servername> --mkdir "[<datastore>]bundles"
```

The brackets (`[]`) and quotes (`""`) are required. Substitute your datastore name for the `<datastore>` variable.

NOTE You will be prompted to enter the username and password for the ESXi host. For convenience, you can add the following options to each command:

```
--username <username> --password <password>
```

Attention **vCLI in Windows**: When using the vCLI in Windows, many of the commands are slightly different. Most of the commands end with `.pl`. Throughout this document, when you run the vCLI in windows, be sure to include the `.pl` to the command. This command would be:

```
vifs.pl --server <servername> --mkdir "[<datastore>]bundles"
```

4. Use the following example command line to transfer the file(s) one by one to the `bundles` directory of the datastore:

```
vifs --server <servername> --put "<path-on-local-machine>/<filename>"
"[<datastore>]bundles/<filename>"
```

Where `<filename>` is the full filename, for example:

- `highiops_<version>-<date>.fff`
- `iomemory-vsl_<version>.offline-bundle.zip`.

Installing the ioMemory VSL on ESXi 5.x

NOTE **VUM Installation**: These instructions describe how to install the ioMemory VSL on a single hypervisor. However, if you are familiar with, and use, the VMware Update Manager (VUM) plugin for the Virtual Center Server (vCenter Server), you can use that to install the ioMemory VSL on multiple hosts. Please see the vCenter Server documentation for more details on VUM.

Attention **Uninstall**: An update/upgrade installation is not recommended. Instead, uninstall the previous version of the ioMemory VSL software before you install this version. See *Common Maintenance Tasks* for more information on uninstalling the software.

You may choose to install the software using the vCLI or Shell (SSH). Whether you use the Shell or vCLI, **you must first transfer the files to a datastore on the ESX(i) host**.

Attention The offline bundle may be within a .zip archive: `iomemory-vsl-<version>.zip`. Unpack the offline bundle for installation.

vCLI Installation

1. Install the bundle by running the following command against your ESXi 5.x system using the vCLI:

   ```
   esxcli --server <servername> software vib install -d <offline-bundle>
   ```

   Where `<offline-bundle>` is the **absolute path** to the offline bundle on the hypervisor host. For example, if the offline bundle is in the `bundles` directory of a datastore with the name of `datastore1`, the (local) path would be:
   `/vmfs/volumes/datastore1/bundles/iomemory-vsl_<version>.offline-bundle.zip`

   Attention This absolute path must begin with a forward slash (/) or ESXi will return an error message.

2. Reboot your ESXi system.

The ioMemory VSL and command-line utilities are installed on the host.

Command-line Installation

1. Install the bundle by running the following command against your ESXi 5.x system using TSM/SSH:

   ```
   esxcli software vib install -d <offline-bundle>
   ```

   Where `<offline-bundle>` is the **absolute path** to the offline bundle on the hypervisor host. For example, if the offline bundle is in the `bundles` directory of a datastore with the name of `datastore1`, an example (local) path would be:
   `/vmfs/volumes/datastore1/bundles/iomemory-vsl_<version>.offline-bundle.zip`

2. Reboot your ESXi system

The ioMemory VSL and command-line utilities are installed on the host.

You can now continue to *Installing Optional Remote Management Software*. If you wish to skip that optional step, continue on to the *Upgrading the Firmware* section.

Installing the ioMemory VSL on ESX(i) 4.x

Attention **Uninstall**: An update/upgrade installation is not recommended. Instead, uninstall the previous version of the ioMemory VSL software before you install this version. See *Common Maintenance Tasks* for more information on uninstalling the previous versions of the software.

vCLI Installation

The installation bundles shouldn't reside on the ESX(i) 4.x host when you using the vCLI. Instead, they will need to be on the remote machine.

1. On your remote machine, navigate to the directory that contains the downloaded files.
2. Install the bundle by running the following command against your ESX(i) 4.x system using the vCLI:

   ```
   vihostupdate --server <server-name> --install --bundle <offline-bundle>
   ```

   Where `<offline-bundle>` is the full path of the offline bundle **on your remote machine**. For example, on a Linux machine an example local path would be `./cross_vmware-esx-drivers-block-iomemory-vsl_<version>-offline-bundle.zip`

3. Reboot your host system

The ioMemory VSL and command-line utilities are installed on the host.

Command-line Installation

You may use the COS (on ESX 4.x) or the TSM/SSH (on ESXi 4.x) to install the software. In both cases, you must first transfer the files to the host.

1. Navigate to the directory where you have transferred offline bundle.
2. Run the `esxupdate` command to install the ioMemory VSL using the offline bundle.

   ```
   $ esxupdate --bundle <offline-bundle> update
   ```

   Where `<offline-bundle>` is the full name of the offline bundle that you downloaded. For example, `cross_vmware-esx-drivers-block-iomemory-vsl_<version>-offline-bundle.zip`

3. Reboot the host system.

The ioMemory VSL and command-line utilities are installed on the host.

You may now follow the instructions on *Installing Optional Remote Management Software*. If you wish to skip that optional step, continue on to the *Upgrading the Firmware* section.

Installing Optional Remote Management Software

To manage the ioMemory VSL software and IBM High IOPS Adapters, you must use the provided management utilities. There are two options available for managing the VSL:

- **COS/Shell/TSM command-line utilities**: These utilities are installed with the ioMemory VSL software. In order to use these utilities on ESXi, the Shell/TSM (Tech Support Mode) must be enabled.
  - The `fio-bugreport` troubleshooting utility is only available as a COS/Shell/TSM command-line utility.
  - For more information about these utilities, see *Appendix A- Command-Line Utilities*
- **Optional Remote SMI-S Scripts**: These optional scripts provide remote management of the software and devices without enabling Tech Support Mode (TSM) or logging in to the COS.
  - To use the SMI-S interface, you must install the CIM (SMI-S) provider on the ESX(i) host and the Python SMI-S Management Scripts on a remote machine.
  - The CIM provider and SMI-S remote scripts are separate downloads. These managment packages are available along with the ioSphere software downloads.

Upgrading the Firmware

With the ioMemory VSL software loaded, you need to ensure that the IBM High IOPS Adapter's firmware is up-to-date. To do this, run the `fio-status` command-line utility from Shell or use the optional remote management option (see *Installing Optional Remote Management Software* for more information).

If the output shows that the device is running in minimal mode, use the `fio-update-iodrive` utility (in Tech Support Mode/Shell) or the optional remote management option.

If your device was previously used with ioMemory VSL version 2.x or earlier, you will need to upgrade it by following the instructions in *Appendix E- Upgrading Devices from VSL 2.x to 3.x*.

NOTE When using VMDirectPathIO, if you upgrade the firmware on an IBM High IOPS Adapter, you must cycle the power to have the change take place. Just restarting the virtual machine won't apply the change.

Attention Your IBM High IOPS Adapter may have a minimum firmware label affixed (for example, "MIN FW: XXXXXX"). This label indicates the minimum version of the firmware that is compatible with your device.

Attention Do not attempt to downgrade the firmware on any IBM High IOPS Adapter, doing so may void your warranty.

NOTE When installing a new IBM High IOPS Adapter along with existing devices, it is best to upgrade all of the devices to the latest available versions of the firmware and ioMemory VSL software. The latest versions are available at *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**).

For more information regarding firmware and ioMemory VSL software versions and compatibility, consult the *IBM ioMemory VSL Release Notes*.

Configuring the Device to Support VM Disks

Attention ESX(i) requires 512B sector sizes. New IBM High IOPS Adapters come pre-formatted with 512B sector sizes from the factory. If yours is a new device, there is no need to format it.

However, if your IBM High IOPS Adapter was previously used in a system that allowed for larger sector sizes (such as Linux and 4KB sectors), then you must perform a format using the `fio-format` utility or the remote management software (see Installing Optional Management Software for more information). Follow formatting instructions carefully, including disabling and re-enabling autoattach.

Within the vSphere Client, select the **Configuration** tab. Under **Hardware** click **Storage**, then click **Add Storage** located on the top right corner. The Add Storage wizard will appear. Use this wizard to configure the device.

For more information, and an explanation of options (including setting the VM File System Block Size), consult your vSphere documentation.

NOTE You can also create a VMFS datastore using `fdisk` and `vmkfstools` in the Tech Support Mode (directly on the ESXi host), however **this method is not supported by VMware**.

Attention The preferred type of virtual disk is "eagerzeroedthick." A "thin" provisioning may degrade performance significantly.

Once the storage has been added and configured, it is now possible to store virtual machines on the IBM High IOPS Adapter(s).

Modifying a VMware Resource Pool to Reserve Memory

Under certain circumstances, the ESX(i) operating system may temporarily require most, if not all, of the RAM available on the system, leaving no memory for the ioMemory VSL software.

NOTE For example, a host running VMware View may need to rapidly provision multiple VDI images. This may happen so quickly that the host memory is temporarily exhausted.

If the VMs starve the ioMemory VSL software of RAM, the IBM High IOPS Adapter(s) may go offline or stop processing requests. To address this use case, follow the procedure and guidelines below for limiting memory consumed by the VMs.

We recommend limiting RAM available to the VMs equal to: Total Host RAM - RAM equivalent to 0.5% of the total IBM High IOPS Adapter capacity (see the **Example Scenario** below for more information on this calculation). The easiest way to set this limit is by modifying the user pool.

The exact amount to limit is workload dependent, and will require tuning for specific use cases.

To modify the user pool, follow the steps below, using the vSphere client:

1. Click the **Summary** tab in the vSphere client to view the current memory usage and capacity.
   - Also visible is the total IBM High IOPS Adapter datastore capacity, make note of that capacity.
2. Navigate to the **user Resource Allocation** window:
   a. Select the host -> **Configuration** tab -> **Software** pane -> **System Resource Allocation** link -> **Advanced** link

   b. The **System Resource Pools** appear.

   c. Select the **user** node under the host tree.

   d. The details for the user appear below, click the **Edit settings** link.

   e. The **user Resource Allocation** window appears.
3. Limit the Memory allocated to the VMs.
   a. Under **Memory Resources**, clear the **Unlimited** checkbox so you can set the limit for memory resource allocation.

   b. You can now set the limit on VM memory consumption.

Example Scenario:

An ESXi host has

- Memory capacity of `36852MB`
- Total IBM High IOPS Adapter datastore capacity of `320GB` (or approximately `320000MB`).

`320000MB` device capacity * `0.5%` of device capacity ~ `1600MB` of RAM equivalent.

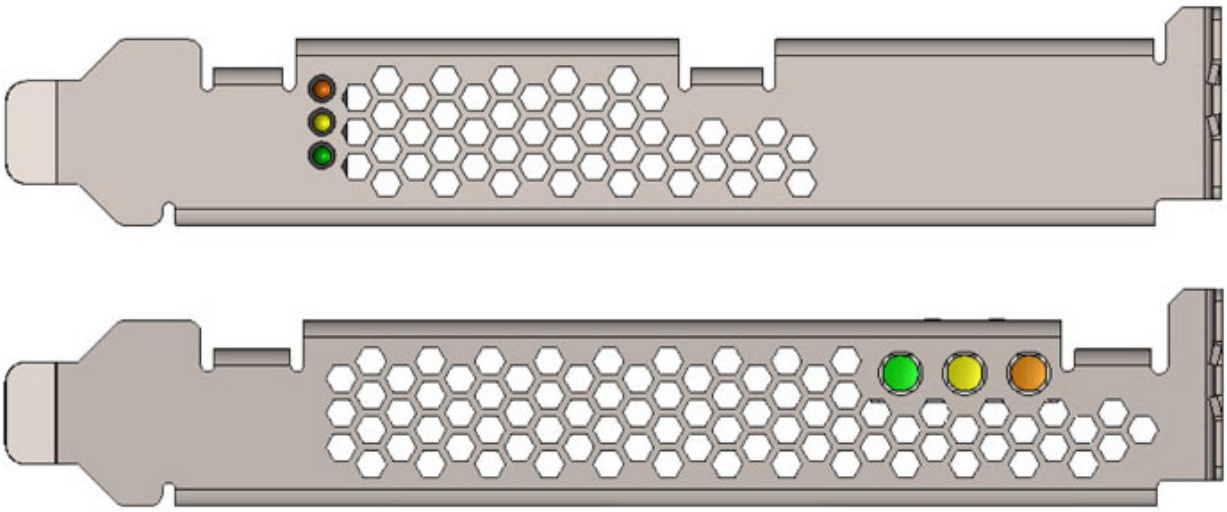
`36852MB` total memory capacity - `1600MB` free = `35252MB` of memory limited to the host. The new value under **Limit** in **Memory Resources** would be `35252MB`.

Maintenance

The IBM High IOPS Adapter includes both software utilities for maintaining the device as well as external LED indicators to display its status.

Device LED Indicators

The IBM High IOPS Adapter includes three LEDs showing drive activity or error conditions. The LEDs on your device should be similar to one of these configurations:



This table explains the information that these LEDs convey:

Green	Yellow	Amber	Indicates	Notes
Off	Off	Off	Power off	
Off	Off	On	Power on. Problem with device, or driver not loaded (and device unattached)	Use fio-status to view problem, or load driver (and attach device)
On	Off	Off	Power on. Driver loaded (device may not be attached)	You may need to attach the device
On	(Flashing)	Off	Writing (Rate indicates volume of writes)	Can appear in combination with the Read LED indication
(Flashing)	Off	Off	Reading (Rate indicates volume of reads)	Can appear in combination with the Write LED indication
On	On	On	Location Beacon	

Management Utilities

There are two options available for managing the VSL:

- **COS/Shell/TSM command-line utilities**: These utilities are installed with the ioMemory VSL software. In order to use these utilities on ESXi, the Shell/TSM (Tech Support Mode) must be enabled.
  - The `fio-bugreport` troubleshooting utility is only available as a COS/Shell/TSM command-line utility.
  - For more information about these utilities, see *Appendix A- Command-Line Utilities*
- **Optional Remote SMI-S Scripts**: These optional scripts provide remote management of the software and devices without enabling Tech Support Mode (TSM) or logging in to the COS.
  - To use the SMI-S interface, you must install the CIM (SMI-S) provider on the ESX(i) host and the Python SMI-S Management Scripts on a remote machine.
  - The CIM provider and SMI-S remote scripts are separate downloads. These managment packages are available along with the ioSphere software downloads.

Command-Line Utilities for Tech Support Mode and COS

Several command-line utilities are included in the installation packages, these command-line utilities are only accessible through VMware's **Tech Support Mode** (also known as Shell/SSH) in ESXi and the COS in ESX.

Attention VMware suggests that the TSM only be used "for the purposes of troubleshooting and remediation." VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more

information visit VMware's *Knowledge Base article* on using this mode.

- `fio-attach`
- `fio-beacon`
- `fio-bugreport`
- `fio-detach`
- `fio-format`
- `fio-pci-check`
- `fio-status`
- `fio-update-iodrive`

For more information on command-line utilities, see *Appendix A- Command-Line Utilities*.

Common Maintenance Tasks

In ESX, these task require the COS. In ESXi, some of these maintenance tasks are only accessible through VMware's **Tech Support Mode** (also known as Shell/SSH).

Attention VMware suggests that the TSM only be used "for the purposes of troubleshooting and remediation." VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more information visit VMware's *Knowledge Base article* on using this mode.

Detaching an IBM High IOPS Adapter

We do not recommend detaching IBM High IOPS Adapters that are used as datastores. The best practice is to:

1. Disable auto-attach (see the next sub-section)
2. Reboot
3. Perform the necessary maintenance operations
4. Re-enable auto-attach
5. Then reboot again.

If you must detach an IBM High IOPS Adapter, carefully read all of the warnings in the ***`fio-detach`*** (or the optional remote management documentation) before running the detach utility. Failure to follow the instructions may cause errors, data loss and/or corruption.

Disabling Auto-Attach

Disabling Auto-Attach in ESX

To load the ioMemory VSL with auto-attach disabled, run the following command and then restart:

```
esxcfg-module -s 'auto_attach=0' iomemory-vsl
```

This will not be enforced until you reboot the system. **To enable auto-attach**, set the parameter back to `1`.

Disabling Auto-Attach in ESXi

To load the ioMemory VSL software on boot with auto-attach disabled, set the auto_attach parameter equal to 0 using the vCLI:

```
$ vicfg-module --server <server-name> iomemory-vsl -s 'auto_attach=0'
```

This will not be enforced until you reboot the system. **To enable auto-attach**, set the parameter back to `1`.

Unloading or Disabling the ioMemory VSL software

If you need to diagnose or troubleshoot a problem, you may need to unload or disable the ioMemory VSL software. Both methods will take the ioMemory VSL software offline, however we recommend disabling the ioMemory VSL software autoload and rebooting rather than unloading the ioMemory VSL driver.

Attention You **must** properly unmount and detach all IBM High IOPS Adapters before unloading the ioMemory VSL driver. However if you disable autoload and then reboot, the devices will safely unmount and detach on shutdown and then not auto attach or mount on boot.

If you must unload the driver (and detach an IBM High IOPS Adapter), carefully read all of the warnings in the *`fio-detach`* (or the optional remote management documentation) before running the detach utility. Failure to follow the instructions may cause errors, data loss and/or corruption.

Again, we recommend disabling autoload rather than directly unloading the driver.

Disabling the ioMemory VSL software Autoload

The ioMemory VSL driver automatically loads by default when the operating system starts. By disabling the autoload and rebooting, the ioMemory VSL software will be offline.

To disable driver auto-load, run these commands in COS/TSM then reboot the system:

```
$ esxcfg-module --disable iomemory-vsl
```

NOTE In ESX 4.x, you must also run the following command before you reboot:

```
esxcfg-boot -b
```

NOTE If you disable the driver autoload in ESXi 5.1 or newer, you also disable the ability to directly load the driver. You will need to re-enable the driver to load the driver.

This prevents the ioMemory VSL driver from loading on boot, so the device won't be available to users. However, all other services and applications are available.

Unloading the ioMemory VSL Driver

If you need to unload the driver for diagnostic or troubleshooting purposes, you **must** properly unmount and detach all IBM High IOPS Adapters.

To unload the ioMemory VSL driver, run this commands in COS/TSM:

```
vmkload_mod -u iomemory-vsl
```

Loading or Enabling the ioMemory VSL Driver

If you have previously disabled driver autoload, you may want to re-enable it and then reboot. Otherwise, you may bring the driver online by loading directly. If you load the driver, you will need to re-attach the IBM High IOPS Adapters in your system. See *fio-attach* for more information.

NOTE If you disable the driver autoload in ESXi 5.1 or newer, you also disable the ability to directly load the driver. You will need to re-enable the driver to load the driver.

If you enable driver autoload and then reboot, the IBM High IOPS Adapters should attach automatically (unless you have disabled auto attach, see below).

NOTE Depending on your situation, you may want to both re-enable driver autoload (to ensure that the ioMemory VSL driver will load on the next boot) and directly load the driver to bring it online immediately.

Enabling ioMemory VSL Driver Autoload

To enable the ioMemory VSL driver (on boot) after maintenance, run these commands in TSM/COS and reboot the system.

```
$ esxcfg-module --enable iomemory-vsl
```

NOTE In ESX 4.x, you must also run the following command before you reboot:

```
esxcfg-boot -b
```

After a reboot, if the driver is enabled, then it will appear in the modules listed when this command is run:

```
$ esxcfg-module --query
```

Loading the ioMemory VSL Driver

To immediately load the ioMemory VSL software, run the following command:

```
vmkload_mod iomemory-vsl
```

This command loads the driver with default parameters (even if you have modified the parameters). You can force the driver to load with modified perameters, for example:

```
vmkload_mod iomemory-vsl auto_attach=0
```

See *Appendix C- Using Module Parameters* for a list of these parameters.

Uninstalling the ioMemory VSL Package and Command-line Utilities

Uninstalling the Software in ESX 4.x

To uninstall the ioMemory VSL package, run these commands:

1. Find the ioMemory VSL `Bulletin ID`:

   ```
   $ esxupdate query
   ```

   Sample Output

   ```
   ------Bulletin ID------ -----Installed-----
   ---------------------Summary----------------------
   iomemory-vsl-3.0.6.360  2012-01-16T03:49:33 iomemory-vsl: block driver
   for ESX/ESXi 4.X
   ```

2. Remove ioMemory VSL using its `Bulletin ID`:

   ```
   $ esxupdate -b <Bulletin-ID> remove
   ```

Uninstalling the Software in ESXi 4.x

To uninstall the ioMemory VSL package, run this command using the vCLI (from a remote machine):

1. Determine the bundle "bulletin" name:

```
vihostupdate --server <server-name> --query
```

Sample output:

```
---------Bulletin ID---------
iomemory-vsl-2.2.0.7601742

-----Installed-----
2011-02-08T10:37:05

---------------Summary----------------
iomemory-vsl: block driver for ESXi 4.1.X
```

2. Remove the "bulletin" containing the driver & utilities:

```
vihostupdate --server <server-name> --remove --bulletin
iomemory-vsl-2.2.0.7601742
```

Uninstalling the software in ESXi 5.x

To uninstall the ioMemory VSL package, run this command using the vCLI from a **remote machine** (remove `--server <servername>` if you are on the host CLI):

1. Remove the VIB containing the driver & utilities:

```
esxcli --server <servername> software vib remove -n block-iomemory-vsl
```

Unmanaged Shutdown Issues

Unmanaged shutdowns due to power loss or other circumstances can force the IBM High IOPS Adapter to perform a consistency check during the restart. This may take several minutes to complete.

Attention Check `fio-status` after a crash to see if the devices are in an "Attaching" state.

Although data written to the IBM High IOPS Adapter is not lost due to unmanaged shutdowns, important data structures may not have been properly committed to the device. This consistency check repairs these data structures.

Performance and Tuning

IBM High IOPS Adapters provide high bandwidth, high Input/Output per Second (IOPS), and are specifically designed to achieve low latency.

As IBM High IOPS Adapters improve IOPS and low latency, the device performance may be limited by operating system settings and BIOS configuration. These settings may need to be tuned to take advantage of the revolutionary performance of IBM High IOPS Adapters.

While IBM devices generally perform well out of the box, this section describes some of the common areas where tuning may help achieve optimal performance.

Disable CPU Frequency Scaling

Dynamic Voltage and Frequency Scaling (DVFS) are power management techniques that adjust the CPU voltage and/or frequency to reduce power consumption by the CPU. These techniques help conserve power and reduce the heat generated by the CPU, but they adversely affect performance while the CPU transitions between low-power and high-performance states.

These power-savings techniques are known to have a negative impact on I/O latency and IOPS. When tuning for performance, you may benefit from reducing or disabling DVFS completely, even though this may increase power consumption.

DVFS, if available, is often configurable as part of your operating systems power management features as well as within your system's BIOS interface. Within the operating system and BIOS, DVFS features are often found under the Advanced Configuration and Power Interface (ACPI) sections; consult your computer documentation for details.

Limiting ACPI C-States

Newer processors have the ability to go into lower power modes when they are not fully utilized. These idle states are known as ACPI C-states. The `C0` state is the normal, full power, operating state. Higher C-states (`C1`, `C2`, `C3`, etc.) are lower power states.

While ACPI C-states save on power, they can have a negative impact on I/O latency and maximum IOPS. With each higher C-state, typically more processor functions are limited to save power, and it takes time to restore the processor to the `C0` state.

When tuning for maximum performance you may benefit from limiting the C-states or turning them off completely, even though this may increase power consumption.

Setting ACPI C-State Options

If your processor has ACPI C-states available, you can typically limit or disable them in the BIOS interface (sometimes referred to as a Setup Utility). APCI C-states may be part of of the Advanced Configuration and Power Interface (ACPI) menu. Consult your computer documentation for details.

Appendix A- Command-Line Utilities

These command-line utilities are only accessible through VMware's **Tech Support Mode** (also known as Shell/TSM) on ESXi and the Console Operating System (COS) on ESX.

Attention VMware suggests that the TSM only be used "for the purposes of troubleshooting and remediation." VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more information visit VMware's *Knowledge Base article* on using this mode.

NOTE **SMI-S Management**: You may choose to use the SMI-S remote management tools instead of TSM command-line utilities. The SMI-S remote management tools provide a management experience similar to these command-line utilities. For more information, see *Installing Optional Remote Management Software*

The ioMemory VSL installation packages include various command-line utilities, installed by default to `/usr/bin`. These provide a number of useful ways to access, test, and manipulate your device.

Attention There are some additional utilities installed in the `/usr/bin` directory that are not listed below. Those additional utilities are dependencies (used by the main ioMemory VSL utilities), and you should not use them directly unless Customer Support advises you to do so.

Utility	Purpose
`fio-attach`	Makes an IBM High IOPS Adapter available to the OS
`fio-beacon`	Lights the IBM High IOPS Adapter's external LEDs
`fio-bugreport`	Prepares a detailed report for use in troubleshooting problems
`fio-detach`	Temporarily removes an IBM High IOPS Adapter from OS access
`fio-format`	Used to perform a low-level format of an IBM High IOPS Adapter
`fio-pci-check`	Checks for errors on the PCI bus tree, specifically for IBM High IOPS Adapters.
`fio-status`	Displays information about the device
`fio-update-iodrive`	Updates the IBM High IOPS Adapter's firmware

NOTE There are `-h` (Help) and `-v` (Version) options for all of the utilities. Also, `-h` and `-v` cause the utility to exit after displaying the information.

fio-attach

NOTE The `fio-attach` utility requires that the ioMemory VSL software is loaded and that the device is already detached. Refer to *`fio-detach`* for details on detaching a device.

Description

Attaches the IBM High IOPS Adapter and makes it available to the operating system. This creates a block device. You can then add it to ESX(i) as a storage area. The command displays a progress bar and percentage as it operates.

Syntax

```
fio-attach <device> [options]
```

where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, etc. For example, `/dev/fct0` indicates the first IBM High IOPS Adapter installed on the system. Use *`fio-status`* to view these.

Option	Description
`-r`	Force a metadata rescan. This may take an extended period of time, and is not normally required. Attention Only use this option when directed by Customer Support.
`-c`	Attach only if clean.
`-q`	Quiet: disables the display of the progress bar and percentage.

Notes

If a device attaches, but the claiming process hangs, then one or more of the devices may not have been properly unclaimed when they were previously detached. The improperly unclaimed device(s) are preventing other devices from being claimed.

To solve this issue, attempt to attach each of the other devices individually. This will claim the device or devices that were improperly unclaimed and allow the hung device to proceed with attaching. You may then run `fio-detach`, if desired, on any devices to detach them again.

fio-beacon

Description

Lights the IBM High IOPS Adapter's three LEDs to locate the device. You should first detach the IBM High IOPS Adapter and then run `fio-beacon`. See *Common Maintenance Tasks* for best detach practices.

Syntax

```
fio-beacon <device> [options]
```

where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, etc. For example, `/dev/fct0` indicates the first IBM High IOPS Adapter installed on the system. This devices node is visible using *`fio-status`*.

Options	Description
`-0`	Off: (Zero) Turns off the three LEDs.
`-1`	On: Lights the three LEDs.
`-p`	Prints the PCI bus ID of the device at `<device>` to standard output. Usage and error information may be written to standard output rather than to standard error.

fio-bugreport

Description

Prepares a detailed report of the device for use in troubleshooting problems.

Syntax

```
fio-bugreport
```

Notes

This utility captures the current state of the device. When a performance or stability problem occurs with the device, run the `fio-bugreport` utility and contact Customer Support at *http://www.ibm.com/systems/support* for assistance in troubleshooting.

The output will indicate where the bugreport is saved.

Attention **Upload Report**: For best results, do not email the bug report file. Instead please create a case (by emailing Customer Support), and then upload the report to the case using a web browser.

Sample Output

```
~ # fio-bugreport
VMkernel-5.0.0
Report output: /var/tmp/fio-bugreport-20111006.223733-sc07HE.tar.gz
OS: VMware-ESXi-5.0.0

...

Building tar file...

Please attach the bugreport tar file
    /var/tmp/fio-bugreport-20111006.173256-sc07HE.tar.gz
  to your support case, including steps to reproduce the problem.
  If you do not have an open support case for this issue, please open a
support
  case with a problem description and then attach this file to your new
case.
```

For example, the filename for a bug report file named `fio-bugreport-20111006.173256-sc07HE.tar.gz` indicates the following:

- Date (20111006)
- Time (173256, or 17:32:56)
- Misc. information (`sc07HE.tar.gz`)

fio-detach

Description

Detaches the IBM High IOPS Adapter. By default, the command displays a progress bar and percentage as it completes the detach.

Unmounting the Device

Attention **Read Carefully**: Read the following instructions carefully. Detaching a device while mounted, or under use, can cause errors, data loss and/or corruption.

In most cases, we do **not** recommend using the `fio-detach` utility to ensure that a device is detached. Instead, as a best practice, follow the instructions in the *Common Maintenance Tasks* section on disabling auto-attach as a safe detach workaround.

Syntax

```
fio-detach <device> [options]
```

where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, etc. For example, `/dev/fct0` indicates the first IBM High IOPS Adapter installed on the system.

Options	Description
`-q`	Quiet: Disables the display of the progress bar and percentage.

Notes

Attempting to detach an IBM High IOPS Adapter may fail with an error indicating that the device is busy. This typically may occur if the IBM High IOPS Adapter is in use by VM or other process, or some process has the device open.

fio-format

Attention The `fio-format` utility requires that the ioMemory VSL software be loaded with the IBM High IOPS Adapter(s) detached. Refer to ***`fio-detach`*** for details.

Description

Performs a low-level format of the device. By default, `fio-format` displays a progress-percentage indicator as it runs.

Attention Use this utility with care, as it deletes all user information on the device. You will be prompted as to whether you want to proceed with the format.

NOTE VMFS (VMware File System), the filesystem employed byESX(i), requires 512 byte sector size.

NOTE If you do not include the `-s` or `-o` options, the device size defaults to the advertised capacity. If used, the `-s` and `-o` options must include the size or percentage indicators.

Attention Do not interrupt the formatting! We recommend adding power backup to your system to prevent power failures during formatting. If formatting is interrupted, please contact Customer Support.

Syntax

```
fio-format [options] <device>
```

where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, etc. For example, `/dev/fct0` indicates the first IBM High IOPS Adapter installed on the system.

Options	Description

`-b <size B|K>`	Set the block (sector) size, in bytes or KiBytes (base 2). The default is 512 bytes. For example: `-b 512B` or `-b 4K` (`B` in `512B` is optional). Attention ESX(i) only supports 512b sector sizes for use in VMFS datastores. Do not format your IBM High IOPS Adapter with any other sector size if you plan to use VMFS. If you are passing the device through to a VM (using VMDirectPathIO), then the guest VM can use any sector size appropriate for the the guest OS. In this case, formatting is done in the guest.
`-f`	Force the format size, bypassing normal checks and warnings. This option may be needed in rare situations when `fio-format` does not proceed properly. (The "Are you sure?" prompt still appears unless you use the `-y` option.)
`-q`	Quiet mode: Disable the display of the progress-percentage indicator.
`-s <size M|G|T|%>`	Set the device capacity as a specific size (in TB, GB, or MB) or as a percentage of the advertised capacity, for example: • `T` Number of terabytes (TB) to format • `G` Number of gigabytes (GB) to format • `M` Number of megabytes (MB) to format • `%` Percentage, such as 70% (the percent sign must be included).
`-o <size B|K|M|G|T|%>`	Over-format the device size (to greater than the advertised capacity), where the maximum size equals the maximum physical capacity. If a percentage is used, it corresponds to the maximum physical capacity of the device. (Size is required for the `-o` option; see the `-s` option above for size indicator descriptions.) Attention Before you use this option, please discuss your use case with Customer Support.
`-R`	Disable fast rescan on unclean shutdown to reclaim some reserve capacity.
`-y`	Auto-answer "yes" to all queries from the application (bypass prompts).

You must re-attach the device in order to use the IBM High IOPS Adapter. See *fio-attach* for details.

fio-pci-check

Description

Checks for errors on the PCI bus tree, specifically for IBM High IOPS Adapters. This utility displays the current status of each IBM High IOPS Adapter. It also prints the standard PCI Express error information and resets the state.

NOTE It is perfectly normal to see a few errors (perhaps as many as five) when `fio-pci-check` is initially run. Subsequent runs should reveal only one or two errors during several hours of operation.

Syntax

```
fio-pci-check [options]
```

Options	Description
`-d <value>`	1 = Disable the link; 0 = bring the link up (Not recommended)
`-f`	Scan every device in the system.
`-i`	Print the device serial number. This option is invalid when the ioMemory VSL software is loaded.
`-r`	Force the link to retrain.
`-v`	Verbose: Print extra data about the hardware.

fio-status

Description

Provides detailed information about the installed devices. This utility operates on either `fctx` or `fiox` devices. The utility depends on running as root and having the ioMemory VSL driver loaded. If no driver is loaded, a smaller set of status information is returned.

`fio-status` provides alerts for certain error modes, such as a minimal-mode, read-only mode, and write-reduced mode, describing what is causing the condition.

Syntax

```
fio-status [<device>] [<options>]
```

where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, etc. For example, `/dev/fct0` indicates the first IBM High IOPS Adapter installed on the system.

If `<dev>` is not specified, `fio-status` displays information for all cards in the system. If the ioMemory VSL driver is not loaded, this parameter is ignored.

Options	Description
`-a`	Report all available information for each device.
`-e`	Show all errors and warnings for each device. This option is for diagnosing issues, and it hides other information such as format sizes.
`-c`	Count: Report only the number of IBM High IOPS Adapters installed.
`-d`	Show basic information set plus the total amount of data read and written (lifetime data volumes). This option is not necessary when the -a option is used.
`-fj`	Format JSON: creates the output in JSON format.
`-fx`	Format XML: creates the output in XML format.
`-u`	Show unavailable fields. Only valid with `-fj` or `-fx`.

`-U`	Show unavailable fields and details why. Only valid with `-fj` or `-fx`. NOTE Some `fio-status` fields are unavailable depending on the operating system or device. For example, some legacy fields are unavailable on newer IBM High IOPS Adapters.
`-F<field>`	Print the value for a single field (see the next option for field names). Requires that a device be specified. Multiple `-F` options may be specified.
`-l`	List the fields that can be individually accessed with `-F`.

Attention **Output Change**: The standard formatting of `fio-status` ouput has changed compared to the output from ioMemory VSL software version 2.x. This will affect any custom management tools that used the output of this utility.

Basic Information: If no options are used, `fio-status` reports the following basic information:

- Number and type of devices installed in the system
- ioMemory VSL software version

Adapter information:

- Adapter type
- Product number
- External power status
- PCIe power limit threshold (if available)
- Connected IBM High IOPS Adapters

Block device information:

- Attach status
- Product name
- Product number
- Serial number
- PCIe address and slot
- Firmware version
- Size of the device, out of total capacity
- Internal temperature (average and maximum, since ioMemory VSL software load) in degrees Centigrade
- Health status: healthy, nearing wearout, write-reduced or read-only
- Reserve capacity (percentage)
- Warning capacity threshold (percentage)

Data Volume Information: If the -d option is used, the following data volume information is reported *in addition* to the basic information:

- Physical bytes written
- Physical bytes read

All Information: If the `-a` option is used, all information is printed, which includes the following information *in addition* to basic and data volume information:

Adapter information:

- Manufacturer number
- Part number
- Date of manufacture
- Power loss protection status
- PCIe bus voltage (avg, min, max)
- PCIe bus current (avg, max)
- PCIe bus power (avg, max)
- PCIe power limit threshold (watts)
- PCIe slot available power (watts)
- PCIe negotiated link information (lanes and throughput)

Block device information:

- Manufacturer's code
- Manufacturing date
- Vendor and sub-vendor information
- Format status and sector information (if device is attached)
- FPGA ID and Low-level format GUID
- PCIe slot available power
- PCIe negotiated link information
- Card temperature, in degrees Centigrade
- Internal voltage (avg and max)
- Auxiliary voltage (avg and max)

- Percentage of good blocks, data and metadata
- Lifetime data volume statistics
- RAM usage

Error Mode Information: If the ioMemory VSL software is in minimal mode, read-only mode, or write-reduced mode when `fio-status` is run, the following differences occur in the output:

- Attach status is "Status unknown: Driver is in MINIMAL MODE:"
- The reason for the minimal mode state is displayed (such as "Firmware is out of date. Update firmware.")
- "Geometry and capacity information not available." is displayed.
- No media health information is displayed.

fio-update-iodrive

Description

Attention Your IBM High IOPS Adapters must be detached before running `fio-update-iodrive`. See *`fio-detach`* for details or *Common Maintenance Tasks* for information on disabling auto-attach.

Updates the IBM High IOPS Adapter's firmware. This utility scans the PCIe bus for all IBM High IOPS Adapters and updates them. A progress bar and percentage are shown for each device as the update completes.

To update one or more specific devices:

- Make sure the ioMemory VSL software is loaded.
- Use the `-d` option with the device number.

Attention It is extremely important that the power not be turned off during a firmware upgrade, as this could cause device failure. If a UPS is not already in place, consider adding one to the system prior to performing a firmware upgrade.

Attention Note that when running multiple upgrades in sequence, it is critical to reboot the system after each upgrade. Otherwise the on-device format will not be changed, and there will be data loss.

Attention Do not use this utility to downgrade the IBM High IOPS Adapter to an earlier version of the firmware. Doing so may result in data loss and void your warranty. Contact Customer Support at *http://www.ibm.com/systems/support* if you need to downgrade your firmware.

Attention The default action (without using the `-d` option) is to upgrade all IBM High IOPS Adapters with the firmware contained in the `fusion_<version>-<date>.fff` firmware archive file. Confirm that all devices need the upgrade prior to running the update. If in doubt, use the `-p` (Pretend) option to view the possible results of the update.

Attention **Upgrade Path**: There is a specific upgrade path that you must take when upgrading IBM High IOPS Adapter. Consult the *IBM ioMemory VSL Release Notes* for this ioMemory VSL software release before upgrading IBM High IOPS Adapters.

NOTE If you receive an error message when updating the firmware that instructs you to update the midprom information, contact Customer Support.

NOTE When using VMDirectPathIO, if you upgrade the firmware on an IBM High IOPS Adapter, you must cycle the server power to have the change take place. Just restarting the virtual machine won't apply the change.

Syntax

```
fio-update-iodrive [options] <firmware-path>
```

where `<firmare-path>` is the full path to the firmware archive file (`highiops_<version>-<date>.fff`) available at *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**). The firmware archive path will depend on where it is located on the ESX(i) host. For example, you could transfer the archive to a folder on a datastore and then use the path to the file in that folder.

Options	Description
`-d`	Updates the specified devices (by `fctx`, where *x* is the number of the device shown in `fio-status`). If this option is not specified, all devices are updated. Attention Use the `-d` option with care, as updating the wrong IBM High IOPS Adapter could damage your device.
`-f`	Force upgrade. Attention Use the -f option with care, as it could damage your card.
`-l`	List the firmware available in the archive.
`-p`	Pretend: Shows what updates would be done. However, the actual firmware is not modified.
`-c`	Clears locks placed on a device.
`-y`	Confirm all warning messages.
`-q`	Runs the update process without displaying the progress bar or percentage.

If you arrived at this section from the *Upgrading the Firmware* section of the installation instructions, you should return to that section.

Appendix B- Monitoring the Health of IBM High IOPS Devices

This section describes how the health of IBM High IOPS Adapters can be measured and monitored in order to safeguard data and prolong device lifetime.

NAND Flash and Component Failure

An IBM High IOPS Adapter is a highly fault-tolerant storage subsystem that provides many levels of protection against component failure and the loss nature of solid-state storage. As in all storage subsystems, component failures may occur.

By proactively monitoring device age and health, you can ensure reliable performance over the intended product life.

Health Metrics

The ioMemory VSL software manages block retirement using pre-determined retirement thresholds. `fio-status` (or the optional remote management software) shows a health indicator that starts at 100 and counts down to 0. As certain thresholds are crossed, various actions are taken.

At the 10% healthy threshold, a one-time warning is issued. See the *Health Monitoring Techniques* section below for methods for capturing this alarm event.

At 0%, the device is considered unhealthy. It enters *write-reduced* mode, which somewhat prolongs its lifespan so data can be safely migrated off. In this state the IBM High IOPS Adapter behaves normally, except for the reduced write performance.

After the 0% threshold, the device will soon enter *read-only* mode – any attempt to write to the IBM High IOPS Adapter causes an error. Some filesystems may require special mount options in order to mount a read-only block device in addition to specifying that the mount should be read-only.

Read-only mode should be considered a final opportunity to migrate data off the device, as device failure is more likely with continued use.

The IBM High IOPS Adapter may enter failure mode. In this case, the device is offline and inaccessible. This can be caused by an internal catastrophic failure, improper firmware upgrade procedures, or device wearout.

NOTE For service or warranty-related questions, contact the company from which you purchased the device.

NOTE For products with multiple IBM High IOPS Adapters, these modes are maintained independently for each device.

Health Monitoring Techniques

`fio-status`: Output from the `fio-status` utility shows the health percentage and device state. These items are referenced as `Media status`.

The following Health Status messages are produced by the `fio-status` utility:

- Healthy
- Read-only
- Reduced-write
- Unknown

Appendix C- Using Module Parameters

The following table describes the module parameters you can set using the `esxcfg-module` command.

Attention The the remote option (`--server`) is only required for the vCLI.
Sample Command:

```
esxcfg-module --server <server-name> iomemory-vsl -s '<parameter>=<value>'
```

NOTE You must reboot the ESX(i) system to enforce any parameter changes.

Module Parameter	Default Value (min/max)	Description
`auto_attach`	1	1 = Always attach the device on driver load. 0 = Don't attach the device on driver load.
`force_minimal_mode`	0	1 = Force minimal mode on the device. 0 = Do not force minimal mode on the device.
`parallel_attach`	1	1 = Enable parallel attach of multiple devices. 0 = Disable parallel attach of multiple devices.
`tintr_hw_wait`	0 (0, 255)	Interval (microseconds) to wait between hardware interrupts. Also known as interrupt coalescing. 0 is off.

NOTE module parameters are global—they apply to all IBM High IOPS Adapters in the computer.

To query the current module parameters, use the following command:

```
esxcfg-module --server <server-name> iomemory-vsl -g
```

Appendix D- Working with IBM High IOPS Devices and VMDirectPathIO

Each IBM High IOPS Adapter can either be used as a VMFS datastore in ESX(i), or they can be passed through directly to a virtual machine. In VMware documentation this is often referred to as VMDirectPathIO and is commonly referred to as PCI passthrough.

Attention If you are passing the device(s) through, you do not need to install the ioMemory VSL software on the ESX(i) system. Instead, install the software on the guest system. Only install the ioMemory VSL software on the host if you plan on creating a VMFS on the device(s).

NOTE When using VMDirectPathIO, if you upgrade the firmware on an IBM High IOPS Adapter, you must cycle the power to have the change take place. Just restarting the virtual machine won't apply the change.

Using Products with Multiple Devices

Some products contain multiple devices, such as the IBM High IOPS Duo Adapter. The ioMemory VSL does not support splitting the modules between two functions or virtual machines. The following scenarios are supported:

- Both IBM High IOPS Adapters are used as a VMFS datastore in ESX(i).
- Both IBM High IOPS Adapters are passed through to the same virtual machine (using VMDirectPathIO).

Appendix E- Upgrading Devices from VSL 2.x to 3.x

This version of the ioMemory VSL software supports new features, including the latest generation of High IOPS architecture and improved Flashback protection. These features require the latest version of the IBM firmware. Every IBM High IOPS Adapter in a system running 3.1.x or later must be upgraded to the latest version of the firmware.

For example, if you have a system running 2.x ioMemory VSL software with IBM High IOPS Adapters previously installed, and you want to install new IBM High IOPS Adapters (that require the latest version of the firmware), then you will need to upgrade all of the existing devices to the latest firmware version.

Attention You cannot revert a device's firmware to an earlier version once you have upgraded the device (without voiding your warranty). If you experience problems with your upgrade, please contact Customer Support at *http://www.ibm.com/systems/support*.

Attention Upgrading devices (previously configured for VSL 2.x.x) to work with VSL 3.x.x will require a low-level media format of the device. No user data will be maintained during the process. Be sure to backup all data as instructed.

Attention **Upgrade Path**: Depending on the current firmware version of your devices, you may need to upgrade your device's firmware multiple times in order to preserve internal structures. Consult the ioMemory VSL software for the upgrade path. Visit *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**) for all of the required software and firmware versions.

For more information on upgrading from one version to the next, see the *IBM ioMemory VSL Release Notes* (available at *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**)) for the version you will upgrade the device to. Then follow the upgrade instructions in that version's user guide for your operating system (including the firmware update instructions).

Upgrade Procedure

Be sure to follow the upgrade path. Make sure that all previously installed IBM High IOPS Adapters are updated with the appropriate firmware.

Attention Upgrade on all existing IBM High IOPS Adapters **before** installing the new IBM High IOPS Adapters.

1. Prepare each existing IBM High IOPS Adapter for upgrade.
    a. Backup user data on each device.

    Attention The upgrade process will require a low-level media format of the device. No user data will be maintained during the process; be sure to make a complete backup.

    Use a backup method of your choice. For best results, use software and backup devices that have proven effective in the past. Do not backup the data onto another IBM High IOPS Adapter on the same system. The back up must be to a local disk or to an externally attached volume.

    b. Run the *fio-bugreport* TSM command-line utility and save the output. This will capture the device information for each device in the system. This device information will be useful in troubleshooting any upgrade issues. Sample command:

```
fio-bugreport
```

2. Uninstall the 2.x ioMemory VSL software:
    a. Stop all of the virtual machines and put the host in maintenance mode.
    b. Follow the instructions for your platform:
        i. ESXi 5.x uninstall vCLI command:

```
esxcli --server <servername> software vib remove -n
block-iomemory-vsl
```

        ii. ESXi 4.x uninstall vCLI procedure:
            1. Determine the bundle "bulletin" ID:

```
vihostupdate --server <server-name> --query
```

            Sample output:

```
---------Bulletin ID--------- -----Installed-----
----------------Summary-----------------
iomemory-vsl-2.2.0.7601742 2011-02-08T10:37:05
iomemory-vsl: block driver for ESXi 4.1.X
```

            2. Remove the "bulletin" containing the driver & utilities:

```
vihostupdate --server <server-name> --remove --bulletin
<Bulletin-ID>
```

        iii. ESX 4.x uninstall procedure:
            1. Enter the following command to determine the Bulletin ID of any previously installed versions:

```
esxupdate query
```

            Sample Output

```
------Bulletin ID------ -----Installed-----
--------------------Summary---------------------
iomemory-vsl-3.0.6.360  2012-01-16T03:49:33
iomemory-vsl: block driver for ESX/ESXi 4.X
```

            2. Run the following command to remove installed version(s):

```
esxupdate -b <Bulletin-ID> remove
```

3. Install the new ioMemory VSL software and related packages.
    a. Download the ioMemory VSL offline bundle, firmware, and (optional) CIM provider from *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**). For more information, see the section *Downloading the Software* at the beginning of this guide.

    b. Install the ioMemory VSL software and utilities. Follow the instructions in one of the following sections, then return to this procedure:

        NOTE Be sure to follow the suggestion to copy over the firmware file to the ESX(i) host, and make note of the firmware location.

        - *Installing the ioMemory VSL on ESX(i) 4.x*
        - *Installing the ioMemory VSL on ESXi 5.x*

    c. Reboot the system.

4. Update the firmware on each device to the latest version using the `fio-update-iodrive` TSM/COS command-line utility.

    Attention **Prevent Power Loss**: Take measures to prevent power loss during the update, such as a UPS. Power loss during an update may result in device failure. For all warnings, alerts, and options pertaining to this utility, see the `fio-update-iodrive` utility reference in the appendix.

    NOTE If you are updating a device within an ESX(i) 4.x host, you may choose to use the remote management option instead, see *Installing Optional Remote Management Software*.

    Sample syntax:

    ```
    fio-update-iodrive [options] <firmware-path>
    ```

    where `<firmare-path>` is the full path to the firmware archive file (`highiops_<version>-<date>.fff`) available at *http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723* (follow that link and then select **IBM High IOPS software matrix**). This command will update all of the devices to the selected firmware. If you wish to update specific devices, consult the *utility reference* for more options.

5. Reboot the system

    NOTE If run, `fio-status` will warn that the upgraded devices are missing a `lebmap`. This is expected, and will be fixed in the next step.

    Attention **Destructive Step**: Running `fio-format` (or formatting using the remote management option) in the next step will erase the entire device, including user data. Once this format is started, the device cannot be downgraded to the 2.x ioMemory VSL software without voiding your warranty. If you experience problems with your upgrade, please contact Customer Support at *http://www.ibm.com/systems/support*.

6. Format each device using `fio-format` or the remote management option, for example:

```
fio-format <device>
```

   You will be prompted to confirm you wish to erase all data on the device.

   Attention The format may take an extended period of time, depending on the wear on the device.

7. Attach all IBM High IOPS Adapters by running `fio-attach` for each device, for example:

```
fio-attach /dev/fct1
```

8. Check the status of all devices using `fio-status` (or the remote management option), for example:

```
fio-status -a
```

Your IBM High IOPS Adapters have now been successfully upgraded for this version of the ioMemory VSL software. You may now install any IBM High IOPS Adapters.

IBM Support

IBM High IOPS Adapter software and documentation are available on the web at the following address:

http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723 (follow that link and then select **IBM High IOPS software matrix**).

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