Fusion ioMemory™ VSL® 4.1.2

Release Notes

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Introduction

This document describes details about the 4.1.2 Fusion ioMemory™ VSL® software release:

- System requirements, including supported operating systems and hardware requirements.
- Upgrade Notes, including the firmware version required for this release.
- Changes since the last generally available release.
- Issues that may arise using this release.

NOTE-

Throughout this document, when you see a reference to any io3 Flash Adapter, you may substitute your particular device(s) from the list of See Supported Devices on page 8.

System Requirements

This section outlines the hardware requirements, supported devices, and supported operating systems for this release of the Fusion ioMemory VSL software.

Hardware Requirements

NOTE-

For complete hardware requirements and installation instructions, please refer to the *io3 Flash Adapter Hardware Installation Guide*.

NOTE-

For the latest System x server configuration information and requirements for io3 Flash Adapters, please see the URL below:
http://www.ibm.com/support/entry/portal/docdisplay?lndocid=SERV-IO3

Sufficient System Memory (RAM)

The amount of RAM the Fusion ioMemory VSL software requires varies according to the average block size written to the device. Using the average block size table below, you can estimate the amount of system memory needed.

Sector Sizes

Depending on your operating system, you can reduce worst-case memory use by formatting your io3 Flash Adapter with a 4096-byte sector size and thereby force the average written block size to be 4096 bytes (4KiB) or greater. However, some operating systems do not allow 4KiB sector sizes.

io3 Enterprise Value Adapters and io3 Enterprise Adapters ship with 4KiB sector sizes.

Attention!

512B-only Support
Some applications and operating systems will only work with 512B sector sizes. These operating systems include: VMware ESXi.

Consult the `fio-format` section for your operating system's *Fusion ioMemory VSL User Guide* for more information.

Attention!

Windows 4KiB Support
While Microsoft does not officially support 4KiB sector sizes with Windows Server 2008 R2, 4KiB sector sizes do work with many applications. The performance benefit of 4KiB sectors is significant enough in Windows operating systems that we recommend testing 4KiB sectors for use with your application.

Microsoft does support 4KiB sector sizes on Windows Server 2012.

Even if you cannot use a device formatted with native 4KiB sector sizes, the average write I/O size for most workloads is 4KiB or larger. For this reason, 4KiB average write size is typically the most accurate representation of memory utilization.

Maximum RAM Requirements

The amount of RAM required by the Fusion ioMemory VSL software depends on the io3 Flash Adapter capacity, formated sector size, and how it is used. This section describes the upper limit of RAM that may be required of your system in a worst-case scenario.

	Worst case GB of RAM Required for Formatted Block Sizes (bytes)			
Device Capacity	**4096-byte Blocks**	**2048-byte Blocks**	**1024-byte Blocks**	**512-byte Blocks**
1.0TB	2.4GB	4.7GB	9.2GB	18.2GB
1.25TB	3.0GB	5.8GB	11.4GB	22.6GB
1.3TB	3.1GB	6.0GB	11.8GB	23.5GB
1.6TB	3.7GB	7.3GB	14.5GB	28.8GB
2.6TB	6.0GB	11.8GB	23.5GB	46.9GB
3.2TB	7.3GB	14.5GB	28.8GB	57.8GB

5.2TB	11.7GB	23.3GB	46.4GB	92.6GB
6.4TB	14.3GB	28.5GB	59.9GB	113.7GB

For example, if your system is equipped with a device that has a total capacity of 3200GB (3.2TB) **formatted to use 4096 byte sectors**, your system may require as much as **7.3GB of system RAM** in a worst-case scenario.

Attention!

The amount of RAM used by the Fusion ioMemory VSL software will depend on your use case; the table entries above are worst-case numbers. Actual RAM usage will likely be less than the amount listed.

You may run `fio-status -a` on the command line to see how much RAM the Fusion ioMemory VSL software is using per io3 Flash Adapter.

Supported Devices

io3 Enterprise Value Adapter

- 1250GB Enterprise Value io3 Flash Adapter
- 1600GB Enterprise Value io3 Flash Adapter
- 3200GB Enterprise Value io3 Flash Adapter
- 6400GB Enterprise Value io3 Flash Adapter

io3 Enterprise Adapter

- 1000GB Enterprise io3 Flash Adapter
- 1300GB Enterprise io3 Flash Adapter
- 2600GB Enterprise io3 Flash Adapter
- 5200GB Enterprise io3 Flash Adapter

NOTE-

The Supported Devices referenced in this documentation are referred to throughout as io3 Flash Adapters. Substitute your particular adapter for io3 Flash Adapter when referenced in this documentation.

Supported Operating Systems

All operating systems must be 64-bit and they must be x86 architecture to support io3 Flash Adapters. Running the latest service pack / update of a release is strongly recommended.

Supported Microsoft Windows Operating Systems

- Microsoft Windows Server 2008 R2 SP1 64-Bit
- Microsoft Windows Server 2012

- Microsoft Windows Server 2012 R2
- Microsoft Hyper-V Server 2012
- Microsoft Hyper-V Server 2012 R2

NOTE-

io3 Flash Adapters cannot be used as hibernation devices.

Hyper-V support

Hyper-V, as a Type 2 hypervisor on top of Windows Server 2008 R2, Windows Server 2012, or Windows Server 2012 R2, is supported.

Attention!

With Hyper-V on Windows Server 2008 R2, only a 512B sector size is supported on io3 Flash Adapters. For more information on sector sizes in Windows, see the following Microsoft Knowledge Base article:http://support.microsoft.com/kb/2510009.

Supported Linux Distributions

Attention!

The following distributions are supported. Some distribution versions may have binary packages available for download. If your version does not have a binary package available, you can build the installation package from the available source package. Check the download folders for available packages.

- Red Hat Enterprise Linux 5 (up to 5.11), 6 (up to 6.6), 7.0
- SUSE Linux Enterprise Server (SLES) 11, 11 SP2, 11 SP3, 12

Supported VMware Operating Systems

- ESXi 5.1
- ESXi 5.5

Attention!

When using a VMware operating system, only a 512B sector size is supported on io3 Flash Adapters.

NOTE-

All ESXi updates are supported unless otherwise specified.

NOTE-

Only SCSI versions of the Fusion ioMemory VSL software for ESXi are supported.

io3 Flash Adapters are only compatible with operating systems that are 64-bit x86 architecture. This means the following scenarios are supported:

1. Using the io3 Flash Adapter as VMFS datastore or cache device (including VSAN) 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 io3 Flash Adapter.
2. Using VMDirectPathIO, allow a virtual machine to directly use the io3 Flash Adapter. In this case, only supported operating systems can use the device.

Attention!

VMDirectPathIO is currently supported on Windows and Linux operating systems that are supported by SanDisk.

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

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

Upgrade Notes

This version of the Fusion ioMemory VSL software only supports io3 Enterprise Adapters and io3 Enterprise Value Adapters, and it does not support devices that were compatible with Fusion ioMemory VSL software version 3.x.x or earlier.

Firmware Version

Use the firmware archive file that is released with this version of the Fusion ioMemory VSL software. The archive file `fio-firmware-highiops-<version>.<date>.fff` contains the controller firmware version `8.7.6.117378` for all io3 Flash Adapters.

If the current controller firmware version on any device is lower than the version number listed above, we recommend upgrading to the latest version. We recommend using this version or newer.

Do Not Downgrade Device Firmware

Attention!

Do not downgrade the io3 Flash Adapter to an earlier version of the firmware. Earlier versions of the firmware are not compatible with the device, and downgrading the firmware will result in data loss. If you have issues with your firmware upgrade, contact Customer Support http://www.ibm.com/systems/support for compatibility information and to discuss your use case.

Change Log

4.1.2 Change Log

In addition to various improvements, the following are changes made to the Fusion ioMemory VSL software since version 4.1.1, including:

General Changes

General Improvements and Features

- Updated supported operating systems. See See Supported Operating Systems on page 8 for details.
- Improved how multiple Fusion ioMemory VSL software utilities simultaneously access io3 Flash Adapters.
- Augmented the fio-status utility JSON output to include FPGA firmware version.

Fixed General Issues

- Misleading debug messages

Issue	The Fusion ioMemory VSL software printed misleading debug messages in the system log. For example: `Suspect pad <number> on bank <number> checked: at least <percentage> retired.`
Resolution	These misleading messages no longer appear.

- Rare Powercut issue

Issue	In the rare instance that the Fusion ioMemory VSL software was erasing a block on the device during a powercut event, the device could fail to properly write pending data. The device would then require a rescan or not properly attach.
Resolution	Devices now abort erases and properly handle the powercut flush in these instances.

- Erroneous power throttling messages

Issue	The Fusion ioMemory VSL software reported power throttling messages for io3 Enterprise Value Adapters when the devices were not throttled.
Resolution	These erroneous messages no longer appear.

- Issues with non-0 PCI domains

Issue	The Fusion ioMemory VSL software utilities, especially the fio-pci-check utility, did not properly handle non-0 PCI domains.
Resolution	The utilities now handle multiple PCI domains.

- Erroneous hardware configuration messages

Issue	Erroneous error message "unable to configure hardware" with no actual hardware failure.
Resolution	Suppressed erroneous error message.

- Ignored interrupts

Issue	Due to a race condition, the Fusion ioMemory VSL software could ignore a hardware interrupt for up to 10ms.
Resolution	This race condition has been removed.

- Channel failures causing crashes

Issue	An operating system would crash when an io3 Flash Adapter experienced a channel failure in a system with multiple io3 Flash Adapters
Resolution	The kernel will no longer crash when an io3 Flash Adapter experiences this failure.

- Kernel panics in minimal mode

Issue	An unlikely kernel panic may occur when io3 Flash Adapters are in minimal mode
Resolution	The kernel no longer panics in this scenario.

Windows Changes

Fixed Windows Issues

- Irrelevant messages

Issue	Irrelevant Windows driver memory management messages were displayed. For example: `,FusionEventDriver,4,(2),"Alloc memory chunk FFFFEC022B600000, size = 134217728 bytes, pages = 32768"`
Resolution	These messages no longer appear.

- Multiple instances of fio-detach caused hangs

Issue	Running the fio-detach utility on multiple devices at the same time in Windows would cause the utility to hang.
Resolution	You can now run multiple instances of this utility in parallel.

Linux Changes

Linux Changes

- Improved logging for invalid Linux I/O requests.

Fixed Linux Issues

- Driver load issues

Issue	Updating the system kernel or Fusion ioMemory VSL software would insert the Fusion ioMemory VSL software into the `initrd` and ignore the software configuration file (`/etc/modprobe.d/iomemory-vsl.conf`). This issue created software loading issues that required dracut to fix.
Resolution	Multiple solutions to this configuration issue: 1. If DKMS is installed and configured the Fusion ioMemory VSL software is configured for the new kernel. 2. If `dracut` is installed, the Fusion ioMemory VSL software uses that program to fix the configuration issue. 3. If both the `fio-sysvinit` and `fio-common` packages are installed, the Fusion ioMemory VSL software is excluded from the `initrd`.

- Watchdog poll counter

Issue	The `saved_by_watchdog_poll` counter did not increment.
Resolution	The `saved_by_watchdog_poll` now increments properly.

- Unnamed threads

Issue	Fusion ioMemory VSL block threads were not matched to specific devices and the device names were replaced with question marks. For example, **`fio?`**:
	`root 25205 0.0 0.0 0 0 ? S Aug28 0:00 [fio?-scan]`
	`root 25206 0.0 0.0 0 0 ? S Aug28 0:00 [fio?-sselect]`

Resolution	The threads are now properly named.

- Improper shutdowns

Issue	Certain io3 Flash Adapter failures in combination with the parameter `use_work_queue=3` will cause the Fusion ioMemory VSL software to fail to shut down properly.
Resolution	The Fusion ioMemory VSL software now shuts down properly under these conditions.

- 3.16 kernel Support

Issue	The Fusion ioMemory VSL software would not build for the 3.16 Linux kernel.
Resolution	The software will now build on the 3.16 kernel.

- Build error

Issue	Attempting to build the Fusion ioMemory VSL software for the `2.6.39-400.215.10.el5uek` kernel or newer would fail with the following error: `WARNING: /lib/modules/2.6.39-400.215.10.el5uek/extra/fio/iomemory-vsl4.ko needs unknown symbol kfio_bio_alloc_chain`
Resolution	The software now builds with this kernel and newer.

Solaris Changes

Fixed Solaris Issues

- Fixed CPU usage

Issue	The reported Fusion ioMemory VSL software CPU consumption on Solaris was 100%.
Resolution	The reported/actual CPU consumption on Solaris is now decreased.

- Issue when compiling the software

Issue	The Fusion ioMemory VSL software for Solaris would fail to load due to an installation script error.
Resolution	The Fusion ioMemory VSL software now loads properly.

Known Issues

This section describes issues you may encounter when using this Fusion ioMemory VSL release.

General

Don’t disable or enable (decrease or increase) the number of active CPUs after loading the Fusion ioMemory VSL driver

If you plan to take any CPUs offline or online (including disabling or enabling Hyper-Threading Technology), you should do so before the Fusion ioMemory VSL driver loads and begins to use the available CPUs. If you disable or enable any CPUs that were being used by the Fusion ioMemory VSL software, then the software may hang.

Keep default MSI-X for better performance

All io3 Flash Adapters use MSI-X message signaled interrupts. This improves performance while decreasing CPU load. However, we have observed some compatibility issues with MSI-X in certain environments.

If you are experiencing performance issues, you may want to disable MSI-X. Doing so will then enable MSI interrupts by default. If you wish to use legacy interrupts instead, you may also disable MSI intterupts

To disable either MSI-X or MSI, set the appropriate module parameter (`disable_msix` or`disable_msi`) value to `1`. For examples on setting module parameters, please see the **Module Parameter** appendix in the *Fusion ioMemory VSL User Guide* for your platform (all platforms except Windows).

NOTE-

Disabling MSI in Windows
If you must disable MSI in Windows, edit the `MSISupported` registry entry. You cannot disable just MSI-X in Windows. If you need to disable MSI-X, you must disable both MSI and MSI-X by disabling MSI. See this Microsoft article for more information:
http://msdn.microsoft.com/en-us/library/windows/hardware/ff544246(v=vs.85).aspx

Proper Time On Startup

If the io3 Flash Adapter does not boot up with proper time set on system, this may delay starting the software as the Fusion ioMemory VSL software self-tunes to the difference between the reflected age data and actual age of data.

If the time is set backwards on a running system, this may result in decreased card performance for the lesser of 1 day or the amount the time is set backwards.

"Proper time" is within a few minutes of actual time.

Management Specific

Make sure the utilities match the Fusion ioMemory VSL software version

When you install this version of the Fusion ioMemory VSL software, ensure that you install the utilities that go with this version. Each set of utilities is designed to work with a specific version of the Fusion ioMemory VSL software.

If you use a set of utilities that does not match the Fusion ioMemory VSL software, you may see an error in the command line or logs such as `unhandled ioctl` or `Error: This version of <utility> is not compatible with the running driver`. To solve this issue, reinstall the utilities using the package with the correct version number.

Utility failed while running fio-bugreport

The `fio-bugreport` utility uses other utilities to create the report. Depending on the operating system, some of these additional utilities may not be available and `fio-bugreport` will display an error that a `fio utility failed` or was not found.

The `fio-bugreport` utility is designed to continue even if a component fails and the report will still be created.

`fio-status` may not display failed devices

On rare occasions, when an io3 Flash Adapter fails, the device may no longer appear in `fio-status`. If your device has failed, contact Customer Support.

Windows Specific

SCSI ID conflict with other storage devices

If your Windows system uses a storage device in addition to an io3 Flash Adapter, the devices may have duplicate SCSI IDs which will cause conflicts. You can resolve the conflict by changing the io3 Flash Adapter SCSI ID using the `WIN_SCSI_BUS_ID` module paramter.

This parameter sets the Windows SCSI ID number for all io3 Flash Adapters in the system to avoid conflicts with other SCSI device IDs. The default value, `0`, is off and no IDs are set. Any value between `1-254` will set the SCSI IDs for all io3 Flash Adapters in the system to that number.

> **NOTE-**
> io3 Flash Adapters do not directly use SCSI IDs, so any non-conflicting number will do.

For more information, see the fio-config documentation in the *Fusion ioMemory VSL User Guide for Windows*.

Fusion ioMemory VSL software not loading or attaching devices after install

If the Fusion ioMemory VSL software is not loading or attaching io3 Flash Adapters after installation (including an upgrade), make sure that you have rebooted the system after the installation.

If a reboot does not solve the problem, follow the manual installation procedure in the appendix of the *Fusion ioMemory VSL User Guide for Windows*. Repeat this procedure to install each device.

Linux Specific

`dracut: not found` error during installation

When you install the Fusion ioMemory VSL software on a system that does not have `dracut` installed, you will see the following error:

```
# rpm -ivh iomemory-vsl4-<version>.rpm
Preparing...                ##########################################
[100%]
   1:iomemory-vsl4-<version>-39##########################################
[100%]
/var/tmp/rpm-tmp.52200: line 12: hash: dracut: not found
```

You may safely ignore this message. The Fusion ioMemory VSL software does look for the `dracut` utility to assist in loading the Fusion ioMemory VSL software, but the utility is not required. See the Linux changes in the See Change Log on page 12 for more information on changes to how the software loads.

Error messages when installing Fusion ioMemory VSL software on RHEL 7.0

When you install the Fusion ioMemory VSL software on RHEL 7.0 you may see errors similar to the following:

```
dracut-install: ERROR: installing 'vi'
dracut-install: ERROR: installing '/etc/virc'
/usr/lib/dracut/dracut-install -D /var/tmp/initramfs.pcKkj9 -a vi
/etc/virc ps grep cat rm
rm: cannot remove '/var/tmp/dracut-log.LctCNA': Directory not empty
```

This is a known issue with RHEL 7.0, and despite the errors the software should install correctly. For more information on this issue, see https://bugzilla.redhat.com/show_bug.cgi?id=1118988

fio-firmware may incorrectly report pending firmware

In the rare case when firmware version information gets corrupted, fio-firmware will start reporting that there is pending firmware, even when there isn't. Please use fio-status to confirm that there really is pending firmware.

Upgrading the Kernel in Linux

If you ever plan to upgrade the kernel when the Fusion ioMemory VSL software is installed, you **must**:

1. Unload the Fusion ioMemory VSL driver.
2. Uninstall the Fusion ioMemory VSL software.
3. Upgrade the kernel.
4. Install the Fusion ioMemory VSL software package that is compiled for the new kernel.

Failure to follow this procedure may result in driver load issues.

Compiler Cache (`ccache`) causes Fusion ioMemory VSL software src.rpm rebuild failures on some distributions

If the `ccache` package is installed, rebuilding the Fusion ioMemory VSL software src.rpm may fail with an error similar to the following:

```
CC [M] /root/fio/iomemory-vsl-<version>/root/usr/src/iomemory-vsl/driver_
init.o /root/fio/iomemory-vsl-<version>/root/usr/src/iomemory-vsl/driver_
init.c:116: error: initializer element is not constant
[...]
```

To allow the VSL to rebuild, remove the `ccache` package or disable ccache.

Rare error on driver unload using kernels older than 2.6.24

An issue in Linux kernels prior to 2.6.24 can cause a general protection fault or other kernel error when the driver is unloaded. This issue also affects non-SanDisk drivers. The issue has been resolved in newer kernels.

Because this is an issue in the Linux kernel, SanDisk cannot resolve this issue for older kernels.

ext4 in Kernel 2.6.33 or earlier may silently corrupt data when discard (TRIM) is enabled

The ext4 filesystem in kernel.org kernel 2.6.33 and earlier has an issue where the data in a portion of a file may be improperly discarded (set to all 0x00) under some workloads. Use the 2.6.34 Linux kernel or newer to avoid this issue. For more info see the patch [1] and bug report [2] below.

The fix is included in RHEL6 as of pre-release kernel `kernel-2.6.32-23.el6`. The production RHEL6 kernel is not affected by this issue.

Discard support was added to the kernel.org mainline ext4 in the 2.6.28 Linux kernel and was enabled by default. Discard was set to default to disabled in v2.6.33-rc1 and was back ported to 2.6.31.8 and v2.6.32.1.

1. http://git.kernel.org/?p=linux/kernel/git/torvalds/linux-2.6.git;a=commitdiff;h=b90f687018e6d6
2. https://bugzilla.kernel.org/show_bug.cgi?id=15579
3. http://git.kernel.org/?p=linux/kernel/git/torvalds/linux-2.6.git;a=commitdiff;h=5328e635315734d

Kernels 2.6.34/35 don't handle switching interrupt types

Linux kernels around 2.6.34/35 may have problems processing interrupts if the Fusion ioMemory VSL driver is loaded using one interrupt type, unloaded, and then loaded again using a different interrupt type. The primary symptom is that the Fusion ioMemory device is unusable, and the kernel logs have errors with "doIRQ". For example, the following sequence on an affected system would likely result in errors.

1. Load the driver with the module parameter `disable_msi=1` which selects APIC interrupts

```
$ modprobe iomemory-vsl4 disable_msi=1
```

2. Unload the driver

```
$ modprobe -r iomemory-vsl4
```

3. Load the driver, enabling MSI interrupts

```
$ modprobe iomemory-vsl4 disable_msi=0
```

To work around this issue, reboot if you see the error and always load with the same interrupt type selected. To change between interrupt types, reboot first.

Switching interrupt types with newer kernels can cause errors

With newer Linux kernels, switching interrupt types after initial driver load can cause `doIRQ` errors to be reported by the kernel. As a work around, reboot your system before loading the driver with the new interrupt type specified.

RHEL6 udevd warning

When using an io3 Flash Adapter under RHEL6 (or any Linux distro with udev version 147 or greater), udevd may emit the following innocuous messages:

```
udevd[154]: worker [19174] unexpectedly returned with status 0x0100
udevd[154]: worker [19174] failed while handling
'/devices/virtual/block/fioa'
```

You can ignore this warning.

RHEL6 warn_slowpath during device attach

When attaching an io3 Flash Adapter under RHEL6, you may find log messages similar to the following:

```
kernel: ------------[ cut here ]------------
kernel: WARNING: at fs/fs-writeback.c:967 __mark_inode_dirty+0x108/0x160()
(Tainted: P           ---------------- )
.
.
.
[<ffffffff8106b857>] warn_slowpath_common+0x87/0xc0
```

```
[<ffffffff8106b8aa>] warn_slowpath_null+0x1a/0x20
.
.
.
```

This is due to an issue in the 2.6.32 kernel, and the warning can safely be ignored.

Do not use an io3 Flash Adapter as a `kdump` target

Do not direct `kdump` to dump the crash information to an io3 Flash Adapter. Due to the restricted memory environment in `kdump`, the Fusion ioMemory VSL software should not load in the `kdump` crashkernel and io3 Flash Adapters are not supported as `kdump` targets.

VMware Specific

Only 512B Sectors Supported

Only a 512B sector size is supported onVMware hypervisors. After you install the Fusion ioMemory VSL software, you must reformat the sectors to a 512B size on io3 Enterprise Value Adapters and io3 Enterprise Adapters before using the devices. Consult the `fio-format` section of the *Fusion ioMemory VSL User Guide* for more information.

ESXi 5.5 Rollup Driver Installer

The Rollup Driver installer for ESXi 5.5 includes version 3.2.6 of the Fusion ioMemory VSL software. If you use this version of the ESXi 5.5 installer, you will need to uninstall Fusion ioMemory VSL version 3.2.6 before you install any newer version, such as this version 4.1.2 of the Fusion ioMemory VSL software. See the *Fusion ioMemory VSL User Guide for VMware ESXi* for more information.

ESXi 5.x injected installer allows installation on an io3 Flash Adapter

io3 Flash Adapters are not designed to be bootable, therefore you should not install the host OS on an io3 Flash Adapter. The ESXi injected installer will permit you to install the OS on an io3 Flash Adapter, but the installation will fail on reboot.

vCenter cannot manage extents on io3 Flash Adapters

You cannot use vSphere vCenter to manage extents on io3 Flash Adapters, including growing or spanning extents. However, you can connect directly to the host using the vSphere client and manage extents on io3 Flash Adapters.

Download Location

Software, utilities, and related documentation for this version can be found at http://www.ibm.com/support/entry/portal/docdisplay?lndocid=MIGR-65723 (follow that link and then select **IBM io3 Flash Adapter software matrix**)