

Fusion ioMemory™ VSL® 3.2.15

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Introduction

This document describes details about the 3.2.15 Fusion ioMemory™ VSL® software release:

- System requirements, including supported operating systems and hardware requirements.
- Supported SanDisk Fusion ioMemory devices.
- 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 Fusion ioMemory device, you may substitute your particular device(s) from the list of [Supported Devices on page 13](#).

ATTENTION!

Products with Multiple Devices

Some products, such as a Fusion ioMemory ioDrive Duo device, are actually comprised of multiple Fusion ioMemory devices. If your product consists of multiple Fusion ioMemory devices, you will manage each Fusion ioMemory device as an independent device.

For example, if you have a Fusion ioMemory ioDrive Duo device, you can independently attach, detach, and/or format each of the two Fusion ioMemory devices. Each of the two devices will be presented as an individual device to your system.

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 *Fusion ioMemory Hardware Installation Guide*.

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 located in the following section, you can estimate the amount of system memory needed.

Sector Sizes

If your applications and operating system fully support 4KiB sectors, you may want to use 4KiB sectors to reduce the worst-case memory consumption. However, it is rare to see IO write sizes smaller than 4KiB, even when using 512B sector sizes. When using 4KiB sectors, the actual memory consumption will only be reduced if writes smaller than 4KiB in size are being performed on a routine basis.

When the Fusion ioMemory device is formatted to 4KiB, the Fusion ioMemory VSL software does NOT emulate 512B sectors. This means that any attempts to perform IO that is not aligned to a sector boundary and a multiple of the 4KiB sector size will result in IO errors.

All Fusion ioMemory devices supported in this release ship formatted with 512B sector sizes except the following devices: 420GB Fusion ioMemory ioFX devices, 3.2TB ioScale devices, and 3.0TB Fusion ioMemory ioDrive2 devices.

ATTENTION!

512B-only Support

Some applications and operating systems will only work with 512B sector sizes. These operating systems include: VMware ESXi, OS X, and Solaris.

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 and 2012 R2.

WARNING!

However, some applications may require 512B sector sizes. Do not implement 4KiB sectors if your application is not compatible.

Even if you cannot use a device formatted to use 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 the worst-case memory utilization.

Calculating Maximum RAM Requirements

The amount of RAM required by the ioMemory VSL software depends on the Fusion ioMemory device 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. Depending on the use, devices that have a capacity greater than 2TB may require more RAM than devices with less than 2TB of capacity.

You will need to reference the following table to calculate the maximum RAM that may be required for your device size and average written block size:

Average Written Block Size (bytes)	Devices <2TB: MB RAM per GB Capacity	Devices >2TB: MB RAM per GB Capacity
8192	1.33	1.43
4096	2.67	2.87
2048	5.34	5.73
1024	10.68	11.47
512	21.35	22.93

Using the information above and the equations below, you can calculate the maximum RAM required for each device:

Devices with <2TB Capacity:

300MB RAM + (<MB RAM per GB [see table]> * <total GB of device capacity>)

Devices with >2TB Capacity:

350MB RAM + (<MB RAM per GB [see table]> * <total GB of device capacity>)

For example, if your system is equipped with a device that has a total capacity of 1200GB **formatted to use 4096 byte sectors**, your system may require as much as:

300 MB + (2.67MB of RAM per GB) * (1200GB capacity) = **3,504MB (or around 3.5GB) of system RAM** may be used by the Fusion ioMemory VSL software in a worst-case scenario.

Note that some products, like Fusion ioMemory ioDrive2 Duo devices, have more than one Fusion ioMemory device within the product. You must calculate the RAM usage for each of those Fusion ioMemory devices.

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 Fusion ioMemory device.

Device Operating System Support

The following table shows which device types are supported for each operating system:

Device Type	Linux	Windows	ESXi	Solaris	OS X	FreeBSD
ioDrive2 Devices	X	X	X	X*	X	X
ioDrive2 Duo Devices	X	X	X	X	X	X
ioCache Devices			X			
ioFX Devices	X	X			X	

Device Type	Linux	Windows	ESXi	Solaris	OS X	FreeBSD
ioDrive Devices	X	X	X	X		X
ioDrive Duo Devices	X	X	X	X		X
ioDrive Octal Device	X	X		X		
ioScale Devices	X	X	X	X*	X	X

* The Fusion ioMemory VSL software can only present up to a 2TB volume. You must downformat 3.2TB ioScale and 3.0TB ioDrive2 devices to a 2TB volume in Solaris.

Supported Devices

This section lists the SanDisk devices that are supported with this version of the Fusion ioMemory VSL software.

ioDrive2 Devices

- 365GB MLC ioDrive2
- 785GB MLC ioDrive2
- 1205GB MLC ioDrive2
- 3.0TB MLC ioDrive2
- 400GB SLC ioDrive2
- 600GB SLC ioDrive2

ioDrive2 Duo Devices

- 1200GB SLC ioDrive2 Duo
- 2410GB MLC ioDrive2 Duo

ioCache Devices

- 600GB MLC ioCache
- 750GB MLC ioCache

ioFX Devices

- 410GB MLC ioFX
- 420GB MLC ioFX
- 1.6TB MLC ioFX

ioDrive Devices

- 80GB SLC ioDrive
- 160GB SLC ioDrive
- 320GB SLC ioDrive
- 320GB MLC ioDrive
- 640GB MLC ioDrive

ioDrive Duo Devices

- 320GB SLC ioDrive Duo
- 640GB SLC ioDrive Duo
- 640GB MLC ioDrive Duo
- 1280GB MLC ioDrive Duo

ioDrive Octal Device

- 10TB MLC ioDrive Octal

First Generation ioScale Devices

- 845GB MLC ioScale
- 1300GB MLC ioScale
- 3.2TB MLC ioScale

Second Generation ioScale Device

- 410GB MLC ioScale
- 825GB MLC ioScale
- 1650GB MLC ioScale

Virtual Controller Technology Support

Virtual Controller technology is supported on Windows and Linux operating systems. The following devices support Virtual Controller technology and will result in the following approximate capacities when the device has been configured for virtual devices:

Device	Number of Virtual Devices	Capacity per Virtual Device	Combined Capacities
785GB MLC ioDrive2	2	367.5GB	735GB
1205GB MLC ioDrive2	2	577.5GB	1155GB
400GB SLC ioDrive2	2	187.5GB	375GB
600GB SLC ioDrive2	2	287.5GB	575GB
1200GB SLC ioDrive2 Duo	4	287.5GB	1150GB
2410GB MLC ioDrive2 Duo	4	577.5GB	2310GB
845GB MLC ioScale	2	397.5GB	795GB
1300GB MLC ioScale	2	625GB	1250GB

ATTENTION!

Only relatively new devices (with few writes performed) may be configured to use Virtual Controller technology. Devices with too much wear are unsuitable for converting to or from a Virtual Controller configuration. Merging virtual devices may also result in additional wear (depending on the wear differences of the two virtual devices). See the *Fusion ioMemory VSL User Guide* for your platform for more information on considerations on using this feature.

Supported Operating Systems

All operating systems must be 64-bit x86 architecture to support Fusion ioMemory devices. 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 64-Bit
- Microsoft Windows Server 2012 R2 64-Bit
- Microsoft Windows 7 (only supported for ioFX devices)
- Microsoft Windows 8 (only supported for ioFX devices)
- Microsoft Windows 8.1 (only supported for ioFX devices)

NOTE-

Fusion ioMemory devices cannot be used as hibernation devices.

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 6.9), 7 (up to 7.4)
- SUSE Linux Enterprise Server (SLES) 10.4, 11.3, 11.4, 12.1, 12.2
- Oracle Linux 5 (up to 5.11), 6 (up to 6.9), 7 (up to 7.4)
- Oracle VM 3.2.8, 3.2.9, 3.3.2, 3.3.3, 3.3.4
- CentOS 5 (up to 5.11), 6 (up to 6.9), 7 (up to 7.4)
- Debian Wheezy
- Debian Jessie
- Fedora 23
- Ubuntu 12.04, 14.04, 16.04, 16.04.1, 16.04.2

Supported VMware Operating Systems

- ESXi 5.0
- ESXi 5.1
- ESXi 5.5
- ESXi 6.0
- ESXi 6.5 (using the ESXi 6.0 binary; there is no separate binary for 6.5)

NOTE-

All ESXi updates are supported unless otherwise specified.

Fusion ioMemory devices are only compatible with operating systems that are 64-bit x86 architecture. This means the following scenarios are supported:

1. Using the Fusion ioMemory device 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 Fusion ioMemory device.
2. Using VMDirectPathIO (also known as PCI Passthrough), allow a virtual machine to directly use the Fusion ioMemory device. In this case, only supported operating systems can use the device.

ATTENTION!

VMDirectPathIO is currently supported with Windows and Linux guest 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 passing a device through to the guest OS using VMDirectPathIO, install the Fusion ioMemory VSL software on each guest OS VM that has a device passed through to it. (For more information on using VMDirectPathIO, see the VMDirectPathIO appendix in the *Fusion ioMemory VSL User Guide for VMware ESXi*.) If you are using a device as a VMFS Datastore, install the Fusion ioMemory VSL software on the ESXi host. If you have multiple devices installed, you can have some devices configured for passthrough and some configured as VMFS Datastores; in this case, you would need to install the VSL software in both environments (on the ESXi host and on each guest OS VM).

Supported Solaris Operating Systems

ATTENTION!

The Fusion ioMemory VSL software does not support SPARC processors.

- Solaris (x86, 64-bit) 10 Update 11
- Solaris (x86, 64-bit) 11 (up to 11.3)

Supported OS X Operating Systems

- Yosemite (10.10)

Support for Unified Utilities

4.2.x Unified Utilities lets you use a common set of standard utilities to manage and report on multiple generations of Fusion ioMemory devices within your installation. Unified Utilities is compatible between systems running Fusion ioMemory VSL software versions VSL 3.2.11 (or newer) and 4.2.1 (or newer). Only certain operating systems installed with VSL 3.2.11 (or newer) can use the 4.2.1 (or newer) utilities. For a list of operating systems that are compatible with Unified Utilities on a VSL 3.2.15 system, please refer to the section below.

NOTE-

Unified Utilities includes the same standard set of utilities (for example, `fio-status` and `fio-attach`) that have previously been provided with the 4.2.x VSL utilities. Compatibility with Unified Utilities simply means your system can use the VSL 4.2.1 (or newer) utilities with both VSL 3.2.15 and VSL 4.2.1 (or newer). For example, your system can use the VSL 4.2.4 utilities with VSL 3.2.15 and VSL 4.2.4.

This solution is mainly advantageous for users managing multiple generations of Fusion ioMemory devices within an installation base that includes systems running VSL 3.2.15 with Gen 2 (ioDrive and ioScale) devices, and systems running VSL 4.2.1 (or newer) with Gen 3 (SX300, SX350, and PX600) devices. Users benefit from having a consistent user interface for all devices.

ATTENTION!

In the 4.2.1 (or newer) utilities, the `fio-kinfo` command replaces the `fio-proctl` command; therefore, if you are running 4.2.1 (or newer) Unified Utilities on a 3.2.15 system, any scripts using the `fio-proctl` command must be updated to use the new 4.2.1 (or newer) `fio-kinfo` command.

To use the 4.2.1 (or newer) Unified Utilities to manage Fusion ioMemory devices on a VSL 3.2.15 system, install the VSL 4.2.1 (or newer) Unified Utilities package shipping with VSL 4.2.1 (or newer) after you have installed the VSL 3.2.15 utilities package on your system(s).

NOTE-

- For instructions on installing VSL 4.2.1 (or newer) utilities on a VSL 3.2.15 system, please refer to the 3.2.15 *Fusion ioMemory VSL User Guide*.
-

Unified Utilities Supported Operating Systems

The following operating systems running VSL 3.2.15 can use either the VSL 4.2.1 (or newer) utilities or the VSL 3.2.15 utilities.

Unified Utilities Supported Microsoft Windows Operating Systems

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

Unified Utilities Supported Linux Distributions

- Red Hat Enterprise Linux 5 (up to 5.11), 6 (up to 6.9), 7 (up to 7.4)
- SUSE Linux Enterprise Server (SLES) 10.4, 11.3 11.4, 12.1, 12.2
- Oracle Linux 5 (up to 5.10), 6 (up to 6.9), 7 (up to 7.4)
- CentOS 5 (up to 5.11), 6 (up to 6.9), 7 (up to 7.4)
- Debian Jessie
- Debian Wheezy
- Fedora 23
- Ubuntu 12.04, 14.04, 16.04, 16.04.1, 16.04.2

Unified Utilities Non-Supported Operating Systems

ATTENTION!

The following operating systems running VSL 3.2.15 do not support VSL 4.2.1 (or newer) utilities, and must use the VSL 3.2.15 utilities.

Unified Utilities Non-Supported Windows Operating Systems

- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows 8.1

Unified Utilities Non-Supported Linux Distributions

- Oracle Linux 5.11
- Oracle VM 3.2.8, 3.2.9, 3.3.2, 3.3.3, 3.3.4

Unified Utilities Non-Supported VMware Operating Systems

- ESXi 5.0
- ESXi 5.1
- ESXi 5.5
- ESXi 6.0
- ESXi 6.5

Unified Utilities Non-Supported Solaris Operating Systems

- Solaris (x86, 64-bit) 10 Update 11
- Solaris (x86, 64-bit) 11, 11.1, 11.2, 11.3

Unified Utilities Non-Supported OS X Operating Systems

- Yosemite (10.10)

Upgrade Notes

Firmware Version

The following table shows the latest firmware archive file that accompanies this version of the Fusion ioMemory VSL software and the firmware controller version that it contains for each device type.

NOTE-

The VSL 3.2.15 release uses the same firmware archive file released with VSL 3.2.11. The 3.2.11-20150618 firmware archive file is included with the VSL 3.2.15 release files for your convenience.

Products	FW Archive	Controller Firmware
ioDrive2	3.2.11-20150618	7.1.17.116786
ioDrive2 Duo	3.2.11-20150618	7.1.17.116786
ioDrive	3.2.11-20150618	7.1.17.116786
ioDrive Duo	3.2.11-20150618	7.1.17.116786
ioCache	3.2.11-20150618	7.1.17.116786
ioScale	3.2.11-20150618	7.1.17.116786
ioFX	3.2.11-20150618	7.1.17.116786
ioDrive Octal	3.2.11-20150618	7.1.17.116786

If the current controller firmware version on any device is lower than the version number listed above, we recommend upgrading to the latest version. However, this version of the Fusion ioMemory VSL software will work with any controller firmware versions within this range:

- Minimum firmware required with this release: 7.1.13
- Maximum firmware version supported with this release: 7.1.255

The archive file that is released with this version of the Fusion ioMemory VSL software does support Virtual Controller technology on specific devices in Windows and Linux operating systems. [Virtual Controller Technology Support on page 14](#) for a list of compatible devices.

Upgrading Devices for Fusion ioMemory VSL software 3.2.15

This version of the Fusion ioMemory VSL software supports new features. These features require a minimum version of the Fusion ioMemory device firmware as described above. **Every Fusion ioMemory device in a system should be upgraded to the same version of the firmware.**

For example, if you have a system running 2.3.1 with Fusion ioMemory ioDrive devices previously installed, and you want to install new Fusion ioMemory ioDrive2 devices (that require the latest version of the firmware), then you will need to upgrade all of the existing devices to the latest firmware version.

WARNING!

You cannot revert a device's firmware to an earlier version once you have upgraded the device. If you experience problems with your upgrade, please contact Customer Support <https://link.sandisk.com/commericalsupport>.

Device 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. The following is the minimum upgrade path that must be followed. Upgrade the Fusion ioMemory VSL software on the system (and **upgrade the firmware** to the compatible version for each version of the software) in this order:

1.2.4 -> 1.2.7 -> 1.2.8 -> 2.1.0 -> 2.3.1 -> 3.2.15

For example, if your device is using the firmware for Fusion ioMemory VSL software version 2.1.0, upgrade to 2.3.1 (both the Fusion ioMemory VSL software **and compatible firmware**) and then continue on the path. Download the required software and firmware versions at <https://link.sandisk.com/commericalsupport>.

Upgrading from Fusion ioMemory VSL software Version 2.x

WARNING!

Upgrading devices previously configured for ioMemory VSL 2.x or earlier to work with VSL 3.2.15 will require a firmware upgrade and a low-level media format of the device. User data will be destroyed during the format process. **Be sure to backup all data as instructed.**

As shown in the Device Upgrade Path section above, you may upgrade your Fusion ioMemory device to the current firmware version from any firmware version that is released with Fusion ioMemory VSL software version 2.3.1 or later.

- If the firmware version you are upgrading from has a different major version number (first number) than the current firmware for this release, you will see a warning that the upgrade may require a format.
- If your device is configured with the following firmware versions **it will require a low-level format** (which will erase the user data on the device) after you upgrade the firmware:
 - Fusion ioMemory VSL software version 2.3.1: Firmware version **5.0.7.101971**
 - Fusion ioMemory VSL software version 2.3.10: Firmware version **5.0.7.107053**

NOTE-

In both firmware versions shown above, the major version number is 5 (the first number). In contrast, the firmware major version number for this current 3.2.15 Fusion ioMemory VSL software release is 7.

It may take an extended period of time to format each device, depending on multiple variables. You can consult the appendix of the *Fusion ioMemory VSL User Guide* for your platform for more information on upgrading the previously configured devices.

Staged Upgrade Example

For more specifics on upgrading from one version to the next, see the *Fusion ioMemory VSL Release Notes*, available at <https://link.sandisk.com/commericalsupport>, for each incremental 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).

However, these upgrade procedures will follow this basic outline:

1. Unload the driver of the Fusion ioMemory VSL software.
2. Uninstall the Fusion ioMemory VSL software.
3. Install the next version of the Fusion ioMemory VSL software in the upgrade path.
4. Load the driver module of the Fusion ioMemory VSL software.
5. Update the firmware on the device(s) to the firmware that came with the Fusion ioMemory VSL software.
6. Reboot
7. Ensure that the newly installed Fusion ioMemory VSL software loads correctly and that all Fusion ioMemory devices attach properly.
8. Repeat this procedure (if necessary) for all upgrades in the sequence.

Once you are ready to install this version of the Fusion ioMemory VSL software (3.2.15), consult the user guide for this version for further upgrade instructions.

Do Not Downgrade Device Firmware

WARNING!

Do not downgrade the Fusion ioMemory device to an earlier version of the firmware. Earlier versions of the firmware may not be compatible with the device, and downgrading the firmware could result in data loss. If you have issues with your firmware upgrade, contact Customer Support <https://link.sandisk.com/commercialsupport> for compatibility information and to discuss your use case.

If you are installing new Fusion ioMemory devices in a system using older devices and firmware, upgrade the older devices to the latest firmware and driver as a best practice.

Upgrading to SCSI Version on VMware Hypervisors

The SCSI driver version includes the following features and capabilities:

- Ability to use devices that are greater than 2TB in capacity.
- Ability to use more than 16 Fusion ioMemory devices in a host system.
- SCSI commands that comply with SPC-3 and SBC-3

NOTE-

As the Fusion ioMemory device is presented as a local storage device, ESXi will not support Raw Device Mapping (RDM) on this device.

SCSI Upgrade Considerations

If you upgrade an existing installation of the Fusion ioMemory VSL software using VUM, the SCSI version will obsolete the block version of the software. This means that you will not be able to use VUM to go back to the block version of the software. If you need to go back, you will need to log into the host to manually uninstall the SCSI version and install the block version.

ATTENTION!

Upgrading from ESXi 5.X Block Version to ESXi 5.5 SCSI Version

If you plan to upgrade from ESXi 5.0 or 5.1 block version of the Fusion ioMemory VSL software to the ESXi 5.5 version of the Fusion ioMemory VSL software, then you must first upgrade to the ESXi 5.0 or 5.1 (respectively) SCSI version of the Fusion ioMemory VSL software. Then you may upgrade to the ESXi 5.5 version.

Depending on your applications and usage, your configuration may be affected when your previously installed devices are attached as SCSI devices. Consider the following:

- Any applications that relied on Fusion ioMemory VSL softwares appearing as "block" devices will be affected.
 - For example, you may have a PSA filter configured to use an ioMemory device as a block device.
- Device identification will change, including:
 - UID
 - Model
 - Path

SCSI Device Upgrade Steps

WARNING!

Please follow the steps provided, as inadvertent selections during the upgrade process may clear data from the device. We recommend you back up your data before performing any upgrade procedure.

Follow these steps after you have installed the SCSI version of the Fusion ioMemory VSL software and rebooted the machine:

1. Make sure all Fusion ioMemory devices are attached.
2. Directly connect to the hypervisor host using vSphere client.

ATTENTION!

Do not use vCenter to reimport datastores when upgrading from a block version ioMemory VSL to a SCSI version. Due to a known issue with vCenter Server, the datastores do not properly import.

3. You will notice that the VMs and datastores on the Fusion ioMemory device(s) are either missing or marked as unknown.

You will need to re-import the data stores.

4. Re-import the datastores for each device:
 - a. Select the **Configuration** tab.
 - b. Under **Hardware** select **Storage** and then select **Add Storage**.
 - c. In the window that pops up, select to add a **Disk/LUN** and then select **Next**.
 - d. You are presented with two options. Choose one of the following options:

- i. **Keep the existing signature:** (Recommended) This will preserve the datastore and all the links to the VMs.
- ii. **Format the disk:** This will **erase the data** and create a new datastore.

WARNING!

This is a data-destructive option.

ATTENTION!

If you accidentally choose **Assign new signature**, the data is still there, but you lose all the links to the VMs. In this case you will need to manually re-import every VM.

Change Log

3.2.15 Change Log

In addition to various improvements, the following are changes made to the Fusion ioMemory VSL software since version 3.2.14, including:

General Changes

General Improvements and Features

- See [Supported Operating Systems on page 14](#) for a full list of supported operating systems.
 - **Newly Supported Operating Systems:**

Linux	<ul style="list-style-type: none"> ■ RHEL 6.9 ■ RHEL 7.4 ■ Oracle Linux 6.9 ■ Oracle Linux 7.4 ■ CentOS 6.9 ■ CentOS 7.4 ■ Ubuntu 16.04 (with 3.2.15.1700 build, which includes support for the 4.8 kernel and fix for barrier issue (CRT-703))
VMware	<ul style="list-style-type: none"> ■ ESXi 6.5 (using the ESXi 6.0 binary)

Fixed General Issues

- Ignore incorrect high temperature taking Fusion ioMemory ioDrive device offline. (CRT-15)
- Fixed a memory leak in the SDK (libvsl). (CRT-573)

VMware Changes

VMware Improvements and Features

- Added support for ESXi 6.5 using the ESXi 6.0 binary; there is no separate binary for ESXi 6.5.

NOTE-

Please see the VMware ESXi 6.5 specific known issue with `fio-bugreport` later in these Release Notes. A `vm-support` package must be provided separately.

Linux Changes

Linux Improvements and Features

- Added Kernel 4.8 support only for Ubuntu 16.04.2 (in VSL 3.2.15.1700 build). (FH-24158)

ATTENTION!

Barriers are not implemented for Linux 4.7 and later kernels (see exception below). Unexpected I/O reordering could result in file system corruption. [KB1310](#) (CRT-703).

EXCEPTION: The barrier issue is fixed in build 3.2.15.1700, which is provided only for Ubuntu 16.04.2.

3.2.14 Change Log

In addition to various improvements, the following are changes made to the Fusion ioMemory VSL software since version 3.2.13, including:

General Changes

General Improvements and Features

- **Updated supported operating systems.** See [Supported Operating Systems on page 14](#) for a full list of supported operating systems.
 - **Newly Supported Operating Systems:**

Linux	<ul style="list-style-type: none"> ■ RHEL 6.7, 6.8, 7.2, 7.3 ■ SLES 11.4, 12.1, 12.2 ■ Oracle Linux 6.7, 6.8, 7.2, 7.3 ■ Oracle VM 3.3.3, 3.3.4 ■ CentOS 6.7, 6.8, 7.2, 7.3 ■ Debian Jessie ■ Fedora 22, 23 ■ Ubuntu 16.04
Solaris	<ul style="list-style-type: none"> ■ Solaris 11.2 ■ Solaris 11.3
Windows	<ul style="list-style-type: none"> ■ Windows 8.1 (only supported for ioFX devices)

- `fio-sure-erase` now ships with all supported OS platforms for a VSL release. (CRT-79)
- A new serial number wildcard (*) allows users to set the `external_power_override` module parameter for all cards in the system. Please refer to the VSL 3.2.14 User Guide for syntax guidelines for your OS. (FH-22188)

Fixed General Issues

- Fixed a bug with persistent trim that could cause device data mismanagement. As a result of this fix, some users could experience reduced performance depending on workload. (FH-23419)

- The VSL driver now correctly handles improper I/O. When a card is formatted with 4KiB sectors, the VSL driver now properly handles I/O that does not start at sector boundaries, or where the length is not an integral number of sectors. (CRT-13)
- `fio-detach` now correctly returns a busy code instead of error. With this version of the Fusion ioMemory VSL software, when `fio-detach` is run while another command such as `fio-format` or `fio-attach` is in progress, `fio-detach` now correctly returns a busy code; previously, `fio-detach` incorrectly returned an error. (FH-23174)
- `fio-update-iodrive` now reports the correct upgraded FW version when upgrading firmware. (FH-23530)

Issue	<code>fio-update-iodrive</code> reported the wrong value for the current firmware version.
Resolution	<code>fio-update-iodrive</code> now reports the correct firmware versions.

Linux Changes

Linux Improvements and Features

- The `fio-preinstall` RPM package is now relocatable at install time, using the “- -prefix” option to rpm. (CRT-77)
- Added Kernel 4.0 support. (CRT-154)

Fixed Linux Issues

- `sysvinit` scripts are now fixed to correctly identify all mounted file systems and to unmount them at driver unload time. (CRT-183)
- Fixed a resource leak which could lead to soft lockups and reduced performance, when a Linux server was configured to use the `intel_iommu`. (CRT-100)
- The "hash: dracut: not found" errors no longer occur when rebuilding the source RPM for SLES 11 and 12 on systems that do not have dracut. (CRT-121)

VMware Changes

Fixed VMware Issue

- Fixed ioMemory VSL SCSI Abort Command handler issue in the VSL ESXi driver that could result in a PSOD or the Fusion ioMemory device going offline. This issue was present in all previous VSL3 SCSI drivers, but not in the "block" drivers. (CRT-90)

Solaris Changes

Solaris Improvement

- In order to conform to Solaris default permissions, the post install script for the Solaris VSL driver now explicitly sets the Fusion ioMemory device to unix mode 0600 (only owner can read and write) from unix mode 0666 (all can

read and write). The system default mode of 0600 permissions means that only the owner can access the storage device on a system. (CRT-98)

3.2.13 Change Log

In addition to various improvements, the following are changes made to the Fusion ioMemory VSL software since version 3.2.11, including:

General Changes

Fixed General Issues

- Fixed issue that caused premature retirement of device

Issue	Under specific workloads at high temperatures, devices were incorrectly reading NAND, resulting in premature retirement of the devices.
Resolution	Improvements were made to ensure NAND output is being correctly read, preventing premature retirements (CRT-84).

Known Issues

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

Knowledge Base Articles

Some known issues in this release have a corresponding knowledge base article on the SanDisk Support Site. The knowledge base articles may be updated as additional information, workarounds, and/or fixes become available for a particular issue.

If a particular issue affects one of your systems, you may benefit from reviewing the associated knowledge base (KB) article for the most current information.

ATTENTION!

Before a KB link will work, you must be logged into the Support Articles section of the SanDisk Support site.

Register for a free account if you have not already done so at <https://link.sandisk.com/commercialsupport.html>.

Sign in to the Support Site with your user name and password, and then navigate to the Support > Support Articles section. Once there, you can type the KB number, or click on the original link in the Release Notes.

Example article link: [KB815](#)

In the above example, after you sign in to the SanDisk Support Site, you can either click the link or search for "KB815" in the Support Articles section of the website.

General

Do not interrupt `fio-sure-erase`

WARNING!

Do not interrupt `fio-sure-erase` (by issuing a forced kill command, or powering down or resetting the system)! Interrupting `fio-sure-erase` could cause the Fusion ioMemory device to become unusable.

VSL does not support non-zero PCI domains

The VSL does not support non-zero PCI domains. This means that devices on non-zero PCI domains will not be visible. For example, if a user runs `fio-pci-check` for a device on a non-zero PCI domain, no information will be returned. (FH-20956)

Don't disable CPUs after loading the Fusion ioMemory VSL driver

If you plan to take any CPUs offline (including disabling Hyper-Threading Technology), you should do so before the Fusion ioMemory VSL driver loads and begins to use the available CPUs. If you disable any CPUs that were being used by the Fusion ioMemory VSL software, then the software may hang. [KB788](#) (FH-17018)

Keep default Message Signaled Interrupts for better performance

With Fusion ioMemory VSL software 3.x and later, all Fusion ioMemory devices have changed from using legacy-style interrupts to message signaled interrupts (MSI). This improves performance while decreasing CPU load.

If you wish to continue using legacy interrupts, set the `disable_msi` VSL module parameter value to 1. For examples on setting module parameters, please see the **Module Parameter** appendix in the *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. See this Microsoft article for more information:

[http://msdn.microsoft.com/en-us/library/windows/hardware/ff544246\(v=vs.85\).aspx](http://msdn.microsoft.com/en-us/library/windows/hardware/ff544246(v=vs.85).aspx)

In limited situations, using legacy interrupts with the 3.x.x series VSL may degrade performance as much as 10% compared to previous releases. With the 3.x.x series VSL, customers are strongly encouraged to use MSI (default setting) for optimal performance. [KB809](#)

Proper Time On Startup

If the Fusion ioMemory device 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. [KB887](#) (FH-11509)

Firmware update may fail with a TDO mismatch error

A Fusion ioMemory ioDrive device firmware upgrade may fail with the following error:

```
ERROR: TDO mismatch
```

This generally occurs when upgrading multiple devices at once.

To resolve this issue, update the devices again, but perform the update one device at a time. This includes Fusion ioMemory ioDrive Duo devices, upgrade each Fusion ioMemory device (on the duo product) individually. [KB812](#)

ATTENTION!

Do not reboot the system until the devices have been successfully updated. (FH-8708)

ioDrive Octal devices in minimal mode

One or more of the ioMemory devices within an ioDrive Octal device may go into minimal mode. This state is visible in `fio-status`. To bring the device(s) out of minimal mode, reboot the system. [KB813](#) (DO-419, FH-14534, FH-14574)

Reboot issues with ioDrive Octal devices

Certain servers may spontaneously reboot when multiple ioDrive Octal devices are installed. Updating the server BIOS may resolve this issue. Contact Customer Support for additional configuration adjustments if updating the BIOS does not resolve the issue. [KB870](#)

Device capacity may change after upgrade

If you upgrade a device that was previously formatted using a much earlier version of Fusion ioMemory device, the device capacity may change. The capacity difference may be minimal (for example 160.94GB becomes 160GB), but it may be an issue if the device was part of an application or database that expects the exact same capacity.

To solve this issue, use the `-o` (overformat) option with the `fio-format` utility. For example:

```
fio-format -o 160940M /dev/fct1
```

[KB815](#)

Management Specific**fio utilities may behave unpredictably during live firmware update**

With this version of the Fusion ioMemory VSL software, during a live firmware update, `fio` utilities may not perform as expected (for example, `fio` utilities may not return data); however, the firmware update still completes successfully. (FH-22765)

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. [KB872](#) (FH-17038)

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. [KB873](#) (DO-555, FH-16429)

Do not run fio-status during driver load

Run `fio-status` after the driver has loaded and not during driver load. Running `fio-status` while the Fusion ioMemory VSL software driver is loading may yield the message:

```
MINIMAL MODE DRIVER: failed to load midprom data.
```

If this message displays while running `fio-status` during the driver load, you must unload and reload the driver and then run `fio-status` after the driver has loaded. [KB874](#) (DO-874)

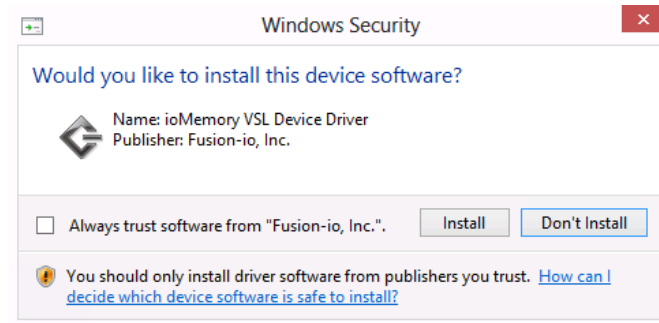
fio-status may not display failed devices

On rare occasions, when a Fusion ioMemory device fails, the device may no longer appear in `fio-status`. If your device has failed, contact Customer Support. [KB875](#) (FH-8851)

Windows Specific

With VSL 3.2.14 and newer, installing unsigned drivers for ioFX in Windows 7, 8 and 8.1 may generate security warning

With VSL 3.2.14 and newer, when installing unsigned drivers for ioFX in Windows 7, 8 and 8.1, users may see the security warning below.



If a user encounters this warning message, click the check box and then click the Install button. The driver should install successfully. This warning should appear only once per system.

fio-status does not support the -w option

The `fio-status -w` (wait-for-fields) option is not supported on Unified Utilities installed with VSL 3.2.11 and higher on Windows. (FH-23216)

fio-config -f is not supported in this VSL release on Windows

On a Windows system with VSL 3.2.11 and higher, the `fio-config -f` option is not supported. If a user needs to set configuration parameters before the VSL driver loads, the user can manually edit the registry directly. (FH-23126, FH-23244)

fio-format hangs after premature fio-attach

If a user runs `fio-attach` while `fio-format` is 99% complete, the card will attach and `fio-format` will hang. If the user tries to abort out of `fio-format`, this warning displays:

WARNING: Do not interrupt the formatting! If interrupted, the `fio-sure-erase` utility may help recover from format errors. Please see documentation or contact support.

To exit out of `fio-format`, the user can close the window `fio-format` is run in, or detach the drive and `fio-format` will close. (FH-23253)

Windows Installer - Repair option is not restoring fio utilities

The Windows "Repair" option has been disabled. To fix a broken installation of the VSL, users need to follow the instructions in the VSL User Guide to uninstall and re-install the VSL. (FH-22932)

SCSI ID conflict with other storage devices

If your Windows system uses a storage device in addition to a Fusion ioMemory device, the devices may have duplicate SCSI IDs which will cause conflicts. You can resolve the conflict by changing the Fusion ioMemory device `fct` index number. This will make it possible to give the Fusion ioMemory device a unique SCSI ID.

1. Determine the PCIe bus number of the device with conflicting ID using `fio-status`.
 - a. The `fio-status` utility displays the bus number as a hexadecimal value. You must convert that value into a decimal value.
 - b. For example, the utility may return a value of `0xb`. This stands for bus 011.
 - c. You should also verify the `fct` value (for example, `fct0`).

2. Open up the Windows registry editor `regedit.exe`, and navigate to the location of the key or path:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\fiodrive\fctDevMap
```

3. You will see that there is one entry per drive. The registry entry visible in the right pane will be named with the PCIe bus number (for example, `000:011:00.0-0` would be for the device on bus 11 (reported as `0xb` in `fio-status`).

The registry entry value is the `fct` index number. For example, a value of 0 results in `fct0`. You should verify that this value matches the current `fct` number of the device.

4. Edit the registry entry and change the `fct` index number.
 - a. The `fct` index must be between 0 and 254. The `fct` index number determines the SCSI Logical Unit of the SCSI ID.
 - b. The value must not already be in use.

NOTE-

For example, you can run `msinfo32.exe` to verify the SCSI IDs of other devices.

5. After changing the number, restart your Windows system for it to take effect. This will be preserved across a system restart.

ATTENTION!

Unused entries may be deleted, but only one device entry may have the same `fct` index, otherwise the results are undefined.

Be aware that if a new Fusion ioMemory device is added to the system, the numbering of the `fct` index will start at the lowest number again, or `fct0`. You may need to modify the registry again in this case.

Read requests delayed for new data

Read IO requests to a sector location that was very recently written may have higher latency (up to around 200ms) than typical read IO requests. This is typically seen in applications that write data and immediately check (read) the data. (FH-19377)

Specific partitions required for devices with capacities greater than 2TB

Devices with capacities greater than 2TB, such as the 3.0TB MLC ioDrive2 or the 3.2TB ioScale device, require the following partition types:

- Single device: GPT (GUID Partition Table)
- Multiple devices (for a RAID configuration): Dynamic Disk

These devices also require sector sizes greater than 512B (we recommend 4KiB sectors). When you format these devices using `fiio-format`, the default sector size is 4KiB. [KB916](#)

Fusion ioMemory VSL software not loading or attaching devices after install

If the Fusion ioMemory VSL software is not loading or attaching Fusion ioMemory devices 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. [KB918](#) (FH-13884)

ioDrive Octal devices report incorrect temperature

One or more of the ioMemory devices of an ioDrive Octal device may report a temperature in the system log that is unlikely high, for example:

```
fmt10-474370: Unlikely temperature from card: 429496714 C
```

This unlikely temperature log is inaccurate and can be safely ignored. [KB920](#) (DO-419)

Linux Specific

Barriers not implemented for Linux 4.7 and later kernels

ATTENTION!

Barriers are not implemented for Linux 4.7 and later kernels (see exception below). Unexpected I/O reordering could result in file system corruption. [KB1310](#) (CRT-703).

EXCEPTION: The barrier issue is fixed in build 3.2.15.1700, which is provided only for Ubuntu 16.04.2.

Building Debian-based source requires extra command options

When building the source for all Debian-based installations, you must use the `-uc` and `-us` options with the `dpkg-buildpackage` command as shown below, or the build may fail.

```
$ sudo dpkg-buildpackage -uc -us
```

You can also build the source for all Debian-based installations as a non-root user using the following `dpkg-buildpackage` command with `-uc` and `-us` options.

```
$ dpkg-buildpackage -rfakeroot -b -uc -us
```

Linux iostat not working as expected with use_workqueue=0

With Linux, the default VSL module setting of `use_workqueue=0` limits the `iostat` information available for Fusion ioMemory devices. In particular, per-partition IO stats are not collected and the information from `blktrace` is reduced. The default value of "0" normally provides better performance; however, if accurate IO statistics are required, it is possible to set the VSL driver module option to `use_workqueue=3`. (CRT-133)

fiobugreport prints to stderr erroneously on Redhat/CentOS (6+) distros

The `fiobugreport` command line utility on Linux calls the "which" command during command execution. On late Redhat/CentOS releases (6+), the Linux "which" command prints to `stderr` if it cannot find the command it is called with. This results in the following:

```
# hgtest02-vm02:/root> fiobugreport
which: no vmware in (/usr/local/bin:/usr/sbin:/sbin:/usr/bin:/bin)
```

These messages printed to `stderr` can safely be ignored. (This issue does not occur on debian/ubuntu systems.) (FH-22769)

SCSI Performance Limitations on OracleVM

The OracleVM requires the use of a SCSI interface for Fusion ioMemory devices. Due to SCSI performance limitations inherent in the Linux kernel, performance is limited compared other operating systems.

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

[KB1385](#)

Increase default Oracle VM Dom0 memory

The default memory allocated to Dom0 on an Oracle VM server is insufficient for the Fusion ioMemory VSL software. Follow the instructions in this Oracle knowledge base article and reserve enough RAM for your installed devices:

http://docs.oracle.com/cd/E27300_01/E27308/html/vmiug-server-dom0-memory.html

See [Hardware Requirements on page 10](#) for worst-case RAM consumption.

The 3.7 kernel is incompatible with the Fusion ioMemory VSL software

The 3.7 Linux kernel has a known issue that makes it incompatible with the Fusion ioMemory VSL software. This is a known issue with some kernel updates for Fedora 17. You may fix the kernel by applying the patch available here:

<https://patchwork.kernel.org/patch/2031631/KB876> (FH-17317)

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 a Fusion ioMemory VSL software package that is compiled for the new kernel.

Following this procedure will ensure that the Fusion ioMemory VSL software is compatible with the new kernel. [KB902](#) (DO-902)

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`. [KB878](#)

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. [KB879](#)

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 or kernel 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 kernel and was enabled by default. For fear of damaging some devices, 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. [KB880](#)

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-vsl disable_msi=1
$ modprobe -r iomemory-vsl
```

2. Load the driver, enabling MSI interrupts

```
$ modprobe iomemory-vsl 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. [KB881](#)

RHEL6 udevd warning

When using a Fusion ioMemory device under RHEL6 (or any Linux distro with udev version 147 or greater), udevd may emit the following innocuous messages:

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

You can ignore this warning. [KB882](#)

RHEL6 warn_slowpath during device attach

When attaching a Fusion ioMemory device 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. [KB883](#)

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. [KB884](#) (DO-138)

Do not use a Fusion ioMemory device as a kdump target

Do not direct `kdump` to dump the crash information to a Fusion ioMemory device. Due to the restricted memory environment in `kdump`, the Fusion ioMemory VSL software does not load in the `kdump` crashkernel and Fusion ioMemory devices are not supported as `kdump` targets. [KB886](#)

VMware Specific**`fio-bugreport` does not collect complete information**

With VSL 3.2.15 running on VMware ESXi 6.5, `fio-bugreport` does not collect complete diagnostic information. When contacting Customer Support, a `fio-bugreport` and `vm-support` package must both be provided. (FH-24198)

Messages stating "function [X] contains unknown suffix" could appear during driver load on ESXi 6.0

The warning messages stating, "function [X] contains unknown suffix" could display in the kernel log during the VSL driver loading on ESXi 6. These warning messages are displayed due to an internal VMware error on ESXi 6.0 and later. You can safely ignore these messages. (DO-1527, FH-23275)

`fio-attach/fio-detach` exhibit incorrect behavior with `--version` parameter

On systems running ESXi, the scripts for `fio-attach` and `fio-detach` exhibit incorrect behavior when the `--version` parameter is specified along with the control device.

When you run `fio-attach` or `fio-detach` with a control device specified (such as `/dev/fct0`) and use the `--version` parameter to query the VSL version all within the same command, the following happens: correct version information is returned, the attach/detach is erroneously attempted but fails, and an error similar to "Attach[or Detach] of `/dev/fct0` failed" is generated.

For example: "`fio-attach /dev/fct0 --version`" returns correct version information, but will attempt to attach, fail and then generate an error message.

To avoid these error messages on ESXi systems, users should not use the `--version` parameter with `fio-attach` and `fio-detach` commands where the control device is specified. Instead, run the following commands separately:

- `fio-attach /dev/fctx`
- `fio-detach /dev/fctx`
- `fio-attach --version`
- `fio-detach --version` (FH-23184)

Only 512B Sectors Supported

Only a 512B sector size is supported on VMware hypervisors. Consult the `fio-format` section of the *Fusion ioMemory VSL User Guide* for more information.

16 block device limit with VMware hypervisors

This issue does not apply to devices that are presented to the hypervisor as SCSI block devices via the SCSI version of the Fusion ioMemory VSL software. If you pass devices through to a guest OS, those devices are not counted toward the 16 block device limit. [KB925](#) (SQA-1375, DO-847)

VMware ESXi hypervisors will only recognize up to 16 Fusion ioMemory devices installed in the host system. This limit includes each device in a multi-device product. For example, VMware will recognize up to eight Fusion ioMemory ioDrive Duo devices (each with two Fusion ioMemory devices).

Hypervisors cannot directly use devices with capacities greater than 2TB

This issue is resolved with the SCSI device version of the Fusion ioMemory VSL software. However, the issue is still seen in the block device version of the software. For more information on this issue, see knowledge base article [KB926](https://link.sandisk.com/commercialsupport) on <https://link.sandisk.com/commercialsupport>. (FH-15962)

Because the VMFS in VMware hypervisors does not directly support devices with capacities greater than 2TB, you cannot use all of the capacity of a 3.0TB MLC Fusion ioMemory ioDrive2 device or a 3.2TB MLC ioScale device when using the device as a LUN. You will need to down-format the device to 2TB using fio-format. For example (using SSH):

```
fio-format -s 2T /dev/fct1
```

You may utilize the entire capacity of the >2TB device if you pass the device through (using VMDirectPathIO/PCI Passthrough) to a guest OS that supports devices with capacities greater than 2TB.

Using VMDirectPathIO with multiple-device products

Some products contain multiple Fusion ioMemory devices on one PCIe adapter, such as the Fusion ioMemory ioDrive Duo device. The Fusion ioMemory VSL software does not support splitting the two Fusion ioMemory devices between two functions or virtual machines.

WARNING!

Splitting an ioDrive Duo among two virtual machines via VMDirectPathIO is not supported.

The following scenarios are supported:

- Both Fusion ioMemory devices are used as a VMFS datastore in ESXi.
- Both Fusion ioMemory devices are passed through (using VMDirectPathIO) to the same virtual machine. (FH-13181) [KB927](#)

ESXi 5.x injected installer allows installation on a Fusion ioMemory device

Fusion ioMemory devices are not designed to be bootable, therefore you should not install the host OS on a Fusion ioMemory device. The ESXi injected installer will permit you to install the OS on a Fusion ioMemory device, but the installation will fail on reboot. [KB929](#) (DO-331)

vCenter cannot manage extents on Fusion ioMemory devices

You cannot use vSphere vCenter to manage extents on Fusion ioMemory devices, including growing or spanning extents. However, you can connect directly to the host using the vSphere client and manage extents on Fusion ioMemory devices. [KB928](#) (FH-14532)

Solaris Specific

Quiesce DDK interface not implemented

The Fusion ioMemory VSL software does not implement the quiesce DDK interface on Solaris. This means that Fusion ioMemory devices may continue to perform DMA operations after the Fusion ioMemory VSL software has been instructed to shutdown, which can result in data corruption if the memory has been reused as well as kernel panics if the IOMMU is enabled. To reduce the chance of data corruption, "fastboot" should be disabled to give the driver a better chance to shutdown cleanly before reboot. (FH-14909)

Only 512B Sectors Supported

Only a 512B sector size is supported on Solaris. Consult the `fio-format` section of the *Fusion ioMemory VSL User Guide* for more information.

Provide adequate RAM

The ioMemory VSL may use a large amount of system RAM. If enough RAM is not available, the system will crash. See [Hardware Requirements](#) for RAM requirements.

As the system runs out of RAM, it may generate the message:

```
verify: bad magic header 0, wanted acca at file /dev/rdisk/c6d0p0 offset 212606976,
length 0
```

[KB922](#)

Solaris cannot use devices with capacities greater than 2TB

Because Solaris does not support devices with capacities greater than 2TB, you cannot use the full capacity of a device such as the 3.0TB ioDrive2 device. You will need to down-format the device to 2TB using `fio-format`. For example:

```
fio-format -s 2T /dev/fctl
```

(FH-15962)

OS X Specific

ATTENTION!

Additional step required to run VSL driver on OS X 10.10

This version of the VSL driver does not load on OS X 10.10 by default. The following additional step needs to be executed to run the VSL driver on OS X 10.10 Yosemite. Run the following command:

```
sudo nvram boot-args=kext-dev-mode=1
```

Reboot the server for the configuration change to take effect. (CRT-101, FH-22637)

Only 512B Sectors Supported

Only a 512B sector size is supported on OS X. Consult the `fio-format` section of the *Fusion ioMemory VSL User Guide* for more information.

Encrypted partitions not supported

Encrypted partitions, new in OS X version 10.7 (Lion), are currently not supported on Fusion ioMemory devices. [KB923](#) (FH-12851)

Provide adequate RAM

The Fusion ioMemory VSL software may use a large amount of system RAM. If enough RAM is not available, the system will crash. See [Hardware Requirements](#) for RAM requirements. [KB922](#)

FreeBSD Specific

Progress indicator for fio-attach returns incorrect percentage

When attaching a device in FreeBSD, the `fio-attach` utility may momentarily return a percentage that is more than 100%, for example:

```
pu05# fio-attach /dev/fct0
Attaching: [=====] (100%)=====] (208%)
fio0 - attached.
```

This is only an issue with the progress indicator; the device will still attach as expected. [KB924](#)

Download Location

Software, utilities, and related documentation for this version can be found (with a support account) at <https://link.sandisk.com/commericalsupport>.

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