



VMware VAAI with HA3969 and HA3969U

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Date: August, 2014

Storageflex Inc.

Agenda

- Introduction to VAAI
- VAAI supported
- Physical environment
- Testing and results
- Summary



Introduction to VAAI

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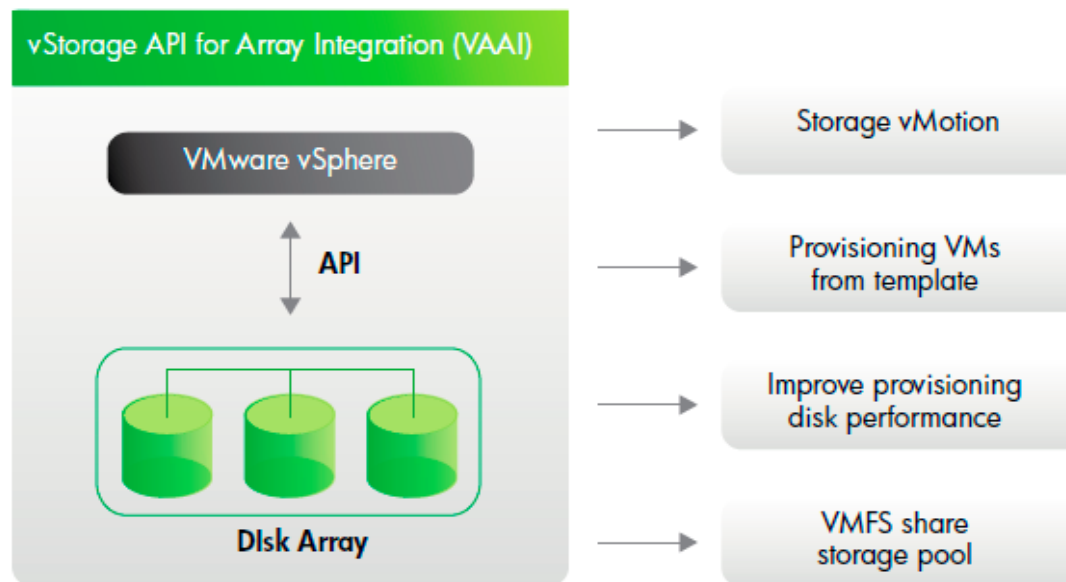
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VAAI introduction

- vStorage APIs for Array Integration (VAAI) is a feature introduced ESX/ESXi 4.1 that provides hardware acceleration functionality.
- VAAI enables key data operations to be executed at the storage level rather than at the ESX server layer.



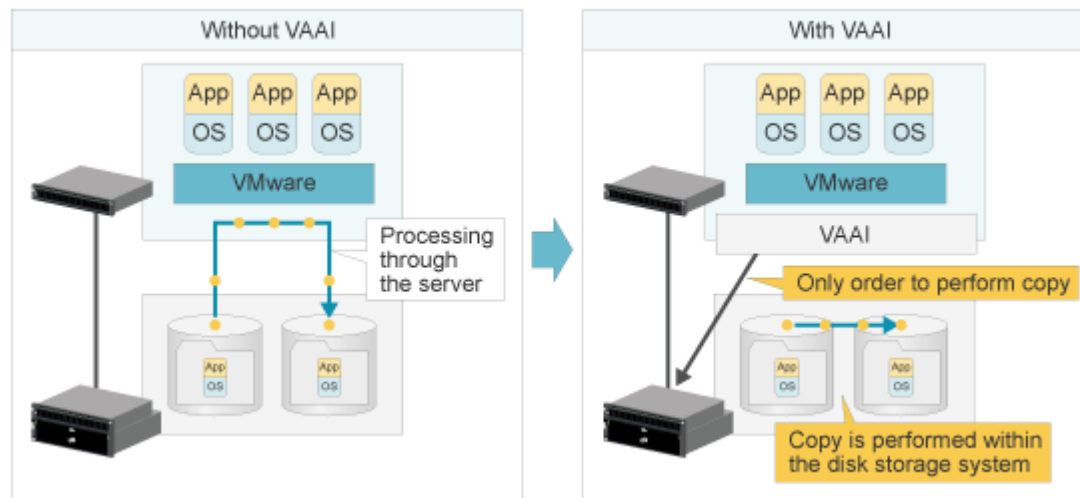
VAAI Primitives

VAAI uses these primitives:

- **Full Copy:** Clone Blocks/Full Copy/XCOPY, which is used to copy or migrate data within the same physical array
- **Block Zeroing:** Zero Blocks/Write Same, which is used to zero-out disk regions
- **Hardware Assisted Locking:** Atomic Test & Set (ATS), which is used during creation and locking of files on the VMFS volume

Full Copy (Hardware-Accelerated Copy)

- Leverage native array copy capability to move blocks within the array



Without VAAI

- **SCSI Read** (Data moved from array to host)
- **SCSI Write** (Data moved from host to array)
- Repeat
- Huge periods of large VMFS level IO, done via millions of small block operations

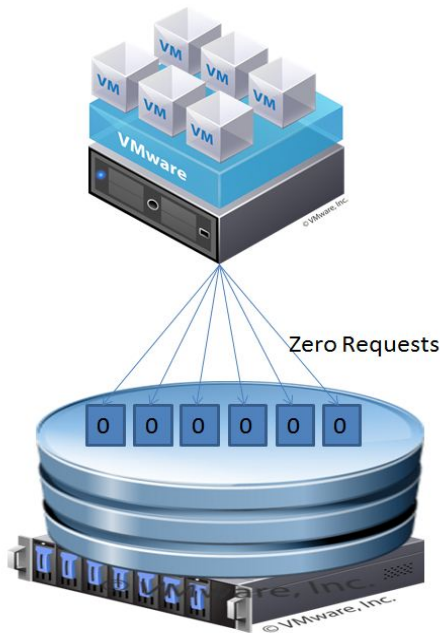
With VAAI

- **SCSI Extended Copy** (XCOPY, Data moved within array)
- Repeat
- Order of magnitude reduction in host/array I/O operations

Block Zeroing (Hardware-Accelerated Zero)

- Eliminate redundant and repetitive host-based write commands with optimized internal array commands

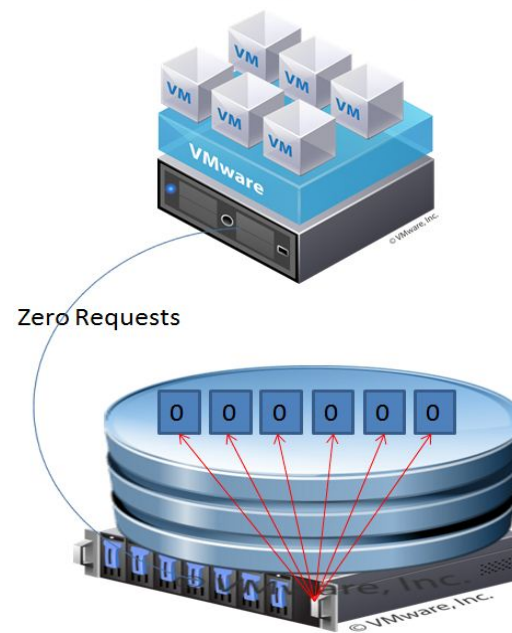
Without Block Zeroing with VAAI



Without VAAI

- **SCSI Write** - Many identical small blocks of zeroes moved from host to array for MANY VMware IO operations

Block Zeroing with VAAI

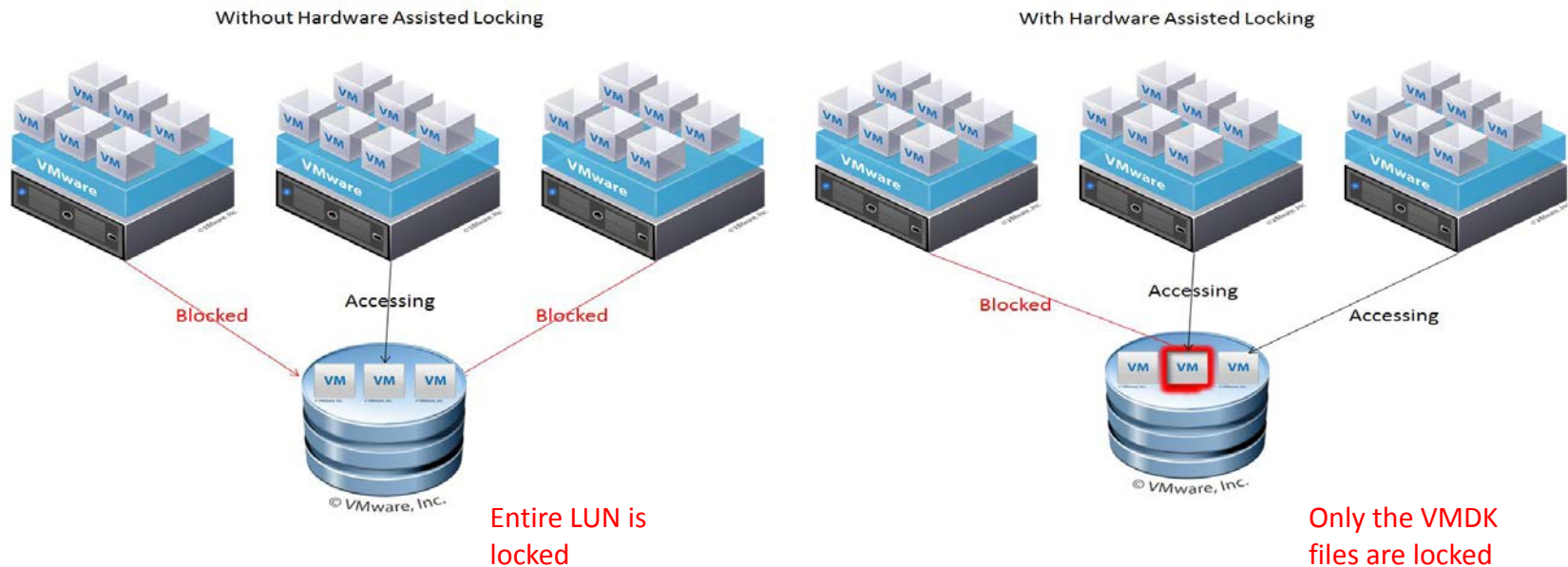


With VAAI

- **SCSI Write Same** - One giant block of zeroes moved from host to array and repeatedly written

ATS; Atomic Test & Set (Hardware-Accelerated Locking)

- Provides granular LUN locking method to allow locking at the logical block address level without the use of SCSI reservations or the need to lock the entire LUN



Without VAAI

- Reserves the complete LUN so that it could obtain a lock and required several SCSI commands
- LUN level locks affect adjacent

With VAAI

- Locks occur at a block level with one efficient SCSI command: **SCSI Compare and Swap (CAS)**
- Block level locks have no effect on adjacent hosts



VAAI supported

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Hardware acceleration status

- In vShaper client, the hardware acceleration status can be verified for the storage arrays.

The screenshot shows the vShaper client interface. The 'Hardware Status' tab is selected, and the 'View' is set to 'Devices'. A red circle with the number '1' highlights the 'View' dropdown. In the left-hand navigation pane, the 'Storage' option is highlighted with a red circle and the number '2'. The main area displays a table of datastores with the following columns: Identification, Status, Device, Drive Type, Capacity, Free, Type, Alarm Actions, and Hardware Acceleration. The table contains three rows: 'Local Disk' (Unknown), 'VV 1' (Supported), and 'VV 2' (Supported). The 'Supported' status for VV 1 and VV 2 is highlighted with a red box.

Identification	Status	Device	Drive Type	Capaci...	Free	Type	Alarm Actions	Hardware Acceleration
Local Disk	Normal	Local Disk3	Non-SSD	367.50	227.08 GB	VMFS5	Enabled	Unknown
VV 1	Normal	Virtual Volume 1:1	Non-SSD	2.00 T	1.88 TB	VMFS5	Enabled	Supported
VV 2	Normal	Virtual Volume 2:1	Non-SSD	2.00 T	1.76 TB	VMFS5	Enabled	Supported

- There are three kind of hardware acceleration status:
 - **Unknowns:** The initial value is Unknown.
 - **Supported:** The status changes to Supported after the host successfully performs the offload basic operations.
 - **No supported:** If the offload operation fails, the status changes to Not Supported.

VAAI enabled

To determine if VAAI is enabled using the vSphere Client:

- In the vSphere Client inventory panel, select the host.
- Click the Configuration tab, and click Advanced Settings under Software.
- Check that these options are set to 1 (enabled):
 - DataMover -> HardwareAcceleratedMove -> 1
 - DataMover -> HardwareAcceleratedInit -> 1
 - VMFS3 -> HardwareAcceleratedLocking -> 1

Note: These options are enabled by default.

Enabling full copy and block zero.

The screenshot displays the VMware ESXi configuration interface for host 172.18.4.171. The interface is divided into several sections:

- Left Panel:** Shows the host name 'SOBEY3' and a folder 'VAAI test' containing two virtual machines, 'Win 2008 R2 - 1' and 'Win 2008 R2 - 2'. A red circle '1' highlights the host name.
- Top Bar:** Displays the host IP '172.18.4.171' and the version 'VMware ESXi, 5.1.0, 799733 | Evaluation (12 days remaining)'. A red circle '2' highlights the version information.
- Navigation Tabs:** Includes 'Getting Started', 'Summary', 'Virtual Machines', 'Resource Allocation', 'Performance', 'Configuration', 'Tasks & Events', 'Alarms', 'Permissions', 'Maps', and 'Storage Views'. The 'Configuration' tab is selected.
- Hardware Section:** Lists various hardware settings such as Processors, Memory, Storage, Networking, Storage Adapters, Network Adapters, Advanced Settings, and Power Management.
- Software Section:** Lists software settings such as Licensed Features, Time Configuration, DNS and Routing, Authentication Services, Power Management, Virtual Machine Startup/Shutdown, Virtual Machine Swapfile Location, Security Profile, Host Cache Configuration, System Resource Allocation, Agent VM Settings, and Advanced Settings. A red circle '3' highlights the 'Advanced Settings' link.
- Advanced Settings Dialog:** A dialog box is open, showing a tree view of settings. The 'DataMover' category is selected, highlighted with a red circle '4'. The settings are:
 - DataMover.HardwareAcceleratedInit:** Set to 1. Description: 'Enable hardware accelerated VMFS data initialization (requires compliant hardware)'. A red box labeled 'Block Zero' with a red circle '5' is placed next to the value.
 - DataMover.HardwareAcceleratedMove:** Set to 1. Description: 'Enable hardware accelerated VMFS data movement (requires compliant hardware)'. A red box labeled 'Full Copy' is placed next to the value.
- Bottom Right:** Contains 'OK', 'Cancel', and 'Help' buttons. A red circle '6' highlights the 'OK' button.

Enabling hardware-assisted locking.

The screenshot displays the VMware ESXi configuration interface for host 172.18.4.171. The interface is divided into several sections:

- Left Panel:** Shows the host name 'SOBEY3' and a folder 'VAAI test' containing two virtual machines, 'Win 2008 R2 - 1' and 'Win 2008 R2 - 2'. A red circle '1' highlights the IP address '172.18.4.171'.
- Top Bar:** Displays the host name and version: '172.18.4.171 VMware ESXi, 5.1.0, 799733 | Evaluation (12 days remaining)'. A red circle '2' highlights the 'Configuration' tab.
- Navigation Tabs:** Includes 'Getting Started', 'Summary', 'Virtual Machines', 'Resource Allocation', 'Performance', 'Configuration', 'Tasks & Events', 'Alarms', 'Permissions', 'Maps', and 'Storage Views'.
- Hardware Section:** Lists categories like Processors, Memory, Storage, Networking, Storage Adapters, Network Adapters, Advanced Settings, and Power Management.
- Software Section:** Lists categories like Licensed Features, Time Configuration, DNS and Routing, Authentication Services, Power Management, Virtual Machine Startup/Shutdown, Virtual Machine Swapfile Location, Security Profile, Host Cache Configuration, System Resource Allocation, Agent VM Settings, and Advanced Settings. A red circle '3' highlights 'Advanced Settings'.
- Advanced Settings Dialog:** A dialog box titled 'Advanced Settings' is open, showing a tree view on the left and configuration options on the right. A red circle '4' highlights 'VMFS3' in the tree view. The right pane shows several settings:
 - VMFS3.EnableBlockDelete:** Set to 0. Description: 'Enable VMFS block delete'. Min: 0, Max: 1.
 - VMFS3.FailVolumeOpenIfAPD:** Set to 0. Description: 'Fail VMFS volume open operation if the underlying device is deemed to be under ..'. Min: 0, Max: 1.
 - VMFS3.HardwareAcceleratedLocking:** Set to 1. Description: 'Enable hardware accelerated VMFS locking (requires compliant hardware)'. A red box highlights this setting with the text 'Hardware-Assisted locking' and a red circle '5'.
 - VMFS3.MaxHeapSizeMB:** Set to 80. Description: 'Maximum size (in MB) to which the VMFS heap is allowed to grow'. Min: 16, Max: 256.
 - VMFS3.OpenWithoutJournal:** Set to 1. A red circle '6' highlights this setting.



Test physical environment

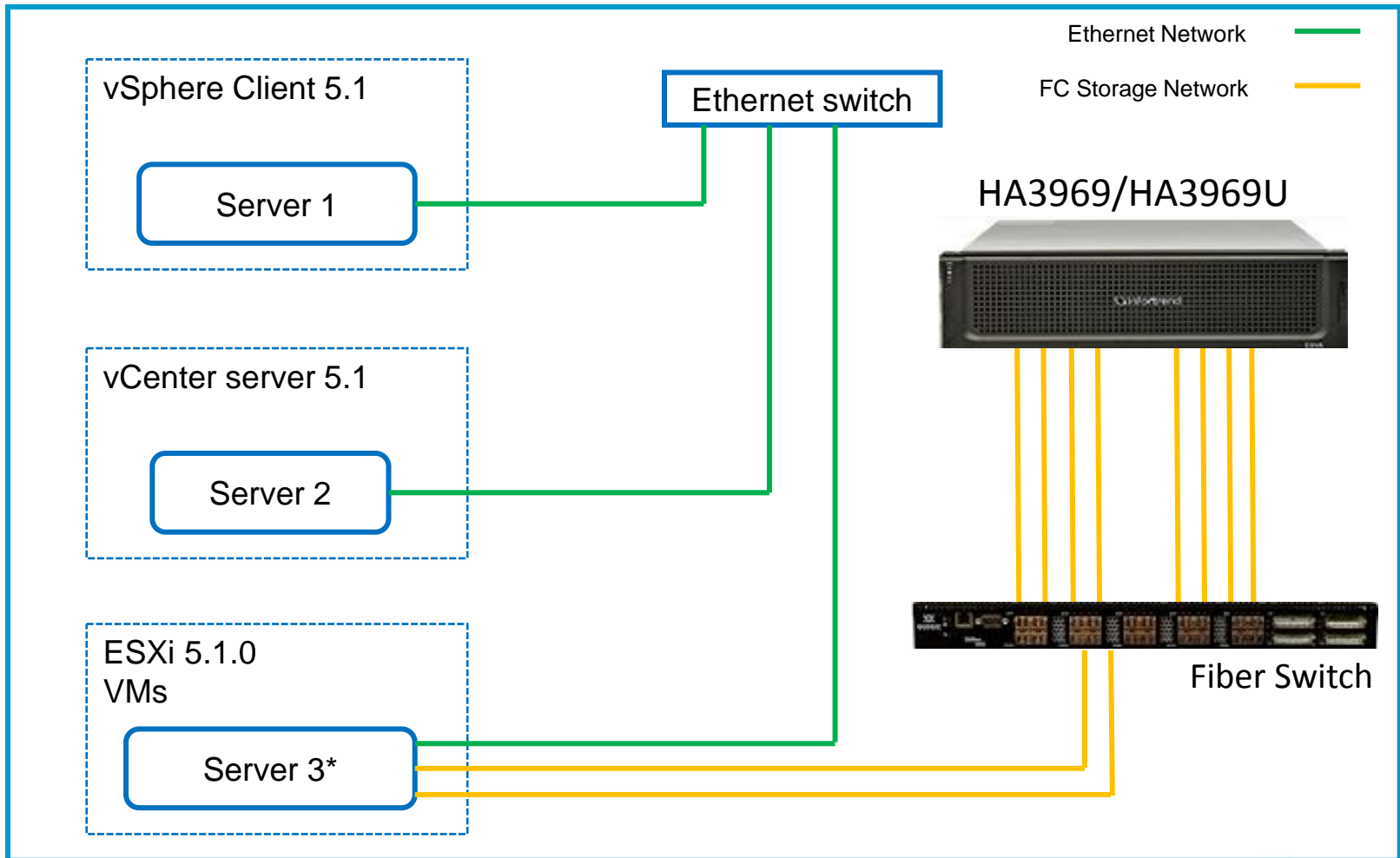
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Network architecture

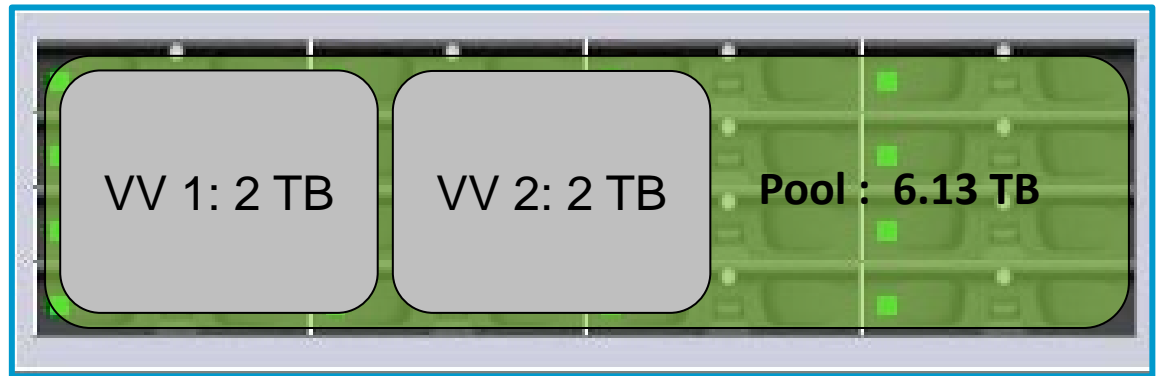


Hardware and software resources

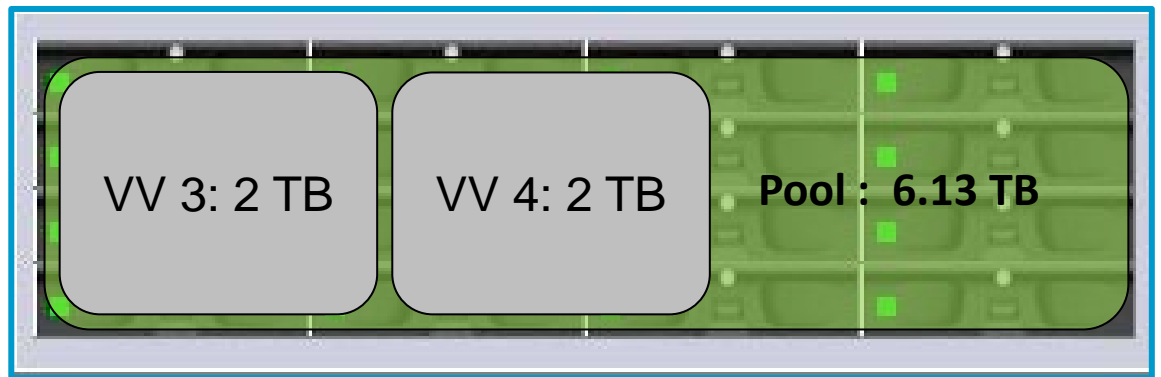
Item	Resource	Detail	Configuration
1	Hardware	HA3969	HDD SAS, 450 GB, 1500 RPM x 16
	Software	NA	Firmware: 3.91C0.8
2	Hardware	Server 1	Memory: 12 GB of RAM CPU: Intel Core i7 3770K CPU 3.50GHz (8 CPUs), ~ 3.9GHz
	Software	Windows server 2008 R2	vSphere Client 5.1, SANWatch 2.4.c.01
3	Hardware	Server 2	Memory: 8 GB of RAM CPU: Intel Pentium III, Xenon (4 CPUs), ~ 2.3GHz
	Software	Window server 2003	vCenter Server 5.1
4	Hardware	Server 3 - Supermicro X7DB8	Memory: 16 GB of RAM CPU: 2 x Intel Xeon E5405 CPU 2.00GHz
	Software	ESXi 5.1.0	Virtual Machines (Window Server 2008 R2 64-bits)

Storage architecture

HA3969/HA3969U



JBOD



HDD SAS, 450 GB, 1500 RPM x 32

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Testing and results

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Full Copy

Steps

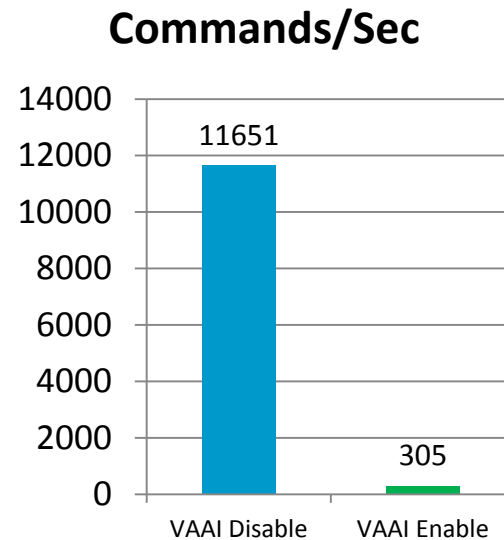
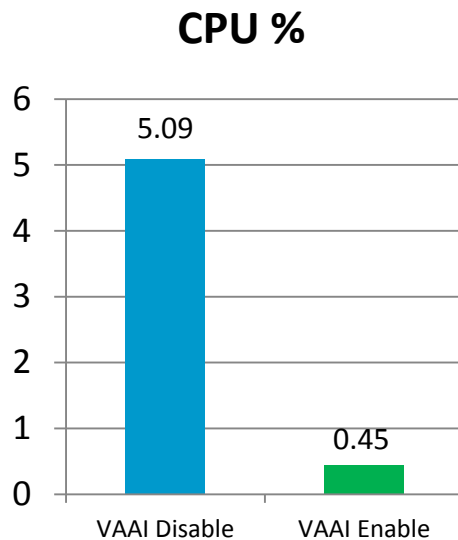
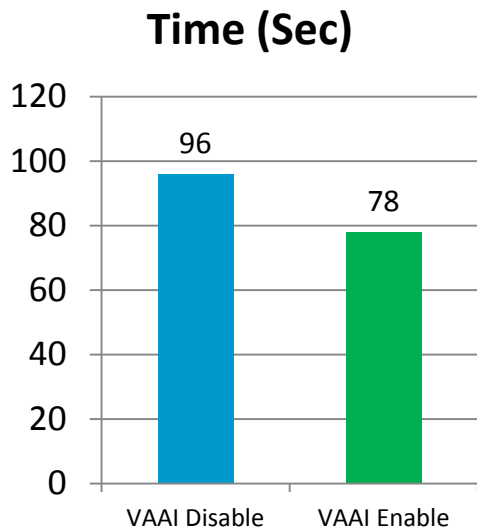
1. Create a 150 GB virtual Machine in VV 1 (Think Provision Lazy Zeroed) , the virtual machine was filled with data equal to 63.9 GB.
2. Clone the virtual machine from VV 1 to VV 3. (Different pools)
3. Measure Time, percent of CPU Utilization and Network traffic.
4. Test with VAAI Disabled and VAAI Enabled.

Item	VAAI Disabled	VAAI Enabled
Time	96 Sec	78 Sec
CPU %	5.09 %	0.45 %
Commands / Sec	11651	305

Full Copy - results

Key finding:

- Cloning a Virtual Machine is **18.75 %** faster using VAAI.
- The percent of CPU utilization decrease in **91.16 %**.
- The decrease of network traffic was **97.38 %** reduced.

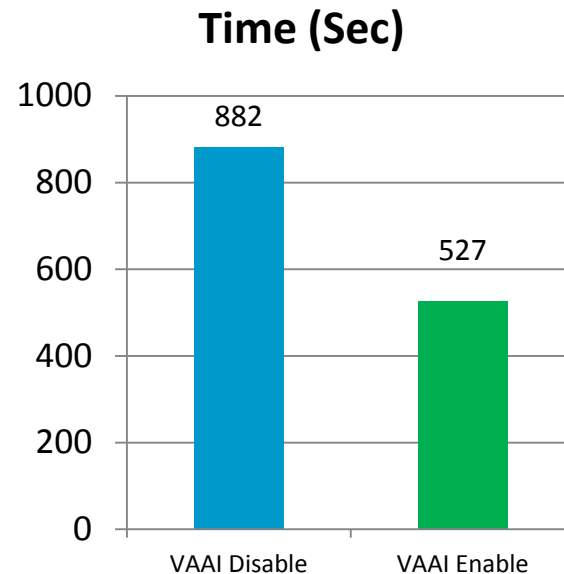


Full Copy – Bonus results

Bonus Key finding:

- Cloning 10 VM Virtual Machine at the same time is **40.24 %** faster using VAAI.

Item	VAAI Disabled	VAAI Enabled
Time	107 Sec	85 Sec



Block Zeroing

Steps

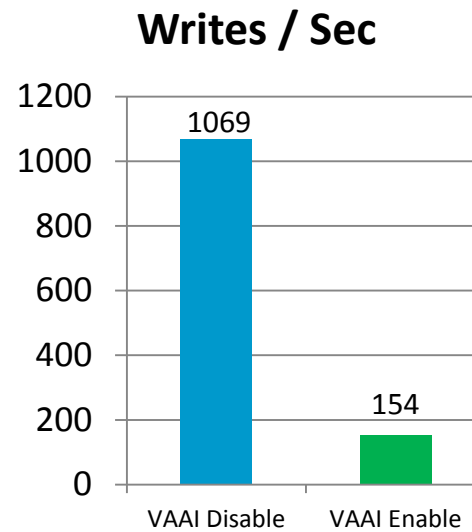
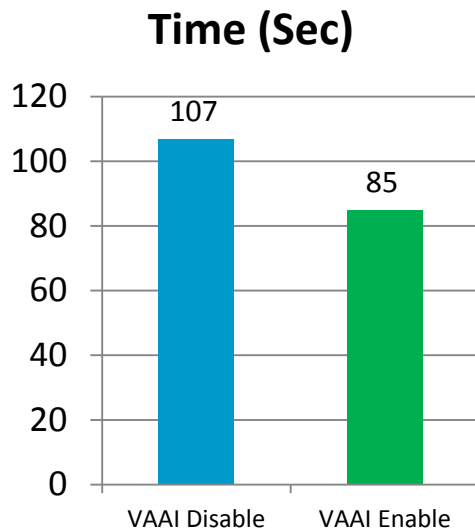
1. Creating 100 GB virtual machine (Think Provision Eager Zeroed).
2. Measure Time and Network traffic.
3. Test with VAAI Disabled and VAAI Enabled.

Item	VAAI Disabled	VAAI Enabled
Time	107 Sec	85 Sec
Writes / Sec	1069	154

Block Zeroing - results

Key finding:

- Creating a Virtual Machine is **20.56 %** faster using VAAI.
- The decrease of network traffic was **85.59 %** reduced.



Hardware Assisted Locking

Steps

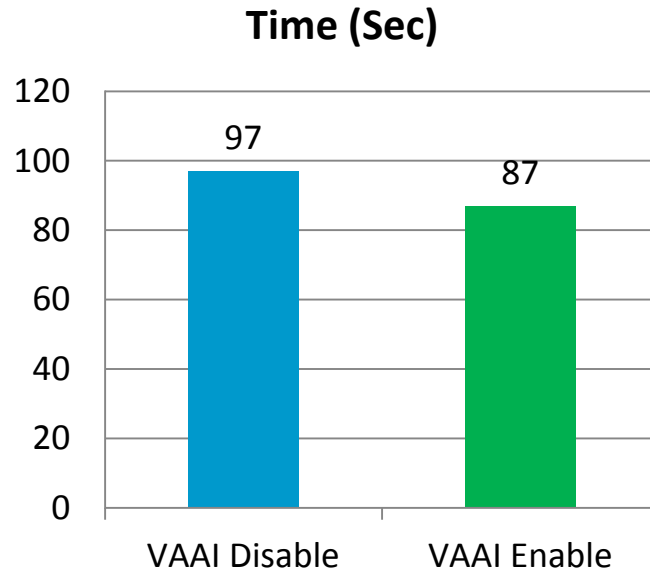
1. Create 100 VM over 4 ESXi servers (25 in each one).
2. Measure Time to power on all the 100 VM at the same time.
3. Test with VAAI Disabled and VAAI Enabled.

Item	VAAI Disabled	VAAI Enabled
Time to power ON	97 Sec	97 Sec

Hardware Assisted Locking - results

Key finding:

- Powering on multiple VMs at the same time reduce the bottleneck caused by LUN locking and is **10 %** faster using VAAI.





Summary

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Summary

Combining HA3969/HA3969U and VMware vSphere 5.1 with VAAI achieves an exceptional performance in virtual environments.

The key benefits of using VAAI is notorious in the high speed processing to complete operations and excellent improvement by reducing the server load and the I/O load.

The test results show the perfect coupling and operation of HA3969/HA3969U with VAAI.

- **Full Copy**

- **19% faster**
- **91% CPU load reduce**
- **97% commands traffic reduce**

- **Block Zeroing**

- **20% faster**
- **86% Writes commands reduce**

- **Hardware-assisted locking**

- **10% faster**
- **Avoid IO bottlenecks caused by LUN locking**



Thanks !

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