



Application Notes
November 2015

QNAP Plugin for VMWare vStorage API for Array Integration (VAAI)



Notices

This user manual details instructions for using the QNAP Enterprise Storage NAS. Please read the instructions carefully, and enjoy the powerful functions of the QNAP Enterprise Storage NAS.

- The QNAP Enterprise Storage NAS is hereafter referred to as the ES NAS or the NAS.
- The product you purchased may not support certain functions dedicated to specific models.

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Overview

What is VAAI?

VMware vStorage APIs Integration (VAAI) is a set of APIs provided by vSphere that allows the ESXi hosts to offload data processing of certain storage-related services to storage systems. The QNAP ES NAS will process the data instead of the ESXi hosts.

Overall Benefits

The integration of QNAP NAS with VMware VAAI offers customers the chance to deploy a virtualized environment with optimized performance. Additionally, it will offload data processing to the NAS releasing additional resources for ESXi hosts in certain tasks.

VAAI for iSCSI supports 4 features

- Full copy (hardware-assisted copy)
- Block zeroing (hardware-assisted zeroing)
- Hardware-assisted locking
- Thin provisioning and space reclamation

VAAI for NAS (NFS) supports 3 features

- Full File Clone
- Space Reservation
- Extended Statistic

VAAI for iSCSI

VAAI iSCSI - Block Copy

Block Copy enables the QNAP storage to make full copies of data within the NAS without needing to have the ESXi host read and write the data.

- Without VAAI:

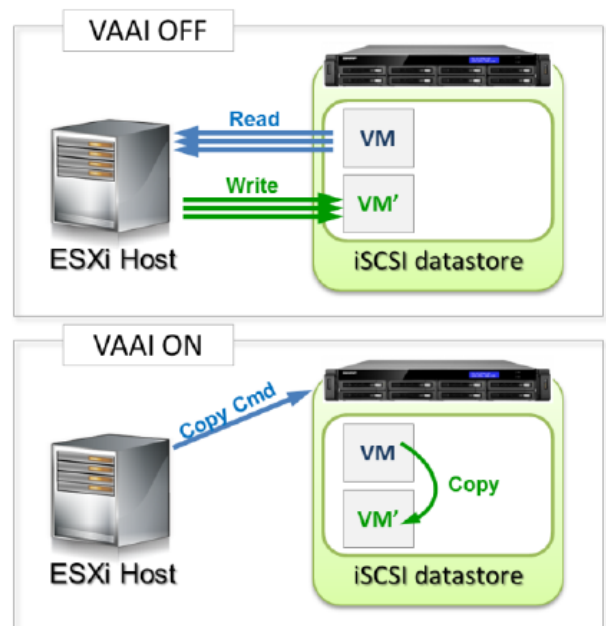
When an ESXi host copies data without VAAI, it will have to read the data from the NAS, and write back the data to the NAS to copy the data. This process consumes memory, network bandwidth, and CPU from the ESXi host, decreasing the resources available for the VMs.

- With VAAI:

When an ESXi host copies data with VAAI, it will send a command to the NAS, and wait for the result. This process offloads the work to the NAS, and leaves the resources allocated to VMs unchanged. The copy process is done directly by the NAS. CPU, memory, and network bandwidth are not used in the copy procedure.

- Benefits:

- Reduces the loading on ESXi hosts
- Faster virtual machine cloning
- Faster template deployment
- Faster storage vMotion

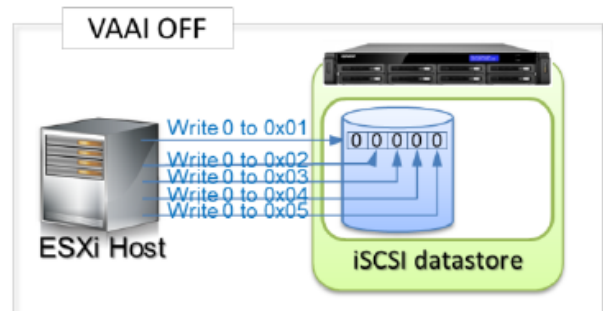


VAAI iSCSI - Block Zeroing

Block Zeroing allows the QNAP NAS to zero out a large number of blocks to speed up the provisioning of VMs.

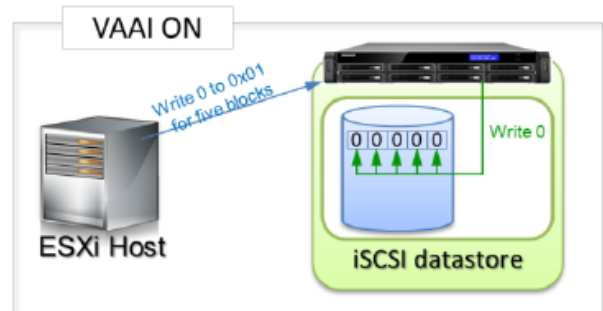
- Without VAAI:

When an ESXi host creates and initializes a virtual disk without VAAI, it has to write numerous zeroes to the NAS to create the initialized file. This process consumes memory, network bandwidth, and CPU from the ESXi host, decreasing resources available for VMs.



- With VAAI:

When an ESXi host creates and initializes a virtual disk with VAAI, it will send a command to the NAS, and waits for the result. This process offloads the work to the NAS, and leaves the resources allocated for VMs unchanged. The block initialization process is done by the NAS directly and CPU, memory, and network bandwidth are not used.



- Benefits of Block Zeroing

- Reduces the work load on ESXi hosts.
- Faster allocation of virtual machine capacity.

- Effective usage

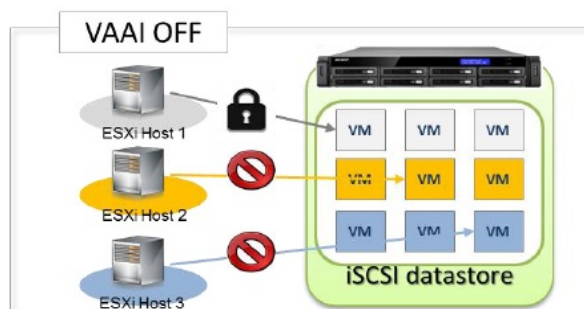
- Create Thick Provisioned Eager Zeroed virtual disks.
- Create VMs with Thick Provisioned Eager Zeroed virtual disks.

VAAI iSCSI - Hardware assisted Locking

Hardware Assisted Locking improves efficiency on large clusters by locking only required blocks instead of an entire LUN. When read/write operations occur from one ESXi server, it will keep the rest of the LUN is available to be accessed, increasing efficiency.

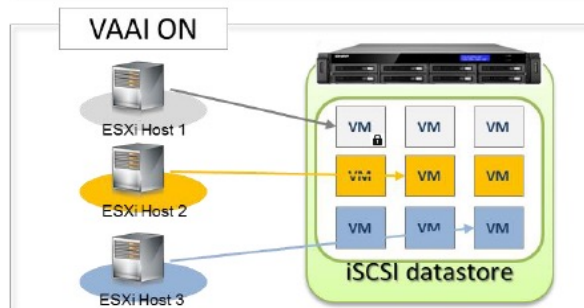
- Without Hardware Assisted Locking

When an ESXi host accesses a datastore on an iSCSI LUN, the iSCSI LUN is locked and other ESXi hosts have to wait for the LUN to be released. The more ESXi hosts that share the same datastore, the lower the performance will be.



- With Hardware Assisted Locking

When an ESXi host accesses a datastore on an iSCSI LUN, the required blocks are locked, and the iSCSI LUN remains accessible to other ESXi hosts. More concurrent operations can be achieved while maintaining a good performance level.



- Benefits of Hardware assisted Locking

- Enables the QNAP NAS to scale to more VMs
- Enables more ESXi hosts without incurring a performance penalty.

- Effective usage

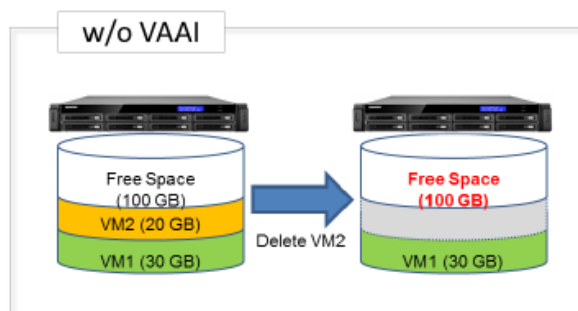
- Large VMware clusters with shared datastores.

VAAI iSCSI - Thin Provisioning and Space Reclamation

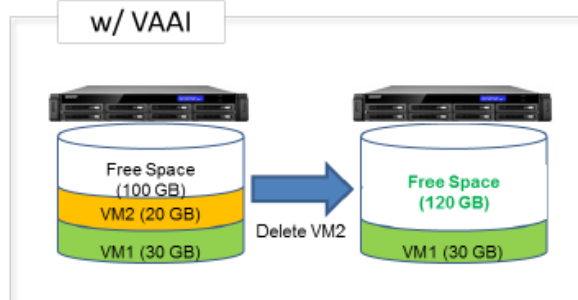
Pre-allocating capacity for iSCSI LUNs can lead to inefficient storage usage. Thin Provisioning allows allocation of storage capacity as it is needed. This capacity will only be used when data, Virtual Machines, or virtual disks, are stored on the LUN.

Space Reclaim allows space to be released when VM or virtual disks are deleted or migrated to other LUNs. It avoids wasting capacity after data has been removed.

- Without Thin Provisioning and Space Reclaim:
Without Thin Provisioning and Space Reclaim, space allocation is done during LUN creation, and cannot be released until the LUN is deleted. If an administrator creates a 100 TB LUN, the 100 TB will be reserved for the LUN and cannot be used for other applications. When data is deleted from the LUN, the NAS will not show the free space, as the is still allocated.



- With Thin Provisioning and Space Reclaim:
With Thin Provisioning and Space Reclaim, the space allocation is done only when data is written, and it can be released when data is deleted. The free space on the NAS will dynamically increase and decrease as the VMs are created and deleted. The storage management is much more flexible and requires less physical capacity, increasing efficiency and lowers the total cost of storage.



- Benefits of Thin Provisioning and Space Reclaim
 - More accurate reporting of real disk space usage.
 - Better and more efficient storage management
 - Lower cost of storage.
 - Use capacity only when needed
 - Purchase Hard Drives only when needed
- Effective usage
 - VM creation / deletion
 - Snapshot creation/deletion

VAAI for NAS (NFS)

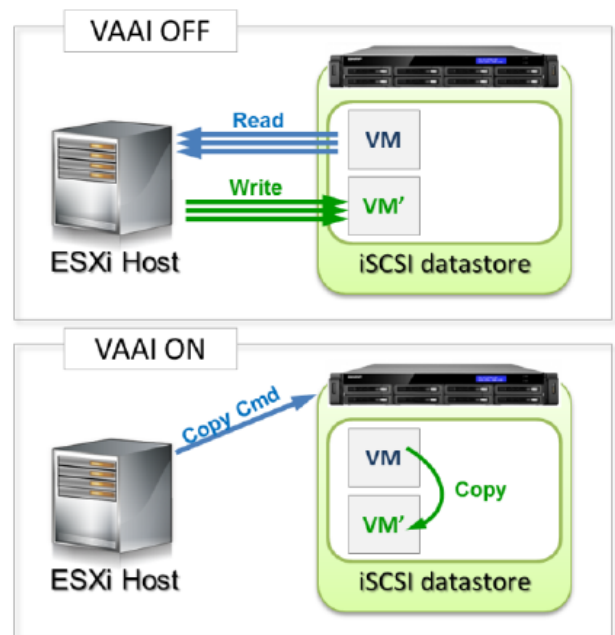
VAAI NAS - Full file clone

Similar to the Full Copy in VAAI iSCSI, it enables the QNAP storage to make full copies of data within the NAS without needing to have the ESXi host read and write the data.

- Without Full File Clone:

When an ESXi host copies data without VAAI, it will have to read the data from the NAS, and write the data back to the NAS. This process consumes CPU, memory, and network bandwidth from the ESXi host, decreasing the resources available for the VMs.
- With Full File Clone:

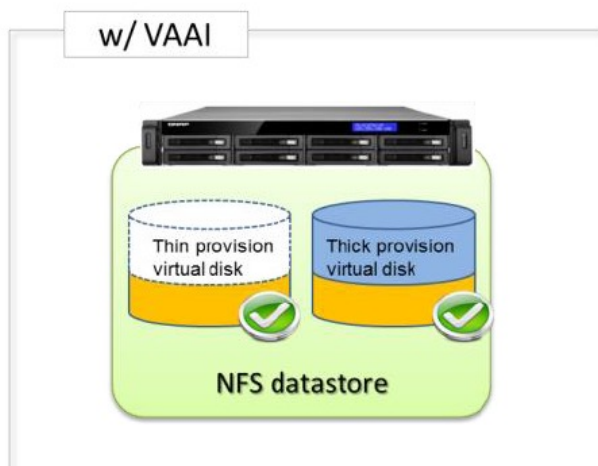
When an ESXi host copies data with VAAI, it will send a command to the NAS, and wait for the result. This process offloads the work to the NAS, and leaves the resources allocated to the VM unchanged. The copy process is done in the NAS. CPU, memory, and network bandwidth are not used.
- Benefits of Full file clone
 - Reduces the loading of ESXi hosts
- Effective usage
 - vCenter Cloning
 - Storage vMotion (cold clone)
 - Deploy VMs from templates



VAAI NAS - Space Reserve

Historically, vSphere only supported building thin provisioned virtual disks on NFS. By supporting Space Reserve, a pre-allocated virtual disk (thick provisioned eager zeroed) is possible with QNAP NFS datastores, by offloading the file creation onto the NAS.

- Without Space Reserve
Without Space Reserve, it is not possible to create Thick Provisioned virtual disks on an NFS datastore, only Thin Provisioned virtual disks are available.
- With Space Reserve:
With Space Reserve, it is possible to create Thick Provisioned virtual disks on NFS datastores.

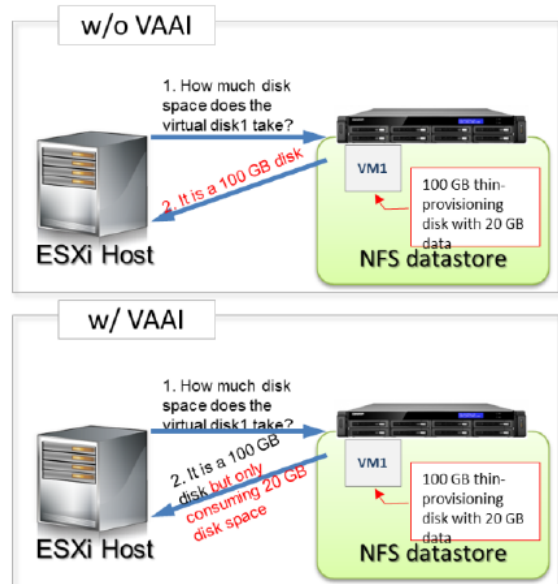


- Benefits of Space Reserve
 - Better virtual disk read/write performance (thin provision disks vs thick provision disks)

VAAI NAS - Extended statistic

Extended Statistic enables vSphere to query space utilization details for virtual disks on QNAP NFS datastores. This includes the size and usage details of a virtual disk.

The extended statistics are used by VMware during specific operations including Space Reserve, and Clone.



The extended statistics can also be retrieved from the ESXi host command line:

```
/vmfs/volumes/86721f64-65fb714e/MyVM1 # vmkfstools --extendedstat MyVM1.vmdk  
Capacity bytes: 17179869184  
Used bytes: 1608630272  
Unshared bytes: 1608630272
```



Installation and Verification

VAAI for iSCSI

VAAI iSCSI is enabled in VMware by default and does not require any installation.

- GUI Verification

To Verify that the storage supports VAAI, simply open the storage configuration in vSphere Client, and select the datastore. The column “Hardware Acceleration” (VAAI) will show supported.

Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions	Hardware Acceleration	Storage I/O Control
FileServer (1)	Normal	172.17.23.20:Publ...	Unknown	2.68 TB	1.18 TB	NFS	2015/11/11...	Enabled	Not supported	Disabled
HDD-Dell	Normal	Local DELL Disk (...)	Non-SSD	923.50 GB	576.89 GB	VMFSS	2015/11/11...	Enabled	Not supported	Disabled
Qnap-iSCSI-40TB	Normal	Qnap iSCSI Disk (...)	Non-SSD	40.00 TB	39.94 TB	VMFSS	2015/11/11...	Enabled	Supported	Disabled
Qnap-NFS-2TB	Normal	10.10.10.317/sha...	Unknown	2.00 TB	2.00 TB	NFS	2015/11/11...	Enabled	Supported	Disabled
Qnap-iSCSI-300GB	Normal	Qnap iSCSI Disk ...	Non-SSD	299.75 GB	298.80 GB	VMFSS	2015/11/11...	Enabled	Supported	Disabled
Qnap-NFS-200GB	Normal	10.10.10.31/sha...	Unknown	200.00 GB	200.00 GB	NFS	2015/11/11...	Enabled	Supported	Disabled

Datastore Details

Qnap-iSCSI-40TB 40.00 TB Capacity

Location: /vmfs/volumes/56420f17-85dc756a-9398-a0369f5631e8

Hardware Acceleration: Supported

59.94 GB Used
39.94 TB Free

Path Selection
Fixed (VMware)

Properties
Volume Label: iSCSI-40TB
Datastore Name: Qnap-iSCSI...

Extents
Qnap iSCSI Disk (naa.6e84... 40.00 TB
Total Formatted Capacity 40.00 TB

Storage I/O Control
Disabled

Paths
Total: 4
Broken: 0
Disabled: 0

Formatting
File System: VMFS 5.61
Block Size: 1 MB

- CLI Verification via SSH or ESXi shell

```
~ # esxcli storage core device vaai status get
naa.6e843b689a4436ed8effd450ad9276d1
VAAI Plugin Name:
ATS Status: supported
Clone Status: supported
Zero Status: supported
Delete Status: supported
```

The screen capture above shows VAAI features supported by the QNAP iSCSI LUN.

Please refer to VMware documentation for details on enabling/disabling VAAI in VMware.

Disabling the VAAI functionality in ESXi/ESX (1033665): <http://kb.vmware.com/kb/1033665>



VAAI for NAS (NFS)

VAAI NFS requires installation of the VAAI plugin on each ESXi hosts.

If the ESXi servers are not connected to the internet:

- Download the VAAI NAS plugin from: <http://www.qnap.com/utility>
- Install the plugin by following the procedure for installing patches on an ESXi 5.x/6.x host from the command line: <http://kb.vmware.com/kb/2008939>
 - Upload the patch to a datastore on your ESXi 5.x/6.x host using the Datastore Browser from vCenter or a direct connection to the ESXi 5.x/6.x host using the vSphere client.

Migrate or power off the virtual machines running on the host and put the host into maintenance mode. The host can be put into maintenance mode from the command line with:

```
# vim-cmd hostsvc/maintenance_mode_enter
```

- Navigate to the directory on the datastore where the patch file was uploaded to and verify that the file exists:

```
# cd /vmfs/volumes/Datastore/DirectoryName
# ls
```

Where *Datastore* is the datastore name where the patch file was uploaded, and *DirectoryName* is the directory you created on the datastore.

- Install or update a patch on the host using these `esxcli` commands:

To Install by using local setup:

```
# esxcli software vib install -v
"/vmfs/volumes/Datastore/DirectoryName/PluginName.vib"
```

Where `PatchName.zip` is the name of the patch file you uploaded to the datastore.



To Update by using local setup:

```
# esxcli software vib update -v  
"/vmfs/volumes/Datastore/DirectoryName/PluginName.vib"
```

- Verify that the VIBs are installed on your ESXi host:

```
# esxcli software vib list
```

For example:

```
[root@esxi2:~] esxcli software vib list  
Name Version Vendor Acceptance Level Install Date  
-----  
QNPNasPlugin 2.0-1 QNAP PartnerSupported 2015-11-10  
mtip32xx-native 3.8.5-1vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-amd 0.3.10-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-atiixp 0.4.6-4vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-cmd64x 0.2.5-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-hpt3x2n 0.3.4-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-pdc2027x 1.0-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-serverworks 0.4.3-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-sil680 0.4.8-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
ata-pata-via 0.3.3-2vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
block-cciss 3.6.14-10vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09  
cpu-microcode 6.0.0-0.0.2494585 VMware VMwareCertified 2015-11-09  
ehci-ehci-hcd 1.0-3vmw.600.0.0.2494585 VMware VMwareCertified 2015-11-09
```

- After the patch has been installed, reboot the ESX host:

```
# reboot
```

- After the host has rebooted, exit maintenance mode and power on the virtual machines:

```
# vim-cmd hostsvc/maintenance_mode_exit
```



- Verify from vSphere client that “Hardware Acceleration” is supported as in the following screenshot

The screenshot shows the vSphere client interface for a VM named '192.168.217.2 VMware ESXi, 6.0.0, 3073146'. The 'Datastores' tab is selected, showing a list of storage devices. The 'QNAP-NFS-2TB' datastore is highlighted, and its 'Hardware Acceleration' status is 'Supported'. The 'Storage I/O Control' is 'Disabled'. Below the list, the 'Datastore Details' for 'QNAP-NFS-2TB' are shown, including server and folder information, and a storage usage pie chart. The 'Storage I/O Control' section is also visible, showing it is disabled.

Identification	Status	Device	Drive Type	Capacity	Free	Type	Last Update	Alarm Actions	Storage I/O Control	Hardware Acceleration
FileServer(1)	Normal	172.17.23.20:Publ...	Unknown	2.68 TB	1.18 TB	NFS	2015/11/11 下午 10:34...	Enabled	Disabled	Not supported
HDD-Dell	Normal	Local DELL Disk (...)	Non-SSD	923.50 GB	576.89 GB	VMFSS	2015/11/11 上午 01:30...	Enabled	Disabled	Not supported
QNAP-iSCSI-300GB	Normal	QNAP iSCSI Disk ...	Non-SSD	299.75 GB	298.80 GB	VMFSS	2015/11/11 下午 08:00...	Enabled	Disabled	Supported
QNAP-iSCSI-40TB	Normal	QNAP iSCSI Disk ...	Non-SSD	46.00 TB	39.94 TB	VMFSS	2015/11/11 下午 08:00...	Enabled	Disabled	Supported
QNAP-NFS-200GB	Normal	10.10.10.31/shar...	Unknown	200.00 GB	200.00 GB	NFS	2015/11/11 下午 08:00...	Enabled	Disabled	Supported
QNAP-NFS-2TB	Normal	10.10.10.31/shar...	Unknown	2.00 TB	2.00 TB	NFS	2015/11/11 下午 08:00...	Enabled	Disabled	Supported

Note: During the installation, if a previous version of the plugin was installed, it will be listed as VIBs Removed:

```
~ # esxcli software vib install -v http://eul.qnap.com/Storage/Utility/QNAP_QNPNasPlugin_1.0.vib --no-sig-check
Installation Result
  Message: The update completed successfully, but the system needs to be rebooted for the changes to be effective.
  Reboot Required: true
  VIBs Installed: QNAP_bootbank_QNPNasPlugin_1.0-1.0j
  VIBs Removed: QNAP_bootbank_QNPNasPlugin_1.0-1.0h
  VIBs Skipped:
```