VMware Virtual Machine Testing
With SANBlaze VirtualAware Emulation

A SANBlaze Whitepaper
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Abstract
SANBlaze Technology introduces VirtualAware™ technology for VMware performance and capacity planning.

With increased use of VMware virtual machines running on ever more capable multiprocessor machines, it is trivial to create a scenario where the storage requirements of the virtual machines exceed the capabilities of the storage system.

Mismatches in performance capabilities between VMware host machines and the storage subsystems hosting their respective Datastores become particularly acute in the capacity planning and test environment, where the goal is to maximize the number of virtual machines per physical multiprocessor initiator.

Increasing the performance of the storage subsystem in an enterprise environment may be accomplished by simply "throwing money" at the problem. Large, highly capable storage arrays with multiple high bandwidth 10G - 40G iSCSI or 8G - 16G Fibre Channel interconnects provide the necessary bandwidth and performance to satisfy the requirements of high-end VMware initiators for the purpose of capacity planning and performance test, but at a price point well out of range for most testing scenarios.

SANBlaze has addressed the qualification and capacity planning for this high-end VMware test environment with the VirtualAware Storage Emulation System. VirtualAware technology leverages the industry-leading storage emulation technology of SANBlaze's VLUN product, providing high performance emulated storage, by adding support for virtual VMware Datastores.

VirtualAware technology is VAAI (vStorage API for Array Integration) capable, supporting full hardware acceleration to VMware. VMware "clones" are deduplicated automatically by the instantaneous SANBlaze cloning process, and completed in a fraction of the master’s storage space. For example, an 8GB Windows Virtual Machine can be fully cloned in as little as 100MB, allowing many virtual machine storage devices to live in RAM and operate at line speed.

Tests that stress disk access, latency and bandwidth, such as a virtual machine "boot storm" can be completed in a fraction of the time at a fraction of the cost of previously available methods, for example.
Table of Contents
Abstract ...................................................................................................................... 2
Table of Contents ....................................................................................................... 3
List of Figures ............................................................................................................. 3
Virtual Storage for VMware Testing ......................................................................... 4
How it Works ............................................................................................................. 5
Line Rate Testing ..................................................................................................... 5
Configuring a VirtualAware SANBlaze System ....................................................... 6
  Create the Master LUN on the VirtualAware System ........................................... 6
  Creating the Slave Virtual Machines ................................................................ 10
  Saving the Entire Configuration ................................................................. 16
  Saving an Individual VirtualAware Configuration ........................................... 16
Conclusion ............................................................................................................... 16

List of Figures
Figure 1: Create a LUN for the Master Datastore ..................................................... 7
Figure 2: Create the Master LUN Datastore ............................................................ 8
Figure 3: Mount the Datastore to VMware and Install Guest OS ......................... 9
Figure 4: Creating Virtual Snapshot Datastores .................................................. 11
Figure 6: Configured VirtualAware Datastore ..................................................... 14
**Virtual Storage for VMware Testing**

This whitepaper introduces the concept and practice of Virtual Storage for VMware performance and capacity planning testing, and the VirtualAware Emulation product from SANBlaze Technology, Inc.

If you are unfamiliar with SANBlaze and the Virtual Storage products they offer, you may be inclined to ask "What is Virtual Storage, and how would I use it?"

SANBlaze VLUN products, with their Virtual Storage, provide a storage subsystem for the purpose of initiator/host testing that looks to the initiator exactly like a "real" disk, except the (virtual) disk is RAM based, and therefore performs line rate transactions with near zero latency.

All user data can be retained by the virtual storage system. Virtual disks can be formatted, mounted and used exactly as one would use a physical disk, with the ability to vary latency, inject errors, present thousands of individual disks, emulate arrays, change operation modes from disk to tape, target to initiator, change disk/tape/SSD attributes and many other operational parameters to aid in the qualification and scalability of initiators and hosts.

VirtualAware emulation brings SANBlaze's leading virtualization technology to the VMware capacity planning and performance test environment.

Using VirtualAware Virtual Emulation, a VMware Datastore is created on a virtual storage device presented from the SANBlaze VLUN system to a VMware virtual machine. Once created, this "Virtual Aware" Datastore can instantly replicate Virtual Machines using the vCenter "Clone" capability. Each clone appears identical to the master, and is capable of saturating multiple 10G Ethernet connections or 4, 8 or 16G Fibre Channel connections.

Connections from the VMware system to the VirtualAware Emulation System can be over iSCSI, SAS, FCoE or native Fibre Channel.
How it Works

The VirtualAware Emulation System is based on the industry proven SANBlaze Target Emulation System with enhancements to optimize VMware capacity planning and performance testing.

VirtualAware allows a VMware Datastore to be created on a virtualized disk presented to the VMware initiator. This disk can be connected via iSCSI, FCoE or a native SAN interface and it will appear to VMware like a native "raw" disk.

The VirtualAware System supports all VAAI optimizations including: Write Same, Extended Copy, Receive Copy Results, Unmap and Compare and Write. The virtual Datastore will be seen as "hardware accelerated" to VMware vCenter.

In addition, the SANBlaze VirtualAware LUN will deduplicate any time a vCenter clone operation occurs, enabling an entire virtual machine to be cloned without any appreciable increase in consumed storage.

Line Rate Testing

The SANBlaze VirtualAware System provides significant configuration and performance advantages to the capacity planning and test environment. After the original virtual machine has been created, it can be cloned multiple times in RAM without exceeding the RAM space available in the SANBlaze emulator.

For example, a single Virtual Machine running Windows(TM) can be created and then instantly replicated to provide additional Windows Virtual Machines each with their own independent virtual disks.

Since all VirtualAware disks reside in memory, with the ability to be backed up to disk files on the SANBlaze appliance, the Virtual Machines see Datastores with low latency and with line rate (10G / 8G FC) performance.
Configuring a VirtualAware SANBlaze System

Configuring a Datastore on a SANBlaze Emulation System consists of a few simple steps:

1. Create a LUN of size N, large enough to contain your Virtual Machines
2. Use VMware to create or copy your Virtual Machine to the LUN created in step 1. above
3. Use the vCenter clone command to copy the Virtual Machine

Create the Master LUN on the VirtualAware System

Create a Virtual LUN that will become the Master Virtual Machine. This master will be the basis for all clones in the next step, so it should be as complete as possible. If you want all your virtual machines to have VMware tools, install VMware tools now to the master so that subsequent clones will be complete.

From the SANBlaze system, choose any port that has a physical connection to your VMware Initiator, and create a LUN large enough to contain the Datastore for your VM and its guest operating system. The example uses 26GB.

You should make the Virtual LUN as large as possible, using all available memory in the system, so that it will be able to house as many virtual clones as possible.

Please note that the "thin provisioned" box must be checked and the page must be applied. Ensure the LUN is enabled, write-enabled, and ready.
Figure 1: Create a LUN for the Master Datastore

VirtualLUN LUN setup page for VMware testing.
In the example above, a 26GB LUN has been created at Port2 Target0 LUN0.

When the LUN is created, VMware will be able to access the LUN for use as a Datastore. You may have to initiate a "rescan" for VMware to discover the LUN, by using "rescan all" in vSphere or with the CLI command:

   esxcfg-rescan -A

Use VMware's vSphere Client or CLI to discover the VirtualAware LUN and initialize it.
Figure 3: Mount the Datastore to VMware and Install Guest OS

Allow VMware to write a vmfs file system to the device and bring the Datastore online.

Create a Virtual Machine using this Datastore as the target for the guest operating system and all configuration files. You can use your preferred method for creating the Virtual Machine: installing from a CD made available to the guest machine, using an iso image, or by simply copying a previously created VM to it.

Once you have created this "Master" LUN Virtual Machine's Datastore, power on the Virtual Machine and verify that the functionality is what you want for your test bed machines. If you are doing an installation from scratch (Windows for example), it is a good idea to stop at various points and save the installation to a snapshot file on the SANBlaze system.
To create these check point snapshots, simply use the "Save to File" on the VirtualAware SANBlaze system. Be certain you are not currently writing to the Datastore when you save to file, or the file will have incomplete data.

**Note:** It is recommended to save the Master Virtual Machine LUN to a file before "cloning" additional Virtual Machines.

A complete installation of Windows7 as a guest operating system as the initial "master" copy consumes 7188 MB of storage space on the VirtualAware SANBlaze LUN.

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**Creating the Slave Virtual Machines**

Once the Master Virtual Machine is created on the Datastore, it can be used to
create N Virtual Snapshots, or clones, for N virtual machines as shown in the figure below.

Figure 4: Creating Virtual Snapshot Datastores

From your VMware vCenter, locate the Virtual Machine that uses the SANBlaze VirtualAware device as its datastore, and use the clone operation as shown in the figure below.

Note that the clone operation is not a native part of ESXi and vSphere. The node must be a member of a vCenter to take advantage of the clone functionality.
The clone operation will take advantage of the VAAI primitives implemented on the SANBlaze VirtualAware storage emulator, and the clone operation will occur in seconds.

Using SANBlaze VirtualAware provisioning, the SANBlaze LUN will automatically deduplicate all common data while completing the VMware clone operation, allowing a full clone in a fraction of the original storage space.

As noted above, the first guest operating system, Windows7, required 7118MB; while the clone copy required only an additional 11MB (0.1%) resulting in a total used space of 7129MB as shown in the figure below.
Booting the cloned Virtual Machine will result in slightly more space being consumed due to write operations performed as the machine boots, but a fully booted the machine will take only a fraction of the space, and will be a complete copy of the master.
VirtualAware technology directs all reads from any Slave to come from a shared memory pool containing the master LUN data, and provides the following significant advantages to the test environment:

- A single copy of the "guest" operating system can be instantly cloned to several Virtual Machines, automatically de-duplicating any common data between the master and clone copies.
- Each Virtual Machine sees a private copy of its own guest operating system, and is completely independent of all other Virtual Machines.
- Each Virtual Machine enjoys RAM speed access to its own guest operating system, limited only by the interconnect speed (currently a multiple 16G, 8G FC or 10G Ethernet) between the VirtualAware Datastore and the VMware Initiator system.
Writes to the VirtualAware system terminate at the individual RAM based clone copy associated with a specific virtual machine, so that each Virtual Machine can be customized without affecting any other. This method has the following significant advantages:

- Each individual VirtualAware based VM appears to the guest operating system as a full installation of a virtual machine, allowing each virtual machine to be customized, becoming a completely independent entity.
- All VirtualAware storage can be saved to file on demand, providing a snapshot in time can be preserved for all N virtual machines.
- All virtual machines can be restored to any saved snapshot.
- Customizations to all Virtual Machines can be saved to a named file for permanent retention.
- All Virtual Machines can be returned to "factory default" (the master copy) at any time, reverting the test bed to its start of the day condition.

The figure below shows the original "master" installation of Windows7 and four fully functional "clones". Each Virtual Machine shows it consumes 8.25GB out of 25GB available. Collectively, the Virtual Machines "see" 125G of capacity, and together consume ~42GB.

In reality, this entire configuration is running on the SANBlaze VirtualAware system using only 7.4G of RAM.
Saving the Entire Configuration

The entire test bed, Master LUN and all clones can be saved to a named configuration at any time, by selecting the Configuration page from the menu, providing a file name and selecting "Save".

Saving an Individual VirtualAware Configuration

Any individual Virtual Datastore can be saved at any point by selecting the VirtualAware LUN and using the "save to file" function.

Conclusion

SANBlaze VirtualAware technology provides RAM based line rate datastores for high-end VMware initiator capacity planning and performance test environments.

Simple configuration hardware, accelerated "clone" operations and automatic de-duplication allow for large installations to be staged and deployed quickly for maximum test efficiency.

Page 16

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VirtualAware allows instantaneous "clone" operations allowing multiple snapshots of a single master guest operating system on vmfs3 Datastores to be presented as unique Virtual Machine storage to VMware virtual machines.

RAM based operation and high bandwidth interconnects to the VMware initiator provide a perfect test bed for applications that would otherwise be limited by the performance of the storage subsystem, such as the "boot storm" scenario when hundreds of virtual machines try to access their Datastores simultaneously.