



XenDesktop Storage  
Validation on Nimble Storage  
Whitepaper



# Citrix XenDesktop Validation on Nimble Storage's Flash-Optimized Platform



## Executive Summary

Nimble Storage's flash-optimized CASL™ architecture makes it a great fit for desktop virtualization in the datacenter because it accelerates both reads (such as for boot storms) and writes (for steady state I/O). Citrix and Nimble Storage have been working together to bring best-of-breed solutions to the market. Nimble Storage arrays provide a high-performance yet cost-effective end-user experience for Citrix XenDesktop. For more information about Citrix and Nimble Storage solutions, see <http://www.nimblestorage.com/solutions/alliances/citrix.php>.

For this particular testing program, a standard test bed configuration was created and utilized to test various storage vendor solutions. The test bed was consistent and stable across vendors, providing the ability to reset the test bed to a known beginning state and deliver repeatable host level results useful for comparison.

## The Business Challenge

The challenges for storage solutions to support a VDI (Virtual Desktop Infrastructure) environment stem from two key aspects of the overall virtualization architecture that gets deployed. As hundreds or even thousands of end-user desktops and laptops are centralized into the IT data center, the individual workloads need to be merged and user-experience maintained. A positive end-user experience depends on storage performance, and picking the right storage for VDI is a critical factor for success.

The desktop workloads present an interesting challenge in that there are common everyday tasks that need to be performed by the user – let's call this steady-state – as well as operational tasks that need to be performed that can disrupt a shared environment. Things like booting, logging in, running AV scans, performing updates, or running backups of the users systems can introduce storage I/O stress. The nature of these differing workloads imposes different requirements on the storage system.

The typical measure of throughput (MB/s) or IOPS of the storage layer may not be sufficient to understand the right solution. To ensure end-user experience is maintained, the latency or response time of the storage system becomes a critical performance measure as well.

In short, what is needed is an adaptive storage solution than can cost-effectively handle peak loads of disruption or activity as well as service the steady-state operations in a cost effective and easily administered package. Nimble Storage provides such a solution for VDI environments

## Overview: Citrix VDI Capacity Program for Storage Partners

In Q1 2014, Citrix launched a new program designed specifically to address the storage needs of customers who are implementing XenDesktop using the VDI FlexCast approach. VDI presents multiple types of data, each with its own unique requirements, to the storage infrastructure. Storage in turn can respond to with these requirements using a variety of HW and SW based approaches, some of which can be combined in hybrid solutions. The variety of choices and the differences between them has led to some confusion for customers and partners. To resolve this, Citrix constructed a turnkey “VDI Capacity” test rig in their Santa Clara Solutions Lab. This rig contained the necessary server capacity to generate 750 users of a reference XenDesktop workload. The VDI farm was complete and fully operational with the exception of storage. Citrix storage partners were invited to connect their storage to the VDI farm and participate in a “VDI Capacity” test that simulated of “a day in the life” of a 750 user Citrix farm.

### Test methodology:

The focus of the VDI Capacity Program for Storage Partners is on provisioning the appropriate amount of storage performance and capacity with a cost-efficient design. Using a simple, binary pass/fail methodology, if a partner’s provided storage solution can successfully support “a day’s” run to the defined user capacity, while sustaining required performance metrics, the partner passes and the test ends. Once passed, Citrix will describe the storage partner as “750 User Verified” for XenDesktop.

Login VSI, a highly regarded and respected tool for standardized VDI performance and capacity testing, was used to generate VDI workloads and to measure performance. 750 desktops were created, launched and executed a workload program that simulates a typical work day. Pass/fail was determined by whether or not the storage system used could successfully handle the storage demands placed on it without reaching a latency limit called “VSI Max”. More about Login VSI can be found [here](#).

### Partner Overview:

#### Nimble Storage Solutions

Nimble has developed an entirely new approach to storage that seamlessly combines SSDs with high-capacity drives. Nimble’s breakthrough CASL™ architecture is designed from the ground up to address the performance and cost challenges of facing the storage industry. VDI solutions are a good example of a demanding storage configuration.

Nimble Storage iSCSI arrays provide a complete application-aware data storage solution that includes flash accelerated primary storage, cost effective capacity, integrated data protection, and replication. This allows you to consolidate management of primary, secondary, and off-site disaster recovery storage within a single storage solution.

The specifics of the Nimble Storage array are covered in the Addendum section.

## Partner Solution

A Nimble Storage array provides iSCSI target volumes (LUNs) to the hypervisor host(s). In this case, the hypervisor of choice was Microsoft Hyper-V. Volumes created on Nimble Storage arrays are highly optimized for virtual machines by providing the following benefits:

### Performance and Capacity Efficiency

- CASL's innovative use of flash enhances read performance and addresses boot-storm and login-storm situations (i.e., multiple users booting or logging in at the same time). Serializing random writes enhances write performance – effectively meeting peaks in write IO's triggered by virus scans and OS upgrades.
- CASL compresses all data and provides savings 30-75% capacity savings. Zero-copy cloning ensures duplicate images don't consume valuable disk space.
- Most importantly, Nimble can respond rapidly to workload fluctuations. In comparison, traditional tiered architectures require hours or even days to respond to changes in IO patterns.
- Thin Provisioning: Efficiently stores actual data written rather than reserved space.

### Integrated Data Protection

- Highly efficient snapshots allow frequent recovery points with 60-90 days of retention of virtual desktop images and user data. Backups take seconds and do not impact application or storage performance.
- Zero-Copy Cloning: Preemptive de-duplication to eliminate storage footprint of repetitive data.
- Built-in replication ensures VDI data is protected off-site in the event of a site failure.

### Pain-Free Operations

- The intuitive Nimble UI eliminates the complexity of provisioning and managing separate storage, backup, and disaster recovery devices.
- Frequent heartbeats monitor system health to identify potential failures before they occur. High availability and resiliency features combined with truly non-disruptive upgrades virtually eliminate downtime.

### The Results

750 desktops were built utilizing 11 Nimble volumes for the Citrix Provisioning Services Write Cache. Each volume was 1TB in size. One volume was presented to each Hyper-V host using the Microsoft iSCSI Connection Manager. One 27TB volume was created for desktop sharing. The created volumes can be seen in Figure 1, below. All volumes took advantage of Nimble's built in thin provisioning and compression.

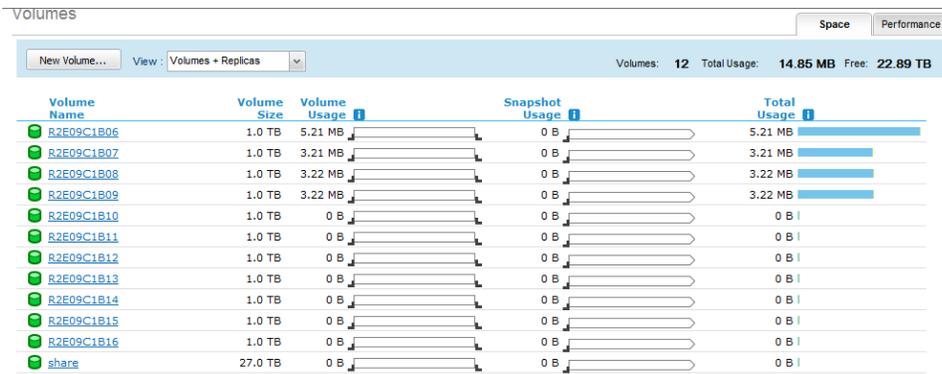


Figure 1 - 1TB volumes and 1 27TB volume created on the Nimble CS220G-X4

The boot storm began at 10:00AM utilizing approximately 2000 IOPs. Assuming the boot storm had an average block size of 4-8K IO. The approximate limit of the CS220G-X4 with those block sizes is 15-20K IOPs, which is above what was needed for the boot storm. The extra IOPs could have been used to boot the virtual desktops quicker if the server infrastructure could handle the extra load. The extra performance headroom could also be used to support greater numbers of desktop users or other applications on the same storage platform.



Figure 2 - Nimble CS220G-X4 metrics shown with boot storm and LoginVSI test

The Login VSI tests were run at 2:00PM, utilizing approximately 5400 IOPS. The blocksize of Login VSI running a medium workload is typically 8-12K IO. At that workload the Nimble Storage will be able to sustain 8-10K IOPS. The CASL operating system with its flexibility for read or write efficiency can be seen as Citrix PVS generates high write workloads to the storage that are easily processed.

## Solution components/ Architecture Design

The Nimble CS Array product line consists of the 200 and 400 series, with a number of models available within each product line. If additional storage is needed, extra shelves can be purchased. Take a look here for more [information](#). For this test a CS220G-X4 was chosen for its unbeatable performance and price. See Figure 3 for more information regarding the product lines and what options were chosen for the Citrix Capacity Program.

### Technical Specifications

Nimble CS-Series	CS210	CS220	CS240	CS260	CS420 <sup>1</sup>	CS440	CS460
Controller Type	High Performance				Extreme Performance		
Raw Disk Capacity, Base (TB) <sup>2</sup>	8	12	24	36	12	24	36
Effective Capacity, Base (TB) <sup>2</sup>	4 - 9	8 - 16	16 - 33	25 - 50	8 - 16	16 - 33	25 - 50
Effective Capacity, Maximum (TB) <sup>2,3</sup>	38 - 76	109 - 218	117 - 234	125 - 249	109 - 218	117 - 234	125 - 249
Max Number of Expansion Shelves	1	Up to 3					
Base Flash Capacity (GB)	160	320	640	1,200	-	640	1,200
-X2 Flash Capacity (GB)	320	640	1,200	2,400	640	1,200	2,400
-X4 Flash Capacity (GB)	640	1,200	2,400	-	1,200	2,400	-
-X8 Flash Capacity (GB)	-	2,400	-	-	2,400	-	-
Network Connections Per Controller	4x 1GbE	6x 1GbE / 2x 10GbE + 2x 1GbE (G-model)					
Protocols Supported	iSCSI						
External SAS Connectivity Per Controller	1x 6Gb SAS						
Power Requirement	450W	500W			550W		

Figure 3 - Nimble technical specifications of the two available product lines

Both the 200 and 400 series pack a huge punch in a small package. As seen in Figure 4 the Nimble array which contains both active and standby controllers and disks, all in 3 rack units.



Figure 4 - Front facing image of Nimble Storage 3U CS Series Array – front grill attached / removed

With the grill removed the HDD and SSD arrangement of the Nimble CS220G-X4 can be seen. All Nimble arrays have a similar disk arrangement - this model includes 12 HDD (Hard Disk Drives) and 4 X SSD (Solid State Drives). Refer to Figure 3 for specific HDD and SSD sizes, since they vary per each model.

The Nimble array is not only easy to rack, but it simple to add to the network as well. The Nimble storage connected to the Citrix Capacity Program infrastructure used two sets of 10gig Ethernet transmitting iSCSI traffic, in an active/standby model. Management was handled by a 1gig Ethernet connection, also cabled active/standby. The detailed wiring along with the back of the array can be seen in Figure 5.

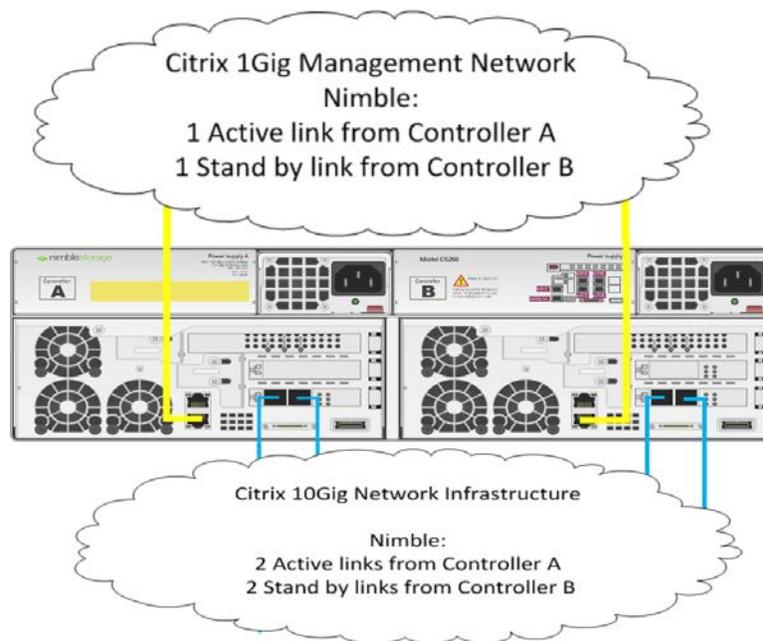


Figure 5 - Nimble Storage connections to Citrix Storage Validation network

Highly intuitive, the Nimble array can be administered through GUI or CLI. Displayed below in Figure 6, the health and connections of the Nimble array can quickly be observed. This view also provides a look at the disks, ports, array status; IP addresses HDDs, SSDs, model and software version. The estimated cost per desktop including 1 Yr NBD support for the CS220G-X4 used in this testing is about \$64. For latest Nimble pricing information, please contact [sales@nimblestorage.com](mailto:sales@nimblestorage.com) or call 1-877-364-6253.

Array > citrixready

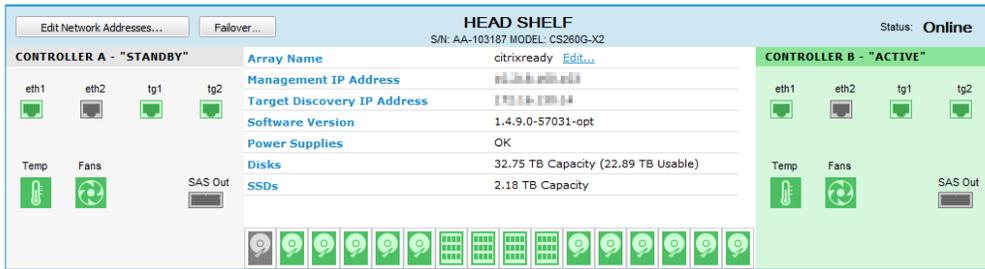


Figure 6 - Nimble Storage GUI showing overview of array connections and health

Digging further into the GUI, networking can easily be audited and set. Figure 7 reflects the networking infrastructure the Nimble array was connected to while performing the Citrix Storage Validation.

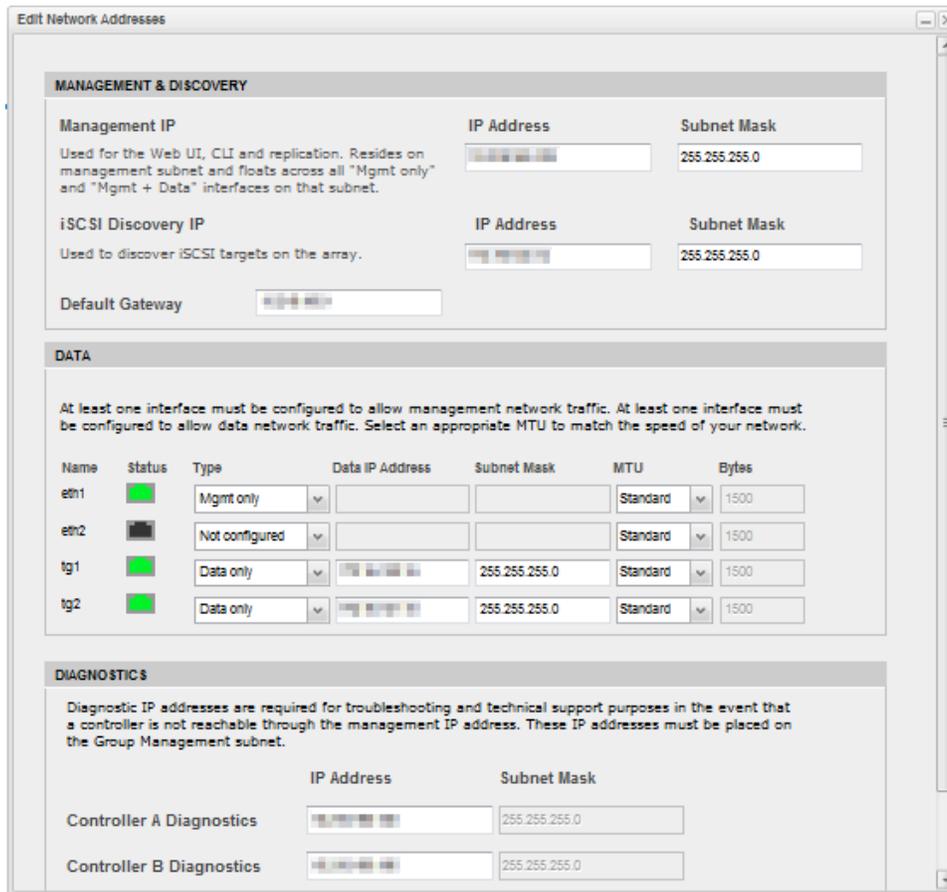


Figure 7 - Nimble Storage GUI with detailed view of network connectivity to the Citrix Storage Validation network

## Additional solution data

Nimble Storage provides extreme flexibility, which allows it to weather boot and login storms as well as the demanding needs of steady state computing. Nimble provides a flexible, fast and stable environment while maintaining a 3U footprint and affordable pricing. Nimble Storage's flash-optimized CASL™ architecture breaks away from the traditional mind share awarding its benefits to you.

## Conclusion and Call to Action

The Citrix Storage Validation test conducted with XenDesktop 7, Nimble Storage CS220G-X4 array and Login VSI 3.7, showed that a robust yet simple configuration is possible for VDI scenarios with up to 750 concurrent VDI desktop users.

For more information on Nimble Storage visit [NimbleStorage.com](http://NimbleStorage.com) and for additional technical papers see the [Technical Papers](#) page at NimbleStorage.com.

## Addendum

### Minimum storage requirements as determined by Citrix for 750 concurrent VDI desktop users:

- Write Cache Files:
  - 6 GB Write cache file per user
  - 4.5 TB minimum required
  - Additional 2.5 TB added to LUN for overhead
- User Data:
  - 30 GB allowed for each user
  - $750 * 30 = 22$  TB of required space
  - 3 TB added for overhead
- Total storage capacity required:
  - 7 TB for write cache + 25 TB for user data = 32 TB required

### Citrix Provided Server Configuration

- A single HP C7000 enclosure will be used hold the servers
- The enclosure will be in a separate isolated environment
- Servers will be BL460c G7 with 2 Procs and 192 GB of memory
  - 1 server to contained the necessary infrastructure VMs
  - 4 servers will contain client VMs necessary to drive work load
- A separate Login VSI 3.7 license will be obtained to further provide isolation
- VM Configuration - 32-bit Win7 1.5GB memory, 1 vCPU
  - 11 servers will contain XD7 desktops
- VM Configuration – 64-bit Win7 1.5 GB memory, 1 vCPU
  - Servers will be Windows 2012 Hyper-V



Figure 8 - Server Configuration

## Citrix Provided Configuration

### Network Configuration

- FlexFabric will be configured to allow for either Ethernet or Fibre connectivity from the blades. These will be connected to a 4gb Brocade switch
- Four networks will be created:
  - Network 1 – internal to HP Virtual Connect for PXE boot of VMs, 5 GB
  - Network 2 – Connection to lab storage and management, 1gb
  - Network 3 – Production network for connection between clients and XD VMs, 5 GB
  - Network 4 will be either:
    - Connection to vendor storage for using iSCSI, 9 GB OR
    - Fibre connection to SAN for vendor storage
- There will be no HA or redundancy across the NICs

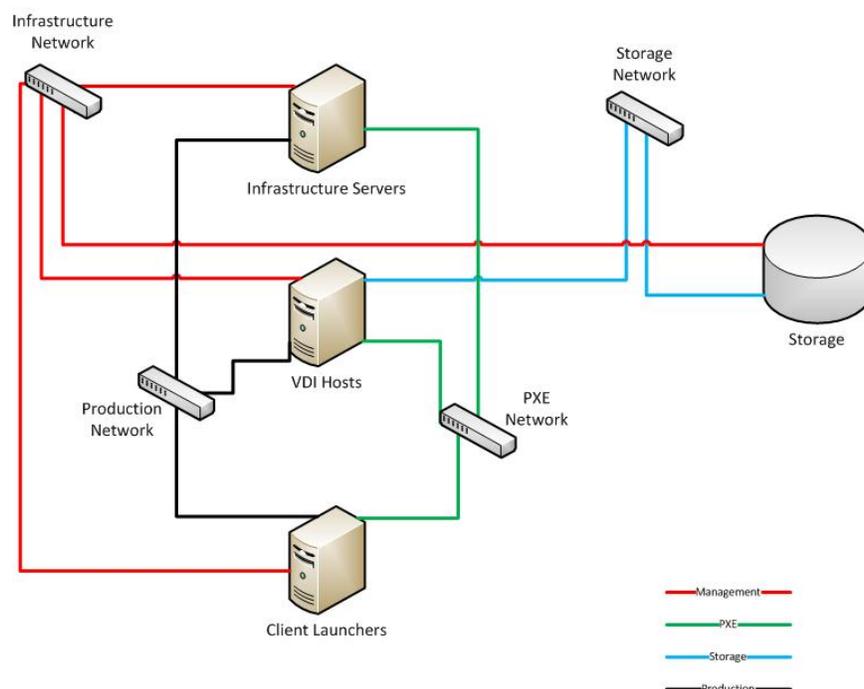


Figure 9 – Network Layout

### XenDesktop Configuration

- XenDesktop 7 will be used
- Provisioning will be done with PVS version 7.0.0.46. Due to MCS working best with file based storage and not all vendors supporting file based storage (NFS), PVS will be used to provision the desktop VMs. This will create a write-intensive environment.
- One each broker (DDC) and PVS VM will be created to support the Infrastructure

**Storage Configuration completed by Vendor**

- For this solution, a Nimble Storage CS 200 Series Array was used. The specific model that would meet the desktop storage and performance needs is a CS220G-X4. The array was equipped with the flash SSD (1.2TB) and dual 10GB network connections (as described above).
- 11 X 1TB LUNs were created and each individual LUN connected to a Hyper-V host using Microsoft iSCSI Initiator Service (fits in usable capacity with ~1.5x compression inclusive of thin provisioning)
- 1 X 27TB LUN was created for user data best practices (unused and thin provisioned)

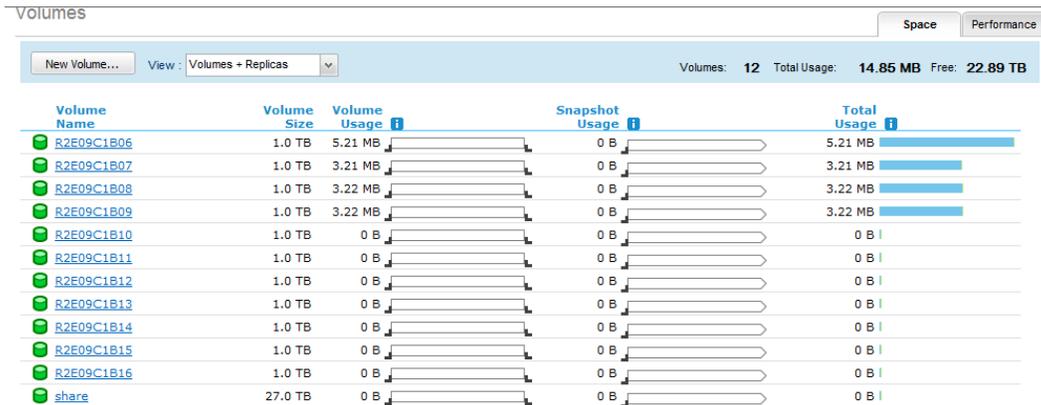


Figure 10 - Nimble Storage GUI with view of 12 iSCSI LUNs created per Citrix requirement

**Definitions**

VM definitions

- Infrastructure VMs:
  - All will be 64-Bit Windows 2012
  - AD VM – 4GB memory, 1 vCPU
  - DDC VM – 8 GB memory, 2 vCPU – locally configured SQL
  - PVS VM – 4 GB memory, 2 vCPU – locally configured SQL
- Client VMs
  - 32-bit Win7, 1.5 GB memory, 1 vCPU
- XD VMs
  - 64-bit Win8, 1.5 GB memory, 1 vCPU

Login VSI

- Login VSI 3.7 will be used
  - VSIShare will be inside the chassis
  - IOPs medium work load will be used