

Nexenta Liberates Storage to Deliver a Better ROI

Executive Summary

Nexenta was pleased to have worked together with Citrix in testing NexentaStor as part of the VDI Capacity Program. The results were a validation that NexentaStor provides a superior storage backend for VDI with a cost per seat of less than \$15 as it liberates enterprises from costly storage hardware systems that have abrogated many best efforts to deploy VDI environments. And using a software-defined storage solution which liberates storage management from the underlying hardware doesn't mean giving up features as NexentaStor is a fully featured NAS/SAN software platform with capabilities that meet and even exceed the capabilities of legacy storage systems.

The Business Challenge

There are a number of technical challenges to consider when it comes to virtual desktop infrastructure (VDI), from understanding associated licensing requirements to network issues. However, the single most difficult pain point when it comes to VDI is storage.

Applications traditionally required externally shared data storage systems to supply them with capacity, performance, and data protection. Most data storage systems perform these functions reasonably well, but they have shortcomings around limited automation and an inability to adapt in real time to dynamic changes required by the applications. Storage is not customarily designed to allocate capacity and performance resources on-demand. Resources are typically manually allocated in advance. As storage resources are consumed, the storage administrator will then manually allocate more. It's not a dynamic automated process for the vast majority of storage systems. Allocation tasks are labor intensive require scheduled downtime which is a rare commodity in today's 7x24 global economy.

To respond to the storage challenges that VDI presents, companies have sought solutions from hardware-based to software-based. True software-defined storage (SDS) is characterized by a separation of the storage hardware from the software that manages it. Moving to SDS liberates the administration of storage. This separation allows enterprises to make storage hardware purchase decisions independent from concerns about over/under-utilization or interoperability of storage resources. It also increases flexibility, automates management, and provides cost efficiencies that work together to drive a higher ROI.

As the global leader in SDS, NexentaStor offers a full featured NAS/SAN software platform that can be installed on standard commercial hardware with capabilities that meet and exceed the capabilities of legacy storage systems. This paper will outline the performance and administrative advantages gained from the use of NexentaStor in a Citrix VDI solution.

Overview: Citrix VDI Capacity Program for Storage Partners

Early in 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 tier. Storage in turn can respond to with these requirements using a variety of HW and SW based approaches, some of which can be combined with 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

NexentaStor has become the data center storage solution of choice for multi-petabyte scale cloud and virtualization deployments. This VDI Capacity analysis is a validation that NexentaStor adds a great deal of value to VDI environments.

As the global leader in true SDS offerings, NexentaStor is a full featured NAS/SAN software platform that can be installed on standard commercial hardware with capabilities that meet and exceed the capabilities of legacy storage systems. It concurrently supports block (FC, iSCSI) and file (NFS, SMB) access protocols across active/active controllers delivering a complete suite of data services: unlimited snapshots, clones, thin provisioning, inline deduplication, compression, and replication across all-HDD, all-SSD, and Hybrid configurations.

NexentaStor delivers a superior storage environment and is characterized by:

- #1 SDS product in both number of customers and in amount of global data under management – 1EB
- Most flexible SDS product with its broad hardware compatibility and complete storage system support
- Leading reliability with industry leading failover times among true SDS products
- High scalability with its market leading support for very large memory cache footprints
- Best operational performance with its use of the ZFS file system and its industry leading replication performance

This testing was performed using NexentaStor, the core SDS software from Nexenta. Nexenta also offers a product called NexentaConnect™ XenDesktop Edition which is an all-in-one VDI automation, storage auto-deployment, and storage acceleration solution providing wizard-guided provisioning, benchmarking, and calibration of the Citrix XenDesktop environment. NexentaConnect would, of course, deliver the same results as this testing shows but with these added administrative benefits.

Partner Solution

While many analysts have warned that storage makes up the lion's share of the cost of developing a proper VDI environment, Nexenta comes to the rescue with a full-featured storage solution for less than \$15 per seat.

System Configuration

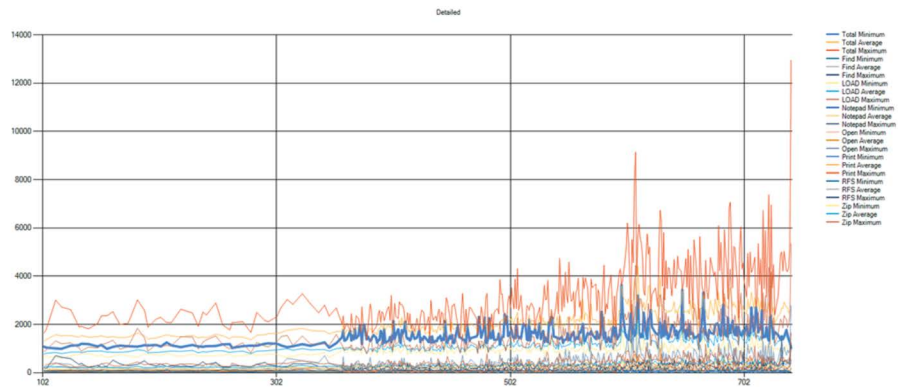
Item	Unit Street Price	Qty	Total Price
SuperMicro™ SuperStorage Server 6027R-E1R24L	\$ 1,485	1	\$ 1,485
Intel Xeon E5-2609 2.4GHz, 4-core	350	2	700
24 GB ECC Registered Memory (192GB Total)	315	8	2,520
Seagate 2TB SAS 7.2K HDD	105	8	840
Sandisk Optimus 200GB MLC SSD	699	2	1,398
Intel X520-DA2 dual 10GbE adapter	420	1	420
NexentaStor 4.0 – 16TB License with 1YR Gold support	3,850	1	3,850
Total Cost of Storage Backend			\$11,211
Cost/Seat (750 seats)			\$15

The Citrix VDI test environment as described in detail in the addendum below, required at least 32TB of logical storage but because of the compression inherent in NexentaStor, the amount of physical storage needed was only 16.5TB as per the table above. The total logical storage provisioned (effective capacity) in the NexentaStor environment was calculated at 118TB.

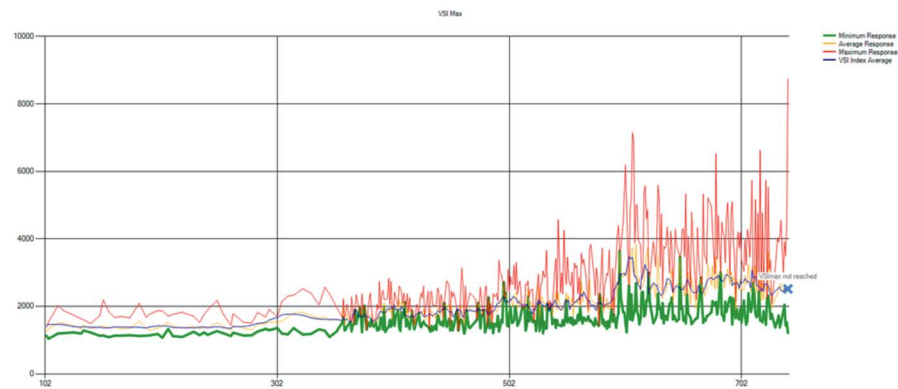
In terms of cost per seat, this configuration was not allowed to hit any maximums, so the storage cost per seat could have theoretically gone below \$10 per seat using the NexentaStor solution.

LoginVSI Data

LoginVSI successfully launched 742 desktops and VSIMax was not reached indicating that far more than 750 desktops could have been successfully deployed and managed in this environment. LoginVSI data and IOstats on the NexentaStor software showed that we could have supported over 1000 desktops on the same configuration.



Graph 1: Detailed Data



Graph 2: LoginVSI VSI Max Score

ARC usage

Disk I/O is a common source of performance issues despite modern cloud environments, modern file systems, and huge amounts of main memory serving as file system cache. Understanding how well that cache is working is a key task while investigating disk I/O issues.

NexentaStor utilizes the ZFS file system whose performance is typically viewed through its Adaptive Replacement Cache (ARC). The ARC is the ZFS main memory cache (in DRAM), which can be accessed with sub microsecond latency. An ARC read miss would normally read from disk, at millisecond latency (especially random reads). The L2ARC is a second layer of cache that sits in-between, extending the main memory cache using fast storage devices - such as flash memory based SSDs.

Detailed output of "show performance arc" command

ZFS ARC Statistics

time	read	miss	miss%	dmis	dm%	pmis	pm%	mmis	mm%	arcsz	c
11:44:24	23M	24K	0	13K	0	11K	0	16K	0	157G	205G
11:44:25	11K	0	0	0	0	0	0	0	0	157G	205G
11:44:26	11K	0	0	0	0	0	0	0	0	157G	205G
Current ARC Size				Minimum ARC Size				Maximum ARC Size			
150 GB				244 GB				196 GB			

Higher cache percentages indicate less hard drive usage and thereby a faster desktop performance with the larger portion of the desktop being based on cache hits. So an overall performance of 93% on cache means that nearly all data was handled out of the higher performing cache.

Compression Ratio

The NexentaStor software includes compression algorithms that can drastically improve performance for VDI workloads. Compression can also save on storage space. For many VDI client operating systems, the default NexentaStor compression algorithm can save at least half of the raw disk space. Enabling compression not only saves space, but also improves performance. This is because the time it takes to compress and de-compress the data is quicker than the time it takes to read and write the uncompressed data to disk.

During this test, the compression ratio averaged over 14x (data) after login using 12 LUNs – eleven for the desktops and one for user data. This means that the number of read/writes was only about 7% of the number when not using NexentaStor, thereby greatly increasing performance all the way down to the end user. The ratio dropped to 3x when all desktops are logged in and in use.

Detailed output of “zfs get compressratio” command:

After provisioning and login

NAME	PROPERTY	VALUE
data	compressratio	14.73x
data/R2EO9C1B06	compressratio	7.17x
data/R2EO9C1B07	compressratio	12.10x
data/R2EO9C1B08	compressratio	14.60x
data/R2EO9C1B09	compressratio	16.12x
data/R2EO9C1B10	compressratio	15.25x
data/R2EO9C1B11	compressratio	16.92x
data/R2EO9C1B12	compressratio	14.56x
data/R2EO9C1B13	compressratio	13.93x
data/R2EO9C1B14	compressratio	14.54x
data/R2EO9C1B15	compressratio	16.84x
data/R2EO9C1B16	compressratio	14.56x
data/R2EO9C1EXT	compressratio	19.06x

After running medium LoginVSI workload:

NAME	PROPERTY	VALUE
data	compressratio	2.56x
data/R2EO9C1B06	compressratio	7.25x
data/R2EO9C1B07	compressratio	2.59x
data/R2EO9C1B08	compressratio	2.56x
data/R2EO9C1B09	compressratio	2.56x
data/R2EO9C1B10	compressratio	2.57x
data/R2EO9C1B11	compressratio	2.56x
data/R2EO9C1B12	compressratio	2.54x
data/R2EO9C1B13	compressratio	2.57x
data/R2EO9C1B14	compressratio	2.56x
data/R2EO9C1B15	compressratio	2.56x
data/R2EO9C1B16	compressratio	2.55x
data/R2EO9C1EXT	compressratio	19.06x

Performance

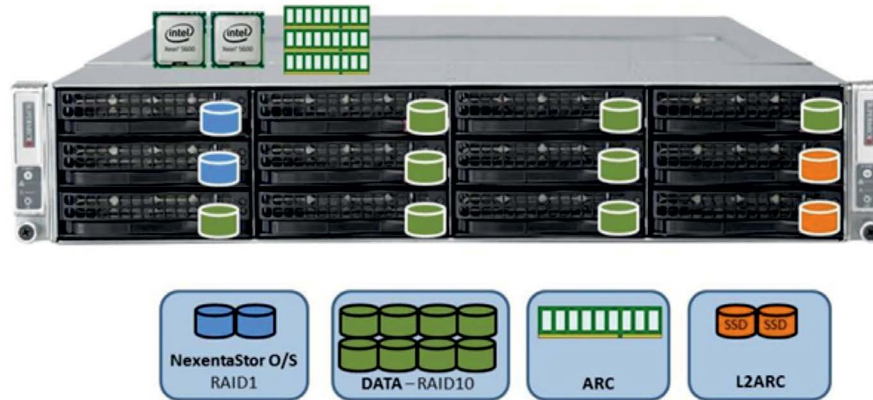
IOPS is perhaps the most challenging, least understood, and most common resource bottleneck that can stall large VDI projects. In order to deliver a consistently high performance end user experience that is equal or better than having a local PC, a VDI solution requires constant access to low latency and high throughput storage.

According to the test data, we found that peak IOPS experienced during the boot storm averaged close to 19K. The NexentaStor environment was clocked at an average of 250K write IOPS (317K peak) and 500 read IOPS (702 peak). Therefore this 750-user test utilized only 6% of the total IOPS capacity.

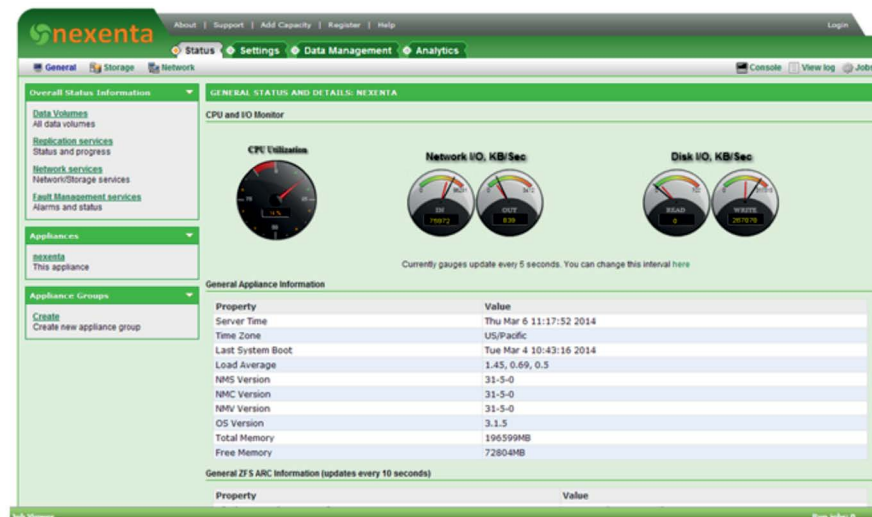
Solution components/ Architecture Design

The storage configuration used for the NexentaStor test environment included the following components:

- SuperMicro™ SuperStorage Server 6027R-E1R24L
- Dual Intel Xeon E5-2609 2.4GHz, 4-core
- 192 GB ECC Registered Memory
- Seagate 16TB SAS 7.2K HDD
- Sandisk Optimus 400GB MLC SSD
- Intel X520-DA2 dual 10GbE adapter
- NexentaStor 4.0 – 16TB License with 1YR Gold support



Despite the components in this list, any standard server and hard drives could have been used. To allow customers the most flexibility in their deployments, NexentaStor has the broadest hardware and component certification of any SDS product in the market with dozens of third-party hardware manufacturers and hundreds of individual products from these vendors which are certified and supported. In this solution, the NexentaStor software was a bare-metal install so no other operating system or hypervisor was required.



NexentaStor management console

Additional solution data

The key benefits of software-defined storage over traditional storage are increased flexibility, automated management, and cost efficiency. NexentaStor has delivered on this promise by creating a full-featured storage management system. A Gartner report from January, 2013, ranked NexentaStor better than its competitors (Dell, EMC, NetApp, Hitachi, HP, IBM, Quantum) in terms of price/performance.

This test validated that NexentaStor delivers a highly efficient storage backend for VDI compressing data at a 14x compression ratio, caching 93% of the data, and delivering over 250,000 IOPS – all at one of the lowest costs per seat in the industry. It is no wonder that Nexenta can help enterprises deliver better ROI on their VDI projects.

Conclusion and Call to Action

The results were a validation that NexentaStor provides a superior storage backend for VDI with one of the most efficient and lowest costs per seat for a VDI storage system. And using a software-defined storage solution which liberates storage management from the underlying hardware doesn't mean giving up features because NexentaStor is a fully featured NAS/SAN software platform with capabilities that meet and even exceed the capabilities of legacy storage systems.

To get more information on how NexentaStor or NexentaConnect can help you get the best ROI on your VDI solution while delivering high performance, please contact us.

For more information please go to the Nexenta website:

<http://nexenta.com/corp/products/nexentastor>

Or email at:

North America Email: sales@nexenta.com

EMEA Email: emea.sales@nexenta.com

Addendum

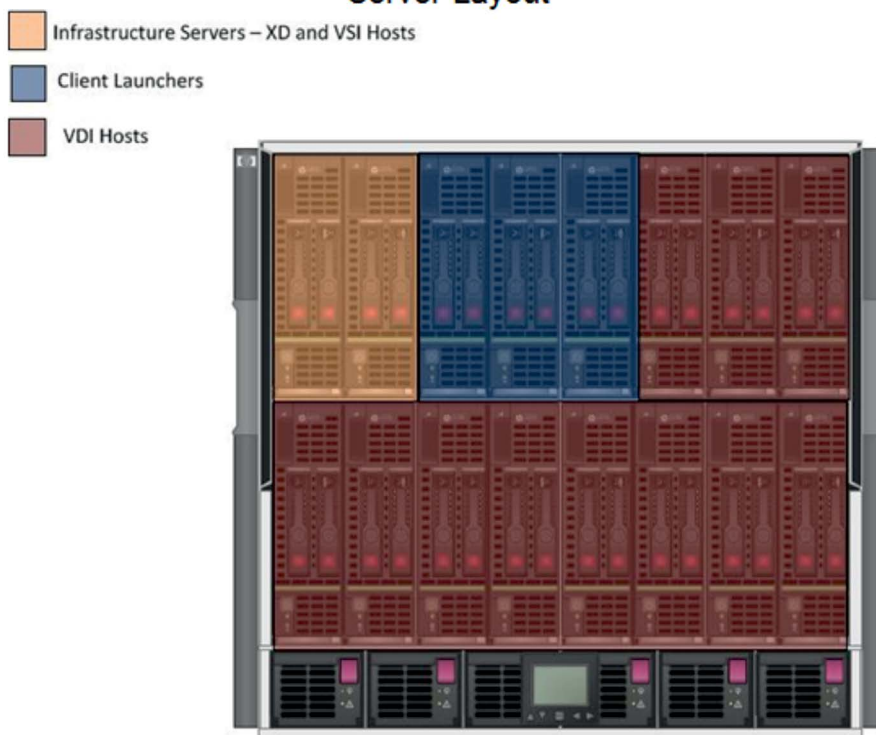
Minimum storage requirements as determined by Citrix for 750 concurrent VDI desktop users:

- 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 4.0 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

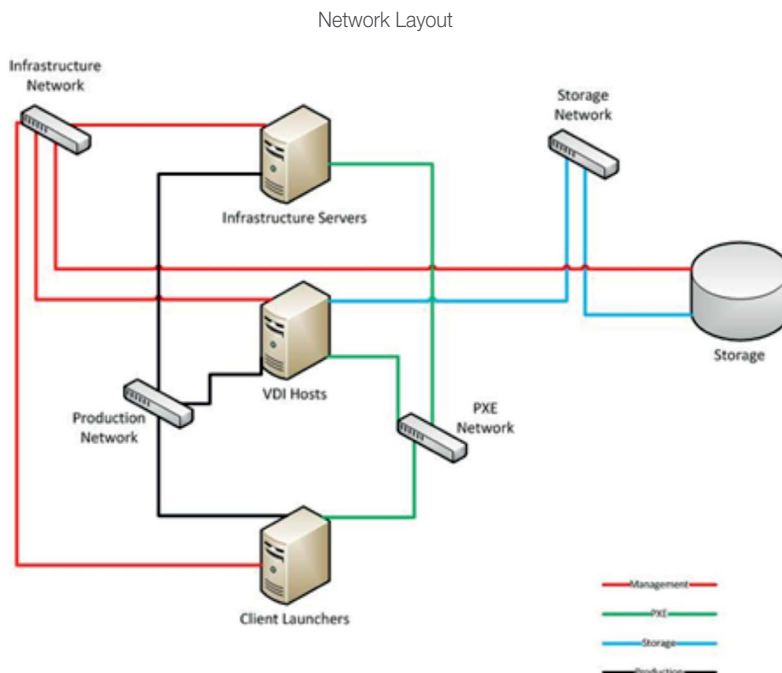
Server Layout



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



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
- Vendor controls setup of their storage: Number of LUNs, Cache Usage, iSCSI vs Fibre, etc.
- Citrix will provide any necessary configuration information prior to vendor on-site (IP addresses, etc)
- Vendor must provide full disclosure of configuration. Citrix must sign-off on configuration.
- All configurations must contain best practices as would be recommended to customers in productivity environment
- Vendor must disclose street price of storage configuration, that number will be used to determine cost per user for 750 users

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

LoginVSI

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



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