750 Seats Citrix XenDesktop

On NetApp Storage at $37 storage per desktop
Executive Summary

As part of a Citrix program designed specifically to address the storage needs of customers who are implementing XenDesktop using the VDI FlexCast approach, NetApp joined Citrix at their Solutions Lab in early 2014 to stress test a NetApp FAS2240-2 hybrid storage array. This stress testing took place against a 750 seat desktop virtualization environment based on XenDesktop 7.1. The end goal was to prove NetApp can deliver a storage solution at a very economical end user cost of $37 per desktop. This whitepaper outlines the solution tested and the performance results of the tests.

The key highlights from this storage performance validation are:

1. NetApp FAS2240-2 (2U storage array with 24 internal SAS drives & IO optimization with NetApp Clustered ONTAP software defined storage) can easily support at least 750 virtual desktops (specified as the success criteria for the Citrix Ready VDI Capacity program) at a compelling $37 per desktop.
2. 935 virtual desktops booted and logged in under 20 minutes, which is an acceptable SLA for real world production deployments.
3. 800 virtual desktops successfully stress tested for steady state operations using LoginVSI, the industry standard VDI benchmarking tool
4. Very low storage latency for boot, login, and steady state operations, ensuring a consistent end user experience
5. Only 1.4TB TB storage consumed (total 7TB usable storage available) for the entire duration of the test.
6. FAS2240-2 storage array was very simple to setup and it was up and running in less than 2 hours.
7. Total LoginVSI testing was completed in less than 2 hours

The Business Challenge

For desktop virtualization, customers require storage solutions that can simplify the architecture in a cost-effective manner, deliver a better end user experience, and provide the maximum uptime. NetApp clustered Data ONTAP®, with its key capabilities such as non-disruptive operations, unified storage, multiprotocol architecture, secure multi-tenancy, storage efficiency, read and write performance, and cost-efficient data protection, is ideal for cost-efficiently designing and deploying an end-to-end storage solution for virtual desktops. Whether the customer is a large enterprise in need of multiple “pods” or a small to medium business for which cost density is a primary driver, NetApp offers an effective and compelling storage solution that is offered in both Hybrid as well as an all Flash configuration.

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. Desktop virtualization 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 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 “a day in the life” of a 750 user Citrix farm. Based on the key requirements outlined in the VDI capacity program (i.e. capacity, IOPS, cost-efficiency), NetApp participated in the testing with the entry level FAS2240-2 storage array with 24 internal 10K RPM SAS drives; and read and write IOPS optimized by NetApp WAFL software which is part of the solution. This storage array can support multiple protocols (FC, iSCSI, NFS, CIFS) to host all data components of any XenDesktop deployment (e.g. PVS vDisk, write cache file, user data, profiles, app virtualization repositories, ShareFile repositories, etc.)

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. Login VSI simulates users work with the same applications as your average employee, including Microsoft Word, Excel, Outlook and Internet Explorer. 750 desktops were created, launched and executed a workload program that simulates a typical workday. 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.

NetApp Storage Solution Overview

For a large enterprise considering a small starting deployment of several hundred virtual desktops or a small to medium business considering desktop virtualization, the FAS2240-2 platform offers an excellent starting point configuration. The NetApp FAS2200 series, named a “Champion” and “Best in Overall Value” by Info-Tech Research Group, is affordable and is a more powerful storage platform than other systems in its class. With it, businesses protect storage investments with systems that grow with business needs.

Key benefits for the FAS2240-2 platform with the Clustered Data ONTAP® operating system include:

- Available in All Flash, Flash + HDDs, and all HDD hardware configurations with additional IO optimization in the NetApp WAFL software layer.
- Unified storage architecture to host all desktop virtualization data components (VM OS, Apps, Data, Profiles, etc.).
- Non-disruptive scalability: add capacity quickly and easily with clustered Data ONTAP
- Built in backup and recovery with storage efficient NetApp snapshot and remote replication technology.
• Seamlessly upgrade to other NetApp systems while using the same operating system and software tools.

• Built-in investment protection with the ability to convert the FAS2240-2 system to an external disk shelf for upgrading to larger NetApp FAS systems.

• Integration with various hypervisors and cloud management software (e.g. vSphere, Hyper-V, XenServer, etc.) to fully automate storage provisioning and data management tasks.

**Test Summary**

Through this 750 seat proof of concept, NetApp’s FAS2240-2 has been validated, by NetApp and Citrix, to run up to 750 Citrix Provisioning Server (PVS) based virtual desktops. Achieving or passing the 750 virtual desktop threshold was the criteria for passing the validation. Better still, through subsequent tests, NetApp’s FAS2240-2 proved easily capable of running 800 virtual desktops without any impact on performance or storage latency.

This storage configuration supported 750 PVS based virtual desktops in a two-rack unit (2U) NetApp FAS2240-2 storage system. Considering standard discounts, this specific configuration comes in at an impressive $37 per desktop. Better still, scale to thousands of desktops at the same $37 storage cost per desktop by adding more 2U NetApp FAS2240-2 storage systems to the environment.

The highly economical $37 storage cost per desktop includes:

• NetApp hardware: FAS2240-2 with 24 internal HDDs (600GB SAS, 10K RPM)

• NetApp software:
  – Clustered ONTAP operating system with WAFL software layer optimizing the reads and write IOPS
  – NFS, CIFS, FC, iSCSI (storage protocols). Our test configuration setup used iSCSI to host the write cache files and CIFS for user data. However, FC and NFS protocol licenses are also included at no additional cost.

• Support and services: 36 months, 24/7 premium, 4-hour parts replacement, and initial installation.

**Storage Solution Architecture Design**

The NetApp FAS2240-2 was completely configured and setup in under two hours. Below is an outline of the entire NetApp storage solution configuration.

• A single NetApp FAS2240-2 Array, with 14TB raw storage, was used to facilitate all storage requirements of this test.
  – Drive configuration: 24 x 600GB 10K SAS HDDs
  – NetApp Clustered Data ONTAP® 8.2 operating system
  – Dual controllers with active/standby configuration. This configuration ensured high IOPS for boot, login, and steady state operations as well as consistent high performance for end users in case one storage controller fails
• Each controller has 2 10GbE ports and x FC ports that can be used for data and cluster interconnect. For this test setup, each controller was configured with:
  – 1 x 10GbE Cluster inter-connect for HA
  – 1 x 10GbE iSCSI Data Logical Interface (LIF) per controller with LIF migration established for HA
  – Jumbo Frames were not used for the iSCSI Data LIFs in this test scenario
• The 24 HDDs were configured as such:
  – Active Controller:
    a. 16+2 RAID DP® configured for the main data Aggregate (16 data drives and 2 for parity) hosting the virtual machines
    b. 1+1 RAID 4 for the root Data ONTAP® Aggregate
    c. 1 Spare Drive
  – Standby Controller:
    a 1+2 RAID DP® for the root Data ONTAP® Aggregate
• The storage was configured with a single iSCSI clustered Data ONTAP® storage virtual machine (SVM) for hosting the virtual desktops as well as a single SVM for CIFS shares to host user data.
  – iSCSI Virtual Server contained 1 x 11TB Volume
    a. 11 x 1TB LUNs created for PVS Write Cache
    b. Each LUN was attached to a unique Hyper-V host which contained 85 virtual desktops booting from Citrix PVS.
  – CIFS Virtual server contained 1 x 22TB Volume
    a. 1 x 22TB share created for user data

Figure 1: NetApp Storage Architecture
Storage Solution Test Data

Boot and Login Storms
The first test scenario consisted of a boot storm of 935 virtual desktops. There were 11 Virtual Hosts that contained 85 XenDesktop virtual desktops each. Once all desktops were booted and logged in, the test was initiated. All desktops were booted and logged in within 20 minutes, which is very fast for any customer looking at a resilient and high performing VDI solution.

Steady State Operations
Login VSI medium workload was used to validate the NetApp FAS2240-2 Hybrid storage solution. See Figure 2 below for Login VSI test results. VSI Max was not reached during test, signifying that the environment could have supported more than 800 virtual desktops. The solution was successfully stress tested with LoginVSI for up to 750 desktops.

Overall, the total test time was approximately 2 hours.

Note: VSI Max is a metric derived by the Login VSI analyzer to determine whether the target environment has reached its saturation point and, if so, at how many concurrent sessions.

In Figure 3, we see that the NetApp storage delivered 18K IOPS during the boot & login storm of 935 virtual desktops at approximately 13:21.

During the steady state test using Login VSI medium workload, we see IOPS loads of more than 10K on the storage array (average 8 IOPS per desktop) and low latencies. Again, the storage latency and LoginVSI average response time was well within the acceptable limits. The array managed these IOPS and low latencies with the IO optimization intelligence in the NetApp software and 24 total HDDs.
Conclusion

For customers looking for an efficient, scalable, and resilient XenDesktop deployment under 1000 seats, the NetAppFAS2240-2 based storage solution excels at providing substantial performance, density and scalability at a very affordable $37/desktop. Through this Citrix Ready validation program, NetApp has demonstrated the ability to deliver a cost effective virtual desktop that provides a better user experience without impacting overall performance, scalability, or manageability. With the capability to run 750 desktops from a 2 rack unit hybrid storage array and the ability to scale without disruption to operations, this solution can be used by both small businesses and large enterprises. NetApp provides an outstanding solution for your desktop virtualization needs.

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 was used to hold the servers
- The enclosure was in a separate isolated environment
- Servers were BL460c G7 with 2 Processors and 192 GB of memory
  - 1 server contained the necessary infrastructure VMs
  - 4 servers contained client VMs necessary to drive work load
- A separate Login VSI 4.0 license was 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

Network Configuration
- FlexFabric was configured to allow for either Ethernet or Fibre connectivity from the blades. These were connected to a 4gb Brocade switch
- Four networks were 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 – Used for PXE boot of VMs
- Connection to vendor storage for using iSCSI, 9 Gb
XenDesktop Configuration

- Citrix XenDesktop 7.1 was used for this test scenario.
- All Virtual Machine Provisioning was accomplished with Citrix PVS version 7.0.0.46. This created a write-intensive environment.
- To support this environment, one Citrix Desktop Delivery Controller (DDC) and one Citrix Provisioning Server (PVS) were created. Both were virtualized.

Definitions

VM definitions
- Infrastructure VMs:
  - All were 64-Bit Windows 2012
  - Active Directory 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 was used
  - VSI Share was contained inside server chassis and not on storage
  - IOPs medium work load was used
About Citrix Ready

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About NetApp

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