

# Citrix XenApp & RDS Workload Improvements with Atlantis ILIO



## Findings

Deploying Citrix XenApp and RDS workloads behind Atlantis ILIO can reduce storage requirements, improve provisioning and boot time and improve scalability when I/O is a limiting factor for scale. When I/O is not a limiting factor, there are still storage savings, faster provisioning and boot time, but scale is reduced slightly in a single server scenario.

## PROJECT BACKGROUND:

When implementing Citrix XenApp and RDS servers in a virtualized environment, a commonly overlooked area is storage performance. While many people are very aware of the storage impact of VDI, few people give enough thought to the impact of XenApp performance from the shared storage tier. Often customers find that virtualizing their RDS/XenApp servers result in less scalability and performance compared to when the servers were on physical hardware. Sometimes this can be attributed to lack of performance on the shared storage platform.

## PROJECT SCOPE:

### Objective:

Determine if ILIO has a positive impact on RDS/XenApp workloads in a single server scalability test. Items of interest are storage savings, provisioning time, boot time and session scalability and session responsiveness. In order to determine this, tests were conducted both on local storage (6x146GB 10k SAS disks) as well as on NFS NAS storage iomega ix4-200d (4x3TB 7200rpm SATA). The ILIO appliance requires a vCPU and 22GB RAM allocation. Testing was conducted to determine whether or not the improvements that ILIO makes to storage I/O would overcome the CPU/RAM pressure created by the VM appliance.

## PROJECT PROCESS:

### Atlantis ILIO Architecture:

Atlantis ILIO can be deployed in two configurations: On host or at top-of-rack. In the on host configuration, the ILIO appliance runs on the host hardware where the VMs are running that host RDS/XenApp sessions. In a top-of-rack configuration, the ILIO appliance would exist on a completely separate hypervisor host. Given that this test report is focused on single server scalability impact, an on host configuration was chosen. In theory, the benefits of ILIO will increase as more demand is placed on shared storage, but that exercise is outside the scope of this paper.

## Testing Process:

To determine the impact of ILIO on XenApp/RDS workloads, LoginVSI was used to generate simulated user load against XenApp/RDS VMs. These XenApp/RDS VMs were tested in a number of configurations:

- XenApp/RDS VMs on local SAS storage
- XenApp/RDS VMs on remote NFS storage (iomega ix4-200d SATA)
- XenApp/RDS VMs inside an ILIO datastore on remote NFS storage (iomega ix4-200d SATA)

For each of these scenarios, LoginVSI was used to calculate the VSI<sub>max</sub> value which is the point in time where the server reaches saturation.

## Finding the right VM size:

The initial phase of the project was determining the optimal number of VMs with varying CPU/RAM configurations needed to reach the maximum density of users with Login VSI<sub>max</sub>. When creating these load tests, care was taken to not overcommit virtual CPUs or virtual memory. Since there were 24 vCPUs and 96GB of memory, those items were carved up into the various configurations to reach those numbers. Because VMware itself takes some memory, there was a slight amount of memory overcommit, but it was only about 1GB of RAM. A sampling of various configurations against local storage and the VSI<sub>max</sub> achieved in those configurations are shown in Figure 1.

# of virtual machines	vCPUs	RAM	Pagefile	VSI <sub>max</sub> (classic)
6	4	16 GB	32 GB	90
8	3	12 GB	24 GB	100
12	2	8 GB	16 GB	105

Figure 1 – VMs on local storage with varying CPU/RAM combinations

## Lab Setup:

### **Hardware:**

#### Dell PowerEdge R610 Server

- BIOS Version 6.0.7
- Firmware 1.70 (Build 21)
- Dual 6-core Xeon X5650 @ 2.67Ghz (12 cores + hyperthreading = 24 cores)
- 96 GB RAM
- Dell PERC 6/I integrated RAID controller + BBWC
- 6x146GB 10k SAS drives (in RAID 5 configuration)

#### IOMega ix4-200d NA

- Version 3.1.14.995
- RAM 512 MB
- 4x3TB Hitachi HDS723030ALA640 7200rpm SATA drives in RAID-5 config (approx. 9 TB useable)
- Storage exposed to VMware as NFS

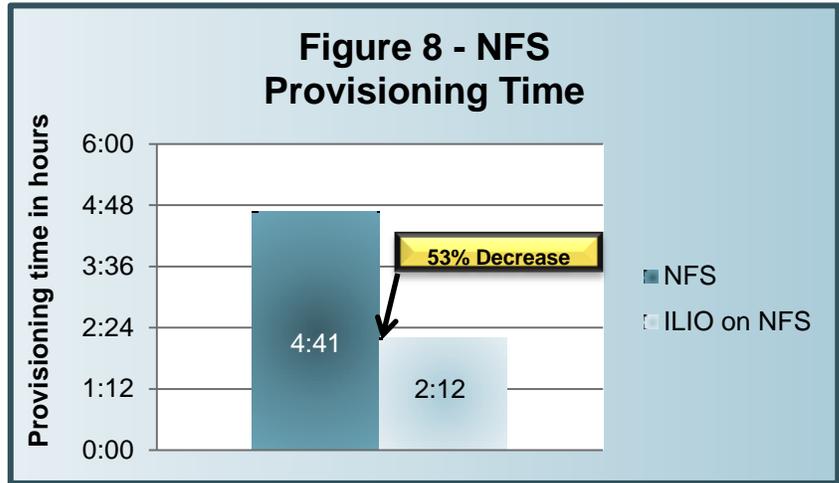
### **Software**

- ESXi 5.0.0 Build 469512
- LoginVSI v3.5 Medium Workload was used for generating user activity during scale tests
- Atlantis ILIO v2.2.4.4 for XenApp was used for the storage appliance scale testing. VMs were running Server 2008 R2 with Service Pack 1 and all current Windows Updates
- XenApp 6.5 was installed on all VM templates, but scale testing was conducted purely with RDS to simplify the testing effort.

## NFS Storage Compared to NFS Storage with ILIO

In the NFS storage scenario, a template VM is created with a 40GB hard disk that is thin provisioned on NFS at a size of 19GB. The VMDK is then copied twelve times from NFS storage to ILIO on NFS storage.

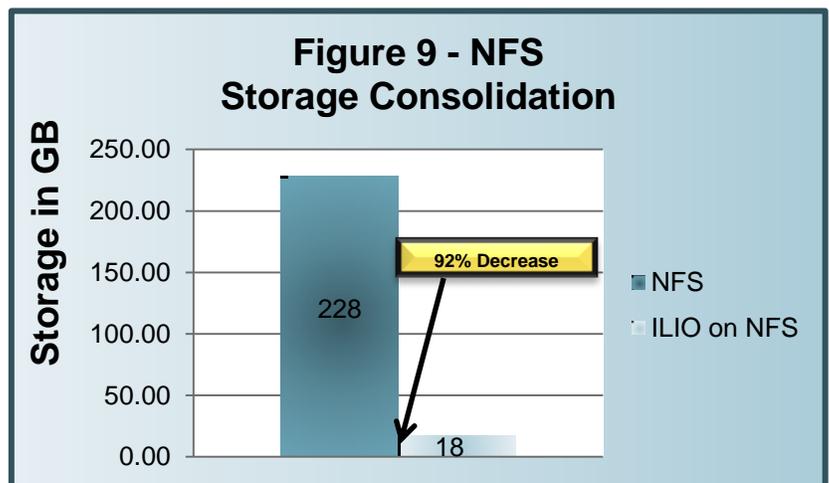
The time to duplicate these twelve XenApp/RDS VMs was 4 hours and 41 minutes. When this same template was cloned onto the ILIO datastore on NFS disk, it took 2 hours and 12 minutes. ILIO reduced provisioning time by 53% as shown in Figure 8.



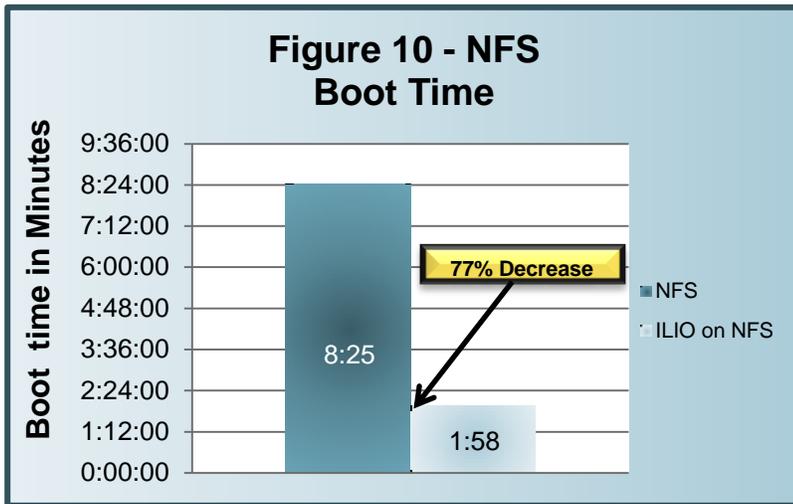
Once these VMs were duplicated, the datastores were examined to see how much storage was occupied by the VMs. In the case of NFS storage, the VMs were thin provisioned which resulted in a 19GB VMDK per cloned VM for a total storage of

228GB. When ILIO is configured on NFS storage, it is automatically deduplicated at a block level. Since ILIO provides built-in inline de-duplication, it was configured with the base 5GB boot disk and a 50GB data volume where the ILIO datastore would be located. Even though we would expect ILIO to require less than the entire 50GB partition due to the inline de-duplication, we needed to make the partition larger than 40GB in order for Virtual Center's Datastore Browser to allow us to clone the VM template VMDK into the ILIO datastore. Looking at the ILIO data store after the copies were

**Atlantis ILIO Fast Clone**  
The provisioning testing performed by Shawn Bass was done using Atlantis ILIO version 2.2 before the introduction of Atlantis ILIO Fast Clone. Atlantis ILIO Fast Clone creates new full clones of XenApp instances in seconds making it possible to perform the same provisioning task in 3-4 minutes (97% faster provisioning). Unlike other storage cloning, Atlantis ILIO Fast Clone creates new virtual desktops using metadata rather than copying data from storage.



made, it occupied 18GB of storage on NFS. This means ILIO reduced storage by 92% as seen in Figure 9.

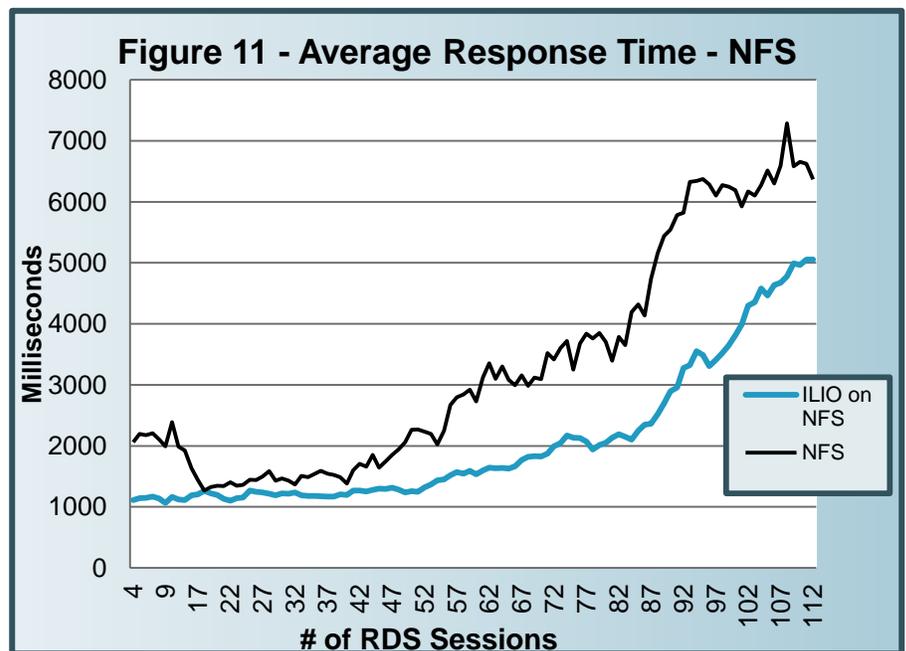


After the VMs were duplicated, they were renamed and joined to the testing domain. They were then powered on simultaneously and a stopwatch was used to calculate the amount of time it took to power the VMs on until they all reached a Ctrl-Alt-Delete sign-on page. For the NFS VMs, it took 8 minutes and 25 seconds. For the ILIO-based VMs

on NFS it was 1 minute and 58 seconds. This means ILIO improved the startup time of these VMs by 77% as seen in Figure 10.

The next test is to see how the presence of ILIO affects the server scalability from an XenApp/RDS session count as well as user experience perspective. The ILIO VM has a 22GB RAM reservation assigned to it as well as a vCPU. This means that on a single server scalability test we are overcommitting 1 vCPU as well as 22GB of RAM since we're keeping the same twelve VMs with

2vCPU and 8GB of RAM. Figure 11 shows the VSImax index of the twelve VMs on NFS storage vs. the same twelve VMs running on ILIO on NFS storage. Figure 11 indicates that the VSImax value on NFS is arrived at 83 sessions. Putting the RDS VMs behind ILIO on this same NFS storage allows us to achieve 96 sessions. This means ILIO is providing an additional 16% scalability in this situation where I/O is constrained.

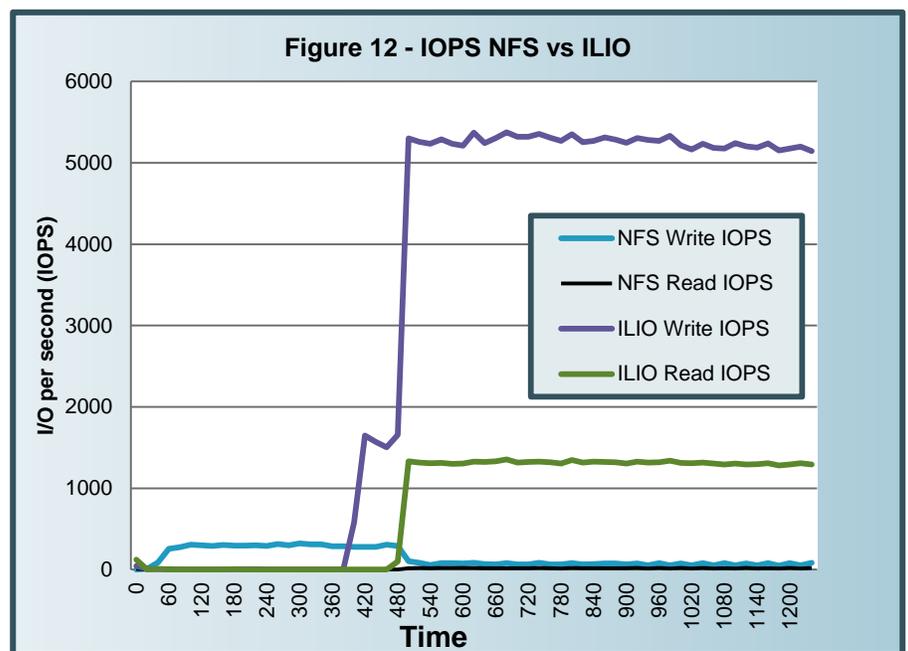


## Extrapolating Storage Performance

During this single server scalability exercise we were able to easily reach the maximum capabilities of this low end NFS NAS device (iOMega ix4-200d). We found that we reached a LoginVSI max at 83 sessions which clearly left us storage bound given that the same hardware was capable of delivering 105 sessions on local storage where we were able to achieve a higher level of IOPS and throughput with less latency. What we were not able to determine is how much more storage performance ILIO is providing in our server scalability testing. One way to determine these numbers is to conduct scale testing with a larger number of host machines with a greater number of RDS VMs. Another method for determining this is to create a synthetic storage stress test in order to extrapolate data about how much additional storage performance is being provided by ILIO running on top of our storage bound NAS system. To gather this data, a Windows XP VM was created using 1 vCPU, 1GB RAM and a 15 GB virtual hard disk. This VM was loaded with IOMeter version 2006.07.27. An iometer specification was built to leverage the C: drive of the VM with the following parameters:

- 4kb transfer request size
- 80% random / 20% sequential distribution
- 80% write / 20% read distribution
- Disk size 16,777,216 sectors (8,589,934,592 bytes = 8GB) – Set to 8GB to eliminate any caching on shared storage.
- 64 outstanding I/Os per target

This iometer synthetic benchmark was then executed with the XP VM running on the ioMega datastore on NFS. Statistics were gathered from iometer as well as datastore performance metrics from VMware. During this time, there were no other VMs running on this datastore or the hypervisor host. After data collection, the VM was powered off and the ILIO VM was started. Once the ILIO VM was running, the XP stress VM was copied into the ILIO datastore and booted. The same exact iometer test was run on ILIO over NFS and



the results were recorded. Examining the results in Figure 12, we see that the same NFS storage when backed by ILIO is able to achieve 5100-5300 sustained write IOPS vs. regular NFS which ran 50-80 write IOPS on average. This means ILIO is capable of supporting approximately 60-100 times the amount of write IOPS over the same existing storage subsystem. Both VDI and RDS/TS follow patterns of approximately 80-90% write activity vs. read activity during steady state. This means that this enhanced write capability is extremely important to the scalability of the Citrix XenApp & RDS/TS platform.

IOPS are not the only important measurement for good storage performance. We need also be concerned with storage throughput and disk latency. When measuring throughput using IOMeter, the NFS based NAS pushed only 0.34 MB/sec. With the same NFS storage front ended by ILIO, we achieved 25.66 MB/sec. This means ILIO delivered 75 times the disk throughput for the same underlying storage system.

Disk latency is also a very important factor in the overall responsiveness and end user perceived performance. Examine the IOMeter performance screenshots in Figure 13 that illustrate the perceived disk latencies for the IOMeter execution within the NFS VM vs the VM running on top of ILIO on NFS.

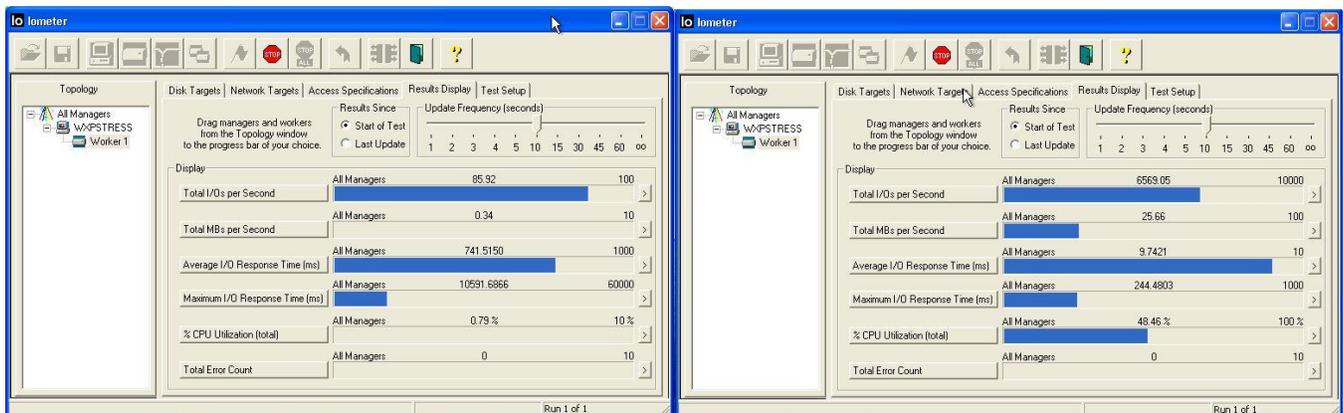


Figure 13 – IOMeter results on NFS vs ILIO on NFS

We see from the IOMeter performance results that the VM running on top of ILIO had I/O response times that were on average 9.74ms whereas the NFS based VM has I/O response times averaged 741.5ms. This means that ILIO provided a perceived I/O responsiveness that is about 75 times faster response time.

Extrapolating the performance data, ILIO is able to provide roughly 50-75 times the amount of IOPS, throughput and reduction in storage latency. This theoretically means that ILIO should allow easy scaling of a substantially larger number of RDS VMs on top of a poor shared storage subsystem without needing to invest in a more expensive SAN infrastructure. While testing multiple hosts/hypervisors was outside of the scope of this whitepaper, we should easily be able to scale up additional host machines filled with RDS VMs while leveraging the same low end NFS NAS storage system that already reached its maximum storage throughput by a single host system.

## **Summary of Findings**

In testing ILIO for RDS workloads in a storage constrained environment, ILIO was able to:

- **Reduce storage requirements by 92%**
- **Reduce provisioning time by 53% (97% Faster When Using Atlantis ILIO Fast Clone)**
- **Reduce VM boot time by 77%**
- **Provide 16% more RDS sessions while providing approx. 30-100% faster response time (as measured by VSImax).**

But testing single server scalability isn't enough to show ILIO's true value. To illustrate this, IOMeter tests were conducted to push the maximum IOPS and throughput possible on the constrained underlying storage and ILIO was found to:

- **Increase IOPS by a factor of 60-100**
- **Increase disk throughput by a factor of 75**
- **Reduce perceived storage latency by a factor of 75**