Quad-Core AMD Opteron™ Processors with AMD Virtualization™ (AMD-V™) Deliver Increased Scalability and Performance for Virtualized Citrix XenApp on XenServer.

Virtualization is becoming a standard method for creating flexible, dynamic data centers that can rapidly respond to changing business needs while effectively managing costs. Citrix XenServer™ 5, Enterprise Edition, has been optimized to support Citrix XenApp™ 4.5, offering excellent XenApp performance in a virtualization environment. This optimization helps IT organizations implement more robust virtualization solutions that enable server consolidation and virtualized application delivery.

One key metric when evaluating the performance of a server virtualization solution is the number of concurrent user sessions a virtual machine can support before system responsiveness negatively affects user experience. This paper reports scalability test results for concurrent user sessions on Dell™ PowerEdge™ R805 servers running either Dual-Core or Quad-Core AMD Opteron™ processors.

Citrix engineers conducted scalability tests using Citrix EdgeSight™ for Load Testing, a commercially available product that emulates real-world workloads for testing virtualization solutions. The test methodology used an intense workload representative of typical user activity in production XenApp environments. The workload consisted of quickly looping through the following scenario while adding more users with each new loop: the user logs onto an Independent Computing Architecture (ICA) session for Microsoft Office Word, creates a new document, enters some text, closes the document, logs off, and logs back on. The constant logon and logoff created significant load on the server.

Citrix XenApp 4.5 running on Citrix XenServer 5 was tested on a two-socket PowerEdge R805 server with 32 GB of RAM. In the first configuration, the server used two Dual-Core AMD Opteron™ 2222 3.0GHz processors; the second configuration used two Quad-Core AMD Opteron™ 2356 2.3GHz processors. The goal for this testing was to determine how many concurrent user sessions each server configuration could support before an appreciable slowdown in single user logon time was detected.

The results indicate that for the given workload, Dual-Core AMD Opteron processors supported 70 concurrent user sessions before single user logon time increased to a point where the user experience was adversely affected. In contrast, the Quad-Core AMD Opteron processors supported 120 concurrent user sessions before the same slowdown was experienced. Using quad-core processors created a 71.4% increase in concurrent user sessions.

For customers running XenApp on older servers with 32-bit architectures that are RAM constrained, virtualizing XenApp with XenServer on two-socket PowerEdge R805 servers with Quad-Core AMD Opteron processors represents an opportunity to consolidate multiple 32-bit physical servers without change as virtual machines on fewer, faster servers. Virtualizing XenApp with XenServer helps IT departments easily bridge 64- and 32-bit environments, resulting in better scalability, improved server utilization, and the highest performance possible for virtualized XenApp workloads among leading virtualization solutions.
THE HARDWARE REALITIES OF VIRTUALIZATION

As an increasingly common method for creating flexible IT infrastructures, virtualization helps organizations respond to rapidly changing business requirements while helping to keep costs low. Server consolidation and virtualized application delivery are two areas where virtualization creates flexibility and scalability by increasing user density and reducing the number of physical servers.

RAM and processor power are key metrics in determining how many virtual machines (VMs) can be hosted on a single physical server. For heavily utilized workloads such as XenApp servers, CPU performance plays a critical role as the system scales to support large numbers of users. And as with most resources, the more RAM you add to a server, the more VMs you can host on that server. In many instances, however, memory tends to be a limiting factor in the number of VMs you can add to a physical server—especially with 32-bit hardware.

Many organizations that have implemented virtualization solutions like Citrix XenApp on 32-bit hardware are reaching the limits of addressable memory. These memory constraints effectively limit the scalability possible for VMs on 32-bit servers—even though additional processor cycles may still be available. Newer servers with 64-bit architectures provide much greater flexibility for virtualization solutions because they offer significantly more memory capacity as well as multicore processors, which provide greater processing power, and hardware assistance for virtualization like AMD Virtualization™ (AMD-V™).

While moving to newer 64-bit servers with virtualized workloads might seem the obvious choice for high scalability, low capital expenditures, and low operating expenses, taking this path is not always possible. The 64-bit architecture is not suitable for some 32-bit workloads because of lack of support for printer drivers, legacy applications, and so on. Virtualizing Citrix XenApp workloads on Citrix XenServer 5 takes advantage of 64-bit power and flexibility while still providing support for 32-bit workloads. This approach helps reduce the hardware footprint of XenApp server farms in the data center by consolidating existing servers onto fewer, newer servers with more memory and more processor cores. And because XenServer 5 is optimized for XenApp, it offers the highest performance for XenApp of any virtualization platform.

For organizations that choose to take this approach and virtualize 32-bit XenApp servers with XenServer 5, moving to a dual-core or quad-core platform can result in hosting from four to eight XenApp VMs on a single physical server. So the question becomes what hardware configuration will provide the best scalability in terms of concurrent user sessions (ICA sessions)—a key metric in determining optimum user density for virtualized application deployment and the subsequent server consolidation.

DETERMINING XENAPP SCALABILITY

Citrix and AMD set out to answer this question by conducting tests that compare the number of concurrent user sessions possible between Dual-Core and Quad-Core AMD Opteron processors in PowerEdge servers. The goal of this testing was

INCREASING PERFORMANCE WITH AMD VIRTUALIZATION™ (AMD-V™) TECHNOLOGY

AMD Virtualization (AMD-V) is a hardware-based technology that improves the efficiency and reduces the performance overhead of software-based virtualization solutions. It reduces, and can often eliminate, the burden of trapping and emulating instructions executed within a guest operating system. In addition, AMD-V technology leverages AMD Opteron processors with Direct Connect Architecture to provide fast and efficient memory handling, which is vital for memory-intensive applications like virtualization.

Rapid Virtualization Indexing (RVI), a key feature in AMD-V, helps accelerate the performance of many virtualized applications by enabling hardware-based virtual machine memory management. It allows VMs to directly manage memory by using hardware rather than software resources, and it can help reduce hypervisor cycles and increase VM performance. AMD-V technology with RVI helps improve performance of virtualized applications and reduces software virtualization overhead. No other processor vendor can match the AMD capabilities for x86 virtualization.
to provide standardized results that make it possible for organizations to compare the following kinds of workloads with XenApp workloads virtualized through XenServer 5 running on newer 64-bit multicore servers:

- Virtualized XenApp workloads on older 32-bit servers
- Existing physical workloads on older 32-bit servers that are coming up for refresh

The results from this testing are not intended for comparison with physical and virtual workloads running on the same server. Previous testing conducted by The Tolley Group has shown that the performance overhead of running XenApp workloads on a physical server versus on XenServer is less than 10%. Because XenServer has been tuned to provide the fastest XenApp performance possible, the question at hand is which hardware configuration (dual-core or quad-core) can provide the best scalability and user experience in a virtualization environment.

**A WORD ON SCALABILITY DATA**

In practically any virtualization environment, scalability is very closely tied to the application set that is virtualized. Depending on the applications being delivered, one organization might be able to load 90 users on a server, whereas another may be able to load only 50 users on the same hardware. The difference in concurrent user sessions depends entirely on the applications being delivered.

For example, some organizations use XenApp to host custom, internal applications, while others deploy an office productivity suite and similar applications, and still others deliver a wide variety of applications to their users. Consequently, you should always take into consideration the type of workload that will be delivered when applying scalability data to your unique situation.

**Test System Specifications**

Citrix engineers used the following hardware and software to conduct XenApp scalability tests.

**SERVER CONFIGURATION**

A two-socket PowerEdge R805 server with 32 GB of RAM was used with default hardware settings. The following processors were used:

- For dual-core testing, two AMD Opteron™ 2222 3.0GHz processors
- For quad-core testing, two Quad-Core AMD Opteron™ 2356 2.3GHz processors

Local storage (15 KRPM SAS drives) on the server was used for virtual storage.

**XENSERVER CONFIGURATION**

Citrix XenServer 5 was installed on the PowerEdge server with its default configuration, which included the following options enabled:

- Citrix XenApp Optimization (Figure 1)
- AMD Virtualization™ (AMD-V™) with Rapid Virtualization Indexing (RVI)

**VIRTUALIZATION INDEXING (RVI)**

XenServer 5 includes specific optimizations for XenApp, including tunable parameters to significantly increase performance for each XenApp VM. It also has an advanced virtual memory system that lets it easily handle virtual memory changes and context switching. These XenServer 5 optimizations all contribute to excellent performance for virtualized XenApp workloads.
XENAPP CONFIGURATION

XenApp 4.5 32-bit software was installed on the PowerEdge server. The engineers followed XenServer best practices for setting up the XenApp VMs. The VMs were all configured with two virtual CPUs (VCPUs) and 8 GB of RAM. Consequently, the dual-core configuration contained two VMs while the quad-core configuration had four VMs.

This VM configuration closely emulates the type of hardware that many organizations are preparing to refresh. It also facilitated comparing test results from the dual-core and quad-core processors. By assigning two VCPUs to each VM, the engineers maintained the same environment for each server configuration: the only variable was the presence of a dual-core or quad-core processor. This allowed the test results to reveal how the underlying platform affected scalability, performance, and user experience. (See the appendix for detailed environment configuration information.)

Test Methodology

TESTING TOOL

Many previously published benchmark tests for Citrix XenApp have used AutoSSS as the testing tool. However, the tests described in this paper were conducted using Citrix EdgeSight™ for Load Testing (ESLT). The move to ESLT was made for two primary reasons:

1. ESLT more closely emulates real-world workloads and user activity, including multiple logon/logoff cycles.
2. ESLT is a commercially available product from Citrix that customers can use to replicate test results published by Citrix in their own environments.

Testing using real-world workloads provides better insight into performance and scalability that can be applied to each organization’s unique virtualization environment.

CREATING USER LOAD

The test methodology used a high-stress workload generated by looping through the following scenario every 20 seconds: a user logs on to an ICA session for Microsoft Office Word, creates a new document, enters some text, closes the document, logs off, and logs back on. The continual logon/logoff activity put substantial load on the system and represents user loads in many production XenApp environments. During testing, the effect of the continual logon/logoff actions became evident: processor queue lengths jumped significantly as more users logged on. The simulated workloads were spread across all VMs during the testing.

WHY VIRTUALIZE XENAPP WITH XENSERVR 5?

Citrix XenApp 4.5 delivers applications to client devices where they are run in a protected, virtual environment. This converts applications into an on-demand service that is always available and up-to-date. Because application performance is a key factor in IT planning, being able to flexibly and quickly meet business requirements by serving up-to-date applications to as many users as possible without corresponding server sprawl creates significant business advantages.

By itself, XenApp supports simplified application delivery, but when combined with Citrix XenServer 5, it creates a great opportunity for businesses to take advantage of the benefits of virtualization without sacrificing performance. XenServer 5 is an enterprise-class solution for virtualizing application workloads across any number of servers in the data center as a flexible aggregated pool of computing resources. It is a native 64-bit hypervisor based on the open source Xen hypervisor.

XenServer runs on bare metal (i.e., it doesn’t require an operating system) and has been optimized for hardware-assisted virtualization delivered on AMD Opteron™ processors with AMD-V™. Virtualization with XenServer 5 also enhances system availability with features like XenMotion for zero downtime hardware maintenance, automated high availability to recover from physical system failures, and disaster recovery to bring an entire site back online from a second backup site.

Most importantly for application delivery, XenServer 5 has been optimized to run XenApp 4.5. It delivers excellent performance while reducing the space required to support XenApp server farms, lowering operating expenses associated with server power and cooling, and reducing capital expenditures on hardware and other equipment.
DETERMINING MAXIMUM CONCURRENT USER SESSIONS

The goal for these tests was to determine how many concurrent user sessions each server configuration could support before an appreciable slowdown in single user logon time was detected. A difference of two or more seconds between a loaded logon and an unloaded logon was used to determine the point where users would begin to notice a slowdown in their logon experience. While users in many environments are often accustomed to longer logon times, the two second mark was chosen because this is when most users begin to notice that the logon is going slowly.

To determine the maximum number of concurrent user sessions, engineers used ESLT to load the XenApp VMs with 40 users. They then measured the time it took for a completely new user to log on to the system. They continued this process by incrementing the user load by 10 users and then measuring the logon time for a new user after each increase in the number of concurrent user sessions (e.g., after 50 users, after 60 users, and so on). When the new user logon time reached two seconds longer than the logon time on an unloaded system, the current load was considered the maximum number of concurrent user sessions possible.

TEST RESULTS

The results indicate that for the given workload, Dual-Core AMD Opteron™ 2222 3.0GHz processors

THE FUTURE OF VIRTUALIZED APPLICATION DELIVERY

Today, data centers use multiple servers to host different kinds of workloads, often resulting in underutilized hardware and increased power and facilities costs.

By moving to an architecture where XenApp servers are virtualized using XenServer, workloads can be consolidated onto fewer physical servers. This results in better hardware utilization, more flexibility for running workloads, and lower power and facilities costs.
supported 70 concurrent user sessions before the single user logon time increased to a point where the user experience was adversely affected. In contrast, the Quad-Core AMD Opteron™ 2356 2.3GHz processors supported 120 concurrent user sessions before the same slowdown was experienced (Figure 2). Using quad-core processors created a 71.4% increase in concurrent user sessions when all other hardware remained the same.

While workloads can vary widely, the load created for this test was designed to represent typical user loads in production XenApp environments. Consequently, while the exact figure can change depending on the user load, Quad-Core AMD Opteron™ processors can increase XenApp performance by over 70% as measured by the number of concurrent XenApp user sessions.

These results indicate that for organizations planning to refresh their older 32-bit hardware, choosing PowerEdge servers with Quad-Core AMD Opteron processors can create tangible business benefits, including more productive workers, better IT flexibility to meet changing business needs, and increased hardware utilization through server consolidation and virtualized application delivery.

**CONCLUSION**

Citrix XenApp 4.5 on XenServer 5 can support over 70% more concurrent user sessions when running on Dell PowerEdge R805 servers with Quad-Core AMD Opteron 2356 2.3GHz processors as compared to Dual-Core AMD Opteron 2222 3.0GHz processors. For customers running older servers with RAM constrained 32-bit architectures, virtualizing XenApp on XenServer 5 using two-socket PowerEdge R805 servers with Quad-Core AMD Opteron processors presents an opportunity to benefit from excellent XenApp performance.

To learn more about how your business can do more with less by virtualizing Citrix XenApp 4.5 on XenServer 5 and using PowerEdge servers with Quad-Core AMD Opteron processors, visit www.citrix.com/dell.
APPENDIX: TEST SYSTEM CONFIGURATION

CLIENT TEST ENVIRONMENT
The client test environment consisted of three AMD whitebox computers running XenServer 5. Each whitebox was configured as follows:

Hardware
→ Two Quad-Core AMD Opteron™ 2360 processors
→ 8 GB RAM

Software
→ One Windows XP–based virtual machine
→ An EdgeSight for Load Testing client on each VM
→ One ESLT launcher per VM to initiate simulated user load
→ One ESLT controller to manage all three VMs
→ Each VM configured to use all available resources on the whitebox

LAN/WAN
→ Standard GB Ethernet network
→ All computers (whiteboxes and server) located on one network

This environment was designed to receive simulated user load from the server. However, the client hardware itself had no bearing on the server-side performance that was measured during testing.

DELL POWEREDGE R805 SYSTEM SPECIFICATIONS
The following server configuration was used in the testing. The only difference in the server configuration was the processor used for each round of testing:
→ Dual-Core Testing: 2x Dual-Core AMD Opteron™ 2222, 75W, 3.0 GHz
→ Quad-Core Testing: 2x Quad-Core AMD Opteron™ 2356, 75W, 2.3 GHz

| Memory: | 40 GB memory, 10x4 GB, 667 MHz, dual-ranked, quad processors required (311-7992) |
| Video Card: | LOM NICs are TOE, iSCSI ready (R905/R805) (311-8713) |
| Hard Drive: | 73 GB 15 K RPM serial-attach SCSI 3 Gbps 2.5-in hot-plug hard drive (341-4727) |
| Operating System: | Virtualization hypervisor option, no operating system (420-8249) |
| CD-ROM or DVD-ROM Drive: | DVD-ROM drive, internal, SATA (313-5884) |
| CD-ROM or DVD-ROM Drive: | SATA cable, optical drive, R805 (330-0211) |
| Sound Card: | PowerEdge R805 active bezel (313-5887) |
| Documentation Diskette: | PowerEdge R805 e-documents, including OpenManage docs, on disk (310-9978) |
| Additional Storage Products: | 73GB 15K RPM serial-attach SCSI 3 Gbps 2.5-in hot-plug hard drive (341-4727) |
| Feature: | Internal SAS RAID controller, two hard drives in RAID 1 configuration (341-5839) |
| Feature: | Universal Sliding Rapid/Versa Rails, includes Cable Management Arm (310-7412) |
| Miscellaneous: | XenServer 4.1 Embedded Express, no subscription, USB (420-8536) |
| | 4x Broadcom NetXtreme II 5708 1GbE onboard NICs with TOE (430-2713) |
| | 1GB SD card, internal, contains embedded hypervisor (313-5888) |
| | Power cord, C13 to C14, PDU style, 10 amp, 10 feet / 3 meter (310-8511) |