

## CA WAM Solution Hundred Million User Test – Technical Whitepaper

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## Executive Summary

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Today's business environment requires the secure delivery of information and applications over the Web. Fundamental challenges to this are performance and scalability. In their infancy, Web Access Management (WAM) systems were used to protect resources for organizations with thousands of users. Today WAM systems protect millions of users. This paper focuses on the impending requirement for WAM solutions to handle even larger user populations of 100 million users or more.

Consider the following examples:

- A leading bank takes advantage of market forces and acquires several key competitors. The sum of users for the consolidated financial institutions is a user population approaching 100 million bank customers. This institution will require a system that can support concurrent transactions for this massive population of customers.
- A government agency handles tax reporting. While some activity occurs quarterly, the majority of activity on an income tax system takes place in the days just before the filing deadline, and the system must handle significant spikes in usage as important dates approach. For such a system the requirements for a sustained transaction load far surpass most existing enterprise requirements.
- A Software as a Service (SaaS) provider offers backend services to online shopping sites. These sites rely on the service provider for 100% availability during peak retail shopping periods. Thousands of transactions per second must be handled by the service provider during the peak holiday shopping season.

This paper is the result of independent testing completed by Enex TestLab to verify that CA, Inc. has a WAM solution available today (CA SiteMinder Web Access Manager and CA Directory) that can handle the performance and scalability demands of today and tomorrow.

## The Test

Enex TestLab assembled an environment to simulate the conditions created when a WAM system is scaled to meet the requirements of the scenarios described above. In this paper you will find:

- Details about the hardware and software used in the test environment
- Details about the WAM software and directory solutions used to meet the challenges posed above
- Test methodology used by Enex TestLab
- Results of the executed tests
- Analysis of the results as they apply to a 100 million user WAM implementation

## The Results

CA's WAM solution (CA SiteMinder WAM and CA Directory) exceeds the requirements for a 100 million user implementation. Highlights of the results include:

- The average initial load time for 100 million records into the user store was less than 51 minutes
- The average restart time for the user store was less than 8 minutes
- The maximum transaction rates calculated from the tests equates to 300,000+ concurrent users
- One hundred million unique users can login and access 10 separate pages over a 48 hour period
- The Directory and SiteMinder components successfully handled failover and restart testing
- Web Agents evenly distributed the load to the SiteMinder Policy Server cluster, CPU usage on the Policy Server cluster was stable, and the SiteMinder components functioned normally during failover testing

## The Conclusion

During testing CA's WAM solution efficiently handled the user store population and the transaction demand to support 100 million users.

## The Challenge

Organizations continuously try to improve performance, security and reliability for customer access to their online services. In a global marketplace organizations should be able to serve online populations of millions and even tens of millions of users. WAM systems provide centralized, enterprise security infrastructure for, and control access to, online services.

Given the trend toward larger and more comprehensive Web applications and services, WAM systems must support increasingly large communities of users. Managing vast numbers of users and securing their access to applications and services is now a *critical* business issue.

### Business Merger/Market Consolidation Challenge

Corporate mergers are a regular part of the business landscape. Mergers generally result in increased user populations for the merged enterprise. These populations require near immediate access to systems, and in today's global market, many of those systems are web-based applications and services.

Consider a leading financial company with a large online-banking presence. When such a company acquires other smaller financial institutions, these institutions' customers need access to a set of seamlessly integrated systems. If a leading global bank acquires several competitors, the resulting vast organization could be required to provide online access for a user population approaching 100 million users. Part of the value proposition of the merger is how quickly the customers can be made comfortable with the merged enterprise. Loss of customers can severely damage the return on the merger.

### Government Challenge

Government agencies handle enormous amounts of transactions with citizens and businesses. As more people turn to online applications for government services, the demands for handling massive user communities increases.

For example, a government's revenue agency processes tax filings by its citizens and businesses. While some activity may occur quarterly, the majority of activity on an income tax system occurs over a short span of time. The system must handle significant spikes in usage as important tax deadlines approach. For such a system, the requirements for a sustained transaction load often far surpass the transaction load of an average enterprise..

Consider the Internal Revenue Service (IRS) for the United States of America. Electronically filed tax returns for annual taxes have increased steadily over the last decade. Here are the statistics since 1997:

| Year | Returns       | Total E-file | Percent E-file |
|------|---------------|--------------|----------------|
| 1997 | 121.5 million | 19.2 million | 15.80%         |
| 1998 | 123.8 million | 24.6 million | 19.90%         |
| 1999 | 125.9 million | 29.3 million | 23.30%         |
| 2000 | 128.4 million | 35.4 million | 27.60%         |
| 2001 | 131.0 million | 40.2 million | 30.70%         |
| 2002 | 131.7 million | 46.9 million | 35.60%         |
| 2003 | 131.6 million | 52.9 million | 40.20%         |
| 2004 | 132.2 million | 61.5 million | 46.50%         |
| 2005 | 134.0 million | 68.5 million | 51.10%         |
| 2006 | 136.1 million | 73.3 million | 53.80%         |

For more information see the IRS web site: <http://www.irs.gov/newsroom/article/0,,id=175470,00.html>

## Cloud Computing/SaaS Provider Challenge

Software vendors increasingly offer their software as a service. Cloud computing is gaining momentum. While today's service offerings might not require a WAM system with a 100 million user capacity, such scalability requirements are rapidly approaching.

For example, consider a service provider that offers services to online shopping vendors. These vendors rely on the service provider for 100% availability during peak retail shopping periods. Around the holiday season, thousands of transactions per second will be processed by the service provider to ensure that vendors maximize their profits during this critical period.

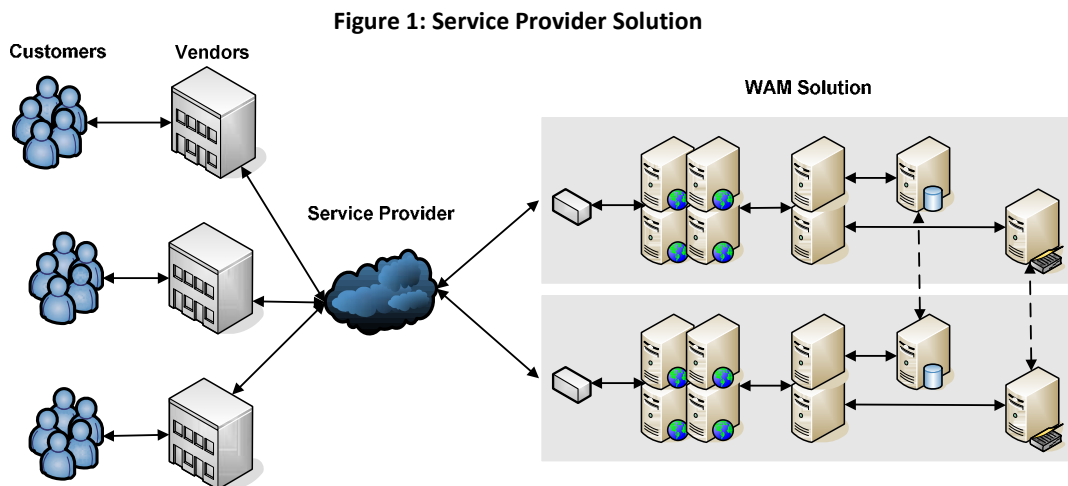


Figure 1 shows a service provider hosting a WAM solution for its customers.

## Business Enablement: The Technical Challenges

While the business challenges described above are clear, the technical issues created by them warrant some explanation. Externally-facing WAM deployments tend to be much larger and much more sophisticated than a typical internal deployment. Internal deployments typically need to scale to just a few thousands or tens-of-thousands of users, and if transactions involve both reading and writing data, peak login periods only require concurrent servicing of a few hundred transactions per second. External WAM solutions for the business problems presented in this paper require performance at a greater order of magnitude. Based on the scenarios above, 100 million users should be considered a legitimate business need for many Web-centric organizations.

The major challenges for user stores and their associated WAM systems include: coping with high transaction loads, concurrency, and exponential growth of users and applications accessing Web services and Web applications. An organization's backend infrastructure, their WAM systems, databases or LDAP directories, can be a bottleneck, slowing their Web security services. As demand grows, the WAM solution must be able to scale with it - now, and into the future.

This section discusses some of the important technical challenges created by the business situations discussed in this paper:

- **High number of users** – As user populations grow, the need for automated security systems increases. Knowing who is accessing your applications and data is crucial. Audit trails of user activity are equally critical. Strong password checks are needed to ensure rogue users cannot impersonate valid users.
- **High throughput of transactions** – Coping with the sheer numbers of simultaneous users is a mounting challenge for organizations. Sustaining a high volume of concurrent authentication, authorization, and audit rates through a WAM system is critical.

- **High number of directory operations** – Performance of the system depends in part on the performance of the underlying data store. Underlying user data should be stored in a system that is specifically designed to meet extreme performance requirements. WAM systems must not only query user data, but must also record data such as password changes. Performance for read and write operations must, therefore, be extremely high.
- **Customization** – WAM systems are required to retrieve customer data from user stores and pass it to applications (in the form of headers and cookies) for application personalization.
- **Low Latency** – User stores must be able to rapidly load large numbers of users onto the system. This may be required during disaster recovery, during a transition between systems, or during the addition of a large number of new users in a short period.
- **Fault tolerance** – A WAM system should provide uninterrupted and error-free customer service, even with significant hardware failure or other outage. It should also have the ability to cope with peak numbers of concurrent users after restarting the service. Sudden peaks or partial hardware outages should not lead to the collapse of the system or the deterioration of the service.
- **Scalability for future growth** – A WAM system must provide high performance security and access management for current transaction requirements, it must also be able to scale to support constantly increasing Web user populations.
- **Cost of Hardware** – Too often the hardware requirements for software are excessive and lead to an unwieldy and expensive infrastructure. A WAM system should not require an excessive expenditure for hardware. A WAM system's hardware requirements should be incrementally scalable and able to be deployed with relatively inexpensive hardware that can be scaled linearly to additional growth.
- **Cost to the business if SLA is not met** – Important WAM system features are often 'pruned' to improve the system's responsiveness, resulting in a substandard customer experience and missed opportunities for improved security. A WAM system should support both read-heavy and write-heavy transactions to offer a full range of features to an enterprise.
- **Manageability** – The time required to manage and start or re-start an environment should be minimal, regardless of the scale of your infrastructure or number of users. The time between when the environment starts and when it is fully operational is critical.

## CA's Solution

As the testing completed for this paper shows, CA already provides the WAM solution to meet the business problems created by 100 million user deployments. This solution is comprised of CA SiteMinder Web Access Manager (CA SiteMinder WAM) and CA Directory. When used together, these products combine to provide world-class web access management and directory services capable of an extraordinary volume of processing, without the need for extraordinary hardware expenditures.

**Figure 2: Simple CA WAM Solution**

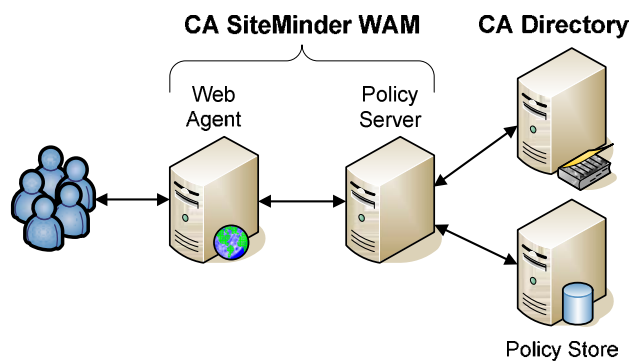


Figure 2 shows a simple CA WAM deployment.

**Figure 3: Complex CA WAM Solution**

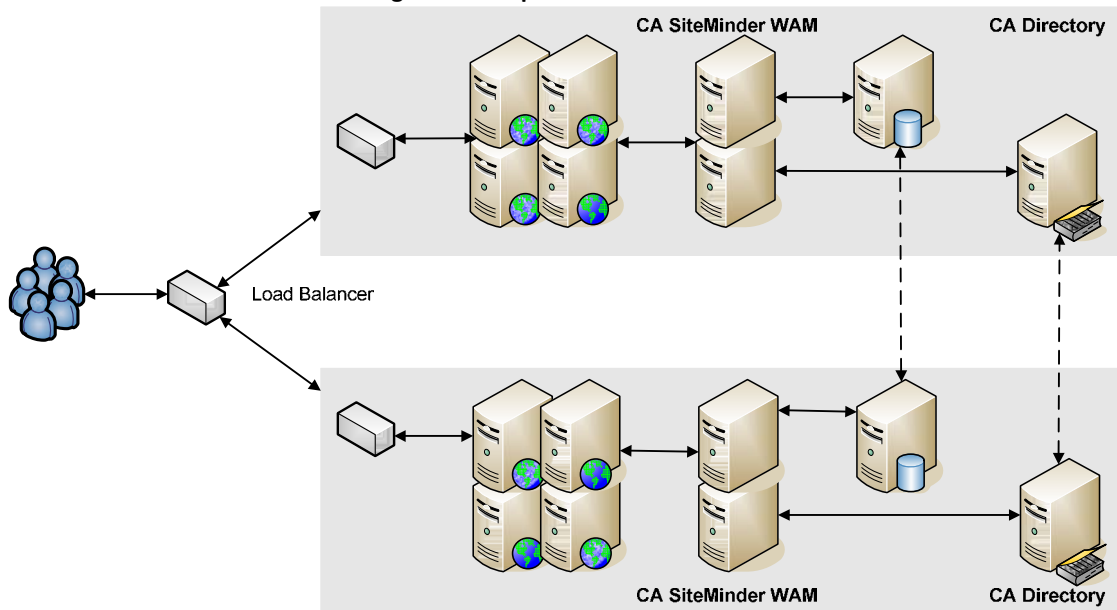


Figure 3 shows a more complex large scale CA WAM deployment.

## CA SiteMinder WAM

WAM systems are the key infrastructure for enabling business over the Web while limiting security exposure. A WAM system protects and controls access to your Web applications, records user and administrator activities, and is responsible for creating a seamless single sign-on experience for any user including employees, partners, and customers.

CA SiteMinder WAM helps you:

- Create a seamless experience for users, including access to partner systems
- Reduce costs with delegated administration and simplified management
- Respond to business needs with the latest features, including strong authentication
- Move beyond retroactive audits and toward continuous compliance

CA SiteMinder WAM addresses your security management concerns so you remain focused on your business. It is the most widely deployed WAM system in the world today. For more detailed information about the product see CA SiteMinder WAM Technical Brief posted on CA's Web site:

<http://www.ca.com/files/TechnologyBriefs/siteminder-web-access-manager.pdf>

## Scalability and Availability

CA SiteMinder WAM's performance and availability provide large-scale Web access management, scaling, efficient use of resources, and a fault-tolerant architecture.

The following list highlights CA SiteMinder WAM's scalability and availability:

- CA SiteMinder Web Agent clustering is supported through the use of popular third-party load balancers to establish the desired capacity and fault-tolerance at the Web tier. Users can flow seamlessly from one Web agent to another as directed by the load balancer. In addition, Web Agents can evenly distribute load across a cluster of Policy Servers.
- Policy Server clustering is built into CA SiteMinder WAM. With Policy Server clusters, administrators can organize processing capacity by application, geography or service level. In a cluster, each Policy Server connects to the same logical, replicated, Policy Store so that it has a common view of infrastructure and policy information. Cluster capacity scales linearly with the addition of new Policy Servers because there is no replication taking place between these Policy Servers, except in the policy store itself. The cluster provides stability to the system and allows for individual Policy Server failures without any transaction losses.
- Failover is provided for the Key Store and Policy Store so that maintenance can be performed on these databases or LDAP servers without requiring a scheduled outage of CA SiteMinder WAM and the applications for which it manages access.
- Replication of Key Store and Policy Store data across data centers is accomplished with third-party replication systems or by the underlying store technology itself.
- User store failover and load balancing is supported through settings in the WAM Administrative UI.

## Password Services

Security specialists agree that username/password-based authentication is far from the ideal method for securing user identities. However, the tests discussed in this paper make use of CA SiteMinder WAM's Password Services for the following reasons:

- Username/password authentication remains the most prevalent authentication approach in the world today, and it will take a long time before stronger authentication can replace username/password authentication in massive Web-based applications.
- Password services that manage password composition and password self-service are critical to WAM implementations.
- CA SiteMinder WAM's Password Services ensure that the tests discussed in this paper include write-heavy transactions on top of the read-heavy transactions for authentication and authorization.

## Application Personalization

CA SiteMinder WAM uses responses to capture data about users from the user store and pass that data back to the Web server as an http header or cookie. This allows SiteMinder to support personalization of Web applications based on the user who is accessing the system.

## CA Directory

Enterprise directory solutions must have exemplary performance, scalability and reliability. CA Directory meets these requirements with its ability to mesh any number of servers (including external LDAP resources) into a backbone infrastructure capable of seamless and transparent distributed operations, guaranteed consistent replication, and automatic recovery.

CA Directory:

- Provides scalability without high hardware costs.
- Meets the needs of new, dynamic business applications.
- Improves operational efficiency by consolidating islands of data into a single information backbone.
- Provides a highly responsive and always available experience for online application users.

## DXgrid

Integral to CA Directory is DXgrid, which is a revolution in directory systems. Compared to the typical LDAP database approach, DXgrid allows for unprecedented levels of scalability, reliability and performance.

DXgrid achieves its performance by using a memory-mapped store and, as seen in testing, cuts the time to bulk load records from days to hours, while at the same time drastically minimizing hardware requirements. The memory-mapped file loaded on each DSA in the CA Directory deployment during start up minimizes disk I/O. The technology includes both *shortest path routing* and *parallel search* capability between cooperating servers.

Reliability is also enhanced by using write-through rather than write-behind technology, and a safe load-sharing and failover capacity.

## LDAP vs. X.500

CA Directory implements both LDAP and X.500, providing open standards for access, distribution and replication. Features like multi-master and real-time replication, which ensure data integrity, cooperative distribution, intelligent fault tolerance, and built in load-balancing are competitive differentiators. A typical LDAP directory on its own cannot provide multi-master replication so data integrity is not guaranteed. An LDAP directory also generally uses referrals instead of chaining, which is less productive, unreliable and inefficient.

For more information on CA Directory, see the product brief posted on CA's Web site:

[http://www.ca.com/files/ProductBriefs/directory\\_product\\_brief.pdf](http://www.ca.com/files/ProductBriefs/directory_product_brief.pdf)

## The Tests

In commissioning 100 million users testing, CA wanted to demonstrate that their WAM solution, using the latest versions of CA SiteMinder WAM and CA Directory, could meet the demands of future WAM deployments, whether in the enterprise, government, or service provider space. The goal of the 100 Million User Test was to determine the performance of the CA WAM solution for a global-scale web site.

To do this, Enex TestLab needed to validate scientifically and independently the following:

- CA SiteMinder WAM with CA Directory scaled to meet the performance requirements of an organization in a real-world scenario of 100 million users.
- The solution achieved fast data load and service start times, high performance, reliability, and redundancy.
- Minimal hardware infrastructure was required.

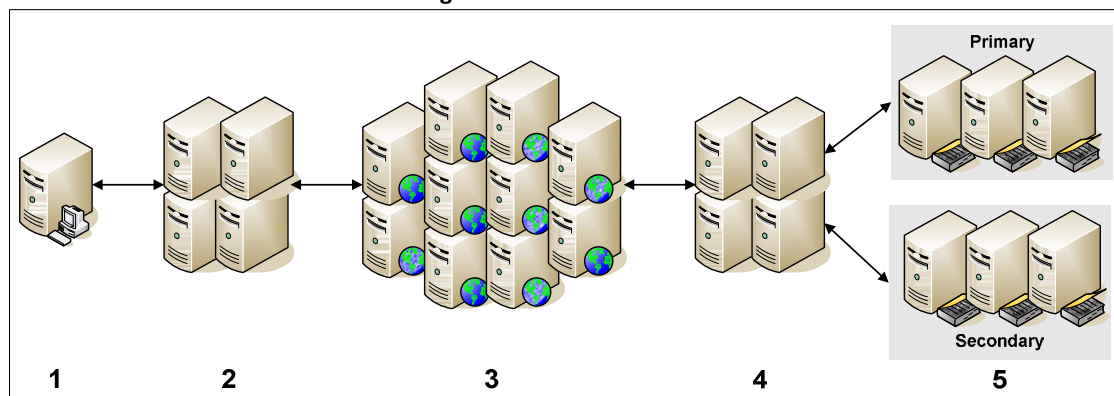
To test these hypotheses, different tests were executed as part of the 100 Million User Test:

1. Time to load 100 million users into the user repository (CA Directory)
2. Startup time for the user repository (CA Directory)
3. Number of Web authentication and authorization transactions (CA SiteMinder WAM and CA Directory)
4. Time to authenticate all users in the repository (CA SiteMinder WAM and CA Directory)
5. Failover and redundancy (CA Directory)
6. Failover and redundancy (CA SiteMinder WAM)

To execute these tests Enex TestLab and CA developed a sophisticated infrastructure featuring a number of different servers and software applications. All of the software was installed on Sun Microsystems hardware including Sun T2000 and Sun X4600 servers.

The test environment provided full transparency of test procedures, test programs and results. Enex TestLab engineers were involved throughout, re-running tests sequences and constructing additional test cases to validate the accuracy of tests and eliminate coincidental results.

**Figure 4: Test Environment**



**Figure 4: The Test Environment**

The test environment contained the following components:

1. Silk Controller (1) – This was the management system for controlling Silk Performer systems used to generate test loads.
2. Silk Performer systems (4) – These systems generated the simulated user load that was applied to the CA WAM solution.

3. Web Agents (11) – These systems hosted the Apache Web Servers which contained protected Web content and CA SiteMinder Web Agents which acted as the policy enforcement points (PEPs) for CA SiteMinder WAM.
4. Policy Servers (4) – Part of the CA SiteMinder WAM product, these systems hosted the Policy Servers which act as policy decision points (PDPs) for the WAM system. The Policy Servers provided all of the transaction processing for CA SiteMinder WAM. The Policy Servers were setup as a cluster. The entire load from the Web Agents was dynamically load balanced across these four servers.
5. CA Directory DSAs (6) – These systems hosted the CA Directory deployment that contained 100 million unique user records with credentials. Three servers were used as the primary DSAs and three servers were used as the secondary DSAs. Each of the servers stored one third of the total user population.

### ***Test Environment Configuration***

CA software was tuned for performance according to the product documentation for CA SiteMinder WAM and CA Directory, and OS vendor documentation. Some highlights include:

- SilkPerformer servers used Microsoft Internet Explorer 6 browsers to generate requests for the test environment.
- Web Agent servers were configured with the Solaris OS. Network settings were tuned as specified in Solaris documentation for maximum throughput.
- Apache Web Server threads were tuned as specified in CA SiteMinder product documentation for maximum throughput.
- Policy Servers were configured in a cluster for failover and dynamic load balancing.
- Policy Servers were configured with the Solaris OS. Network settings were tuned as specified in Solaris documentation for maximum throughput.
- CA SiteMinder Policy Server settings were tuned as specified in the SiteMinder product documentation.
- Each Policy Server used 32 LDAP connections (16 primary and 16 secondary) to evenly distribute load to CA Directory. This number was chosen to equal the number of Policy Server and CPU hyper threads, which helped achieve maximum throughput.

### ***Test Case 1: Time to Load Users***

#### **Test Summary:**

- Test the time required to load data for 100 million users into the user store. The user store was CA Directory with DXgrid.

#### **Test Relevance:**

- In any of the scenarios noted above, loading user data is important. Consider a hardware upgrade. If you need to bring new hardware online to support your WAM solutions or to replace older hardware, the load time for a new system must be as short as possible.

#### **Test Input:**

- CA provided a single LDIF file containing data for 100 million users.
- This data included a password services “blob” attribute that was used in read/write operations to simulate complex user interactions in the later tests.

#### **Test Metrics:**

- The dxloaddb command loads the data from the LDIF file into CA Directory.
- The times recorded for this test case were measured for the duration of the dxloaddb command, from the instant the command was executed, to the moment the load was completed.

**Test Results:**

The time to load 100 million users into the CA Directory DSAs was:

- Run 1 – 51 minutes and 36 seconds
- Run 2 – 48 minutes and 25 seconds
- Run 3 – 51 minutes and 4 seconds

***Test Case 2: Time to Start Up the Repository*****Test Summary:**

- Test the time required for all servers functioning as part of the user repository in the WAM solution to start.

**Test Relevance:**

- In any failover situation when the user repository must recover from a failure, the system startup time must be as fast as possible to minimize the risk of system outage.

**Test Input:**

- Six servers were configured to host CA Directory.
- All servers were loaded with the data from the LDIF file used in Test Case 1.

**Test Metrics:**

- The times recorded for this test case were measured from the time it took to start each DSA to the time that each DSA was available to service CA SiteMinder WAM requests with a fully populated directory cache.

**Test Results:**

The start-up time for the CA Directory DSAs before the user store was ready to carry out transactions was:

- In Operational Mode (DSAs service requests without providing failover or redundancy)
  - o Test Run #1 - 7 minutes
  - o Test Run #2 – 8 minutes
  - o Test Run #3 – 7 minutes and 10 seconds
- In High Availability Mode (DSAs service requests while providing failover and redundancy)
  1. Test Run #1 - 7 minutes and 25 seconds
  2. Test Run #2 – 8 minutes and 3 seconds
  3. Test Run #3 – 7 minutes and 33 seconds

***Test Case 3: Number of Transactions*****Test Summary:**

- Test the number of transactions per second processed by the system under load.

**Test Relevance:**

- The support of 100 million users requires the ability to process a massive amount of concurrent WAM system users. This test focuses on the transaction rate per second to provide evidence of peak performance for the WAM system.

#### Test Input:

- Load from four Borland SilkPerformer Client PCs generating 75 virtual users each were used to create a load of 300 concurrent users with “think times” of zero. (Think time is the time a user would spend on a requested page before moving to a new page.)
- Password Services were enabled on CA SiteMinder WAM to create heavy read/write activity on the CA Directory user store. For each authentication, Password Services verified that the user had not exceeded the maximum number of invalid login attempts.
- A randomized set of users was employed by the testing environment.
- Eleven different user profiles were used to simulate different user activity patterns (and exercise different security policies as the “users” visited different portions of the test Web site).
- Specific user profiles were used for designated custom or non-typical events, such as account lockout and user replications.
- For each user the CA WAM solution executed a single authentication/authorization and nine additional authorizations. This mimicked the typical behavior of a user accessing a protected system and viewing multiple pages before terminating a session.
- For each user CA SiteMinder WAM retrieved four attributes from the user store and returned that data to the user’s browser (two attributes were returned as header variables and two attributes were returned as cookies). This simulated attributes required for personalization by a Web application.

#### Test Metrics:

- The numbers of transactions per second were recorded for 15-, 20-, and 48-hour tests.

#### Test Results:

The transaction rate for CA SiteMinder was measured for 15-, 20-, and 48-hour tests. A transaction was measured as one authentication and ten authorizations per user. The results were:

- Run 1 – 6282 Transactions per second
- Run 2 – 5936 Transactions per second
- Run 3 – 6272 Transactions per second

According to statistical data from Nielsen Online, an average user spends over 50 seconds viewing an individual page before moving to another page. See Nielsen data here:

[http://www.nielsen-online.com/resources.jsp?section=pr\\_netv&nav=1](http://www.nielsen-online.com/resources.jsp?section=pr_netv&nav=1)

Due to requirements of Silk Performer and in order to maximize the transaction load during testing, all transactions were executed with zero seconds spent viewing individual pages. The numbers of concurrent users supported by the CA WAM solution will depend on the time users spend on each requested resource. The more time an average user spends on a page, the greater the number of concurrent users that can be supported. Considering the Nielsen data, many transactions will be processed during the 50 or more seconds an average user spends on an individual page. The following table extrapolates from the test data to provide likely numbers of concurrent users that can be supported as the time users spend on a given page increases.

| With user Response time | Equates to number of concurrent users |
|-------------------------|---------------------------------------|
| 10 seconds per page     | 61,630 users                          |
| 20 seconds per page     | 123,266 users                         |
| 30 seconds per page     | 184,899 users                         |
| 50 seconds per page     | 308,165 users                         |

Based on the performance of the test system and the Nielsen data, over 300,000 users can log in and use the system at any given moment.

## ***Test Case 4: Time to Authenticate All Users in the Repository***

### **Test Summary:**

- Execute a load test and measure the time needed to log in every unique user (all 100 million) in the user store.

### **Test Relevance:**

- For a WAM solution to handle the demands of a 100 million user deployment, the system must be able to process a peak load of transactions in an acceptable amount of time. While the results are subject to interpretation from deployment to deployment, this test can simulate the access to the government tax system for each tax filer in a short period of time, such as the few days before taxes are due each spring in the United States.
- Many WAM system tests by other vendors include the caching of user data on the WAM system to increase performance. By running this test CA demonstrated the ability to perform with no repetition of user data stored on a WAM system cache. All user data was accessed directly from CA Directory.

### **Test Input:**

- 100 million UIDs were randomly assigned to 600 data files.
- Each of the 600 data files was "shuffled" using the Fisher-Yates shuffle algorithm (R. A. Fisher and F. Yates, Example 12, Statistical Tables, London, 1938).
- To further randomize the order of user entries, two files out of the 600 were merged into a single file by writing alternating lines from each original file into the new file until all users were moved to the new file. This process was repeated with pairs of files reducing the 600 data files to 300 files.
- Each of the 300 files was assigned to a SilkPerformer thread that executed logins sequentially for all users in each file.

### **Test Metrics:**

- The sum of the time to process one authentication and ten authorizations for each unique user in the user store.

### **Test Results:**

All 100 million unique users in the CA Directory user store were authenticated and accessed ten separate web pages (authorizations) in 45 hours, 50 minutes, and 50 seconds.

Note that Enex TestLab did not verify the results of this test case. These results were observed by CA, Inc. during the 100 million user project.

## ***Test Case 5: DSA Failover and Redundancy***

### **Test Summary:**

- Test the ability of the WAM user repository to fail over to backup servers and recover when primary servers come back on line.

### **Test Relevance:**

- WAM systems are critical to an organization. This test ensures that components can fail without causing a system outage.

**Test Input:**

- Three DSAs were configured as the primary user store.
- Three DSAs were configured as the secondary (backup) user store. Each server in each group of three contained one third of the total users.
- The primary DSAs were shut down, shifting load from SilkPerformer to the backup DSAs.
- The primary DSAs were restored, shifting load from the secondary DSAs to the primary DSAs.

**Test Metrics:**

- Did the WAM solution successfully operate on secondary systems?
- Did the primary systems recover and resume normal operations?

**Test Results:**

All primary DSAs (three in total) were shut down. The SiteMinder CA Directory solution was able to successfully service incoming requests without interruption by failing over to the secondary DSAs (3 in total).

If all of the primary DSAs were shut down and one of the secondary DSAs was also shut down; errors would occur where only 66.6 million users would be serviced as each of the three DSA's manage one third of the users.

Failover of one, two, or all three of the Primary DSA servers to the secondary servers was seamless and error free.

Restoring the primary DSA servers after a failover was seamless and error free.

### ***Test Case 6: Policy Server Failover and Redundancy***

**Test Summary:**

- Test the failover and recovery of a node in the SiteMinder Policy Server cluster while maintaining testing throughput on the remaining systems.

**Test Relevance:**

- Policy Server systems are critical. This test ensures that components can fail without causing a system outage.

**Test Input:**

- Four Policy Servers were configured as a policy server cluster.
- A single Policy Server was stopped, shifting load from SilkPerformer to the other three Policy Servers.
- The Policy Server was restored, shifting load back to all four Policy Servers.

**Test Metrics:**

- Did the cluster successfully operate after a node failure?
- Was the transaction load evenly distributed to the cluster before and during the failover test?
- Did the stopped Policy Server recover and resume normal operations?

**Test Results:**

Across a SiteMinder Policy Server cluster, the load balancing feature evenly distributed the transaction load from the Web Agents to the four Policy Servers in the cluster.

When a single Policy Server in the cluster was shutdown, the load to the Policy Servers was redistributed seamlessly among the three remaining Policy Servers in the cluster.

The throughput of transactions dropped by one quarter during testing due to the lower number of Policy Server machines.

After restoring the Policy Server, the load was redistributed and the transaction throughput returned to pre-failover levels.

At no point in testing did CPU usage exceed 30% of capacity.

At no point in testing did memory usage exceed 4GB on any Policy Server or Web Agent server.

## User Data

For the tests CA Directory r12 SP1 DXgrid technology was used to populate 100 million users into the directory cache, which was not reset during the tests.

CA SiteMinder Policy Servers and Web Agents did have their caches reset and logs cleared upon the completion of every test run.

## Hardware Used

Figure 4, shown previously, illustrated the Sun Microsystems servers used for the tests described in this paper. The hardware specifications of these servers are listed in the following table.

Note: The Silk Controller system and the SilkPerformer systems are excluded from the table since they are not required in a production deployment.

| CA Solution Component                | Hardware Used                                                                                                                | Number of Systems | Cost in USD (\$) | Total Cost in USD (\$) |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------|------------------------|
| Web Servers/CA SiteMinder Web Agents | Sun T2000<br>Solaris 10 (SPARC)<br>16 GB RAM<br>Single 1.2 GHz<br>CPU (32 virtual CPUs)<br>Apache 2.x Web Server with Tomcat | 11                | \$16,995         | \$186,945              |
| CA SiteMinder Policy Servers         | Sun T2000<br>Solaris 10 (SPARC)<br>16 GB RAM<br>Single 1.2 GHz<br>CPU (32 virtual CPUs)<br>Apache 2.x Web Server with Tomcat | 4                 | \$16,995         | \$67,980               |
| CA Directory Server DSAs             | SunFire X4600<br>Solaris 10 (x86)<br>32 GB RAM<br>4 Opteron 2.6 GHz dual-core CPUs                                           | 6                 | \$23,995         | \$143,970              |
|                                      |                                                                                                                              |                   |                  | <b>\$398,895</b>       |

Note that a gigabit network was required for all communications. Gigabit switches were used to separate the SilkPerformer load generation and the Web Agents.

## The Results

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Testing confirms that the CA WAM solution, consisting of CA SiteMinder and CA Directory, can provide high levels of performance while supporting an active user pool of 100 million users.

### Test Limitations

All environments, testing or production, have physical limitations. In the environment for this test, we experienced two limits that did not allow for progress beyond the results achieved:

1. Saturation of the gigabit network
2. Saturation of the load test farm

Because of these limitations, the test scale stops at 7000 transactions per second. This, however, provides more than enough evidence for meeting test objectives.

## Conclusion

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Testing confirmed that the CA WAM solution, provides a high level of performance that can support an active user pool of 100 million users.

Key test results were:

- 100 million unique users were successfully loaded into the CA Directory DSA servers in approximately 50 minutes.
- Once the users were loaded, DSA services were started and ready to handle requests in 7 - 8 minutes.
- Transaction rates were extrapolated from test data to show that CA SiteMinder handled 300,000 concurrent users.
- The CA Directory and CA SiteMinder WAM products demonstrated excellent levels of failover and redundancy.
- These test results were achieved on a Sun Microsystems hardware solution which enabled the Enex TestLab to test the scalability and performance of the CA WAM solution on a massive scale. The hardware solution used in the tests retails for just under \$400K.

The CA WAM solution combines a highly scalable Web Access Management solution in CA SiteMinder WAM with a resilient and efficient user repository in CA Directory. Together, these CA products form a solution that not only meets today's demand for WAM systems, but can also be counted on to scale for future needs of enterprise, government and service provider applications.

For more information about the Enex TestLab, go to <http://www.testlab.com.au>

For more information about CA's products and solutions, go to <http://www.ca.com>.