

Oracle Access Manager Performance Benchmark

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Access Server Benchmarking for Oracle Access Manager

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Access Server Benchmarking for Oracle Access Manager

This paper proposes a performance benchmark for Oracle Access Manager implementations, the OAM Benchmark.

INTRODUCTION

Oracle Access Manager, formerly known as Oracle COREid Access and Identity, provides identity administration and access control to web applications and other resources. A key component of the Oracle Identity Management Suite, Oracle Access Manager provides security for heterogeneous application environments.

Like any application deployed in demanding, real-time environments, proper server sizing and configuration is critical for acceptable performance. The Oracle Access Manager product documentation provides high-level guidance for deployment sizing. The challenge, however, is in applying such guidance to the needs of a particular deployment. This problem is complicated by a number of factors, including:

- No commonly agreed-upon standards for performance benchmarking.
- The sensitivity of a given deployment to factors such as tuning.
- The performance of supporting services, such as directories and databases.
- A lack of comparable performance data figures which can be applied to real-world deployments.

This paper proposes a performance benchmark for Oracle Access Manager implementations, the OAM Benchmark. The goal of the OAM Benchmark is to provide a benchmark that will be meaningful for a wide variety of real-world Oracle Access Manager deployments.

This paper describes the components of the OAM Benchmark and some of the different tests that may be defined to run with this benchmark. It then describes the results of running the benchmark in a test environment where the Oracle Access Manager components (WebPass, WebGate, Identity Server, Access Server and Policy Manager) are distributed across six dual-processor WINTEL systems. Finally, the Appendix provides detailed information about the system configuration for those seeking to reproduce or extend these results.

The OAM Benchmark design includes an Access Manager user population of 1 million users, a test web site consisting of 100 static HTML pages, and two basic Access Server scenarios.

OAM BENCHMARK

The purpose of the OAM Benchmark is to establish a reproducible test scenario for evaluating Oracle Access Manager performance. The design of the OAM Benchmark reflects an attempt to standardize a set of test conditions and performance criteria that are meaningful for real-world Oracle Access Manager deployments.

The OAM Benchmark design includes the following components:

- Access Manager user population of 1 million users, distributed across 10 organizational units and 10 groups. In some of the test cases, Access Manager performed authorization based on user's membership to a particular LDAP group.
- Test web site consisting of 100 static HTML pages, each 14KB in size, with a defined set of authorization policies for the web pages.
- Two basic Access Server scenarios, referred to as "Login" (i.e. 1 authentication and 1 authorization operation) and "LoginNavi," (1 login operation followed by 10 authorization operations) as fully described in "Access Server Scenarios"

Several different tests can be performed with these scenarios to explore different aspects of performance, scalability and reliability. For purposes of the OAM Benchmark, three types of tests were defined, as fully described in "Test Runs". These are:

- Throughput – to help estimate the upper limits of the authentication and authorization capacity for the system under test.
- Longevity – to evaluate the stability of the system under load over a longer period of time.
- Linear scale – to determine how the system utilization scales with throughput.

For each test, measurements are made while keeping login process response times and protected page navigation response times within acceptable performance boundaries, defined as 2 seconds and 3 seconds, respectively. Details of the OAM Benchmark are described below.

User population

The user population for the benchmark consists of 1 million users randomly assigned to 10 organizational units, each including approximately 100,000 users. Subsets of these users were randomly assigned to 10 groups, each having less than 5,000 members. Characteristics of the groups are as follows:

- Group 1, a static group with less than 100 members
- Group 2, a dynamic group with less than 100 members

- Group 3, a static group with about 5,000 members
- Group 4, a dynamic group with about 5,000 members
- Groups 5 -10, static groups with less then 5,000 members.

Figure 1 provides an overview of the directory structure associated with these organizational units and groups.

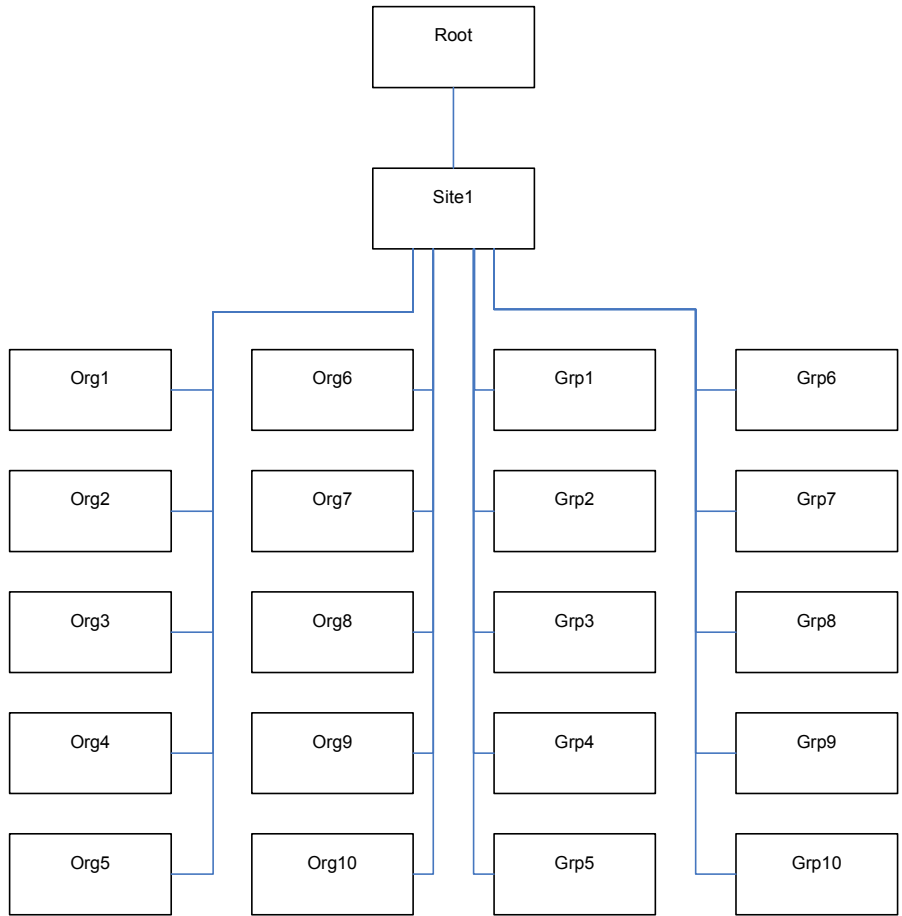


Figure 1: OAM Benchmark organizational unit and group directory design.

Web site and authorization policies

The OAM Benchmark environment specifies a dummy web site containing 100 static HTML pages, each 14KB in size. Authorization policies for the web site are defined as follows:

The OAM Benchmark design includes one policy to deny access to users who do not belong to a small static group, one to deny access to users who do not belong to a small dynamic group, one to deny access to users who do not belong to a large static group, one to deny access to users who do not belong to a large dynamic group, and one to deny access to users who are not administrators.

- Page20 - deny user access if the user is not a member of a small static group in the LDAP directory (Group 1)
- Page40 - deny user access if the user is not a member of a small dynamic group in the LDAP directory (Group 2)
- Page60 - deny user access if the user is not a member of a large static group in the LDAP directory (Group 3)
- Page80 - deny user access if the user is not a member of a large dynamic group in LDAP (Group 4)
- Page90 - deny user access if the user is not an administrator
- For all other pages - allow any authenticated user to view a web page

These authorization policies were designed to generate an approximately 5% authorization denial rate when running the tests described below.

Access Server scenarios

The OAM Benchmark defines two basic Access Server use scenarios, “Login” and “LoginNavi.” These are described below.

Login

The Login scenario consists of one authentication and one authorization operation. The LoginNavi scenario consists of one login operation followed by ten authorization operations, for a total of eleven operations per user session.

The Login scenario consists of one authentication and one authorization operation. There will be 100,000 different user sessions active during a given test run. Sessions are not logged out once created; however, each session remains idle after login.

The Login scenario is designed to generate approximately 85% successful authentications and 15% unsuccessful authentications. The login/sec indicator used in the report is the total of successful and rejected login transactions per second.

LoginNavi

The LoginNavi scenario consists of one login operation followed by 10 authorization operations yielding a total of 11 operations per user session. The number of different user sessions active during a given test run is the same as for the Login operation.

The LoginNavi scenario is designed to generate a 5% rate of authorization denials. Authorization denials are redirected to a particular page, preventing the generation of HTTP 404 errors. The operations/sec indicator used in this report is the sum of all of the navigations, rejected logins, and double the number of successful

logins. (Since each successful login includes one authentication and one authorization, it counted as two operations.)

Test Runs

Several different tests can be performed with the benchmark configuration and Access Server scenarios defined above to explore different aspects of performance, scalability and reliability. For purposes of the OAM Benchmark, three types of tests were defined. These are:

- Throughput
- Longevity
- Linear scale

Each of these is described in detail below.

Throughput

The purpose of the throughput test is to estimate the upper limits of the authentication and authorization capacity for the system under test. With the throughput test, testers may use as many load generators, test threads and virtual users as required, configured without think time, to realize the maximum throughput of the system under load. In addition, the tester is permitted to perform a warm-up run of the test scenario in order to bring the servers to a steady state. Results are reported in operations/sec/cpu for a specified average response time.

Longevity

The purpose of the longevity test is to evaluate the stability of the system under load over a longer period of time. In this test, 2,000 virtual users configured with think times are used to load the servers to between 50% and 80% of CPU capacity. The test is run and monitored over a defined period of time. Results reported are throughput and average response time, as well as systems-level and process-level metrics such as CPU utilization and maximum memory footprint. (Note: For purposes of this report, tests were run for 12 hours. However, tests could be carried out for 12/24/36 hours, etc.)

Linear Scale

The purpose of the linear scale test is to determine how the system utilization scales with throughput. Ideally, the system will show linear behavior throughout its performance range, with no drop-offs or flattening of the performance curve prior to saturation. In this test, virtual users (configured with non-zero think times) are ramped up slowly. Transaction response time and CPU utilization is measured at every increment. The test ends when the CPU utilization saturates or when the response time exceeds acceptable limits. The results are processed to provide the correlation of total transactions vs. CPU utilization (in percent).

A longevity test evaluates system stability of 2,000 virtual users who load the servers to 50%-80% capacity over 12 hours. A linear scale test determines how the system utilization scales with throughput.

Key Performance Indicators

For purposes of generating a simple, comparable metric to use across a variety of system configurations, key performance indicators are defined. In terms of the key performance indicators, the system is defined to be functioning with acceptable performance when:

- Login process response time is less than 2 seconds.
- Protected page navigation response time is less than 3 seconds.

These numbers are based on what is commonly considered acceptable performance by most website users.

BENCHMARK TEST DESCRIPTION

A performance test was performed using the OAM Benchmark. This section describes the test configuration used, and test results.

Test configuration

Benchmark testing was performed using the production 10.1.4 release of Oracle Access Manager. WebPass, WebGate, Access Server, Policy Manager and Identity Server components were deployed across six dual-processor WINTEL systems. Oracle HTTP Server (OHS) instances were deployed to service the web pages for the test site. An LDAP directory instance (SunOne Directory Services) containing the 1,000,000 user entries used for the test was hosted on a Sun Solaris server. Finally, two WINTEL systems running Mercury LoadRunner software were used as drivers to generate the simulated user loads during test. The load driver machines were joined to the system under test through an F5 Networks BigIP switch to provide load balancing across the front-end machines. Test machine specifications are provided in Table 1.

The test of the OAM Benchmark was performed with Oracle Access Manager 10.1.4.

Machine	Number CPUs	CPU Speed	Memory (GB)	OS	Installation
Intel Xeon	2	2.8 Ghz	6	Windows 2003	OHS/WebPass/WebGate
Intel Xeon	2	2.8 Ghz	6	Windows 2003	OHS/WebPass/WebGate
Intel Xeon	2	2.8 Ghz	6	Windows 2003	OHS/WebPass/WebGate
Intel Xeon	2	2.8 Ghz	6	Windows 2003	OHS/WebPass/WebGate
Intel Xeon	2	2.8 Ghz	6	Windows 2003	Identity Server
Intel Xeon	2	2.8 Ghz	6	Windows 2003	Access Server/Policy Manager
Sun Solaris	4	1.2Ghz	8	Solaris9	Sun JS Directory Server
Load Balancer: F5 Networks BigIP V9, Policy: Round-Robin. Health Monitoring: HTTP					

Table 1: Benchmark test machine specifications

A diagram of the complete test environment is illustrated in Figure 2.

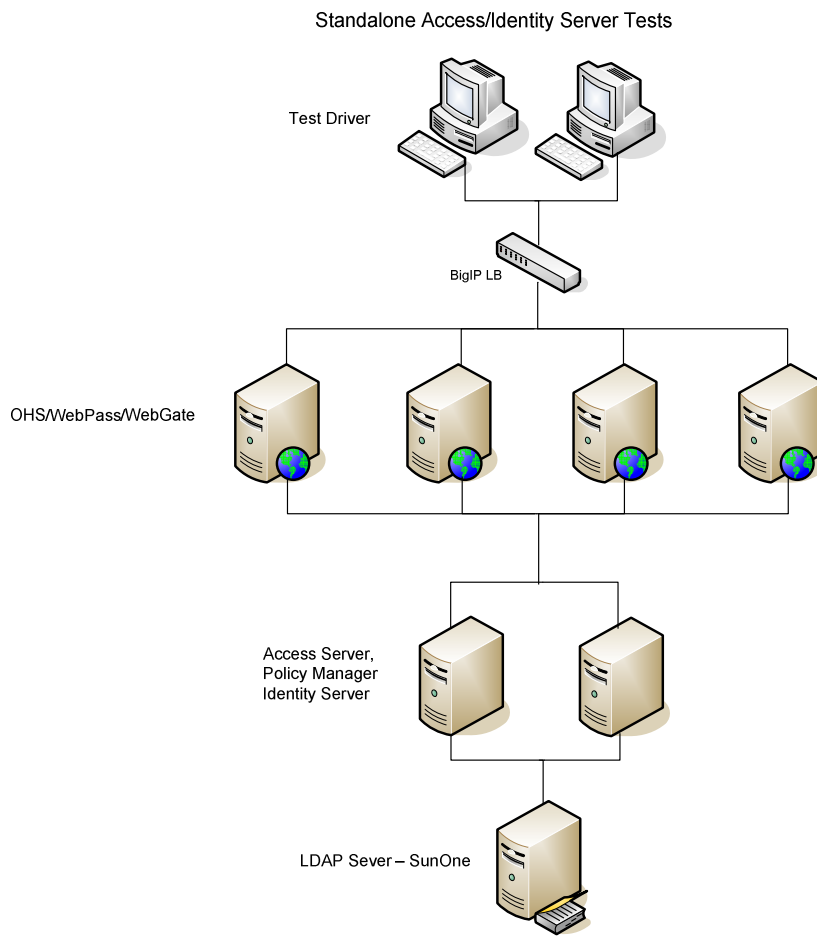


Figure 2: OAM Benchmark test configuration.

Two WINTEL machines running Mercury LoadRunner 8.0 were used to generate the load for the tests. Specifications and configuration of these machines are shown in Table 2.

Machine	Number CPUs	CPU Speed	Memory (GB)	OS	Installation
Intel Xeon	2	2.8 Ghz	6	W2k3	LoadRunner Agent
Intel Xeon	2	2.8 Ghz	6	W2k3	LoadRunner Controller and Agent

Table 2: Load Machine Specifications

Additional information about the server and tool configurations used in the tests is provided in the Appendix.

Test Results and Analysis

A series of throughput, longevity and linear scale tests were performed using the Login and LoginNavi scenarios. Results of the throughput and longevity tests are summarized in Table 3

Scenario (Test)	Average Throughput	Response Time (sec)	Number of Virtual Users
Login (Throughput)	1782 login/sec/CPU	0.02	40
LoginNavi (Throughput)	2530 ops/sec/CPU	0.02	36
LoginNavi (Longevity)	1540 ops/sec	0.02	2000

Table 3 Throughput and longevity test results.

Throughput Testing

In throughput testing of the Login scenario, Oracle Access Manager delivered a throughput of 1782 logins per second, per CPU, with an average 0.02-second response time. In throughput testing of the LoginNavi scenario, Oracle Access Manager delivered 2530 operations per second, per CPU, with an average 0.02-second response time.

These results demonstrate the high peak throughput that can be realized with a properly tuned Oracle Access Manager deployment.

Longevity Testing

In longevity tests of the LoginNavi scenario, Oracle Access Manager delivered 1540 operations per second with a two-CPU machine, under a 2000 concurrent user load. (Virtual users were configured with a 1.2 second think time). The average CPU utilization was 39%, with a maximum observed utilization of about 86%. Maximum memory footprint after 1.5 hours was observed to be 300 MB, and this remained unchanged for the remainder of the test. The run lasted for 12 hours. The response time observed during the longevity test averaged 0.01 seconds for navigation, and 0.02 seconds for login.

These results demonstrate Oracle Access Manager's ability to support a reasonably high transaction load for a sustained period of time, as well as the stability of the system in these environments.

Linear Scale Tests

Finally, three linear scale tests were performed using the LoginNavi scenario. The purpose of these tests is to evaluate the scalability of Oracle Access Manager under simulated real-world conditions.

In the first test, the Access Server was running on one CPU, with no hyper-threading¹. Results of this test are summarized in Figure 3, where the x-axis represents the CPU utilization in percent, and the y-axis represents the total number of transactions/second.

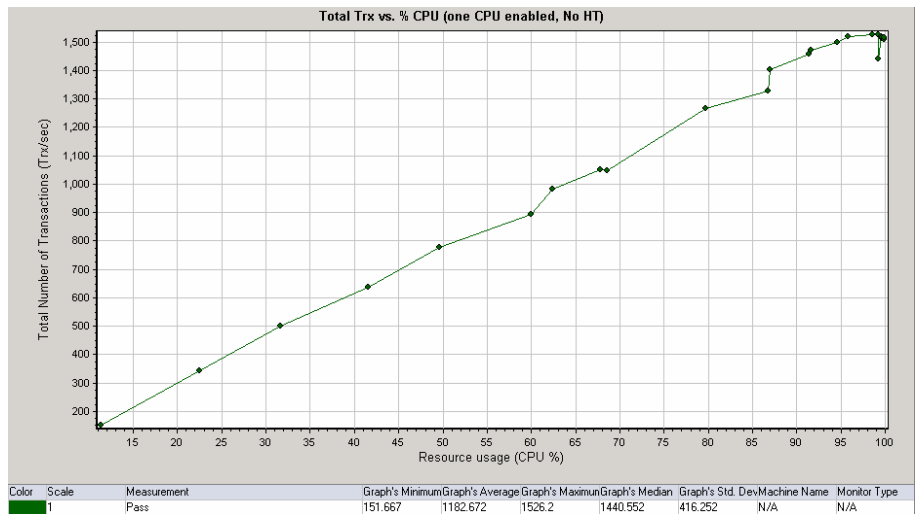


Figure 3: Linear scale test results for one CPU with no hyper-threading.

The second test was performed with the Access Server was running on two CPUs, with no hyper-threading. Results of this test are summarized in Figure 4.

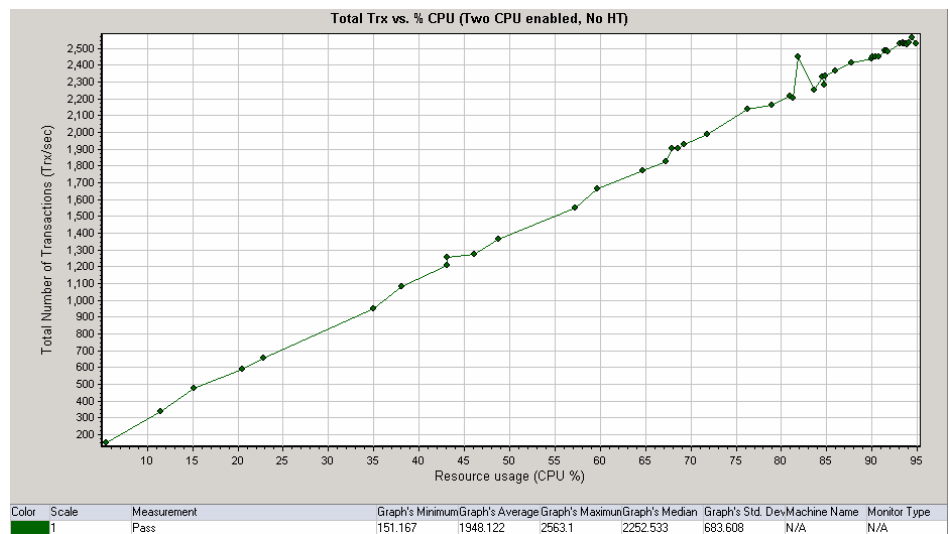


Figure 4: Linear scale test results for two CPUs with no hyper-threading.

¹ Hyper-threading, officially called Hyper-Threading Technology (HTT), is Intel's trademark for their implementation of the simultaneous multithreading technology on the Pentium 4 microarchitecture

The third test was performed with the Access Server running on two CPUs, with hyper-threading. Results of this test are summarized in Figure 5.

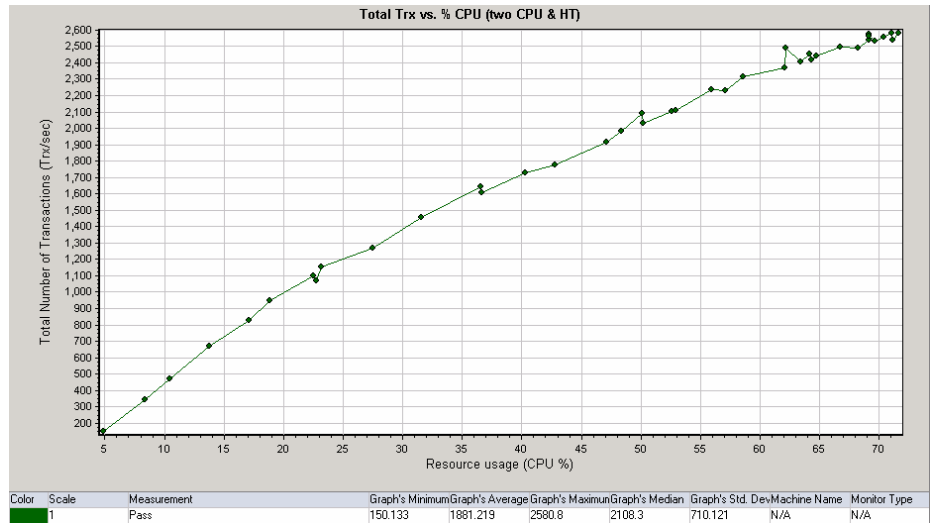


Figure 5: Linear scale test results for two CPUs with hyper-threading.

These curves all show very linear performance across the performance range. The results of all of the linear scale test runs are summarized in the graph in Figure 6. Each curve in the graph indicates the best-fit line for the results of a different combination of processors and threads, where **P** in the legend represents the number of processors, and **L** in the legend represents the number of logical processors. (Note: In Figure 6 and Table 4, the data for the 1P-2L curve is extrapolated. The only way to configure to test the 1P-2L case would be to physically remove one CPU.)

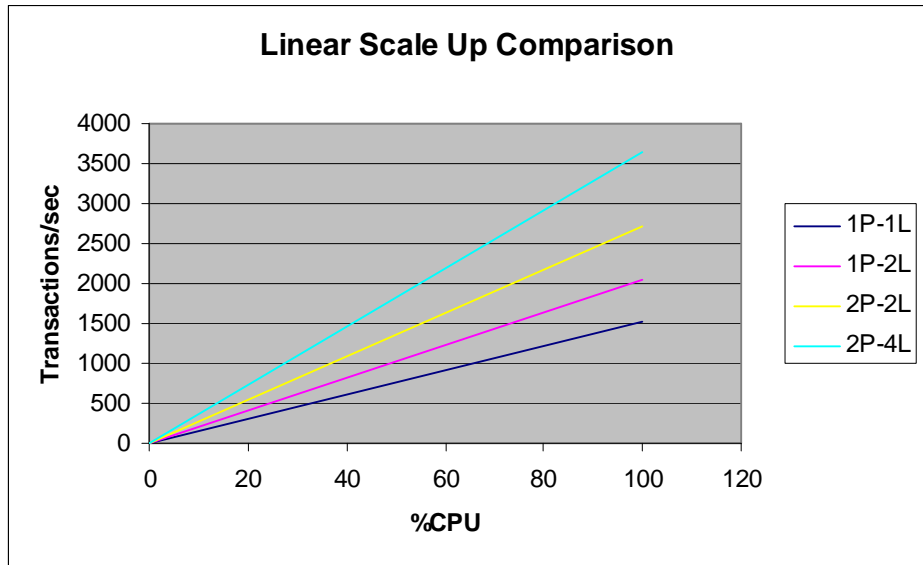


Figure 6: Linear scale test comparisons

From these curves, it is possible to determine a scalability factor measured as the slope of the line. These were estimated and are summarized in Table 4

Oracle Access Manager (10.1.4) Configuration	Scalability Factor
1P-1L	1.00
1P-2L (extrapolated)	1.34
2P-2L	1.78
2P-4L	2.38

Table 4: Scalability factors for linear scale test runs.

As illustrated by the results summarized in Table 4, the Oracle Access Manager system under test showed excellent linear scalability with system load. In addition, performance was demonstrated to scale with additional processors showing, for example, a 78% increase in the system scalability factor when going from the 1P-1L case to 2P-2L case. It also showed that it benefits from hyper-threading, with a 34% increase in the system scalability factor when going from the 2P-2L case to the 2P-4L case.

CONCLUSION

It took a 10:1 ratio of Web Servers to Access Server processes to drive the Access Server to 100% CPU utilization. However, these tests were run under ideal conditions. In an actual deployment, these benchmarks may not be comparable.

This paper described the results of an Oracle Access Manager benchmark definition and testing exercise performed with Oracle Access Manager (10.1.4). Overall, the numbers generated by the OAM Benchmark testing demonstrated the excellent performance and scalability of the Oracle Access Manager system under test.

One indication of the high performance of the Access Server is the fact that it took a 10:1 ratio of Web Server to Access Server processes to drive the Access Server to 100% CPU utilization. To be consistent with earlier test runs we only drove the Access Server CPU usage to 50%. Since two-CPU systems were used for the Access Server, this result was interpreted to be equivalent to one CPU at 100% usage level. This methodology was proved to be valid by our Linear Scale tests.

There are two notes of caution in applying these test results. First, the test cases and setup described here are comparable to those followed in common industry benchmark tests, such as AuthMark. (AuthMark is a propriety benchmark owned by Mindcraft, Inc.) It should be noted, however, that while these benchmarks are superficially similar, very different usage and deployment scenarios drive them. Consequently, one cannot draw conclusions based on results of these test scenarios and compared to other benchmarks.

A second note of caution is that these OAM Benchmark test results represent throughputs that are close to the optimum achievable by Oracle Access Manager. In real-world use, the deployment, system usage and loads can be much more complicated. Hence, the data here should not be interpreted as a sizing recommendation for any particular deployment, but as an estimate of the upper limits of performance realizable with this particular deployment architecture. It is expected that this study will form a basis for developing more refined sizing guidelines.

APPENDIX – SERVER/TOOL CONFIGURATIONS

Oracle HTTP Server:

Version: OHS 10.1.3
Timeout = 300
KeepAlive = On
MaxKeepAliveRequests = 0 (unlimited)
KeepAliveTimeout = 15
MaxRequestsPerChild = 0 (unlimited)
ThreadsPerChild = 1000
SendBufferSize = 16384

WebGate:

Version: 10.1.4.0.1
Maximum Connections = 30 (50 – Longevity)
Cache = 3600 secs.

Access Server:

Version: 10.1.4.0.1
Number of Threads = 100
Audit to File = Off
Maximum Elements in User Cache = 100000
Maximum Elements in Policy Cache = 10000
Maximum Elements in Session Token Cache = 100000
Access - LDAP initial connections: 50
Access - LDAP max connections: 80 (100 – Longevity)
User/Password cache turned on.

Sun One Directory Server Version: 5.2:

DB Cache size: 1 GB
Suffix Cache : 1 GB
Initialize Cache : 500 MB
Sizelimit: 10000
Lookthrough limit: 10000
Timeout: 600 sec.
Max Thread: 100 (150 – Longevity)

Load Runner:

Version: Mercury LoadRunner 8.0
Keep Alive HTTP Connection: Yes
For Login & LoginNavi Scenarios – 36 Vuser, 0 Think time
For Longevity Scenarios - 2000 Vuser, 50-185% of 1.2 seconds think time

Load Balancer

Model: F5 BigIP V9
Policy: Round-Robin
Health Monitoring: HTTP

ORACLE FUSION MIDDLEWARE

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