

# **Onyx Employee Portal – Web / Microsoft® SQL Server™ 2000 Benchmarking White Paper**

**Conducted in partnership with Unisys Corporation and Mercury  
Interactive**

Due to the competitive nature of the Onyx CRM benchmark methodology, select portions of this white paper have been edited out for public distribution. For a more detailed white paper on this benchmark, please contact your nearest Onyx Sales Office.

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## EXECUTIVE SUMMARY

### OVERVIEW

This document describes the results of benchmark tests conducted on Onyx Enterprise Portal 3.0 (OEP) in January 2002 in partnership with Unisys Corporation and Mercury Interactive to evaluate:

- application and platform performance / scalability when the database is running on a 16-processor Unisys ES7000 server
- application and platform performance / scalability under different transaction models
- application network utilization

A team of Onyx personnel conducted these tests with Microsoft® SQL Server™ 2000 Enterprise Edition on Microsoft® Windows™ 2000 Datacenter Server. Tests were conducted at the Unisys ES7000 Performance Center in Tredyffrin, Pennsylvania.

The tests demonstrated Onyx Employee Portal's ability to support up to 57,000 concurrent users while averaging sub-second response times using a farm of 8-processor web/application servers accessing a single 16-processor SQL Server 2000 database server – the largest benchmark published to-date<sup>1</sup> by a CRM vendor.

The benchmark methodology provided a realistic representation of the way an enterprise relationship management system is actually used. Onyx invested significantly in thorough, customer-centric analysis before designing any tests, truly an “outside-in” initiative. Specific industries, including High Technology, Financial Services and Telecommunications business operations and workflow were documented for testing purposes. These formed the basis of the test design, workflow scenarios, database sizing and record counts used in the application testing.

### IN SUMMATION

Onyx tested Onyx Employee Portal 3.0 with twelve thousand six hundred (12,600) and fifty seven thousand (57,000) simultaneous virtual users sharing a single centralized database and multiple web/application servers. The application servers leveraged a shared database connection pool to communicate with SQL Server. While executing the maximum attempted load in excess of 844,000 business transactions per hour, Onyx Employee Portal performed transactions with sub-second average and 90<sup>th</sup> percentile response times over a local area network. System-level and SQL Server-level performance statistics were also well within the Onyx recommended guidelines defined below.

All test scripts were executed using normal playback speed simulating real-world end user interaction with the system. In addition to the virtual use testing, a random sampling of actual physical clients executing the same scenarios using the Onyx Employee Portal application was done. While the virtual user architecture of large-scale test automation tools provides efficiency in emulating thousands of users, the architecture eliminates the client-side rendering of the application within the browser (and in many cases where an n-tiered architecture is present, the middle-tier as well). It is therefore beneficial to validate the performance of physical clients in parallel with virtual clients to understand the true end-to-end performance characteristics.

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<sup>1</sup> The next largest benchmark published to-date is Peoplesoft's announcement on June 4, 2001 stating it had achieved a 30,000 user benchmark with the latest version of its CRM software.

## PERFORMANCE AND SCALABILITY BENCHMARK TEST

### BENCHMARK GOALS AND OBJECTIVES

The goal of this scalability benchmark test was to verify Onyx Employee Portal 3.0's capability to effectively manage data volumes and workflow loads for high-volume implementations.

Tests were conducted at the Unisys ES7000 Performance Center in Tredyffrin, Pennsylvania, to accomplish the following objectives:

- Validate testing scripts that simulate two different real-world, high-volume customer management scenarios
- Under the Enterprise User scenario, evaluate the capability of Onyx Employee Portal to support over 50,000 concurrent enterprise-wide users, averaging a business transaction every 5-7 minutes per user, using a farm of web/application servers accessing a single 16-processor SQL Server 2000 database server
- Under the High-Volume Call Center scenario, evaluate the capability of Onyx Employee Portal to support over 10,000 concurrent call-center representatives, each processing a support call every 1-2 minutes, using a farm of web/application servers accessing a single 16-processor SQL Server 2000 database server
- Provide sizing guidelines for Onyx Employee Portal / ES7000 deployments where the ES7000 is used as a centralized database server
- Analyze system performance and network utilization to facilitate proper infrastructure planning

### DESIGN APPROACH

Onyx established a customer-centric foundation for the entire test for several reasons. First, using a top-down business-analysis approach to define the requirements, Onyx was able to extract unbiased business workflow simulation to ensure relevance to actual high-volume customer management operations. Many technology-based benchmarking scenarios lack real-world relevance and are designed for optimal performance rather than relevance to user workflow. Onyx's analysis does not minimize the importance of technology attributes, but instead forces the initial analysis to examine *what the users do*, rather than *how the system does it*.

By remaining business-process – instead of technology-solution – focused, the team was able to simulate use-case scenarios that realistically represent the user environment and issues, while measuring load-level performance and scalability.

## TESTING METHODOLOGY

Mercury Loadrunner 7.02, the leading commercial Web stress, test-automation scripting tool from Mercury Interactive, was used to implement the business transactions for simulating 12,600 and 57,000 user environments. The test scripts and workflow were automated based on the business processes defined during client elicitation (i.e., how frequently the work occurred) and balanced over the duration of the test to more accurately simulate typical business loads. Extensive system contention periods (e.g., shift change, rush hour) and peak load conditions were not simulated.

Multiple-user sessions were simulated per physical client workstation (see *Test Environment* section for specific details). The scenarios were staggered to ensure that not all activities of the same type were happening simultaneously. For this staggered test-execution approach, workflow was started and completed at a random rate that more closely emulated real-world use.

All user simulations accessed a real-world Onyx production database acquired from an existing, mature client installation. Record counts (See *table 3*) were consistent with the simulated user profiles and included over 4,000 products.

All tests were conducted with randomized record access across the tables. This ensured the timing results only benefited from data and procedure level caching in a manner consistent with real-world environments and avoided blocking conditions that do not represent a typical business environment.

Each virtual user conducted the work tasks at the speed and frequency in which real-world users actually conduct the task. The workload was randomly combined for an overall multitasking, fully loaded work environment that closely emulates the real world.

Multiple iterations of the benchmark tests were run to ensure results were repeatable.

The GA (general availability) version of Onyx Employee Portal 3.0 was used in all user simulations. No customizations were incorporated into the OEP application.

## TECHNICAL ENVIRONMENT

This section lists the equipment and network bandwidth used during the benchmark tests.

### **VIRTUAL CLIENT SIMULATORS (11 MACHINES SIMULATING UP TO 57,000 USERS)**

7 – Unisys ES2000, 4 - 900 MHz Pentium III Xeon Processors, 4 GB Physical Memory, Windows 2000 Advanced Server Service Pack 2

2 – Unisys ES2000, 4 - 700 MHz Pentium III Xeon Processors, 4 GB Physical Memory, Windows 2000 Advanced Server Service Pack 2

2 – Unisys ES2000, 2 - 933 MHz Pentium III Xeon Processors, 2 GB Physical Memory, Windows 2000 Advanced Server Service Pack 2

### **TEST AUTOMATION SERVER (3 CLIENT CONTROLLERS)**

3 – Unisys ES2000, 2 - 933 MHz Pentium III Xeon Processors, 2 GB Physical Memory, Windows 2000 Advanced Server Service Pack 2

### **DATABASE SERVER (SQL SERVER 2000 AND ONYX ENTERPRISE DATABASE)**

1 – Unisys ES7000, 16 - 900 MHz Pentium III Xeon Processors, 12 GB Physical Memory, 1 Disk Subsystem with SAN Switches (20 72GB drives), Raid 0/1 for Database and Log File, Raid 0 for Temp DB, Windows 2000 Datacenter Server Service Pack 2, SQL Server 2000 Enterprise Edition Service Pack 2

### **OEP WEB / OEAS APPLICATION SERVER (19 MACHINES TOTAL)**

8 – Unisys ES2000, 8 - 900 MHz Pentium III Xeon Processors, 4 GB Physical Memory, 140GB Disk, Windows 2000 Advanced Server Service Pack 2, IIS 5.0, Code Page Hotfix Q291597

3 – Unisys ES2000, 8 - 700 MHz Pentium III Xeon Processors, 4 GB Physical Memory, 140GB Disk, Windows 2000 Advanced Server Service Pack 2, IIS 5.0, Code Page Hotfix Q291597

7 – Unisys ES2000, 8 - 700 MHz Pentium III Xeon Processors, 4 GB Physical Memory, 18GB Disk, Windows 2000 Advanced Server Service Pack 2, IIS 5.0, Code Page Hotfix Q291597

1 – Unisys ES2000, 8 - 700 MHz Pentium III Xeon Processors, 4 GB Physical Memory, 54GB Disk, Windows 2000 Advanced Server Service Pack 2, IIS 5.0, Code Page Hotfix Q291597

## NETWORK

Gigabit (1000 Base-T Switched Ethernet) network (Local Area Network)

One additional machine was used to capture, monitor and save test performance information.

## TEST DATABASE

Benchmark tests were conducted against a 12.5GB database. The 12.5GB database was a customer-provided, production database with the following record counts:

Companies	500,798
Contact / Individuals	3,300,070
Incidents (sales and support incidents are both contained in one table)	954,253

Table 3: Database Record Counts

## TEST DESIGN

Test setup required careful consideration of the user simulation equipment. Preliminary testing identified the correct number of users per *virtual client* machine (used for user simulation) to ensure proper resources for Mercury Loadrunner without skewing performance results. User test scenarios were then evenly distributed across the virtual client machines, given their respective resources and capabilities. Workflow scripts were then evenly distributed across the virtual clients for test execution and measurement.

## DATA ACQUISITION

During the test, performance information was gathered using Mercury Loadrunner for business transaction statistics as well as system and database performance statistics

## CONDUCTING THE TEST

All tests were run at “user” speed, meaning that realistic delays were incorporated into the automation scripts to simulate normal transaction workflows (e.g. average call-center user completes a call every 4 minutes). In addition, the tests were staggered to ensure that not all activities of the same type were happening simultaneously. Instead, workflow was started and completed at a random rate more closely emulating real-world loads.

Virtual response time is measured from the point at which a virtual client submits a transaction to the web server through the point at which the Web server, having called the appropriate business object on the Application server which in turn queried the database server and retrieved all output results, builds the finished page and sends it back to the virtual client. As a measure of the real-world nature of this benchmark, test scripts for workflow scenarios executed every business object call performed by the Onyx Employee Portal client.

Please note that Web stress test-automation tools do not simulate the time required for the client browser to render and display the results. **Thus, the “virtual client response time” for these OEP benchmarks does not include the time required for Internet Explorer to render and display the results.**

## TUNING AND OPTIMIZATION

This section describes specific customizations, tuning, and optimizations made to the application, database, and other system components.

### ONYX SPECIFIC CUSTOMIZATION

No customizations or optimizations were applied to the Onyx Employee Portal application or database. The database was installed using default installation options. For a large installation, further performance optimizations may be realized by customizing the OEP installation relevant to specific business criteria. For example, in an organization that characterizes its customers by a special ID number, the database indexes might be modified to potentially provide a faster response. To ensure an accurate result set for the out-of-the-box product, the team did not apply any of these optimization techniques.

The following single configuration was applied to the Onyx Enterprise Database using the Onyx Administration Workbench:

- Set GlobalSessionTimeout in the SystemParameter table to 600000.

In a production setting, this number should be adjusted to the maximum wait time that a user session can remain inactive before timing out, as specified in seconds.

### DATABASE TUNING AND CONFIGURATION

No special configurations were done for SQL Server 2000 Enterprise Edition. The database was installed with default settings and allowed to “auto configure” as appropriate.

### INTERNET INFORMATION SERVER (IIS) TUNING AND CONFIGURATION

IIS 5.0 was used for all web servers and co-located web/application servers. The following two optimizations were performed for Internet Information Server:

- Set Application Protection for Default Web Site to Low (IIS Process).

Applications run in the Web services process (inetinfo.exe) result in higher performance. This is the recommended setting for a high-volume production environment.

- Set Performance Tuning for Default Web Site to “More than 100,000 hits”.

In a production environment, this setting should be adjusted to the number of daily connections you anticipate for the production site. If the number is set slightly higher than the actual number of connections, the connections are made faster and server performance is improved. Setting this number significantly higher than the actual connection attempts will waste server resources and reduce overall server performance.

## OPERATING SYSTEM TUNING AND CONFIGURATION

Windows 2000 Advanced Server Service Pack 2 was used for all web and application servers. No special configurations were done to the operating system on any of these servers.

Windows 2000 Datacenter Server Service Pack 2 was used for the database server. The following optimizations were performed for Windows 2000 Datacenter Server:

- Set Physical Address Extension (PAE) and Address Windowing Extensions (AWE) on

Windows 2000 Datacenter Server uses Physical Address Extension (PAE) and Address Windowing Extensions (AWE) to enable applications to scale beyond 4 gigabytes (GB) of physical memory. Turning PAE and AWE on enabled SQL Server Enterprise Edition to fully utilize the 12GB of available memory.

- Assigned processor affinity for all 16 processors

Windows 2000 Datacenter Server supports processor affinity, enabling processes to be assigned to run only on a specified collection of processors. By using this feature, a process can achieve a larger number of memory cache hits, thus improving performance by reducing the number of processor cache flushes as threads move from one processor to another.

## TEST RESULTS

As stated in the Benchmark Goals and Objectives, the purpose of the Benchmark was not to discover the full performance boundaries of Onyx Employee Portal. Instead, the benchmark focused on verifying OEP's ability to meet realistic performance goals of the targeted 12,600 and 57,000 user loads, while keeping user-perceivable response times less than two to three seconds.

The scalability of Onyx Employee Portal 3.0 running on SQL Server 2000 Enterprise Edition and Microsoft Windows 2000 Datacenter Server met or exceeded expectations by:

- Scaling to 57,000 concurrent users in an enterprise-wide simulation with:
  - sustained sub-second average response time on 99% of all business transactions
  - sub-second average response time for all transactions of 0.311 seconds
  - no 90<sup>th</sup> percentile response time values exceeded 1.674 seconds
- Scaling to 12,600 concurrent users in a high-volume call center simulation with:
  - sustained sub-second average response time on 91% of all business transactions
  - sub-second average response time for all transactions of 0.368 seconds
  - no 90<sup>th</sup> percentile response time values exceeded 3.107 seconds

## MEASUREMENT DEFINITIONS

**Business Transaction:** A business transaction is a unit of work directly related to user workflow, which may involve one or more Loadrunner transactions and one or more committed database transactions.

**Total Transactions:** The number of business transaction occurrences in the test. There is a one-to-many relationship between a business transaction and Loadrunner transactions. There is a one-to-many relationship between a business transaction and committed database transactions.

**Average Performance:** The statistical average execution time for the business transaction.

## RESULTS – 57,000 USER BENCHMARK TEST SIMULATING ENTERPRISE WIDE USAGE

The goal of this user benchmark test was to determine if Onyx Employee Portal 3.0 could support more than 50,000 concurrent enterprise-wide users using a farm of web/application servers accessing a single 16-processor SQL Server averaging sub-second response times while executing the full suite of Onyx call center workflow scenarios.

## SETUP AND CONFIGURATION

Setup Option	Configuration
Total Users	57,000
Duration (minutes)	3 hours
Workflow Scenario Set	1
Equipment Configuration	See <i>Technical Environment for more detail</i>
1 Database Server with SQL Server 2000	16-processor Unisys ES7000
19 Web/Application Servers	8-processor Unisys ES2000
IIS Application Protection	Low
SSL Enabled	False

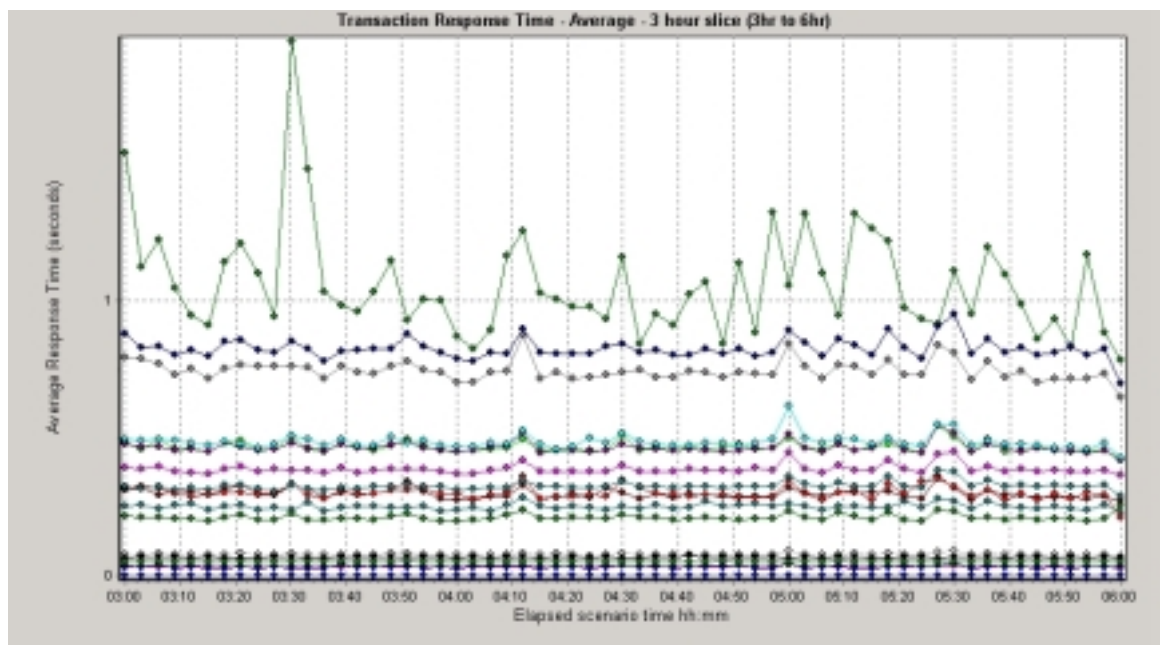
## RESPONSE TIME

Business Transaction	Total Transactions	Average Performance 40,000 Users (sec)
<b>Retrieve Task List</b>		
Select Task Manager	1,749	0.095
Open Filter Form	1,749	0.003
Select User From Group	1,749	0.000
Search for Assigned Tasks	26,958	1.055
<b>Insert Literature Item</b>		
Add Line Item	106,913	0.033
Save Literature Item	106,876	0.247
<b>Insert Individual</b>		
Open Individual Form	53,661	0.034
Save Individual	53,648	0.307
Confirm Save	53,628	0.488
<b>Search for Individual</b>		
Open Search Form	212,194	0.000
Search Individual	212,051	0.484
Backfill Individual Form	212,130	0.080
<b>Update Individual</b>		
Search for Individual	53,715	0.510
Load Individual	53,701	0.065
Update Individual	53,681	0.310
Confirm Save	53,664	0.218

<b>Insert Sales Incident</b>		
Open Sales Incident Form	212,948	0.050
Input Incident Fields	212,897	0.000
Save Sales Incident	212,833	0.747
Confirm Save	212,776	0.400
<b>Update Sales Incident</b>		
Search for Sales Incident	212,499	0.337
Update Sales Incident	212,440	0.847
<b>Total Business Transactions</b>	<b>2,534,460</b>	
<b>Total Business Transactions per hour</b>	<b>844,820*</b>	
<b>Total Business Transactions per user per hour</b>	<b>14.82</b>	
<b>Average Transaction Time per second</b>		<b>0.311</b>

\* Hourly transaction rate extrapolated from actual transaction rate for the 3-hour load test.

Figure 3 below displays the average time taken to perform transactions over the course of the load test. The diagram shows that response times remained relatively constant throughout the entire duration of the test with the average and 90<sup>th</sup> percentile of transactions completing is less than 1 second and no transaction exceeding 2.0 seconds.



Color	Scale	Measurement	Graph's Minimum	Average	Graph's Maximum	Graph's Median	Graph's Std. Deviation
Green	1	DEP_TM_45sech	0.761	1.066	1.94	1.064	0.194
Blue	1	DEPHtkcrl_15selectLitTree	0	0	0	0	0
Yellow	1	DEPHtkcrl_20penLIForm	0	0	0	0	0
Magenta	1	DEPHtkcrl_3AddLineItem	0.027	0.034	0.039	0.033	0.002
Cyan	1	DEPHtkcrl_45aveLit	0.23	0.251	0.294	0.25	0.011
Red	1	DEPSale1_10penIndividualForm	0.027	0.031	0.047	0.03	0.004
Black	1	DEPSale1_25aveIndividual	0.271	0.290	0.362	0.294	0.018
LightGreen	1	DEPSale1_30FCloseSavedConfirmMsg	0.43	0.466	0.546	0.46	0.019
Olive	1	DEPSale2_10penSearchForm	0	0	0	0	0
Purple	1	DEPSale2_38ackMIndividualForm	0.42	0.466	0.547	0.461	0.02
LightBlue	1	DEPSale2_35aveIndividual	0.066	0.076	0.09	0.077	0.003
LightCyan	1	DEPSale3_25aveIndividual	0.428	0.467	0.615	0.481	0.025
LightRed	1	DEPSale3_3loadIndividual	0.062	0.066	0.072	0.066	0.001
LightBlack	1	DEPSale3_4updateIndividual	0.212	0.302	0.361	0.297	0.023
LightGreen	1	DEPSale3_50FCloseConfirmMsg	0.197	0.21	0.25	0.208	0.011
LightBlue	1	DEPSale4_10penSale	0.048	0.051	0.052	0.05	0.001
LightYellow	1	DEPSale4_3rpuFields	0	0	0	0	0
LightCyan	1	DEPSale4_35aveSale	0.648	0.746	0.874	0.738	0.036
LightMagenta	1	DEPSale4_40FCloseConfirmMsg	0.363	0.387	0.449	0.382	0.017
LightRed	1	DEPSale6_15aveSearchSale	0.287	0.327	0.382	0.324	0.015
LightBlack	1	DEPSale6_3updateSale	0.606	0.627	0.949	0.619	0.027

Figure 3: End-to-End LoadRunner Transaction Performance – 57,000 User Test

## SYSTEM PERFORMANCE STATISTICS

### SQL Server

The diagram below shows SQL Server 2000's overall performance during the 45-minute test.

Color	Scale	Measurement	Minimum	Average	Maximum	Std. Deviation
Green	100	Logins/sec (SQLServerGeneralStatistics)onysql	0	0.726	13.002	0.745
Blue	100	Logouts/sec (SQLServerGeneralStatistics)onysql	0	0.726	6.704	0.625
Yellow	1000	Number of Deadlocks/sec (SQLServerLocks_Total)onysql	0	0.005	0.667	0.042
Magenta	0.1	Page Faults/sec (Memory)onysql	27.327	98.967	203.184	27.452
Cyan	100	Pages/sec (Memory)onysql	0	0.094	26.614	1.045
Red	1000	Processor Queue Length (System)onysql	0	0.016	1	0.125
Black	0.01	SQL Re-Compilations/sec (SQLServerSQLStatistics)2346.505	0	3904.389	4651.871	258.705
LightGreen	0.1	Transactions/sec (SQLServerDatabases)QDeckD(154.033)	0	252.167	327.543	22.201
Olive	0.1	User Connections (SQLServerGeneralStatistics)on454	0	480.817	536	11.872
Color	Scale	Measurement	Minimum	Average	Maximum	Std. Deviation
Green	1	% Disk Time (PhysicalDisk_Total)onysql	0.965	3.249	100	26.232
Blue	1	% Idle Time (PhysicalDisk_Total)onysql	87.704	98.155	99.321	1.858
Yellow	10	% Privileged Time (Processor_Total)onysql	2.344	3.792	7.682	0.692
Magenta	10000	% Processor Time (Process sqlmang)onysql	0	0.001	0.521	0.019
Cyan	1	% Processor Time (Process sqlserv)onysql	100	100	100	0
Red	1	% Processor Time (Processor_Total)onysql	90.625	48.999	74.219	5.886
Black	1	% User Time (Processor_Total)onysql	27.847	45.204	70.345	5.617
LightGreen	1E-7	Available Bytes (Memory)onysql	274870272	277799837.785	280289280	1.237263.193
Olive	1	Average Wait Time (ms) (SQLServerLocks_Total)onysql	0	0	0	0
Purple	10	Avg. Disk Queue Length (PhysicalDisk_Total)onysql	0.097	2.431	98.328	8.602

Figure 4: Windows 2000/SQL Server 2000 Test Performance – 57,000 User Test

In figure 4, SQL Server performance, with 57,000 users executing the scripted scenarios and transactions, can be judged utilizing a tabular representation of Windows performance counters. Key performance metrics were as follows:

- Transactions were executing at an average of 252.167 database transactions per second, which equates to 907,801 database transactions per hour, and 15.93 database transactions per user per hour.
- CPU Utilization averaged 48.999% and never exceeded 74.219%
- Physical connections averaged 480.817 and never exceeded 536 (database connection pooling)

## Web / Application Servers

Key performance metrics on the Web/Application servers combined were as follows:

- CPU Utilization averaged 21.064% and never exceeded 93.75%
- Requests Queued averaged 0.016
- Requests per second averaged 35.144

## NETWORK UTILIZATION

Performance Monitor Counter	Value
<b>Web Servers (per Web Server)</b>	
Average Bytes Sent / Second	415,386
Average Bytes Received / Second	92,900
Average Bytes / Second / User	8.92
<b>Database Server running SQL Server 2000</b>	
Average Bytes Sent / Second	1,188,410
Average Bytes Received / Second	907,064
Average Bytes / Second / User	37

## ANALYSIS

The test demonstrated that Onyx Employee Portal scales well in a very large enterprise-wide environment, delivering sub-second average response times with 57,000 users serviced by multiple web/application servers sharing a single database server. The transaction load was representative of a very large enterprise environment with transactions executing at an average business transaction rate of 16.07 per user / per hour representing users submitting a business transaction every 3.73 minutes. Maximum load was 916,126 business transactions per hour.

The average response time for all transaction types never exceeded 1.1 seconds. CPU utilization on the web/application server averaged 21.064%. Database server CPU utilization averaged 48.999% and never exceeded 74.219%, proving that the database server was running below maximum capacity.

## RESULTS – 12,600 USER BENCHMARK TEST SIMULATING HIGH-VOLUME CALL CENTER

### USAGE

The goal of this user benchmark test was to determine if Onyx Employee Portal 3.0 could support more than 10,000 OEP active, high-volume, call-center users using a farm of web/application servers accessing a single 16-processor database server averaging sub-second response times while executing the full suite of Onyx call center workflow scenarios. Throughout the entire 2-hour period reported, all 12,600 virtual users were active.

## SETUP AND CONFIGURATION

Setup Option	Configuration
Total Users	12,600
Duration (minutes)	2 hours
Workflow Scenario Set	2
Equipment Configuration	See <i>Technical Environment for more detail</i>
1 database server running SQL Server 2000	16-processor Unisys ES7000
14 Web/Application Servers	8-processor Unisys ES2000
IIS Application Protection	Low
SSL Enabled	False

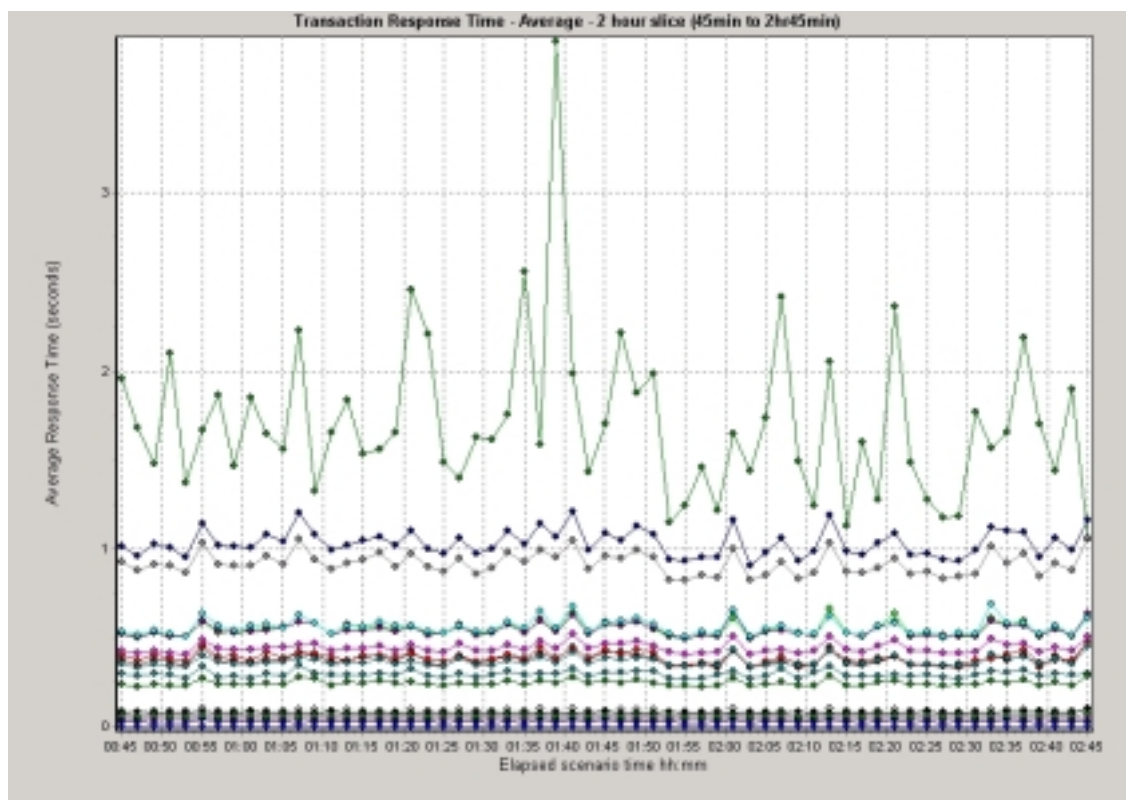
## RESPONSE TIME

Business Transaction	Total Transactions	Average Performance 12,600 Users (sec)
<b>Retrieve Task List</b>		
Select Task Manager	390	0.061
Open Filter Form	390	0.003
Select User From Group	390	0.000
Search for Assigned Tasks	12,365	1.724
<b>Insert Literature Item</b>		
Add Line Item	48,854	0.039
Save Literature Item	48,863	0.285
<b>Insert Individual</b>		
Open Individual Form	24,612	0.026
Save Individual	24,608	0.374
Confirm Save	24,608	0.548
<b>Search for Individual</b>		
Open Search Form	97,510	0.000
Search Individual	97,515	0.089
Backfill Individual Form	97,519	0.542
<b>Update Individual</b>		
Search for Individual	24,563	0.559
Load Individual	24,564	0.075
Update Individual	24,563	0.387
Confirm Save	24,562	0.243

<b>Insert Sales Incident</b>		
Open Sales Incident Form	97,266	0.058
Input Incident Fields	97,275	0.000
Save Sales Incident	97,266	0.914
Confirm Save	97,264	0.442
<b>Update Sales Incident</b>		
Search for Sales Incident	97,475	0.363
Update Sales Incident	97,479	1.031
<b>Total Business Transactions</b>	<b>1,159,901</b>	
<b>Total Business Transactions per hour</b>	<b>579,950*</b>	
<b>Total Business Transactions per user per hour</b>	<b>46.03</b>	
<b>Average Business Transaction Time per second</b>		<b>0.368</b>

\* Hourly transaction rate extrapolated from actual transaction rate for the 2-hour load test.

Figure 1 below displays the average time taken to perform transactions over the course of the load test. The diagram shows that response times remained relatively constant throughout the entire duration of the test with the large majority of transactions completing is less than 1 second, the 90<sup>th</sup> percentile never exceeding 3.1 seconds and no transaction exceeding 4 seconds.



Color	Scale	Measurement	Graph's Minimum	Average	Graph's Maximum	Graph's Median	Graph's Std. Deviation
Green	1	DEP_TM_4Search	1.054	1.724	3.954	1.644	0.447
Blue	1	DEPMarket1_15selectLifree	0	0	0	0	0
Grey	1	DEPMarket1_20openLifrom	0	0	0	0	0
Magenta	1	DEPMarket1_3addLinfitem	0.037	0.04	0.05	0.04	0.002
Cyan	1	DEPMarket1_45saveLit	0.268	0.294	0.347	0.291	0.017
DarkBlue	1	DEPSale1_10perIndividualForm	0.021	0.026	0.043	0.026	0.004
DarkRed	1	DEPSale1_25saveIndividual	0.33	0.374	0.476	0.372	0.034
LightGreen	1	DEPSale1_30KCloseProdConfirmMsg	0.494	0.549	0.956	0.538	0.039
LightBlue	1	DEPSale2_10perSearchForm	0	0	0	0	0
Purple	1	DEPSale2_30ackIndividualForm	0.404	0.542	0.645	0.534	0.036
LightCyan	1	DEPSale2_25searchIndividual	0.081	0.089	0.104	0.088	0.005
LightMagenta	1	DEPSale3_25searchIndividual	0.906	0.989	0.992	0.981	0.043
Black	1	DEPSale3_3loadIndividual	0.072	0.075	0.104	0.075	0.004
Red	1	DEPSale3_4updateIndividual	0.333	0.387	0.477	0.386	0.031
LightGreen	1	DEPSale3_50KCloseConfirmMsg	0.223	0.243	0.283	0.229	0.015
LightBlue	1	DEPSale4_10perSale	0.055	0.059	0.068	0.058	0.002
Blue	1	DEPSale4_3inputFields	0	0	0	0	0
LightBlue	1	DEPSale4_25saveSale	0.821	0.914	1.063	0.91	0.062
Magenta	1	DEPSale4_40KCloseConfirmMsg	0.405	0.442	0.517	0.435	0.025
LightCyan	1	DEPSale6_15searchSale	0.33	0.363	0.449	0.356	0.025
DarkBlue	1	DEPSale6_3updateSale	0.905	1.031	1.208	1.02	0.073

Figure 1: End-to-End LoadRunner Transaction Performance – 12,600 User Test

## SYSTEM PERFORMANCE STATISTICS

### Database Server Running SQL Server

The diagram below shows SQL Server 2000's overall performance during the 2-hour test.

Color	Scale	Measurement	Minimum	Average	Maximum	Std. Deviation
Green	100	Logins/sec (SQLServer:General Statistics):onyxsq	0	0.393	7.67	0.602
Blue	100	Logouts/sec (SQLServer:General Statistics):onyxsq	0	0.393	4.333	0.506
Grey	1000	Number of Deadlocks/sec (SQLServer:Locks_Total):onyxsq	0	0.007	0.667	0.049
Magenta	1	Page Faults/sec (Memory):onyxsq	24.211	63.355	656.005	35.389
Cyan	10	Pages/sec (Memory):onyxsq	0	0.102	29.335	1.228
DarkBlue	1000	Processor Queue Length (System):onyxsq	0	0.027	4	0.195
DarkRed	0.01	SQL Re-Completions/sec (SQLServer:SQL Statistics):onyxsq	2769.517	3881.307	4679.258	247.677
LightGreen	0.1	Transactions/sec (SQLServer:Databases:QDeck0):onyxsq	213.322	287.685	346.765	20.609
LightBlue	0.1	User Connections (SQLServer:General Statistics):onyxsq	358	378.059	406	10.117
Color	Scale	Measurement	Minimum	Average	Maximum	Std. Deviation
Green	1	% Disk Time (PhysicalDisk_Total):onyxsq	1.191	10.323	100	27.053
Blue	1	% Idle Time (PhysicalDisk_Total):onyxsq	85.346	97.74	99.184	2.233
Grey	10	% Privileged Time (Processor_Total):onyxsq	2.734	3.936	6.803	0.524
Magenta	10000	% Processor Time (Process sqlmang):onyxsq	0	0	0.521	0.011
Cyan	1	% Processor Time (Process sqlserv):onyxsq	100	100	100	0
DarkBlue	1	% Processor Time (Processor_Total):onyxsq	40.69	58.618	79.069	6.395
DarkRed	1	% User Time (Processor_Total):onyxsq	36.686	54.692	75.033	6.234
LightGreen	1E-7	Available Bytes (Memory):onyxsq	251305964	258879279.873	260763648	2007981.125
LightBlue	1	Average Wait Time (ms) (SQLServer:Locks_Total):onyxsq	0	0	0	0
Purple	10	Avg. Disk Queue Length (PhysicalDisk_Total):onyxsq	0.119	3.234	78.975	11.279

Figure 2: Windows 2000/SQL Server 2000 Test Performance – 5,400 User Test

In figure 2, database server performance, with 12,600 users executing the scripted scenarios and transactions, can be judged utilizing a tabular representation of Windows performance counters. Key performance metrics were as follows:

- Transactions were executing at an average of 287.685 transactions per second, which equates to 1,035,666 database transactions per hour, and 82.20 database transactions per user per hour.

- CPU Utilization averaged 58.618% and never exceeded 79.069%
- Physical connections averaged 378.059 and never exceeded 406 (database connection pooling)

### Web / Application Servers

Key performance metrics on the Web/Application servers combined were as follows:

- CPU Utilization averaged 33.471% and never exceeded 94.699%
- Requests Queued averaged 0.024
- Requests per second averaged 53.468

### NETWORK UTILIZATION

Performance Monitor Counter	Value
<b>Web Servers (per Web Server)</b>	
Average Bytes Sent / Second	610,351
Average Bytes Received / Second	137,197
Average Bytes / Second / User	830
<b>Database Server running SQL Server 2000</b>	
Average Bytes Sent / Second	1,226,428
Average Bytes Received / Second	1,004,358
Average Bytes / Second / User	177

### ANALYSIS

The test demonstrated that Onyx Employee Portal scales well in a high-volume call-center environment, delivering sub-second average response times with 12,600 users serviced by multiple web/application servers sharing a single database server. The transaction load was representative of a high-volume, call-center environment with transactions executing at an average business transaction rate of 46.03 per user / per hour representing users submitting a business transaction every 1.30 minutes. Maximum load was 579,950 business transactions per hour.

The average response time for all transaction types never exceeded 1.8 seconds. CPU utilization on the web/application servers averaged 33.471%. Database server CPU utilization averaged 58.618% and never exceeded 79.069%, proving that the database server was running well below maximum capacity.