Oracle Business Intelligence Suite Enterprise Edition
10,000 User Benchmark on Sun T2000

An Oracle White Paper
September 2007

ORACLE

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EXECUTIVE OVERVIEW

Business Intelligence (BI) is no longer the domain of a few power analysts or a point application used by a small target audience of middle and upper management. BI has evolved into a mission critical application that is being used by many thousands of users across the broad expanse of the enterprise, ranging from customer touch points such as bank tellers and call center agents, all the way up to the executive offices that drive strategy down through an organization. The requirements therefore have changed dramatically. While evaluating a BI foundation, companies should now consider how it can support thousands of concurrent active users and then be able to elegantly scale for future increases in the user base. This benchmark was designed to showcase how the Oracle Business Intelligence Suite Enterprise Edition (Oracle BI EE) Release 10.1.3.2.1 performs under very high user-loads, and how it can be scaled transparently across multiple nodes in a clustered configuration.

The benchmark test results proved that:

- Oracle BI EE can support a named user population of 100,000 users with the benchmark configuration. This assumes a 10% concurrency rate for the 10,000 active concurrent users in the benchmark.
- That Oracle BI EE shows near linear scalability across multiple nodes enabling transparent scaling of an environment to match increased user load over time.
- Oracle BI EE release 10.1.3.2.1, the first 64 bit version on Solaris OS, shows significant scalability improvements over the previous (32 bit) release.

INTRODUCTION

Benchmark Objectives

The objective of this benchmark is to showcase how Oracle BI EE can support pervasive deployments in large enterprises by simulating an organization that needs to support 10,000 active concurrent users, each operating in mixed mode: ad-hoc reporting; application development; and report viewing.

Product Overview

Oracle Business Intelligence Suite Enterprise Edition is a comprehensive suite of enterprise business intelligence BI products that delivers a full range of capabilities. It features a unified and highly scalable architecture centered on a sophisticated BI Server that provides semantic integration of data, spanning operational and analytical enterprise data sources. It empowers the largest communities with a full range of information access and delivery methods, including live Interactive Dashboards, full ad-hoc analysis over the Web, proactive detection and alerts, advanced pixel-perfect reporting, mobile analytics, Microsoft Office integration, Web Services and business process integration, and more.

Oracle Business Intelligence Suite Enterprise Edition Plus is a comprehensive suite of enterprise business intelligence (BI) products that delivers a full range of capabilities.

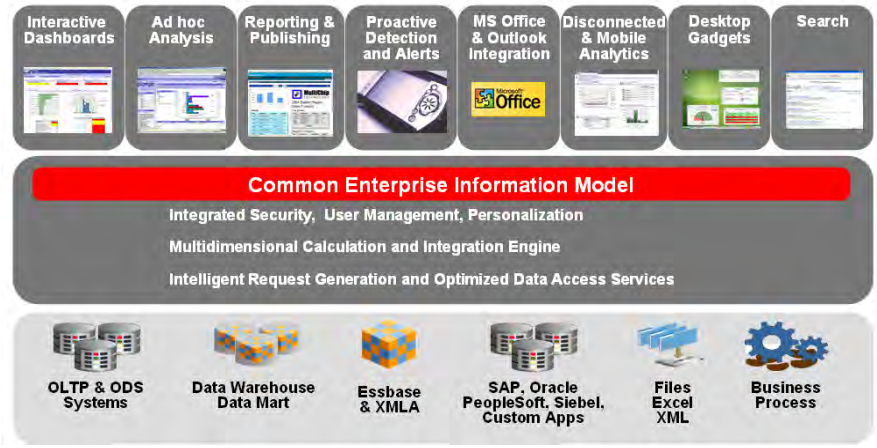

Figure 1. Oracle Business Intelligence Suite Enterprise Edition Plus

To enable true enterprise scaling, Oracle BI EE can be run in both single and clustered node configurations. Clustering can occur at the Presentation Server layer, which supports all end-user tools, such as Oracle Interactive Dashboards and Oracle Answers. Clustering can also occur at the Oracle BI Server layer, which drives all of the data access, data federation, calculations, and computations within the Oracle BI EE environment. This clustering flexibility, combined with sophisticated access and performance enhancing mechanisms, such as BI Server caching, enable the necessary scalability for today's pervasive BI deployments.

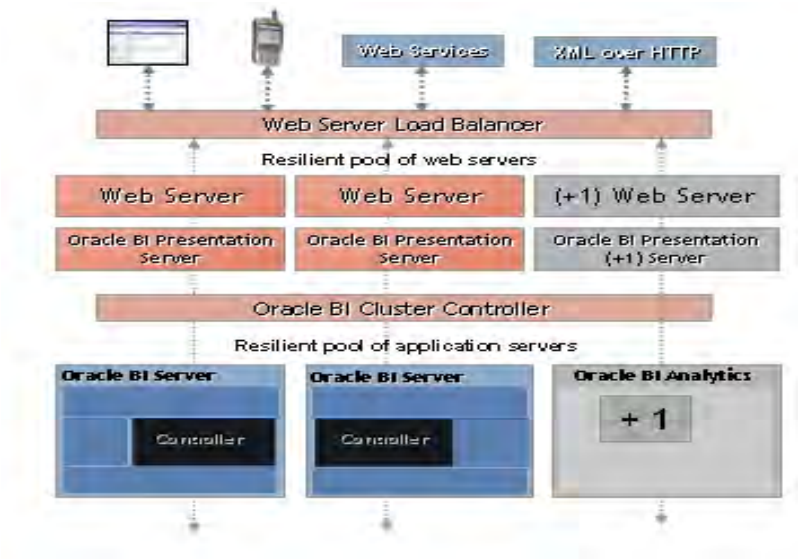

Figure 2. Clustered Configuration Options

Benchmark Scenario Summary

It is important to note that this benchmark did not use a synthetic database schema. On the contrary, the benchmark tests were run on a full production version of the Oracle Business Intelligence Applications with a fully populated underlying database schema. The Oracle BI Applications are a set of complete, pre-built BI solutions that include a pre-built database schema, merchant ETL adapters, and pre-built dashboards and subject areas. These applications deliver intuitive, role-based intelligence for everyone in an organization—from front line employees to senior management—enabling better decisions, actions, and business processes.

This scenario more closely represents a true customer scenario, as these are commercially available BI applications that are in production in some of the largest organizations worldwide.

The benchmark tests executed 197 transactions per second with think times of 60 seconds per user between requests.

The user population was divided into a mix of administrative users and business users. A maximum of 10,000 concurrent users were actively interacting and working in the system during the steady-state period. The tests executed 197 transactions per second, or 516 estimated SQL statements per second, with think times of 60 seconds per user, between requests.

In the test scenario 95% of the workload consisted of business users viewing reports and navigating within dashboards. The remaining 5% of the concurrent users, categorized as administrative users, were doing application development.

Business User Scenario

The benchmark scenario used a typical business user sequence of dashboard navigation, report viewing, and drill down. For example, a Service Manager logs into the system and navigates to his own set of dashboards viz. "Service Manager." The user then selects the "Service Effectiveness" dashboard, which shows him four

distinct reports, "Service Request Trend", "First Time Fix Rate", "Activity Problem Areas", and "Cost Per completed Service Call – 2002 till 2005" .

The user then proceeds to view the "Customer Satisfaction" dashboard, which also contains a set of 4 related reports. He then proceeds to drill-down on some of the reports to see the detail data.

Then the user proceeds to more dashboards, for example "Customer Satisfaction" and "Service Request Overview". After navigating through these dashboards, he logs out of the application.

Results Summary

1. A clustered setup of Oracle BI EE shows linear scaling across multiple nodes, with sub-second average response times.

   The following chart shows the near linear scalability from a 2-node to 5-node clustered BI EE 10.1.3.2.1 setup. Both, the Oracle BI Server (OBIS) and Oracle BI Presentation Server (OBIP) were collocated on the same computer.

The benchmark results showed linear scaling across nodes with sub-second average response times. In addition, the results demonstrated 40% greater scalability of the Oracle BIEE 64 bit version compared to the prior 32 bit version.

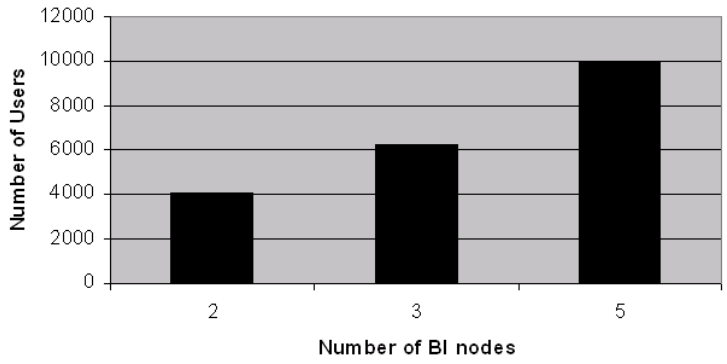

Figure 3. Scalability improvements with clustering

2. The current Oracle BI EE 64 bit release 10.1.3.2.1 shows 40% greater scalability over the prior 32 bit release.

   The following chart shows the improved scalability of Oracle BI 10.1.3.2.1 (64-bit) over the prior release. In this test, the Oracle BI Server (SAS/OBIS) and Oracle BI presentation server (SAW/OBIP) were not collocated on the same computer. Instead each server was installed on a separate computer with the

same hardware configuration.

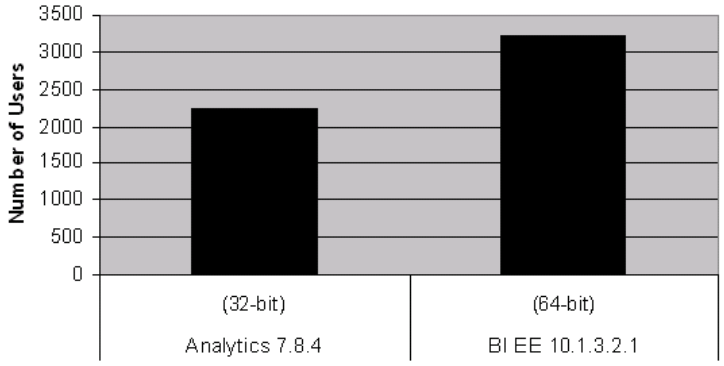

Figure 4. Scalability of Oracle BI EE 64 bit release vs. prior 32 bit release

BENCHMARK DETAILS

The benchmark tests used five different business user roles. These constituted 95% of all user roles, and were Marketing Executive, Sales Representative, Sales Manager, Sales Vice-president, and Service Manager. These roles included a maximum of 5 different pre-built dashboards. Each dashboard page had an average of 5 reports (a mix of charts, tables and pivot tables), returning anywhere from 50 rows to approximately 500 rows of aggregated data. The scenario also included drill-down into multiple levels from a table or chart within a dashboard.

The remaining 5% of users were doing concurrent application development and ad-hoc reporting; i.e. navigating catalogs, creating new reports, modifying existing reports, and saving reports.

The concurrent user load was randomly distributed across all the nodes and generated using HP's Mercury LoadRunner®, a scalability automation test tool. The 10,000 unique concurrent users were spread across all five nodes in the cluster using a round-robin load balancing algorithm.

The benchmark tests simulated different types of users performing multiple tasks, according to their respective roles.

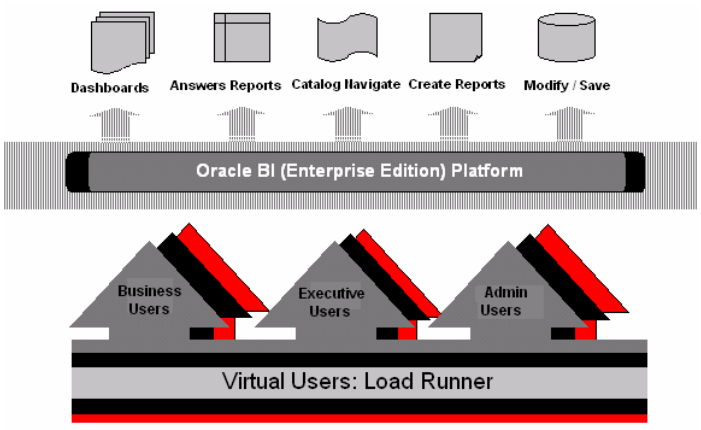

Figure 5. Logical Testing Diagram

To eliminate any network delays and latencies, all the client and server machines were located in the same sub-net, using a 100 Mbps network.

All tests were based on a 2-hour steady-state period. A steady-state period is the time during which concurrent users are logged onto the system performing some type of work.

Benchmark Setup

The benchmark tests were run on a 5-node cluster setup of Oracle BI EE 10.1.3.2.1 using five Sun T2000 computers. As a comparative against a clustered setup a single node implementation was also created with the same hardware.

The Web server used for the Oracle BI Presentation Server was Sun iPlanet6.1. Each Sun T2000 computer had an iPlanet6.1 installation running. The metadata files (OBIP web catalog files) were setup on a Network Attached Storage (NAS) device.

The table below provides the hardware specifications and the software that was installed on each computer.

Installation	Computer	# CPU	# Cores	CPU Speed	Mem-ory	OS	# M/C
HP's Mercury LoadRunner®: LoadRunner Agent/Generator 8.0	Intel Xeon	2	1	2.8 GHz	8 Gb	Win 2003	3
Oracle BI EE 10.1.3.2.1: Oracle BI Presentation Server, Oracle BI Server, and iPlanet Web Server	Ultra-SPARC-T1	1	8	1 GHz	16 Gb	Solaris 10	5
Database: Oracle 10g 64 Bit (10.1.0.3.0)	Ultra-SPARC-III	8	1	900 MHz	16 Gb	Solaris 10	1

10,000 User Benchmark Topology

Oracle BI Server and Oracle BI Presentation Server collocated on the same computer across five nodes.

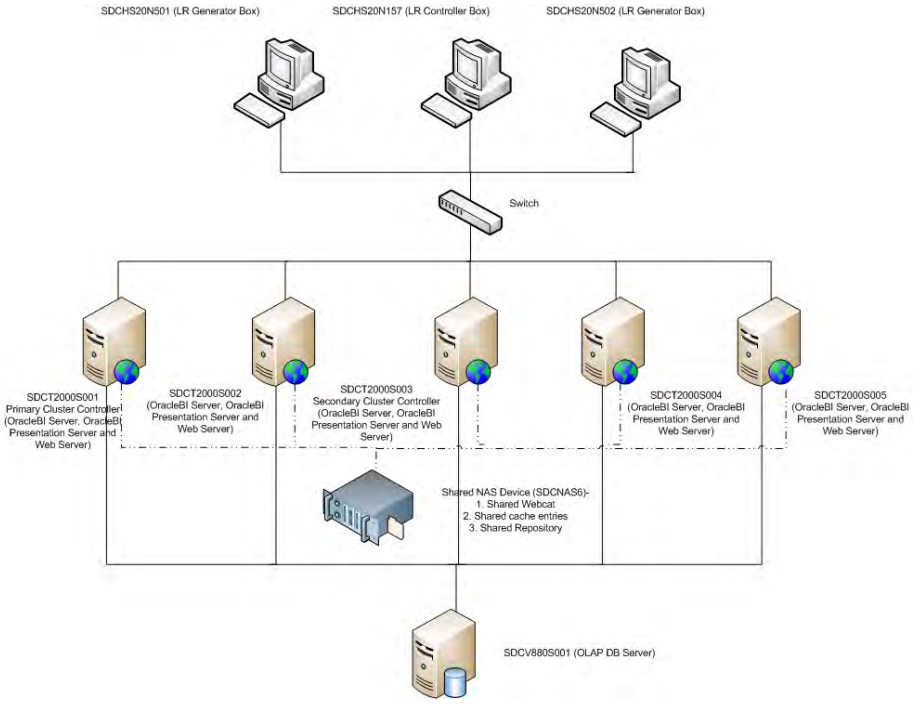

Figure 6. Five-node Topology

Single Instance Benchmark Topology

Oracle BI Server and Oracle BI Presentation Server installed on two separate computers.

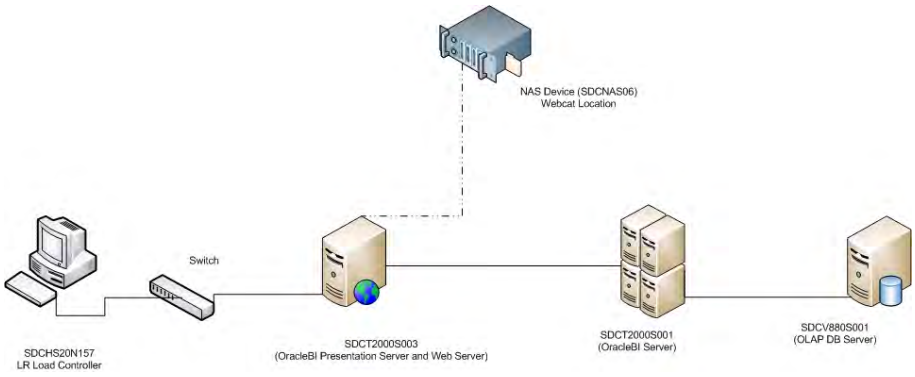

Figure 7. Single node Topology

BENCHMARK RESULTS

CPU and Memory Usage

The following table shows the individual CPU and memory usage for all five nodes during the 10,000 user benchmark. The data shows the high levels of throughput —as measured in transactions per second— across each node.

The benchmark results proved that Oracle BI EE can deliver an average response time of half a second, with 10,000 concurrent users running 197 transactions per second, or 516 estimated queries per second.

Resource	Data
Transactions per Second	197
Average Response Time For Transactions	0.57 sec.
Oracle BI Presentation and Oracle BI Server CPU – Node 1 (Primary Controller)	89% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 2 (Secondary Controller)	81% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 3	78% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 4	73% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 5	72% Usage
Oracle BI Presentation Server Process Virtual Memory – Node 1	4791 Mb
Oracle BI Presentation Server Process Virtual Memory – Node 2	4753 Mb
Oracle BI Presentation Server Process Virtual Memory – Node 3	4747 Mb
Oracle BI Presentation Server Process Virtual Memory – Node 4	4740 Mb
Oracle BI Presentation Server Process Virtual Memory – Node 5	4738 Mb
Oracle BI Server Process Virtual Memory – Node 1	874 Mb
Oracle BI Server Process Virtual Memory – Node 2	868 Mb
Oracle BI Server Process Virtual Memory – Node 3	868 Mb
Oracle BI Server Process Virtual Memory – Node 4	867 Mb
Oracle BI Server Process Virtual Memory – Node 5	867 Mb

The following HP's Mercury LoadRunner® chart shows a steady-state CPU usage for each Sun T2000 computers while the 10,000 concurrent user benchmark was in progress. The resource utilization was steady for the duration of the benchmark testing. All of the CPU's were uniformly utilized during the entirety of the test period, showing active usage across all 10,000 users as seen in the chart below.

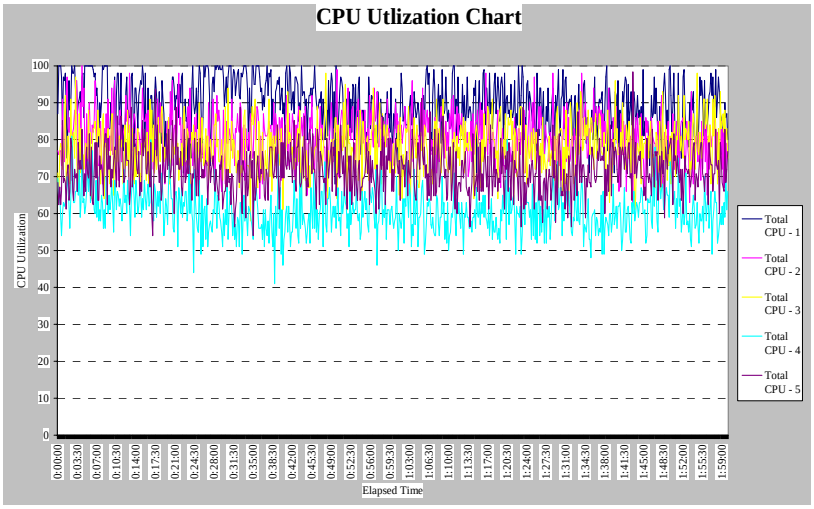

Figure 8. CPU Utilization – HP's Mercury LoadRunner® Screenshot

Comparison of Cluster vs. Non-Cluster Setup

The following table compares a non-cluster setup with a multiple-node cluster setup. The data shows near linear scalability of concurrent user counts when we increase from a 2-node cluster to 5-node cluster. This enables an organization to correctly anticipate additional capacity when adding nodes to a cluster.

Resource	Non-Cluster Setup 2300 Users	2-Node Cluster 4100 Users	3-Node Cluster 6150 Users	5-Node Cluster 10000 Users
Transactions per Second	42	76	113	197
Average Response Time For All Transactions	0.55 sec.	0.516 sec.	0.57 sec.	0.57 sec.
Oracle BI Presentation and Oracle BI Server CPU – Node 1	84% Usage	81% Usage	85% Usage	89% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 2	-	74% Usage	74% Usage	81% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 3	-	-	78% Usage	78% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 4	-	-	-	73% Usage
Oracle BI Presentation and Oracle BI Server CPU – Node 5	-	-	-	72% Usage
Oracle BI Presentation Server Process Virtual Memory -Node 1	4066 Mb	4234 Mb	4517 Mb	4791 Mb
Oracle BI Presentation Server Process Virtual Memory -Node 2	-	4233 Mb	4493 Mb	4753 Mb
Oracle BI Presentation Server Process Virtual Memory -Node 3	-	-	4236 Mb	4747 Mb
Oracle BI Presentation Server Process Virtual Memory -Node 4	-	-	-	4740 Mb
Oracle BI Presentation Server Process Virtual Memory -Node 5	-	-	-	4738 Mb
Oracle BI Server Process Virtual Memory – Node 1	887 Mb	871 Mb	870 Mb	874 Mb
Oracle BI Server Process Virtual Memory -Node 2	-	871 Mb	867 Mb	868 Mb
Oracle BI Server Process Virtual Memory - Node 3	-	-	869 Mb	868 Mb
Oracle BI Server Process Virtual Memory - Node 4	-	-	-	867 Mb
Oracle BI Server Process Virtual Memory - Node 5	-	-	-	867 Mb

Comparison with Previous Release of Oracle BI EE

The following table compares scalability of the current 64 bit release of Oracle BI EE 10.1.3.2.1 with the prior, 32 bit release on Sun T2000 computers. The data shows an approximate 40% scalability improvement in the current 10.1.3.2.1 version. This particular benchmark was performed without collocating the Oracle BI Server and Oracle BI Presentation Server on the same computer. Instead, the servers were installed on separate SunT2000 computers.

The data shows that Oracle BI EE 64-bit is not limited by a 4 Gb process virtual memory, which results in greater scalability. The Oracle BI Presentation server process virtual memory for this test used approximately 5.4 Gb.

Resource	Oracle BI EE 10.1.3.2.1	Siebel Analytics 7.8.4
Number of Concurrent Users	3200	2250
Transactions per Second	59	42
Average Response Time For Transactions	0.74 sec.	0.73 sec.
Oracle BI Server CPU	16 % Usage	24% Usage
Oracle BI Presentation Server CPU	84% Usage	88% Usage
Oracle BI Server Process Virtual Memory	996 Mb	646 Mb
Oracle BI Presentation Server Process Virtual Memory	5463 Mb	2655 Mb

CONCLUSION

This 10,000 concurrent user benchmark demonstrates that Oracle BI EE 10.1.3.2.1 (64-bit) on Sun T2000 servers can meet or exceed the demands of large, pervasive enterprise-wide deployments. This scenario modeled an organization with 100,000 named users, assuming a 10% concurrency rate for active users.

This benchmark also proves that Oracle BI EE 10.1.3.2.1 (64-bit) on Sun T2000 scales linearly across multiple nodes. This means that it can respond to the needs of a growing user base by adding more nodes into a cluster.

In addition, the test results demonstrate that Oracle BI EE 10.1.3.2.1 has at least 40% greater scalability on a SunT2000 computer over the previous release.

Finally, the benchmark also demonstrates that the 64-bit version of Oracle BI EE goes beyond a 4 Gb virtual memory limit, allowing it to support even more users and larger cache sizes, as long as the hardware resources are available.

APPENDIX A – SERVER CONFIGURATIONS

Oracle BI Presentation Server Configuration

1) This benchmark used two chart-server processes in each Sun T2000 computer listening on different (two) ports, as opposed to the default setting of a single chart server.

   To configure two chart-server process add the following lines in $SADATADIR/web/config/instanceconfig.xml,

   <JavaHostProxy>
   <Hosts>
   <Host address="127.0.0.1" port="9810"/>
   <Host address="127.0.0.1" port="9811"/>
   </Hosts>
   </JavaHostProxy>

   Make a copy of $SAROOTDIR/web/javahost/config.xml and save it with different name like, config_2.xml at the same location. Change the "javahost" listening port number to 9811 in config_2.xml file,

   <!-- Javahost TCP/IP connection port -->
   <Port>9811</Port>

   Command for starting the second "javahost" instance,

   $SAROOTDIR/web/javahost/bin/run.sh -service -Config ../web/javahost/config/config_2.xml

2) Set Java Heap Size for the chart-server java process to 512 Mb (in $SAROOTDIR/web/javahost/bin/run.sh).

3) The Oracle BI Presentation Server keeps users' access information in the Web Catalog. Since this benchmark had 10,000 unique users, it could take a significant amount of time to lookup a user if all the users reside in a single directory. To prevent this from skewing results, we had hashed the user-directories. This was achieved by having the following entry in $SADATADIR/web/config/instanceconfig.xml.

4) CacheMaxEntries settings for the Oracle BI Presentation Server were set to 20,000 in $SADATADIR/web/config/instanceconfig.xml. Note that the OBIP process consumes more virtual memory when this parameter is set to a higher value.

   <CacheMaxEntries>20000</CacheMaxEntries>

5) Both the Oracle BI Server and Oracle BI Presentation server create many temporary files while rendering reports/dashboards for a user. This can result in significant I/O waits in the system. You can minimize the I/O waits by pointing the temporary directories to a memory resident disk space, e.g., in

Solaris we can point to /tmp. The following settings need to be present in instanceconfig.xml
.<TempDir>/tmp</TempDir>.

Similarly the Temporary directory ($SATEMPDIR) can be pointed to a memory resident disk, e.g., /tmp, to minimize the I/O waits.

Oracle BI Server Configuration

The following parameters were set in NQSConfig,.INI file:

[CACHE]

ENABLE = YES;
DATA_STORAGE_PATHS = "/vol1/091906/OracleBIData/cache" 500 Mb;
MAX_ROWS_PER_CACHE_ENTRY = 100000; // 0 is unlimited size
MAX_CACHE_ENTRY_SIZE = 1 Mb;
MAX_CACHE_ENTRIES = 1000;
POPULATE_AGGREGATE_ROLLUP_HITS = NO;
USE_ADVANCED_HIT_DETECTION = NO;

[SERVER]

MAX_SESSION_LIMIT = 15000 ;
MAX_REQUEST_PER_SESSION_LIMIT = 500 ;
SERVER_THREAD_RANGE = 40-2000;
SERVER_THREAD_STACK_SIZE = 0;
DB_GATEWAY_THREAD_RANGE = 40-2000;

iPlanet Server Configuration

The following configuration was used for Sun iPlanet (magnus.conf)

KeepAliveThreads 32
RqThrottle 8192
ListenQ 8192
ConnQueueSize 8192
MaxProcs 4
StackSize 131072
TempDir /tmp/https-sdct2000s002-saw2-846b5cc8

Solaris Kernel Configuration

1) **tcp_time_wait_interval:** the time in milliseconds a TCP connection stays in TIME-WAIT state. Set this parameter to the following value, 60000.

2) **tcp_conn_req_max_q:** the default maximum numbers of pending TCP connections for a TCP listener waiting to be accepted by accept (3SOCKET). Set this value to 1024.

3) **tcp_conn_req_max_q0:** the default maximum number of incomplete (three-way handshake not yet finished) pending TCP connections for a TCP listener. Set the value to 4096.

4) **tcp_ip_abort_interval:** the default total retransmission timeout value for a TCP connection in milliseconds. For a given TCP connection, if TCP has been retransmitting for tcp_ip_abort_interval period of time and it has not received any acknowledgment from the other endpoint during this period, TCP closes this connection. Set the value to 60000.

5) **tcp_keepalive_interval:** the tcp_keepalive_interval specifies the interval in millisecond between keepalive packets sent by Solaris for each open TCP connection. This can be used to remove connections to clients that have become disconnected from the network. The keepAlive packet ensures that a connection stays in an active and established state. Set the value to 900000.

6) **tcp_rexmit_interval_max:** the default maximum retransmission timeout value (RTO) in milliseconds. The calculated RTO for all TCP connections cannot exceed this value. Set the value to 10000.

7) **tcp_rexmit_interval_min:** the default minimum retransmission time-out (RTO) value in milliseconds. The calculated RTO for all TCP connections cannot be lower than this value. Set the value to 3000.

8) **tcp_smallest_anon_port:** the tcp_smallest_anon_port controls the number of simultaneous connections that can be made to the server. Set the value to 1024.

9) **tcp_slow_start_initial:** the maximum initial congestion window (cwnd) size in MSS of a TCP connection. Set the value to 2.

10) **tcp_xmit_hiwat:** the default send window size in bytes. Set the value to 32768.

11) **tcp_recv_hiwat:** the default receive window size in bytes. Set the value to 32768.

12) **tcp_fin_wait_2_flush_interval:** Specifies the timer interval prohibiting a connection in the FIN_WAIT_2 state to remain in that state. When high connection rates occur, a large backlog of TCP/IP connections accumulates and can slow server performance. The server can stall during peak periods. Set the value to 67500.

13) **rx_intr_time:** The packet delay timer (rx_intr_pkts) is used to coalesce receive interrupts. This parameter is used to ENSURE that a receive interrupt occurs at some predefined interval after the first packet is received. Set the value to 32.

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