Running Oracle E-Business Suite on Dell PowerEdge Servers

Oracle® E-Business Suite 11i running on Dell™ PowerEdge™ servers and Dell/EMC storage can scale out to support thousands of concurrent users. This article describes a Dell and Oracle project designed to demonstrate that enterprise applications such as E-Business Suite can run effectively on industry-standard servers.

BY JOHN PAGE

Oracle® E-Business Suite 11i is a complete set of applications that can automate business processes such as supply chain management and customer service operations. The suite is widely deployed in several industries, including banking and manufacturing. Oracle E-Business Suite and other enterprise-class software have traditionally been associated with proprietary RISC-based systems rather than commodity servers based on industry standards. This scenario is now changing as more organizations deploy mission-critical software on standards-based servers like the Dell™ PowerEdge® 2650 and Dell PowerEdge 6650 servers.

However, for standards-based servers to meet the needs of the enterprise, they must be able to support large numbers of concurrently connected users. It is not unusual for some businesses to have thousands of users working on the system at the same time. Therefore, if an enterprise application such as Oracle E-Business Suite is to be deployed on standards-based servers, that application must be capable of scaling out. This means that an organization can run the application on a number of relatively small two- or four-processor servers and add servers in parallel as business requirements grow.

To determine how well Oracle E-Business Suite scales out on Dell PowerEdge servers, Dell and Oracle performed a joint project in August 2003 at the Dell Application Solution Centre (ASC) in Limerick, Ireland. The purpose of the project was to simulate a real-world implementation of Oracle E-Business Suite, and specify the additional hardware components required to scale out.

Key components of the test environment
The test environment consisted of four distinct layers: the load-generation, application, database, and storage layers.

Load-generation layer. The Mercury Interactive LoadRunner® version 7.51 tool was used to simulate user activity. The project team loaded this software on Dell PowerEdge 2650 servers running Microsoft® Windows® 2000 Advanced Server Service Pack 3 (SP3). Engineers used between one and seven load-generator systems during the test, depending on the number of users being simulated.

Application layer. The application software was Oracle E-Business Suite 11i version 11.5.8. This software was loaded onto PowerEdge 2650 servers running Red Hat® Enterprise Linux® AS 2.1 with kernel 2.4.9e25. The project team used between 1 and 15 application servers during the test—again, depending on the number of users being simulated.

Database layer. The applications that comprise Oracle E-Business Suite 11i use the Oracle9i™ database for data storage. The database software for the project was Oracle9i release 2 (9.2.0.3). Initially, the database was run on a
PowerEdge 2650 server. As the number of users increased, engineers replaced this server with a PowerEdge 6650. As user numbers increased further, the project team employed up to three PowerEdge 6650 servers, configuring the servers into a cluster using Oracle9i Real Application Clusters (RAC) technology. The operating system (OS) for the database servers was Red Hat Enterprise Linux AS 2.1 with kernel 2.4.9e25.

Storage layer. The shared storage resided on a Dell/EMC CX600 storage array, and the database itself was stored on a 70 GB logical storage unit (LUN) that was part of a six-disk RAID-10 set. The database was populated with data from the Oracle Vision data set—a standard set of sample data that Oracle uses for projects such as this one.

Figure 1 shows the test environment. The precise hardware and software specifications for each layer are provided in Figure 2.

**Description of workload characteristics**

The test scripts that simulated user activity were specifically written for this project. The scripts were designed to produce within the application a realistic simulation of typical user activity, helping ensure that the results achieved would characterize real-world situations.

The workload included transactions from five core modules in Oracle E-Business Suite 11i: Accounts Receivable (AR), Fixed Assets (FA), Inventory (Inv), Order Entry (OE), and Purchasing (PO).

### Load-generation layer
- **Base user count**: The number of users running a given transaction
- **Iterations per user**: The number of times a particular user executes this transaction
- **Transaction total**: The base user count multiplied by iterations per user

The workload also included Pricing (QP) transactions that provided cross-functional testing of the OE and Inv modules. The workload mix consisted of 22 business transactions made up of 16 online transaction processing (OLTP) transactions and 6 transactions that submitted concurrent requests (see Figure 3).

The sample Vision database was populated with thousands of rows of data, yielding a total of approximately 50 GB of data. The project scripts represented the activity of 40 different users; each user executed a transaction a particular number of times to produce an overall total number of transactions. This process is described in Figure 3 as follows:

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**Figure 1. The test environment**

PowerEdge 2650 server. As the number of users increased, engineers replaced this server with a PowerEdge 6650. As user numbers increased further, the project team employed up to three PowerEdge 6650 servers, configuring the servers into a cluster using Oracle9i Real Application Clusters (RAC) technology. The operating system (OS) for the database servers was Red Hat Enterprise Linux AS 2.1 with kernel 2.4.9e25.

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**Figure 2. Hardware and software specifications**

<table>
<thead>
<tr>
<th>Load-generation layer</th>
<th>Application layer</th>
<th>Database layer</th>
<th>Storage layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>PowerEdge 2650</td>
<td>PowerEdge 2650</td>
<td>PowerEdge 2650 and PowerEdge 6650</td>
</tr>
<tr>
<td>Software</td>
<td>Mercury Interactive LoadRunner 7.5.1</td>
<td>Oracle E-Business Suite 11i version 11.5.8</td>
<td>Oracle RAC release 2 (9.2.0.3)</td>
</tr>
<tr>
<td>OS</td>
<td>Microsoft Windows 2000 Advanced Server</td>
<td>Red Hat Enterprise Linux AS 2.1</td>
<td>Red Hat Enterprise Linux AS 2.1</td>
</tr>
<tr>
<td>Processors</td>
<td>Two Intel Xeon processors at 2.8 GHz with 512 KB level 2 (L2) cache, Hyper-Threading Technology enabled</td>
<td>Two Intel Xeon processors at 2.8 GHz with 512 KB L2 cache, Hyper-Threading Technology enabled</td>
<td>Four Intel Xeon processors at 2.0 GHz with 512 KB L2 cache, Hyper-Threading Technology enabled</td>
</tr>
<tr>
<td>Memory</td>
<td>6 GB</td>
<td>6 GB</td>
<td>6 GB (PowerEdge 2650) and 8 GB or 16 GB (PowerEdge 6650)</td>
</tr>
<tr>
<td>RAID controller</td>
<td>PowerEdge Expandable RAID Controller 3, Dual Channel integrated (PERC 3/3i)</td>
<td>PERC 3/3i</td>
<td>PERC 3, Dual Channel (DC)</td>
</tr>
<tr>
<td>Disk storage</td>
<td>Two 36 GB RAID-1 (OS) Three 36 GB RAID-6 (Linux swap partition)</td>
<td>Two 36 GB RAID-1 (OS) Three 36 GB RAID-6 (Linux swap partition)</td>
<td>Six 73 GB RAID-10 (database)</td>
</tr>
<tr>
<td>Network interface cards (NICs)</td>
<td>Two Broadcom integrated NICs</td>
<td>Two Broadcom integrated NICs</td>
<td>Two Broadcom integrated NICs</td>
</tr>
<tr>
<td>Storage area network (SAN) connectivity</td>
<td>N/A</td>
<td>N/A</td>
<td>Two QLogic 2340 host bus adapters (HBAs)</td>
</tr>
</tbody>
</table>

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The term does not connote an actual operating speed of 1 Gbps. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.
As engineers increased the load being applied to the test environment, users were added in groups of 40. Because each group of 40 users had the profile described in Figure 3, the overall characteristic of the workload remained constant regardless of the number of users added to the test. In other words, the same ratio of AR, FA, Inv, OE, PO, and QP transactions was applied regardless of the total number of users.

Data collection and analysis

The project team conducted each test cycle by applying a user load to the configuration under test, measuring the results, increasing the user load, measuring again, and continuing in this manner until the hardware was demonstrably unable to handle the user load. This approach enabled engineers to establish the maximum possible number of concurrent users for each hardware configuration.

Engineers gathered data using the Linux `sar` command and the Oracle statspack utility. Mercury Interactive LoadRunner verified that the run completed with no failures and also gathered the following data during each test:

- Overall average response time
- The 90th percentile response time
- Total number of transactions completed

The 90th percentile response time was the time by which 90 percent of all transactions had completed. If nine out of ten transactions completed within one second, and the tenth took eight seconds, the 90th percentile response time would still be one second.

At the end of each run, the project team analyzed the data and decided whether the workload had passed or failed by establishing whether the hardware had been able to support the workload. Before a workload was deemed to have passed, it had to meet the following criteria; if a workload failed on any one of these criteria, it was deemed to have failed overall:

- The 90th percentile response time did not exceed two seconds
- Overall average response time was less than the 90th percentile response time (to ensure that the values of the excluded 10 percent of transactions were not excessive)
- All business transactions completed successfully

Test cycles and results

The tests were carried out in seven distinct cycles. The goal of each cycle was to establish the maximum number of users that could be supported for one particular hardware configuration. For example, in cycle 2, the project team set out to establish how many users could be supported when the application software and the database software were each running on a separate PowerEdge 2650. In subsequent cycles, the project team added progressively more hardware until, in cycle 7, the configuration had reached 15 application servers, seven load generators, and three database servers. The maximum number of users supported and the hardware configuration tested for each cycle are shown in Figure 4. Note that the maximum user counts are always divisible by 40 because users were added in groups of 40 as the workload increased.

Figure 4 shows that the average response times and the 90th percentile response times for all cycles are comparable with the response times measured from a 40-user workload. (This 40-user workload is described as the *reference workload* in Figure 4.) For example, cycle 7 processed almost a hundred times as many transactions as the reference workload. Despite this, the response times were only marginally greater and were well within the acceptable parameters that defined a successful test.

Of all the cycles, cycle 2 was of particular importance because it established the maximum number of Oracle E-Business Suite users that could be supported on a single PowerEdge 2650 server.
This enabled engineers to determine the minimum number of servers required in the application layer to support a particular number of users, apart from any database considerations. At the end of cycle 2, the test team had identified that a single PowerEdge 2650 server could support a maximum of 280 concurrent users.

Figure 4 contains two user columns: maximum users and 70 percent of maximum users. The maximum users for each cycle is precisely that: the absolute maximum number of users that a particular configuration will support. However, the project team’s recommendation is to allow some leeway and consider 70 percent of the maximum as the number of users that a particular configuration will support.

With this guideline in mind, the following are key findings from the Dell and Oracle joint project:

- In cycle 1, a single PowerEdge 2650 server running both E-Business Suite 11i and the Oracle9i database supported a maximum of 160 users during the test.
- In cycle 2, a single PowerEdge 2650 server running E-Business Suite 11i supported a maximum of 280 users when the database was running on another server.
- In cycle 3, a single PowerEdge 2650 server running the Oracle9i database supported a total of two application servers with 280 users each, giving a maximum of 560 users for a configuration that uses a PowerEdge 2650 with 6 GB of memory to run the database software.
- In cycle 4, by switching the database to a PowerEdge 6650 server with 8 GB of memory instead of a PowerEdge 2650 server, the maximum number of supported users rose to 840 using three application servers supporting 280 users each.
- In cycle 5, by increasing the memory in the PowerEdge 6650 server from 8 GB to 16 GB, a maximum of 1,400 users was supported using five application servers supporting 280 users each.
- In cycle 6, by adding a second PowerEdge 6650 server into a RAC cluster along with the first PowerEdge 6650 server, the maximum number of supported users doubled to 2,800—a scalability factor of 1.0.
- In cycle 7, by adding a third PowerEdge 6650 server to the RAC cluster, the maximum number of supported users increased to 3,920—a scalability factor of 0.8.
- The user counts reported for all cycles are maximum user counts. Dell recommends using the “70 percent” column in Figure 4 as the number of users actually supported. This will help guarantee that a particular configuration will be able to support transient increases in load without the need to purchase additional hardware.

**Scale-out capabilities for Oracle E-Business Suite on Dell hardware**

The results of this Dell and Oracle project strongly support a scale-out strategy for Oracle E-Business Suite 11i deployed on standards-based servers. Having established that a single PowerEdge 2650 server can support a maximum of 280 concurrent users in the application layer, the test team was easily able to support more users simply by adding more servers. Ten servers in the application layer supported a maximum of 2,800 users. Beyond this, the scalability factor dropped off somewhat, but engineers were still able to support a maximum of 3,920 users with 15 application servers and three database nodes deployed on the back end. These findings indicate that an enterprise application that had previously run on large, proprietary servers could now run extremely well on several smaller, industry-standard servers such as Dell PowerEdge servers.

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