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Oracle Utilities Customer Care and Billing 2.3.1 Demonstrates Extreme Performance on Oracle Exadata

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Introduction

As utilities plan new service options and programs that respond to emerging customer and community needs, questions naturally arise about the ability of existing computer hardware, technology, and software applications to handle the new demands. Can utilities move forward with the confidence that today's information infrastructure can perform functions like prepay, demand response, and customer portal access to near-real-time data without sacrificing the rapid and dependable throughput of batch bills that ensures timely revenue flow?

Currently, few utilities—even those with highly advanced billing systems—can answer that question definitively—and for good reason. Financial prudence dictates that utilities structure IT to accommodate current needs. Thus, a utility using a monthly billing cycle typically sizes to accommodate 21 overnight billing runs per month plus an allowance for anticipated and unanticipated delays. This sizing is unlikely to be a helpful measure of the potential to speed up billing in order to accommodate additional customer demands.

To help utilities gain a better sense of maximum billing and customer program performance, Oracle is conducting tests that run Oracle applications on Oracle Exadata and/or Exalogic. The results permit utilities to measure their own systems' performance and gauge their estimated future requirements against hardware and software available today.

The test described in this paper—the first of many planned for release in coming months—demonstrates that Oracle Utilities Customer Care and Billing can process routine customer

bills on Exadata in a fraction of the time used by most utilities today, reducing overnight billing runs to a few minutes. It demonstrates that—should the occasion warrant—the combination of Oracle Utilities Customer Care and Billing and Exadata can process more than 993,0000 bills in an hour.[1] The test also illustrates that even while performing at these remarkable speeds, the hardware and software configuration used still provides additional capacity that can address other utility needs.

[1] Actual results may vary, based on a broad range of implementation-specific factors, such as transaction mix, hardware platform, network parameters, and database size. Oracle does not warrant or guarantee that customers will obtain the same or similar results, even if they use the same or similar equipment and/or software applications. Oracle does not warrant, endorse, or guarantee any performance of any products, any results desired or achieved, or any statements made within this document.

Overview

This test used:

- Oracle's flagship utility billing product, Oracle Utilities Customer Care and Billing. This enterprise-class, market-leading application offers advanced customer and financial data management, practical CRM functionality, and field operations capabilities that respond to emerging customer and community needs. The test provides a specific test of this application's rating and billing functionality, which can perform complex calculations to produce bills with various sets of charges (e.g. internally rated charges, pass-through charges, etc.). Specifically, the test tested the following functions:
  - Mediation (converting measured consumption into ratable units of measure).
  - Rating (applying complex rate and discount structures to the mediated usage).
  - Billing (assembling the rated information into discreet financial transactions for interface to the general ledger).
  - Invoicing (assembling the billable information for presentation to the customer).

The Oracle Exadata Database Machine X2-2 quarter Rack hardware.

The test was designed to demonstrate the linear scalability and the maximum capability of the rating and billing module in Oracle Utilities Customer Care and Billing 2.3.1 on Oracle Exadata database machine X2-2.

Methodology

Historical Data

For the testing effort, 12 months of historical financial data for one million accounts was used. Out of one million accounts, 80% of the accounts were created for residential customers, 18% for commercial customers, and 2% for industrial customers (with interval billing). This account mix and data volume is the base line model established to represent the typical customer base of utilities using Oracle Utilities Customer Care and Billing today.

For this test, master data (persons, premises, accounts, etc.) was created using Oracle Utilities Customer Care and Billing's standard business services to generate all relevant child entities from a set of template accounts. Then, historical data was created using an internal data generation tool to closely emulate production scenarios and realistic distribution of the data. This important process in the test ensured that the database cache hit rate stayed in a realistic range during the test.
In addition to the financial history data, one year of historical meter reads were created. The following table represents total number of rows per key entity in the database:

ENTITY TYPE	NUMBER
Account	1,000,000
Service Agreements (metered)	1,700,000
Service Agreements (un-metered)	300,000
Total Meter	1,700,000
Service Point	1,000,000
Historical Bill	12,000,000
Historical Payment	12,000,000
Historical Meter Read	34,000,000

Workload Profile

On average every account has 2 service agreements (SA). Each SA has 2 service quantity (SQ) rules (special algorithms that manipulate billing determinants for rating purposes) and 25 rate components (corresponding to 25 lines on a bill). For each billing cycle, the billing batch job processes approximately 5% of accounts simulating 21 billing cycles.

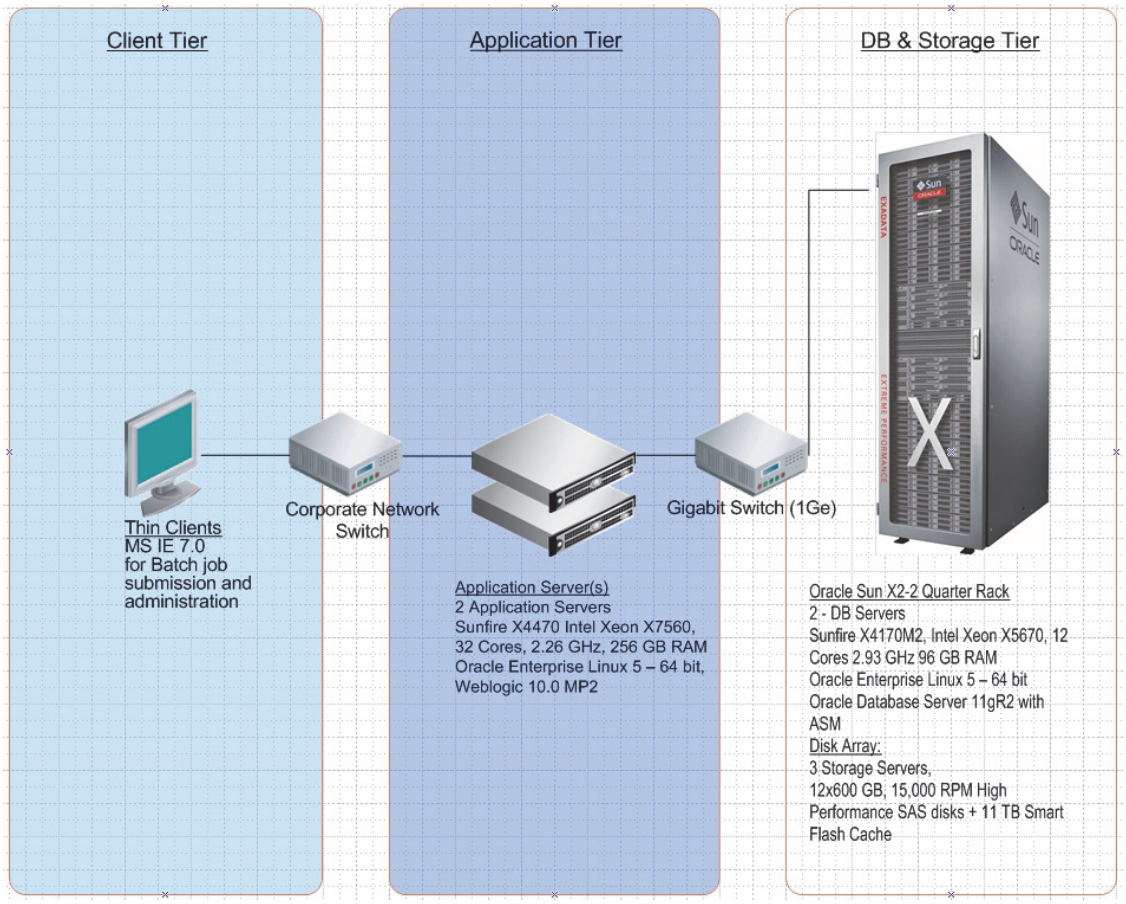
The following table depicts a typical load for a billing run configuration:

ENTITY TYPE	NUMBER	
Bill Created	50,000	5%
Bill Lines Created	100,000	5%

Performance and Testing Environments

The test was executed on an Oracle Exadata Database Machine X2-2. The test was conducted in configurations with single and multiple server nodes on the Application tier for vertical and horizontal scalability evaluation respectively.

Below is a high-level architecture topology diagram.



Overall Hardware Topology for Oracle Exadata Test

Exadata Configuration

For this test, the main table for storing usage was partitioned, and the Line of Business (LOB) data for that table was stored using Oracle Secure Files with the compression level set to medium. The following table further defines the specifications of the database and the host servers.

DATABASE SERVERS/STORAGE SYSTEM	
Platform	Exadata X2-2 Quarter Rack, Sunfire X4170M2
Operating System	Oracle Enterprise Linux 5 – 65 bit
O/S Version and Release	2.6.18-164.el5
Database Software / Version	Oracle Database Server 11gR2 with Automatic Storage Management(ASM)
Number of CPUs	2 Sockets (12 Cores)

Processor /CPU Speed	Intel Xeon X5670 / 2.93GHz
Memory	96 GB
Storage System	3 Exadata Storage Servers with 12 High Performance SAS disks and 1.1 TB Smart Flash Cache
Raid Level	RAID10

Application Servers

The following table outlines the application operating system and hardware specifications. One application server was used for the vertical scalability testing; two application servers were used for the horizontal scalability testing.

APPLICATION/BATCH MIDDLE TIER	
Platform	Sunfire X4770, Intel Xeon X7560
Operating System	Oracle Enterprise Linux 5 – 64 bit
O/S Version and Release	2.6.18-164.el5
Software / Version	Oracle Utilities Customer Care and Billing version 2.3.1 Weblogic 10.0 MP2 – 64 bit
# CPU	4 Sockets (32 Cores)
Processor / CPU / Speed	2.26GHz
Memory	256 GB

RAC Configuration

The primary purpose of the RAC configuration is to determine horizontal scalability characteristics for the application (i.e. throughput vs. resource utilization). This configuration is comprised of two server nodes in each tier (i.e. application & database tiers). On the database tier, a quarter rack Exadata server provides two RAC nodes.

Results

Typically, a one-million-customer utility with this mix of customers would divide batch billing into 21 cycles per month, each producing 47,600 bills. In this test, Oracle Utilities Customer Care and Billing and Exadata produced these bills in 2.87 minutes—a maximum throughput of 276 bills per second (16,500 bills per minute). This is the equivalent of 993,240 bills per hour.[2]

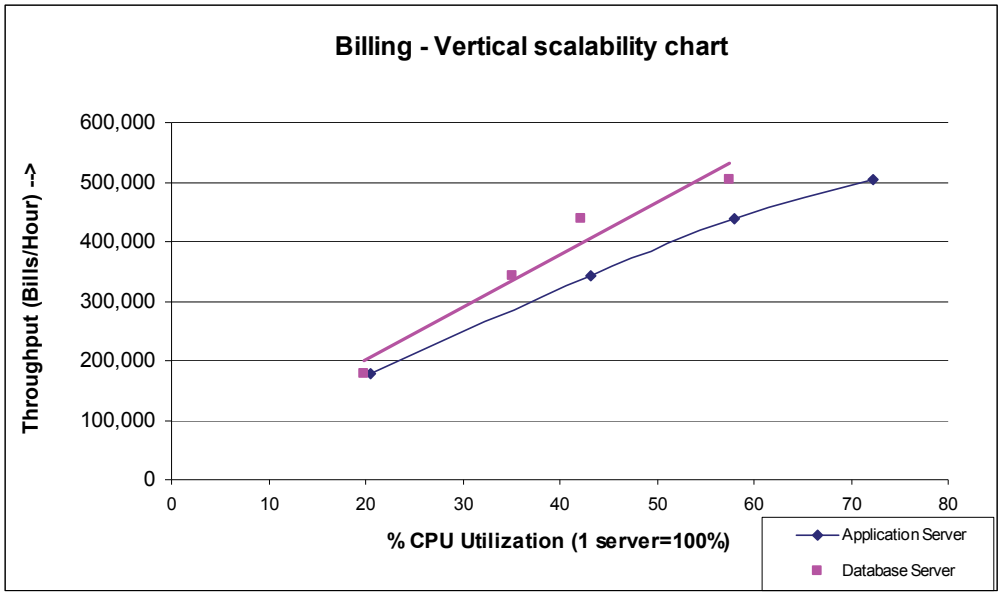
The test showed near-linear vertical scalability (proportional increase in throughput with CPU utilization) up to the point where it reached maximum CPU usage on application server.

- Vertical scalability of Oracle Utilities Customer Care and Billing 2.3.1 was demonstrated by a near-linear increase in application throughput with the increase in hardware resource utilization (in most cases, CPU utilization). This is measured by adding more logical threads to each billing run with only one application server turned on.
- Horizontal scalability of Oracle Utilities Customer Care and Billing 2.3.1 was demonstrated by adding application server nodes on the application server tier.

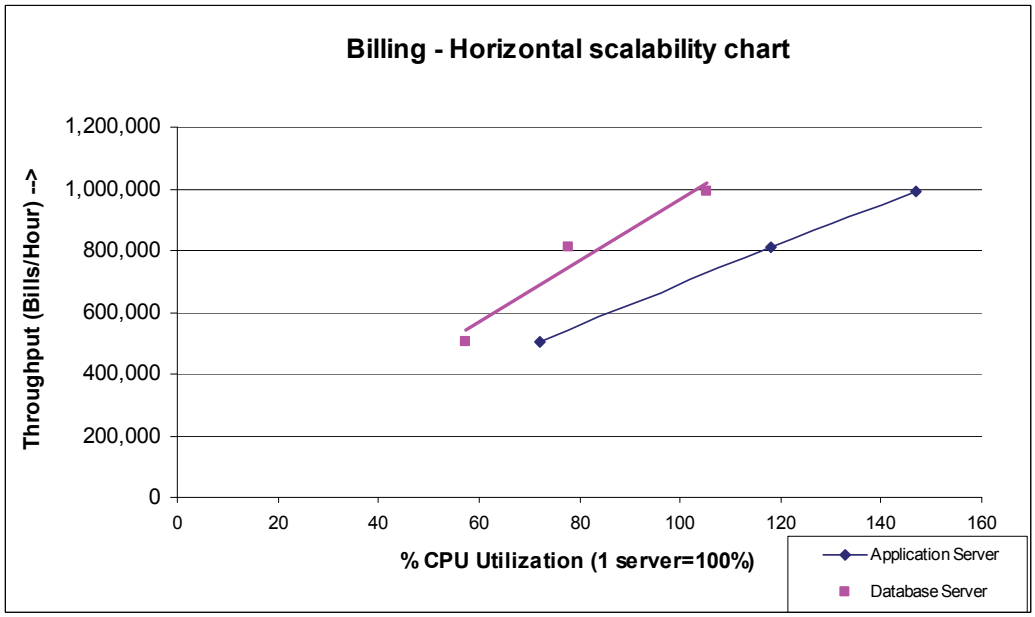
The charts below depict vertical and horizontal scalability characteristics of the application as measured during the tests. The following points provide pertinent information to help interpret the charts:

- Throughput is shown in logical business transactions per hour.
- The X-axis on the charts represents the sum of CPU utilization across all application/database server nodes.
- For the horizontal scalability evaluation tests, the threads were uniformly distributed across all the application servers.
- CPU utilization shown here is the sum of the average CPU utilization for each server.

[2] Arithmetic discrepancies are a result of rounding.



Scalability chart for billing for database and application server CPU%.



Horizontal scalability chart for billing for database and application server CPU%.

In addition to a linear increase of throughput, we observed that the load is spread evenly across the application servers and database RAC nodes as the number of threads increases incrementally. For batch billing jobs, this is a very desirable characteristic; as the demand of the throughput (number of

bills processed per hour) increases, the system will scale out smoothly by adding additional application server nodes. The Exadata quarter rack database server with two RAC nodes was utilized less than 55% while the throughput reached around 1 million bills per hour. This gives ample room for further scaling.

In the previous performance tests conducted on a non-Exadata platform, we were unable to measure maximum capacity of the servers, owing to limitations on input/output (IO) subsystem capacity. In contrast, an Exadata with flash cache results in less demand on physical I/O. The measurements below were taken based on billing runs with the same profile of data and database memory size configurations.

DATABASE SERVER	DISK IOPS DEMAND PER BILL
Non Exadata Server	73.7
Exadata	48.5

To summarize, this test demonstrated that:

- Oracle Utilities Customer Care and Billing 2.3.1 is able to process bills at a rate of 993,240 bills/hour with a data volume of 1 million customers, 2 million service agreements, and 1 year of billed history, using two Sunfire X4470 servers on the application tier and a quarter rack Exadata v2-2 server on database tier. 1 This high rate of throughput was achievable primarily due to the increased input/output capacity in Exadata.
- Oracle Utilities Customer Care and Billing's billing process showed near-linear vertical and horizontal scalability up to the point where throughput becomes limited by hardware.
- While the measured throughput is reaching extreme performance, the Exadata 2-node utilization is less than 55%, which leaves ample room to grow or host other applications in the same database server.

Summary Conclusion

This test finds that:

- Oracle Utilities Customer Care and Billing on Exadata has the potential to process close to 1 million bills in an hour with 55 percent database CPU utilization of a quarter rack Exadata. Expressed another way, Oracle Utilities Customer Care and Billing on Exadata could handle the bill processing requirements of a utility with more than 20 million customers in just one hour per night and still have considerable remaining capacity to handle other tasks simultaneously.
- The test also demonstrated that the solution has a high degree of potential for additional growth in that the billing batch process showed near linear scalability and uniform load distribution across the database servers.

This test—one of a planned series assessing the performance of Oracle Utilities applications on Oracle Exadata (and in some cases, Exalogic)—is an first step toward demonstrating Oracle's superior ability to help utilities handle the smart grid's anticipated "data deluge."

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Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

oracle.com

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