

E-BUSINESS SUITE APPLICATIONS R12 (RUP 4) LARGE/EXTRA-LARGE PAYROLL (BATCH) BENCHMARK - USING ORACLE10g ON AN IBM SYSTEM x3550 M2 SERVER

As a global leader in e-business applications, Oracle is committed to delivering high performance solutions that meet our customers' expectations. Business software must deliver rich functionality with robust performance. This performance must be maintained at volumes that are representative of customer environments.

Oracle benchmarks demonstrate our software's performance characteristics for a range of processing volumes in a specific configuration. Customers and prospects can use this information to determine the software, hardware, and network configurations necessary to support their processing volumes.

The primary objective of our benchmarking effort is to provide as many data points as possible to support this important decision.

SUMMARY OF RESULTS

This batch benchmark test was run on an 8-core server. See inside for results with different numbers of threads/workers.

Batch Workload			
250,000 Employees	Threads	Time (Min)	Hourly Employee Throughput
Payroll Processing	14	7.20	2,083,333
PrePayments	14	2.1	4,838,710
External Archive	14	25.70	583,658
NACHA	14	0.93	16,129,032
Checkwriter	14	2.08	7,211,538
Costing	14	2.10	7,142,857
Totals:		41.12	364,786
Parent Proc. Total		50.80	295,276
Wall Clock Duration*		52.33	286,642

Note that the hourly throughput numbers mentioned above are linear extrapolations. Many factors can influence performance and your results may differ.

* The "Wall Clock Duration" includes all of the job scheduling and management activity (parent process) as well as some idle intervals due to polling or waiting for all workers in a particular process to complete prior to kicking off the subsequent process. These intervals would not increase substantially, if at all, as the workload size is increased. Consequently, the throughput for larger workloads would converge toward the "Totals:" value.

BENCHMARK PROFILE

In September 2009, Oracle and IBM conducted a benchmark in San Mateo, CA to measure the batch performance of the Oracle E-Business Standard Benchmark processes in an environment running Oracle E-Business Suite R12 (RUP 4) with Oracle10g™ database (10.2.0.3) for the Linux® operating system on an IBM® System x3550 M2 server configured with two 4-core Intel® Xeon® 5500 processors (8-cores total), running Red Hat® Enterprise Linux® 5 (64-bit) OS. A single IBM Storage System™ DS4700 disk array was used for storage.

The benchmark measured the Payroll batch business process hourly throughputs for a large/extra-large database model. Testing was conducted in a controlled environment with no other applications running. **The goal of this Benchmark was to obtain reference batch throughputs for Oracle E-Business Suite R12 Benchmark on an IBM System x™ server running Linux.**

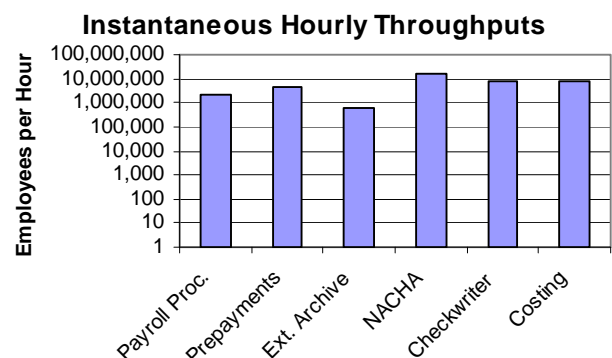


Figure 1: Oracle E-Business Payroll Batch Throughputs

BENCHMARK METHODOLOGY

E-Business Suite R12 Benchmark batch processes are initiated from a benchmark-provided SQL script.

The batch workloads were run as standard concurrent processes via the concurrent manager.

Figure 2 shows the configuration used for this benchmark run.



	<p>System x3550 M2 DB Server/App Server 8-core 64 GB</p> <p>61% Utilized</p>
	<p>DS4700 System Storage 5 Drawers – Data 1 Drawer – Logs</p> <p>1% Utilized</p>

Figure 2: 2-Tier Configuration

This benchmark was run as a “Physical” 2-Tier configuration with a single machine hosting both the Database and Application server instances on a single OS image.

BENCHMARK BUSINESS PROCESSES

This E-Business Suite benchmark consists of a batch flow with six metered processes.

Batch Payroll Processes

Business Process	Number of Threads Used	Process Type
Payroll Process	8, 10, 12, 14	Pro-C
PrePayments	8, 10, 12, 14	Pro-C
External Archive Process	8, 10, 12, 14	Pro-C & PL/SQL
NACHA	8, 10, 12, 14	Pro-C
Check Writer	8, 10, 12, 14	Pro-C & Oracle Report Writer
Costing	8, 10, 12, 14	Pro-C

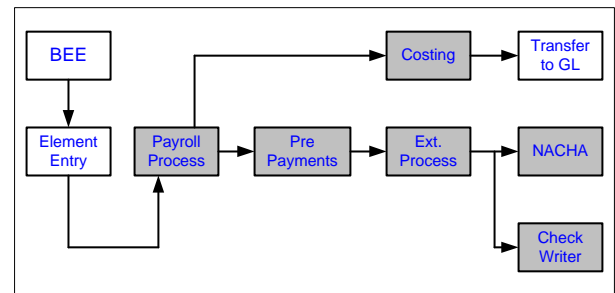


Figure 3: Payroll Process Flow

The Oracle E-Business Suite R12 Payroll processes tested are as follows:

Payroll Process: Identifies all employees to be processed and performs calculations required to complete the gross-to-net calculation, including earnings, deductions, and taxes. The specific groups of employees processed can be controlled by multiple parameters to the payroll process, including the ability for a user to define a rules-based set of employees.

PrePayments: Distributes the net pay for each employee across the various payment methods (Direct Deposit, Check, or Cash). This can be run for a single payroll process or across multiple payroll processes.

External Archiving Process: (Pro-C, PL/SQL) Replicates the results of the Payroll run into a separate archive for audit purposes. This data is primarily used for Payslips (Both printed and on line), as a source for check and direct deposit printing, third party interfaces, and tax remittance reporting.

NACHA: This is the US version of the Global Direct Deposit process, which creates the bank interface file as per NACHA rules, based on the rules in the Pre Payment process.

Check Writer: (Oracle Report Writer) This process allocates check numbers and creates/prints the payroll check and associated paper payslip.

Costing: This process associates the payroll transaction data with the General Ledger (GL) accounts in preparation for transfer of the data to GL. This process uses a sophisticated hierarchical rules-based engine to determine the mapping of the HRMS data and payroll results to the GL accounts.

BENCHMARK RESULTS

Batch Business Metrics	Achieved Output
Payroll	
Payroll Process	500,000
PrePayment	250,000
NACHA + Check	250,000
Costing	250,000

Table 1: Batch Transactions Completed

In this test, 250,000 employees were processed. Table 2 shows the processing time in minutes.

R12 Application changes, data model additions and test methodology improvements render direct comparison to previous Oracle E-Business release 11.5.10 and 11.5.9 results invalid.

250,000 Employees	Time (Min)				Hourly Employee Throughput			
	8-Thread	10-Thread	12-Thread	14-Thread	8-Thread	10-Thread	12-Thread	14-Thread
Payroll Processing	10.05	9.08	7.75	7.2	1,492,537	1,651,982	1,935,484	2,083,333
PrePayments	3.55	3.33	3.05	3.1	4,225,352	4,504,505	4,918,033	4,838,710
External Archive	31.02	28.95	27.22	25.7	483,559	518,135	551,065	583,658
NACHA	0.88	0.9	0.93	0.93	17,045,455	16,666,667	16,129,032	16,129,032
Checkwriter	2.33	2.03	1.97	2.08	6,437,768	7,389,163	7,614,213	7,211,538
Costing	3.17	2.7	2.27	2.1	4,731,861	5,555,556	6,607,930	7,142,857
Totals:	51.0	47	43.18	41.12	294,118	319,149	347,383	364,786
Parent Proc. Total	60.77	56.82	53.08	50.8	246,832	263,992	282,592	295,276
Wall Clock Duration*	62.47	58.28	55.13	52.33	240,115	257,378	272,084	286,642

Table 2: Payroll Batch Performance

SERVER PERFORMANCE

Figure 4 shows the average CPU utilization on the Database server. The value shown is the average across the processors (12 cores total).

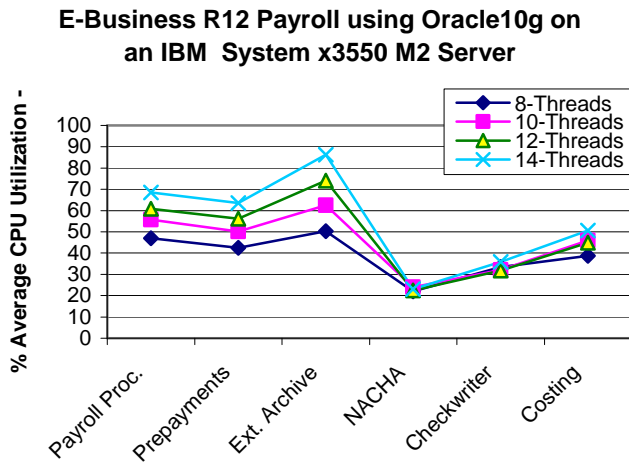


Figure 4: Average Server CPU Utilization

Online Workload	% User	% System	% Idle	% I/O Wait
Payroll Processing	36.00	8.05	53.05	2.85
PrePayments	33.76	5.76	57.57	2.81
External Archive	45.79	3.96	49.76	1.14
NACHA	14.80	2.60	78.00	4.20
Checkwriter	28.14	3.29	66.57	1.93
Costing	27.26	8.21	61.32	3.16
Wall Clock Avg.	34.1	4.3	60.3	1.6

Table 3: Average Server CPU Utilization (8-Threads)

Average GB Used	DB Server
8-Threads	14.63 GB
10-Threads	16.78 GB
12-Threads	17.46 GB
14-Threads	18.24 GB

Table 7: Average Memory Utilization

Online Workload	% User	% System	% Idle	% I/O Wait
Payroll Processing	43.77	9.02	44.31	2.69
PrePayments	40.20	6.65	49.85	3.30
External Archive	55.47	4.51	37.51	2.32
NACHA	16.80	2.40	76.00	4.60
Checkwriter	25.92	3.08	67.92	3.50
Costing	33.00	10.13	54.07	2.93
Wall Clock Avg.	40.5	4.8	52.3	2.3

Table 4: Average Server CPU Utilization (10-Threads)

Online Workload	% User	% System	% Idle	% I/O Wait
Payroll Processing	47.74	10.28	39.17	2.72
PrePayments	45.42	7.26	43.84	3.68
External Archive	66.82	4.99	25.90	2.14
NACHA	15.80	2.60	77.60	4.60
Checkwriter	25.50	2.67	68.25	3.33
Costing	32.29	9.43	55.07	2.93
Wall Clock Avg.	46.11	5.00	46.68	2.08

Table 5: Average Server CPU Utilization (12-Threads)

Online Workload	% User	% System	% Idle	% I/O Wait
Payroll Processing	54.60	11.37	31.53	2.58
PrePayments	52.53	8.05	36.42	3.26
External Archive	78.68	5.96	13.63	1.97
NACHA	15.60	3.00	77.00	4.80
Checkwriter	29.00	3.25	64.08	3.92
Costing	37.08	10.25	49.33	3.33
Wall Clock Avg.	53.23	5.73	39.18	2.03

Table 6: Average Server CPU Utilization (14-Threads)

DATA COMPOSITION DESCRIPTION

Major data components for the model under test are summarized in the following table.

Application	Business Objects	Large/Extra-Large Model
HR	Employees	250,000

Table 8: Data Composition

FLEXIBLE ‘WORKER COUNT’ EXAMPLE

All of the results previously presented in this report have held the thread-count, or number of “workers,” constant for the duration of the Payroll run. However, it is possible to specify a different number of threads for each individual process. An example of this is shown below.

Batch Workload (8-Core Server)			
250,000 Employees	Threads	Time (Min)	Hourly Employee Throughput
Payroll Processing	16	7.20	2,083,333
PrePayments	16	2.98	5,033,557
External Archive	16	24.22	619,323
NACHA	4	0.82	18,292,683
Checkwriter	16	1.80	8,333,333
Costing	14	2.23	6,726,457
Totals:		39.25	382,166
Parent Proc. Total		49.35	303,951
Wall Clock Duration*		52.55	285,442

Table 9: Mixed Threads Batch Performance

Adding threads to some processes generally increased the CPU utilization. This might be useful in some production situations. It is not a standard for benchmark comparisons.

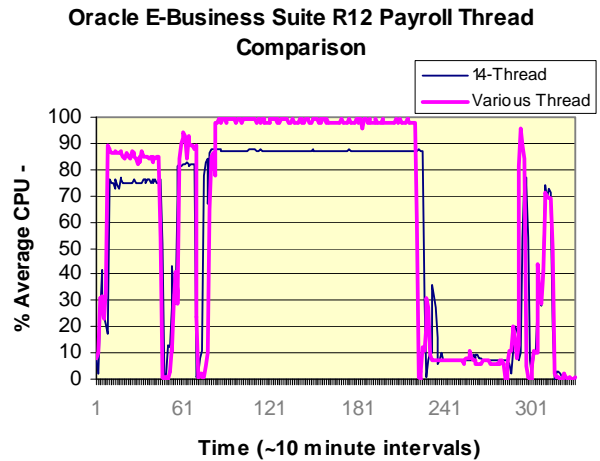


Figure 5: Server CPU Utilization Comparison

PATCHES

The following patches were applied to the benchmark environment on top of Oracle E-Business Applications R12 (RUP 4).

- Per note 386434 (patches)
- 6778401
- 6610000
- 7346620
- 7461822
- 7260001

The following patches were applied to the benchmark environment on top of Oracle 10g 10.2.0.3.

- RDBMS patch 5455880

APPLICATION TUNING

Database:

1. R12 tuning through RUP 4 and handover of benchmark kit.

2. An index was added to per_time_periods as hr.per_time_periods(time_definition_id)

Gather 100% table stats for the following tables:

```
exec
fnd_stats.gather_table_stats('HR','PAY_ACTION_INFORM
ATION',100);
exec
fnd_stats.gather_table_stats('HR','PAY_ASSIGNMENT_AC
TIONS',100);
exec
fnd_stats.gather_table_stats('HR','PAY_PAYROLL_ACTIO
NS',100);
exec
fnd_stats.gather_table_stats('HR','PAY_POPULATION_RA
NGES',100);
exec
fnd_stats.gather_table_stats('HR','PER_ALL_ASSIGNMEN
TS_F',100);
exec
fnd_stats.gather_table_stats('HR','PER_TIME_PERIODS',10
0);
exec
fnd_stats.gather_table_stats('APPLSYS','FND_CURRENCI
ES',100);
exec
fnd_stats.gather_table_stats('HR','PAY_RUN_RESULTS',10
0);
exec
fnd_stats.gather_table_stats('HR','PAY_RUN_RESULT_VA
LUES',100);
```

Gather 100% index stats for the following indexes:

```
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ACTION_INFORMATION_N2',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ACTION_INTERLOCKS_PK',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ACTION_INTERLOCKS_FK2',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ASSIGNMENT_ACTIONS_PK',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ASSIGNMENT_ACTIONS_N50',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ASSIGNMENT_ACTIONS_N51',
estimate_percent => 100);
```

```
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ELEMENT_ENTRIES_F_PK',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ELEMENT_LINKS_F_PK',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_ELEMENT_TYPES_F_PK',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_PAYROLL_ACTIONS_PK',
estimate_percent => 100);
exec dbms_stats.gather_index_stats(ownname =>
'HR',indname => 'PAY_RUN_RESULTS_N50',
estimate_percent => 100);
```

Pinning the following parameters may also help in Payroll:

```
exec dbms_shared_pool.keep('APPS.FFP51704_01010001');
exec dbms_shared_pool.keep('APPS.FFP1893_01010001');
exec dbms_shared_pool.keep('APPS.FND_DATE');
exec dbms_shared_pool.keep('APPS.FND_NUMBER');
exec dbms_shared_pool.keep('APPS.HR_COST');
exec
dbms_shared_pool.keep('APPS.HR_NONRUN_ASACT');
exec dbms_shared_pool.keep('APPS.HR_PRE_PAY');
exec dbms_shared_pool.keep('APPS.PAY_ARCHIVE');
exec dbms_shared_pool.keep('APPS.PAY_CORE_UTILS');
exec
dbms_shared_pool.keep('APPS.PAY_CC_PROCESS_UTIL
S');
exec
dbms_shared_pool.keep('APPS.PAY_INTERPRETER_PK
G');
exec dbms_shared_pool.keep('APPS.PAY_RETRO_PKG');
exec
dbms_shared_pool.keep('APPS.PAY_US_ACTION_ARCH
');
exec
dbms_shared_pool.keep('APPS.PAY_US_NACHA_TAPE');
```

OPERATING SYSTEM TUNING

DATABASE OPERATING SYSTEM TUNING

1. The following additional Kernel parameters were automatically setup during boot via the /etc/sysctl.conf file:

```
net.ipv4.icmp_echo_ignore_broadcasts = 1
net.ipv4.conf.all.rp_filter = 1
net.core.rmem_max = 4194304
net.core.rmem_default = 4194304
net.core.wmem_max = 262144
net.core.wmem_default = 262144
net.ipv4.ip_local_port_range = 1024 65000
kernel.shmmax = 17179869184
kernel.shmmni = 4096
kernel.shmall = 4194304
kernel.sem = 250 32000 100 128
fs.file-max = 6553600
vm.nr_hugepages=6000
```

2. The following limits were modified via the /etc/security/limits.conf file:

```
oracle soft memlock 16793899
oracle hard memlock 16793899
```

```
oracle soft nproc 2047
oracle hard nproc 16384
oracle soft nofile 1024
oracle hard nofile 65536
```

3. Hugepages was enabled for the database instance

BENCHMARK ENVIRONMENT

HARDWARE CONFIGURATION

An IBM System x3550 M2 (7946-AC1) server was used for the database/application/web server. It was equipped with the following:

- 2 × 2.93 GHz Intel Xeon Four-Core 5500 processors (8 cores total), each with 32 KB of Level 1 cache, 256 KB of Level 2 cache and 8 MB of Level 3 cache
- Total Memory: 64 GB (14.6 – 18.2 GB used)
- Network: Gigabit full duplex.
- Operating system: Red Hat Enterprise Linux 5
- For more details on the IBM System x3550 M2, please visit <http://www-03.ibm.com/systems/x/hardware/rack/x3550m2/index.html>
- Storage: DS4700 with a total of 48 × 145 GB 15K RPM fibre-channel disks.
- For more details on DS4700, please visit <http://www.ibm.com/servers/storage/disk/ds4000/ds4700/index.html>

SOFTWARE VERSIONS

Oracle's E-Business Suite (E-Business Suite Kit) R12 (RUP 4)

Oracle10g™ 10.2.0.3 (64-bit)

Red Hat Enterprise Linux 5 update 3 (64-bit) (on the database/application/web server)

Note: Oracle accepts that the results obtained using Redhat Enterprise Linux 5 very closely approximates results that may be obtained if Oracle Enterprise Linux 5 were used in this test.

Glossary and Acronyms:

ATP	Available to Promise
BEE	Batch Element Entries
HVOP	High Volume Order Processing
OASB	Oracle Applications Standard Benchmark
RAC	Real Applications Clusters

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