

E-Business Suite on Exadata

*Oracle Maximum Availability Architecture White Paper
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Maximum Availability Architecture

Oracle Best Practices For High Availability

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Executive Overview

[Oracle E-Business Suite](#) is the most comprehensive suite of integrated, global business applications that enable organizations to make better decisions, reduce costs, and increase performance.

The [Oracle Exadata Database Machine](#) offers extreme performance for large data warehouses, large online transaction processing (OLTP) databases and mixed workloads, making it the ideal platform for consolidation onto private clouds. It is a complete and fully integrated package of high-performance servers, low-latency storage, high-speed InfiniBand networking, and software that is scalable, secure, and redundant.

[Oracle Maximum Availability Architecture](#) (MAA) is Oracle's best practices blueprint for implementing Oracle high-availability technologies.

This paper describes our recommended and validated best practices for running Oracle E-Business Suite Application databases on Exadata Database Machine.

To develop and validate our best practices, the Oracle E-Business Suite 12.1.2 application with Oracle Database 11g Release 2 was deployed on an Oracle Exadata Database Machine in our lab. The database behavior and performance was evaluated for several different online and batch workloads.

Oracle E-Business Suite was found to perform very well on Exadata Database Machine with very little additional tuning. The application benefitted from the Exadata Database Machine's fast processors, large memory, preconfigured clustered database (Oracle Real Application Cluster (RAC), Exadata Smart Flash Cache, and fast IO capabilities.

Introduction

In this paper we offer our recommendations for running the Oracle E-Business Suite database on Exadata Database Machine with best practices for achieving excellent performance and maximum availability.

The paper is divided into the following chapters:

- Getting to Exadata – a high level overview of fresh installation on, and migration to Exadata Database Machine with pointers to more detailed documentation.
- High Availability and Disaster Recovery – an overview of our MAA best practices with pointers to our detailed MAA Best Practice documentation.
- Performance and Scalability – best practices for running Oracle E-Business Suite on Exadata Database Machine based on our internal testing.

We also include the details of our internal lab testing in Appendix 1: Lab Testing Details.

Getting to Exadata

Oracle Database 11g Release 2 and later databases are supported on Exadata Database Machine. The following Oracle E-Business Suite releases support Oracle Database 11g Release 2 and are therefore supported on Exadata Database Machine:

- Oracle E-Business Suite 11.5.10.2
- Oracle E-Business Suite 12.0.4
- Oracle E-Business Suite 12.1

The process for the fresh installation of an Oracle E-Business Suite database, and migration of an existing database to Exadata Database Machine, has been developed and validated by the Oracle MAA Exadata team.

Fresh Installation on Exadata Database Machine

Installation of E-Business Suite is performed using the “Rapid Install” tool. The current releases of “Rapid Install” create a pre-11gR2 database that must be upgraded and moved to Exadata storage to complete the installation. See [Installing Oracle E-Business Suite Release 12 with Exadata Database Machine](#), for full details of how this is done.

Future Oracle E-Business Suite releases will be delivered with 11gR2 on ASM which will facilitate direct installation onto Exadata storage.

Migration to Exadata

It is possible to migrate an existing E-Business Suite database to Exadata from any other database platforms. The options available are documented in [MOS ID 1133355.1: “Migrating an Oracle E-Business Suite Database to Oracle Exadata Database Machine”](#).

High Availability and Disaster Recovery

The best practices for deploying Oracle E-Business Suite on Exadata Database Machine for maximum availability and disaster recovery have been documented and validated by the Application MAA/Exadata team; see the [Maximum Availability Architecture \(MAA\) Home Page](#) for details.

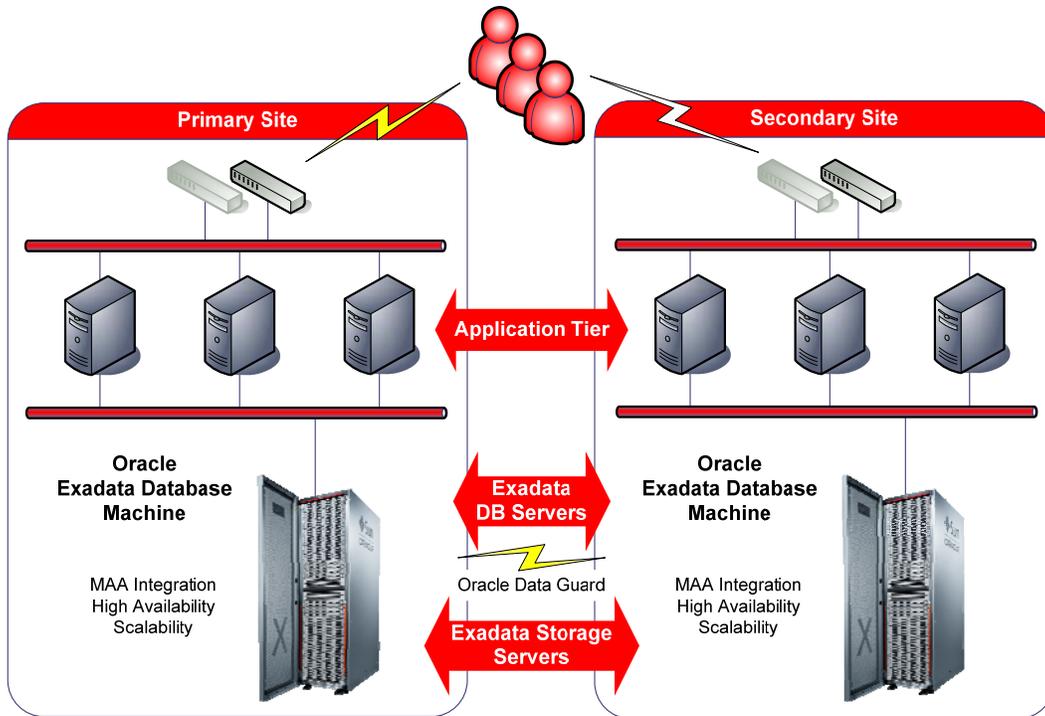


Figure 1: Oracle E-Business Suite Maximum Availability Architecture on Exadata Database Machine

Our Oracle E-Business Suite MAA best practices can be thought of as a set of application best practices layered on a foundation of Oracle database MAA best practices. The Oracle E-Business Suite availability features are:

- Load balanced web and forms servers
- Parallel Concurrent Processing

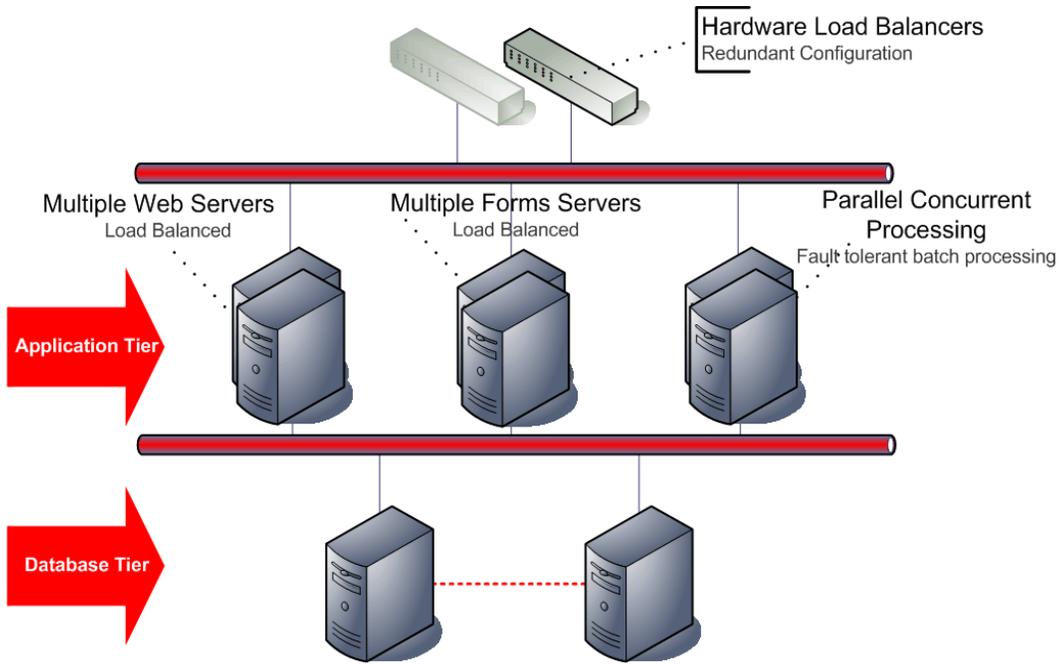


Figure 2: Oracle E-Business Suite Availability Features

The Oracle 11g Release 2 Database features include:

- Oracle Real Application Clusters (Oracle RAC)
- Oracle Clusterware
- Oracle Data Guard
- Oracle Automatic Storage Management (ASM)
- Oracle Flashback Database
- Oracle Recovery Manager (RMAN) & Oracle Secure Backup

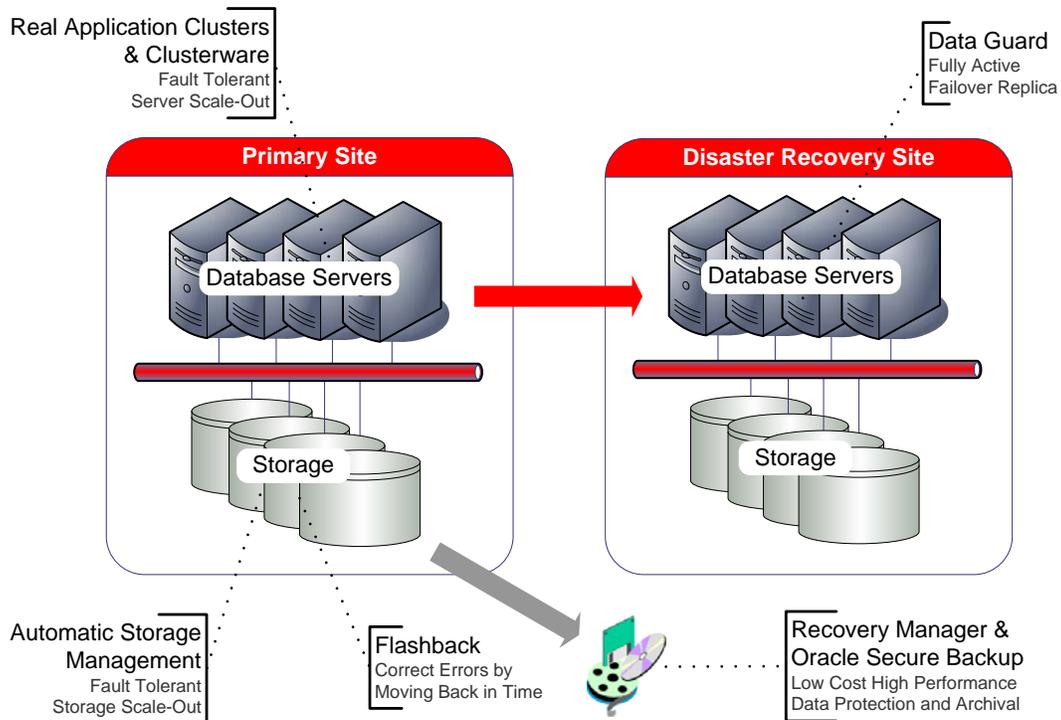


Figure 3: Oracle Database Maximum Availability Architecture Features

Oracle RAC, Clusterware and ASM come preconfigured with Exadata.

Performance and Scalability

To evaluate performance and scalability, the Oracle E-Business Suite application functionality and RMAN backups were executed on Exadata Database Machine. Our goal was to assess how Oracle E-Business Suite database behaved on Exadata Database Machine and develop best practices for configuration and backup. We selected the Oracle E-Business Suite Release 12.1.2 Oracle Application Standard Benchmark (OASB) as our sample application workload. Our internal 18TB GSI database was used for the backup tests. See Appendix 1: Lab Testing Details for details.

Below we describe the characteristics of the workload and our best practice recommendations:

Application Characteristics

All Oracle E-Business Suite workloads were characterized by high database server CPU utilization and therefore benefitted from the fast Exadata Database Machine processors. It would be likely that there would be spare capacity in many cases to facilitate growth or consolidation.

Workloads require large SGA and PGA to facilitate fast access and online scalability, thus benefit from the large Exadata Database machine memory capacity. A large PGA is required for high concurrency online workloads.

Data intensive batch workloads require high IO bandwidth and low latency, and benefit from the high IO request rate and throughput capacity of Exadata Database Machine. High IO capacity also benefits both database backups – up to 21TB per hour in test, and flashback database.

Best Practice Recommendations

Oracle Database Machine Best Practices and Health Check

Review the Exadata Database Machine best practices support notes by searching “My Oracle Support” for “Exadata Database Machine Best Practices”.

If the Oracle Database Machine health check has not been verified yet then follow [MOS ID 1070954.1: "Oracle Exadata Database Machine exachk or HealthCheck"](#).

Hugepages

HugePages are configured by default on the Oracle Exadata Database Machine running the Linux operating system, but only for the default database (DBM) and the ASM instance. It is necessary to manually configure sufficient HugePages for the ASM instance and all database instances on each Linux database server node. This will result in more efficient page table memory usage, especially with a large SGA or if there are high numbers of concurrent database connections. HugePages can only be used for SGA memory space and so memory will be wasted if more are configured than are required.

[MOS ID 361468.1, “HugePages on Oracle Linux 64-bit”](#) describes how to configure hugepages. When running the recommended script provided with Note 401749.1, make sure that all database instances are started.

Automatic Shared Memory Management (ASMM) can be used with HugePages and so use the `SGA_MAX_SIZE` and `SGA_TARGET` parameters to set the SGA size for each instance. Note, HugePages should be configured to the maximum SGA size (`SGA_MAX_SIZE`). If `SGA_MAX_SIZE` is not set then it defaults to the value of `SGA_TARGET`.

Automatic Memory Manage (AMM) cannot be used in conjunction with HugePages and so the `MEMORY_TARGET` and `MEMORY_MAX_TARGET` should be unset for each database instance. See MOS ID 749851.1 “HugePages and Oracle Database 11g Automatic Memory Management (AMM) on Linux” for details.

Set the parameter `USE_LARGE_PAGES='only'` for each instance so that the instance will only start if sufficient HugePages are available. See [MOS ID 1392497.1 “USE_LARGE_PAGES To Enable HugePages In 11.2”](#) for details.

It may be necessary to reboot the database server to bring the new HugePages system configuration into effect. Check to make sure that you have sufficient HugePages by starting all the database instances at the same time.

Hugepages should be configured for the Oracle E-Business Suite database System Global Area (SGA). This will result in more efficient memory usage, especially with a large SGA or if there are high numbers of concurrent database connections.

Starting with Oracle Database 11.2.0.2, a message is logged to the database alert log when HugePages are being used, for example:

```
***** Huge Pages Information *****
Huge Pages memory pool detected (total: 18482 free: 17994)
DFLT Huge Pages allocation successful (allocated: 4609)
*****
```

In this case, 4609 HugePages were used.

Note, there is no need to allow for a large Linux file system cache (page cache) on Exadata Database Machine as this is not used for database file access.

Exadata Smart Flash Cache

High Exadata Smart Flash Cache hit rates were experienced in tests without specific tuning. These were relatively short test runs with a database restore before each run which resulted in flushing of the flash cache. Even higher hit rates would be expected if the cache is allowed to mature over time.

It is recommended that customers start with the automatic caching policy to begin with and then tune specific tables if and when necessary.

Oracle RAC Node Affinity

The online workload was found to work well when spread across multiple Oracle RAC instances, with little cluster contention. This allowed more users to run concurrently on the system. It is recommended that customers spread their online workloads across instances in the Oracle RAC cluster for maximum availability and scalability.

The Order to Cash and Payroll batch workloads are best directed to a specific Oracle RAC instance, and separate instances if running concurrently. See [MOS ID 1129203.1: "How to run a concurrent program against a specific RAC instance with PCP/RAC setup"](#) for details

Middle Tier Location

In our tests, the Oracle E-Business Suite middle tiers were located on separate servers outside the Exadata Database Machine rack and they were found to perform well. We would recommend that production deployments do likewise. Some concurrent manager requests are very “chatty” and so it is recommended that the concurrent manager server is connected to the Exadata Database Machine through a low latency network. The latency can be minimized by limiting the number of network hops between the servers. Gigabit Ethernet will generally provide sufficient network bandwidth, although, 10 gigabit Ethernet and InfiniBand connectivity is available if necessary.

In general, we discourage installing additional software on the database servers but we don't prohibit it. Our guidance is to keep extra software to a minimum (for example backup, management, and security agents). It may make sense to install additional software where there is a serious and measured advantage to running the process directly on the database servers.

We very heavily discourage or disallow modifications to the Operating System other than installing packages or fixes officially provided by Oracle. For example, installing third-party device drivers and third party hardware is disallowed.

Compression

Compression has been found to save space and improve performance for most Oracle E-Business Suite workloads. For detailed results of Oracle E-Business Suite compression tests, see [MOS ID 1110648.1: "Oracle E-Business Suite Release 12.1 with Oracle Database 11g Advanced Compression"](#).

RMAN binary compression can significantly reduce backup size. A size reduction of nearly 4 X was achieved with our internal production database with only a marginal increase in backup elapsed time.

Log Writer Tuning

The large Exadata Database Machine memory can accommodate a large redo log buffer (*log_buffer*). In tests we found an increase to 64MB was beneficial. It was also found to be beneficial to unset the *log_checkpoint_interval* parameter.

Fixed Object Statistics

The following query was found to have a suboptimal query plan in our initial online tests:

```
SELECT P.PID, S.PROCESS, P.SERIAL#, P.SPID
FROM V$PROCESS P, V$SESSION S
WHERE S.AUDSID = USERENV('SESSIONID') AND S.PADDR = P.ADDR
```

The performance was improved considerably by gathering fixed object statistics using the following command:

```
exec dbms_stats.gather_fixed_objects_stats('ALL');
```

This command should be run during high load conditions for optimal results.

Accounts Receivable Tuning

Oracle E-Business Suite Bug 9581788 results in slowness of Accounts Receivable processing. This bug was found during testing, but is not specific to Exadata Database Machine. The bug is fixed in Oracle E-Business Suite 12.1.3, and a patch is available for 12.1.2.

Conclusion

Oracle E-Business Suite benefits from the Exadata Database Machine's fast processors, large memory, preconfigured clustered database (Oracle RAC), Smart Flash Cache, and fast IO capabilities. Our internal testing verified that EBS performs very well without any special tuning required. By following the best practices developed from this testing and described in this paper you will be able to optimize performance, availability and scalability of Oracle E-Business Suite on Oracle Exadata Database Machine.

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Appendix 1: Lab Testing Details

Exadata Database Machine Configuration Tests

Goal

Quantify the benefits of flash cache, smart scan, and Oracle RAC on a sample Oracle E-Business Suite workload.

Test Configuration

The tests were run on an Exadata Database Machine V2 Quarter Rack machine with middle tiers configured on a separate server.

The Oracle E-Business Suite Release 12.1.2 Oracle Application Standard Benchmark (OASB) was selected as our sample workload with a medium model database running on Oracle Database Release 11g Release 2 (11.2.0.2). This included a combination of Order to Cash, Payroll and Online workloads. See [Oracle Applications Benchmark](#) for more details.

The following configuration changes were made to achieve optimal OASB performance on the Exadata Database Machine. Although discovered on Exadata Database Machine, we suspect that these changes would be beneficial for any Oracle E-Business Suite 12.1.2 implementation running on Oracle Database 11g Release 2 as there were no Exadata Database Machine specific changes made.

Database Changes

- *log_buffer* was increased from the default of 10MB to 64MB to reflect the large RAM capacity of the machine
- *log_checkpoint_interval* was unset
- Hugepages were configured and the *sga_target* parameter was used to configure the SGA size
- The online workload was improved by gathering fixed object statistics using the following command:

```
exec dbms_stats.gather_fixed_objects_stats('ALL');
```

Oracle E-Business Suite Patches and Changes

- The patch for bug 9581788 was applied

Results

Exadata Smart Flash Cache Results

Each workload was run to completion and the flash cache hit ratio was calculated as the ratio between two instance activity statistics; *cell flash cache read hits* and *physical read total IO requests*.

EXADATA SMART FLASH CACHE HIT RATE	
WORKLOAD	HIT RATE (%)
Order to Cash	61.2
Payroll	72.1
Online	60.8

Note, in order to achieve consistent results the test database was restored from backup between tests resulting in a flushing of the flash cache. We would expect to see an even higher flash cache hit rate in a production scenario with a mature aged cache.

Smart Scan Results

The O2C, Payroll and Online workloads were found to do very few table scans (as per their design) and therefore did not benefit from Smart Scan functionality.

Oracle RAC Results

The online workload suffered very little cluster contention when connections were distributed across Oracle RAC nodes (~4% of DB time). By balancing the workload we were able to support more database connections and scale to higher user concurrency.

The batch components, namely O2C and Payroll, when executed individually, ran fastest when all database connections were directed to single Oracle RAC instance. When batch components were run concurrently, they ran fastest when each component was directed to a separate Oracle RAC instance.

RMAN Backup Tests

Goal

Evaluate the Oracle E-Business Suite database backup performance on Exadata Database Machine with and without RMAN binary compression.

Test Configuration

The test was performed on an Exadata X2-8 with 2 database instances and 14 storage cells.

The database used for the test was a copy of Oracle's internal Global Single Instance (GSI) Oracle E-Business Suite database. The database was 18TB in size.

The backup was performed to a separate diskgroup on the same X2-8. The source and target diskgroups were configured with normal redundancy. Both Oracle RAC nodes were used to perform the backup with 8 channels on each node.

Results

RMAN BACKUP PERFORMANCE ON EXADATA X2-8

COMPRESSION MODE	ELAPSED TIME (MINUTES)	BACKUP RATE (TB/HOUR) ¹	BACKUP SIZE (TB)	SPACE SAVING (TB)
None	51	13.0	11.1 ²	-
Low	65	10.2	3.0	8.1

¹ The backup rate is measured relative to the uncompressed backup size, which equates to the amount of data read from the source database files.

² RMAN employs unused block compression, also known as unused block skipping, to all backups resulting in a backup that may be smaller than the database file size.



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