

# Oracle<sup>®</sup> for SAP<sup>®</sup>

TECHNOLOGY UPDATE



## DEAR SAP CUSTOMER,

The relationship of Oracle Corporation and SAP SE has been and is based on a long history, a rich heritage of joint developments and a bright future – for the benefit of our mutual customers. Both companies have had an ongoing commitment to our tens of thousands of joint customers for over 30 years.

Our longstanding reseller and support agreements provide enhanced access to Oracle Database technology, Oracle Cloud Infrastructure and world class customer support. Oracle will support SAP Business Suite and SAP BW as long as SAP will be supporting them. With every new release we will provide latest database technology and let customers make use of more and more SAP application optimizations.



Running SAP applications on **Oracle Cloud Infrastructure** has been certified for Bare Metal and Virtual Machine shapes as well as for Exadata Cloud Service and Oracle Exadata Cloud@Customer. Oracle Exadata Cloud Service is the most powerful platform to run Oracle Database in the cloud. Oracle Exadata Cloud@Customer is the Cloud version of Exadata which is located on-premise in the datacenter of the customer; both services are only available from Oracle. Both SAP Application Server ABAP/Java as well as SAP Business Objects are deployable on Oracle Cloud Infrastructure. Cloud Infrastructure combines the elasticity and utility of public cloud with the granular control, security, and predictability of on premises infrastructure to deliver high performance, high availability, and cost effective infrastructure services. Oracle Cloud Infrastructure offers a set of core infrastructure capabilities such as compute and elastic storage to provide customers the ability to run any workload in the cloud. It offers a comprehensive set of integrated, subscription based infrastructure services that enable businesses to run any workload in an enterprise grade cloud-managed, hosted, and supported by Oracle. The Oracle product strategy provides flexibility and choice across the IT infrastructure. There are several Cloud database migration techniques: R3LOAD (SAP), BRSPACE (SAP), RMAN, O2O, Triple O and Data Guard physical standby. For further details regarding cloud migration techniques, please see page 57.

The **Oracle Exadata Database Machine** is engineered to consolidate all of your SAP and non-SAP Databases into a private Database Cloud environment. It delivers the highest performance and most available platform for running the private Oracle Database Cloud for all types of database workloads; including both Online Transaction Processing (e.g. SAP ECC 6.0), and Data Warehousing (e.g. SAP BW 7.0 and higher). The Exadata Database Machine is ready to tackle your largest and most important database workload, often running them up to 10 times faster or more. It has already been deployed by many SAP customers.

**Oracle Private Cloud Appliance** is an engineered system that radically simplifies the way customers install, deploy, and manage converged infrastructures, which can be used as virtualization platform for database and application.

The **Oracle Database Appliance** is a new way to take advantage of the world's most popular Oracle Database, in a single, easy-to-deploy and easy-to-manage system. It's a complete package of software, server, storage, HA and networking that's engineered for simplicity; saving time and money by simplifying deployment, maintenance, and support of database workloads.

**Oracle Linux 8** is Oracle's latest Linux version for SAP infrastructure computing needs. It is fast, brings the latest innovations to customers and delivers best performance for SAP. It is reliable and it provides best security and data integrity. It is optimized for Oracle Database and improves application uptime.

Oracle Linux Virtualization Manager is a server virtualization management platform that can be easily deployed to configure, monitor, and manage an Oracle Linux Kernel-based Virtual Machine (KVM) environment. **Oracle Linux KVM and Oracle Linux Virtualization Manager** provide a modern, open source, high performance alternative to proprietary server virtualization solutions with zero licensing costs.

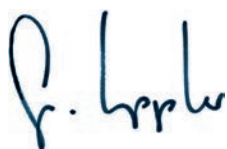
The **Oracle development teams** on site at SAP SE in Walldorf, Germany continue to work together with SAP developers to ensure that SAP customers will always have access to the latest optimized Oracle technologies, ensuring performance, reliability and innovation.

The **Oracle for SAP Service & Support** team offers Advanced Customer Services (ACS) that include health checks, workshops, database migrations, performance tuning, and ACS Oracle Solaris Services for SAP environments, including Assisted Services Engagements (Analysis/Enhancement and SAP Readiness Service for IT Infrastructure).

For more information please visit [www.oracle.com/sap](http://www.oracle.com/sap).

We welcome your comments and questions. Please contact us at: [frontdesk-walldorf\\_de@oracle.com](mailto:frontdesk-walldorf_de@oracle.com)

Sincerely,



Gerhard Kuppler

Vice President SAP Alliances  
Oracle Corporation

*ORACLE CORPORATION: US\$40B total GAAP revenue in FY 2021 • 430,000 customers in 175 countries • 20,000 partners across the globe • 133,000 employees, including: – 41,000 developers and engineers – 13,000 customer support and service specialists, speaking 29 languages - 18,000 implementation consultants • Supports thousands of educational institutions and millions of students in more than 130 countries • More than 18,500 patents worldwide • 5 million registered members of Oracle's customer and developer communities • 469 independent user communities in 97 countries representing more than 1 million members.*



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# Oracle Database for SAP Customers

Latest database technology and support for SAP application optimizations



## HW/OS Platform Independence



### Generic Servers

Unix, Linux, Windows



### Oracle Engineered Systems

Exadata Database Machine, Database Appliance, Private Cloud Appliance



### Oracle Cloud

Oracle Cloud Infrastructure, Exadata Cloud Service, Exadata Cloud@Customer



### Virtual Machines

VMs on generic servers and Oracle Engineered Systems; Virtual Shapes in the Oracle Cloud



## Support for Large and Very Large Databases



### Oracle Database In-Memory

Make existing queries faster. Ask new questions.



### Oracle Advanced Compression

Reduce disk space needed for database by 50% or more.



### Oracle Table and Index Partitioning

Improve application performance and database manageability



### Database Security and Compliance

Encrypt data in transit and at rest. Restrict access to data.



## Support for SAP Application Optimizations



### Application Development Optimizations

CDS-based Application Development



### Workload Distribution Optimizations

ABAP Core Data Services (CDS)



### Data Model Optimizations

Flat Cubes (Optimize SAP BW Cubes for In-Memory Computing)  
Decustering (Convert clustered tables to transparent tables)

## ORACLE DATABASE FOR SAP: LATEST DATABASE TECHNOLOGY AND SUPPORT FOR APPLICATION OPTIMIZATIONS

### Strategy and Roadmap

From the very beginning, the *Oracle Database for SAP or SAP on Oracle Database strategy* had been based on two pillars. The first pillar is the integration of Oracle Database features with the SAP environment. The second pillar is the integration of SAP application features with the Oracle database.

Today, both pillars supporting the SAP on Oracle Database strategy are clearly visible and important: Whenever Oracle releases a major new database feature, a development effort is needed to integrate it into the SAP architecture as well as the installation, administration and monitoring tools provided by SAP. Whenever SAP releases a new application optimization, a similar development effort is needed to integrate it with the Oracle Database technology.

The need to *integrate Oracle Database features with the SAP environment* has always been visible. It was particularly obvious, when Oracle released new database features for which the SAP architecture was not prepared. An example that many customers still remember is the project to integrate Real Application Clusters (RAC) into an SAP architecture based on the assumption that there can be many SAP Application Server instances, but only one Database Server instance. The certification of Oracle Multitenant was a similar architectural revolution and required no less effort than the RAC certification.

The need to *integrate SAP application features with the Oracle Database*, on the other hand, has only rarely been recognized. The classic SAP applications (such as R/3 and BW) were developed on the Oracle Database. Later on, when SAP started to support IBM DB2 and Microsoft SQL Server, they put the least common denominator strategy in place, i.e. they used only those database features that were available in all supported databases. Not much stress, therefore, on the Oracle Database.

This has changed with the advent of SAP's own database (HANA). SAP realized very soon that they had to drop the

least common denominator strategy and change their applications: As long as SAP applications treat HANA as a database similar to all other databases, it is very difficult to convince customers that there is a benefit in implementing HANA. Therefore, SAP has embarked on an application optimization project in order to allow SAP applications to make use of special HANA features.

"Special HANA features", however, does not mean "HANA-only features". There is nothing in HANA that cannot be done by the Oracle Database as well. Therefore, the need to integrate SAP application features with the Oracle Database has recently become more visible.

Oracle recognizes the value that the tight integration between the Oracle database and the SAP application brings to our customers. Oracle's continuing commitment for both pillars is evident through the comprehensive set of database features provided and for the special HANA optimizations currently supported such as Core Data Services and Oracle Optimized Flat Cubes.

### Oracle Database Version: Support Status and Roadmap

2018, new releases of the Oracle Database software are provided annually. In addition, a new numbering schema has been implemented: Instead of the traditional version numbers, the release year is now used to designate a software version (18c, 19c, etc.). There are two types of Oracle Database releases: Long Term Release and Innovation Release.

**Oracle Database Long-Term Releases** are ideal for use cases that benefit from less frequent upgrades to newer releases. They offer the highest level of stability and the longest length of error correction support. These releases have at least 5 years of Premier Support followed by 3 years of Extended Support. When combined with Extended Support, customers typically have 4 or more years to upgrade from one Long Term Release to the next Long-Term Release. – *Oracle Database Long Term Releases are made available (certified) for SAP customers as well.*



Figure 1: Oracle Database version support as of November 2022 (Dates are subject to change at any time).

In between Oracle Database Long Term Releases, Oracle delivers **Oracle Database Innovation Releases** that include many enhancements and new capabilities which will also be included in the next Long-Term Release. Innovation Releases are designed to enable customers to continuously use leading-edge technologies to rapidly develop or deploy new applications or augment existing applications. Support for Innovation Releases includes at least 2 years of Premier Support, but there is no Extended Support. – *Oracle Database Innovation Releases are not certified for SAP.*

An overview of the releases that are currently available can be found in figure 1. – For additional details see SAP Notes 1174136 and 2606828.

### Oracle Database 19c

Oracle Database 19c, certified for SAP since December 2019, is the most current long-term support release, and it is recommended for all SAP on Oracle customers. Premier Support will end on April 30, 2024; Extended Support will end on April 30, 2027. One year of free Extended Support will be in effect from May 1, 2024 until April 30, 2025.

### Oracle Database 23c

Oracle Database 23c, the next long-term support release is planned to be available and to be certified for SAP within the period Q4 CY2023 / Q1 CY2024. This means: The next long-term support release will be supported and certified for SAP before Premier Support for Oracle Database 19c ends.

### SAP Application Optimizations: Workload Distribution

Many people believe that SAP's decision to abandon the least common denominator strategy and to optimize their applications for HANA in mind are seen as a threat by Oracle. And it is certainly true that in the SAP world HANA is a competitor of the Oracle Database. However, in many cases SAP's new application optimizations are greeted with a sigh of relief by Oracle employees as well as by Oracle customers. Taking SAP Core Data Services (CDS) as an example, it is easy to explain why.

The main questions behind Core Data Services are: What is a database? What can it do? And what can it not do?

The traditional answer to these questions claims that a database is nothing but a dumb data store. It is a container that can permanently store data, but that's it. Whenever a customer wants to do something useful with the data, it must be transferred to the application server, because the intelligence sits in the application server.

Traditional SAP applications are based on this very concept. The disadvantages are obvious: If the sum of 1 million values needs to be calculated and if those values represent money in different currencies, 1 million individual values are transferred from the database server to the application server – only to be thrown away after the calculation has been done. The network traffic caused by this approach is suboptimal and suffers with poor performance.

30 years ago, the developers of the Oracle Database asked: Wouldn't it be nice, if this sum could be calculated on the database server side? Would this not improve the answer

to the question what a database is: A database is not only a data store, it can also store and execute procedures working with the data – pieces of code that originally were part of the application running on the application server, but are now moved to the database server. So the application is split into two tiers, one of them running on the application server, the other one on the database server, and therefore the database server is an application tier.

The Oracle developers did not only ask questions or come up with a new concept. They also built a new database version that was able to store and execute database procedures (Oracle 7, released in 1992).

However, at that time the Oracle Database was the only database that could process application logic at the database layer. Stored procedures were not part of the least-common-denominator feature subset, and therefore SAP declined to use them.

20 years later, SAP started to promote HANA. One of the first things they discovered was that their own applications were the worst enemies of the new in-memory database architecture. If an application believes that a database is essentially a dumb data store, that only itself can do calculations efficiently and therefore individual values need to be transferred over the network, actively destroys all potential benefits of an in-memory database. At that time, SAP realized that they had to abandon the least common denominator strategy and its counterpart, the dumb data store concept.

As a response to this insight, SAP developed the “Push down” strategy: push down code that requires data-intensive computations from the application layer to the database layer. They developed a completely new programming model that allows ABAP code to (implicitly or explicitly) call procedures stored in the database. And in order to prevent pure chaos, they defined a library of standard procedures. This library is called Core Data Services (CDS). And they agreed to make this library available for non-HANA databases, too, if those databases support stored procedures.

The 20 years between the release of Oracle 7 and the release of SAP Core Data Services explain the sighs of relief breathed by Oracle customers and employees: The performance gains achieved by SAP’s push-down strategy would have been possible 20 years earlier. Better late than never.

A second example for the same strategy is **FEMS Pushdown**. FEMS queries can be thought of as a spreadsheet and query conditions that define how to calculate the cell values. FEMS Pushdown, which allows all calculations to be done in the database, can reduce database time, network traffic, and application server time considerably. It is supported for the Oracle Database as of July 2019. For more information see SAP Note 2816467.

### SAP Application Optimizations: Application Development

A subset of the standard applications developed by SAP uses CDS by default: ERP 6.0 EHP8, Rapid Replenishment Planning, Convergent Invoicing, Banking Services from SAP. However, the benefits of the CDS framework are by no means restricted to SAP standard applications. For customers, home-grown applications are an essential part of their SAP-related portfolio and workload. Many of these apps can significantly benefit from using CDS features.

For details on how to develop your own applications using CDS, see the white paper ABAP Core Data Services. SAP Business Suite – Best Practice Guide, which can be downloaded from <https://tinyurl.com/SAP-ABAP-CDS-on-anyDB>.

Oracle Database provides the features that are necessary to support this approach. An example is SQL Macros. Originally planned for Oracle Database 21c, this feature has been backported to Oracle Database 19c. SQL Macros allow developers to factor out common SQL expressions and statements into reusable, parameterized constructs that can be referenced in SQL statements. Unlike PL/SQL functions, SQL Macros are evaluated at parse time, which means that at execution time context switches between SQL and PL/SQL can be avoided and SQL runtime can be reduced considerably. See SAP Note 2801989.

### Oracle Database Option: Oracle Database In-Memory

Oracle Database 12c (and higher) comes with a Database In-Memory option, however it is not an in-memory database. Supporters of the in-memory database approach believe that a database should not be stored on disk, but (completely) in memory, and that all data should be stored in columnar format. It is easy to see that for several reasons (among them data persistency and data manipulation via OLTP applications) a pure in-memory database in this sense is not possible. Therefore, components and features not compatible with the original concept have silently been added to in-memory databases such as HANA. Oracle has chosen the opposite strategy: Data can be populated into an In-Memory Column Store whenever this makes sense. In all other cases, data are stored and handled as it always has been.

For more information on the concepts of Oracle Database In-Memory see the article “Implementing a Data Management Infrastructure for SAP with Oracle



database Options and Packs”, in particular the sections „Oracle Database In-Memory“, page 20 and „Summary“, page 32.

Oracle Database In-Memory was certified for SAP in June 2015. Unlike similar options offered by competitors, the use of Oracle Database In-Memory is not limited to SAP Business Warehouse (SAP BW). It is supported for all SAP applications based on SAP NetWeaver, including typical OLTP applications. However, this does not mean that it is always a good idea to use Oracle Database In-Memory. This option is a solution for a specific problem – or for a certain class of problems. It cannot solve all problems. It cannot improve performance in all cases. If used in an inappropriate manner, it can even – like a pure in-memory database – degrade system performance. Therefore, the SAP applications that can benefit from data being loaded into the column store must be selected carefully.

Applications must be selected, individual tables must be selected – the implementation of Oracle Database In-Memory in SAP environments seems to be difficult. However, early adopters consistently mention as their very first experience that Oracle Database In-Memory for SAP can be implemented quickly and easily. This seems to be counterintuitive, but it is not.

First, many customers are already aware of the queries and jobs that take too much time to complete, and they know which tables are involved. In those cases the task to select appropriate SAP applications and tables is trivial.

Second, for customers who do not want to implement Oracle Database In-Memory in order to fix specific issues, but prefer a general approach, Oracle provides an In-Memory Advisor – a wizard that analyzes the workload of a particular system and recommends tables to be populated into the column store based on the amount of memory that is available. (This means that the frequently asked question „How much memory do I need in order to use Oracle Database In-Memory?“ is completely meaningless. It’s the other way round: You tell Oracle how much memory you have, and the advisor will let you know how that amount of memory can be used in the most efficient way.)

Third, once the relevant tables are determined, everything is easy and breathtakingly fast: By issuing an `ALTER TABLE <table_name> INMEMORY` statement you declare that those table data should be available in the column store and from this point on everything else happens automatically in the background.

Finally, unlike the migration to an in-memory database such

## SAP Application Optimizations: Data Model

When the certification of Oracle Database In-Memory for SAP was announced in June 2015, the announcement included a couple of restrictions. In particular, it was strongly recommended not to drop any standard indexes or aggregates. This caused some disappointment, because from a pure Oracle perspective indexes are not needed anymore when the base tables are populated into the column store, and can therefore be dropped.

But in this case (as in all other cases described in this article) the Oracle/SAP development team, which is responsible for the integration of SAP and Oracle technologies, had to follow SAP’s learning curve. The situation immediately after the certification of Oracle Database In-Memory for SAP (in this case: for SAP BW) simply mirrors the early stages of SAP’s project to provide SAP BW on HANA.

The disappointment mirrors SAP’s experience that the traditional SAP BW data model is not compatible with the new concept of an in-memory database. Flat Cubes, which will be explained in this section, utilized the new data model that SAP designed for HANA.

as HANA, the implementation of Oracle Database In-Memory does not require a revolution: no new hardware, no new operating systems, no new database. Customers can continue to use the existing infrastructure, and what administrators need to know about Oracle Database In-Memory can be learned within a few hours

In many cases, data to be loaded into the Business Warehouse arrive as very wide records. E. g. company name, zip code, city, and street address are combined with carrier details, order number, order date, invoice number and dozens, if not hundreds of other data items in one single record. But in the early days of data warehousing, when databases were disk-based only and disk space was expensive, it was not acceptable to waste disk space for redundant data such as the company or the carrier details which occur 1000 times, if that particular company sends 1000 items, and 100,000 times, if that particular carrier is engaged to fulfill 100,000 shipments. Therefore database architects came up with a design called star schema: subsets of data which belong together (all customer details, all carrier details) are moved to separate tables, which are called dimension tables. The remaining data plus IDs pointing to the relevant entries in the dimension tables is stored in the fact table.

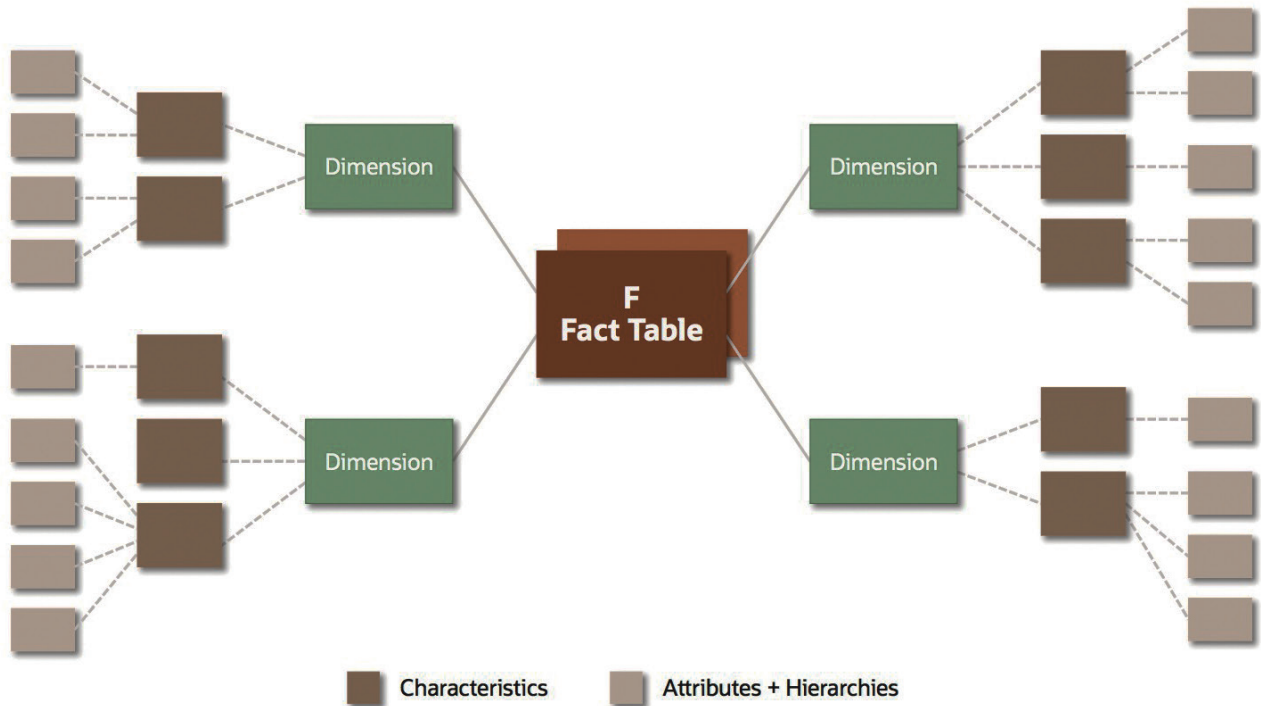


Figure 2: Traditional "star" (= extended snowflake) schema

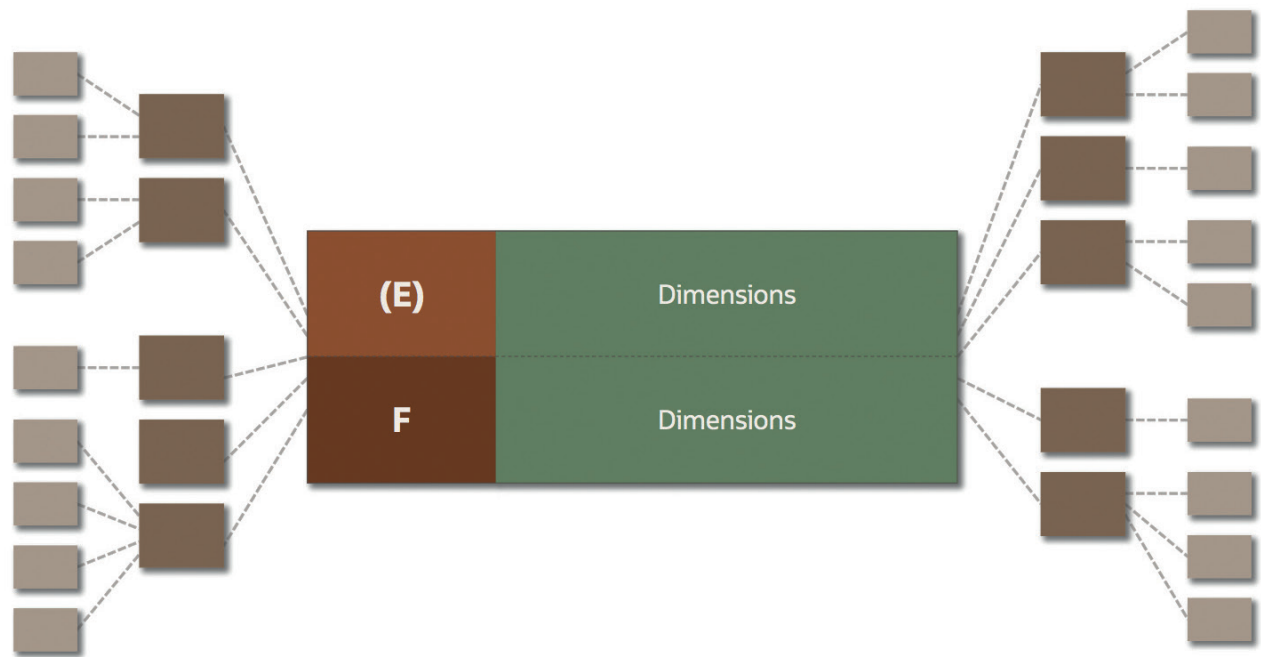


Figure 3: New flat cube design

Such a split was not enough in all cases. E. g. a certain combination of zip code, city name and street may occur several times in the CUSTOMERS as well as in the CARRIERS table. If the same split operation is applied again, additional tables are created which, however, are not connected to the fact table, but to the dimension tables. This results in a more complex, but also (from a disk-space point of view) more efficient design, which is called snowflake schema. High-end data warehouses such as SAP BW add yet another level of detail tables, thus relying on the extended snowflake schema.

This complex architecture has been designed in order to optimize the data model for the requirements of traditional, disk-only relational databases. However the new databases with their focus on memory – and in this respect there is no difference between SAP HANA and Oracle Database In-Memory – have very different requirements.

Therefore, SAP designed a new data model for SAP BW on HANA and consequently called it HANA-Optimized InfoCubes. The simplest, but somewhat surprising description of HANA-Optimized InfoCubes is this: If the process of optimizing the SAP BW data model for disk-oriented databases led from flat and therefore wide records to the extended star schema, the process of optimizing the data model for memory-oriented databases is simply the way back from extended star to flat and wide.

Back but not all the way. HANA-Optimized InfoCubes combine the fact table (actually: the E and F fact tables) and the dimension tables (first level of details) in one single table, whereas the small level 2 and 3 tables (characteristics, attributes and hierarchies) remain in place. This change is sufficient to improve performance and manageability considerably.

This new data model removes the main disadvantages of the previous data model without sacrificing its benefits. It is no longer necessary to split the incoming, wide records in order to distribute them over many tables – this speeds up data load. The traditional indexes are not needed anymore – this speeds up data load as well. It is no longer necessary to join the tables later on – this speeds up query processing. The main disadvantages of the flat data model that originally motivated the development of the extended snowflake schema have been the disk and memory requirements of storing redundant data. This is no longer a concern thanks to Oracle's Advanced Compression features available today that optimize the storage for data on disk as well as data in memory.

If this new data model is made available for a non-HANA database, "HANA-Optimized InfoCubes" is obviously not an appropriate name. "SAP BW Flat InfoCubes for Oracle" or simply "SAP BW Flat Cubes for Oracle" is exactly the same data model, called by a different name. It requires Oracle Database 12c or

higher and Oracle Database In-Memory, as Flat Cubes outside of the Column Store do not make any sense.

Flat Cubes for SAP BW on the Oracle Database is generally available since June 2016. For more information see SAP Note 2335159.

### Flat InfoCubes: Implementation Tools

As Oracle Database In-Memory provides the same functionality as SAP HANA, SAP and Oracle jointly developed support for Flat InfoCubes on Oracle Database In-Memory. The Flat InfoCubes support includes an extension of the SAP-provided *Partitioning Tool*, which (in addition to its original purpose: table partitioning) may now also be used by system/database administrators to convert traditional InfoCubes to Flat InfoCubes.

No other tool (in particular: no tool provided by Oracle) is needed. If customers want to convert non-flat to flat cubes, the Partitioning Tool is sufficient. And it is easy to use: Just select the cube you want to convert. The tool then transforms the tables and determines which of them should be kept in memory.

Special cases:

- If you want to convert a large number of InfoCubes, you can use program RSDU\_IC\_STARFLAT\_MASSCONV for mass conversion (see SAP Note 2523154).
- Conversion of Semantically Partitioned Objects to a flat format is supported as well. However, only SPOs that consist of InfoCubes can be converted, SPOs consisting of DataStore Objects cannot (see SAP Note 2711358).

This may sound like a complete set of technologies and tools, but one element was missing: While customers were able to implement Flat InfoCubes in an existing SAP BW on Oracle system easily, there was no easy way for those customers who wanted to migrate SAP BW on HANA to SAP BW on Oracle. An important step of such a SAP BW migration (a.k.a. heterogeneous system copy) is the report *SMIGR\_CREATE\_DDL*. It is run in the source system, and it creates DDL (in particular: CREATE TABLE) statements for non-standard objects. The output is then used to build the target system.

If a BW system is migrated from AnyDB/Oracle to HANA, traditional InfoCubes are by default converted to Flat InfoCubes. *SMIGR\_CREATE\_DDL* knew very well that these new InfoCubes were non-standard objects, but it was neither aware of Oracle's support for Flat InfoCubes, nor did it know the SQL syntax used to build Flat InfoCubes in the Oracle Database.

The missing information was recently added, and as of December 2020, the enhanced *SMIGR\_CREATE\_DDL* report is generally available. Details can be found in SAP Note 2948714.

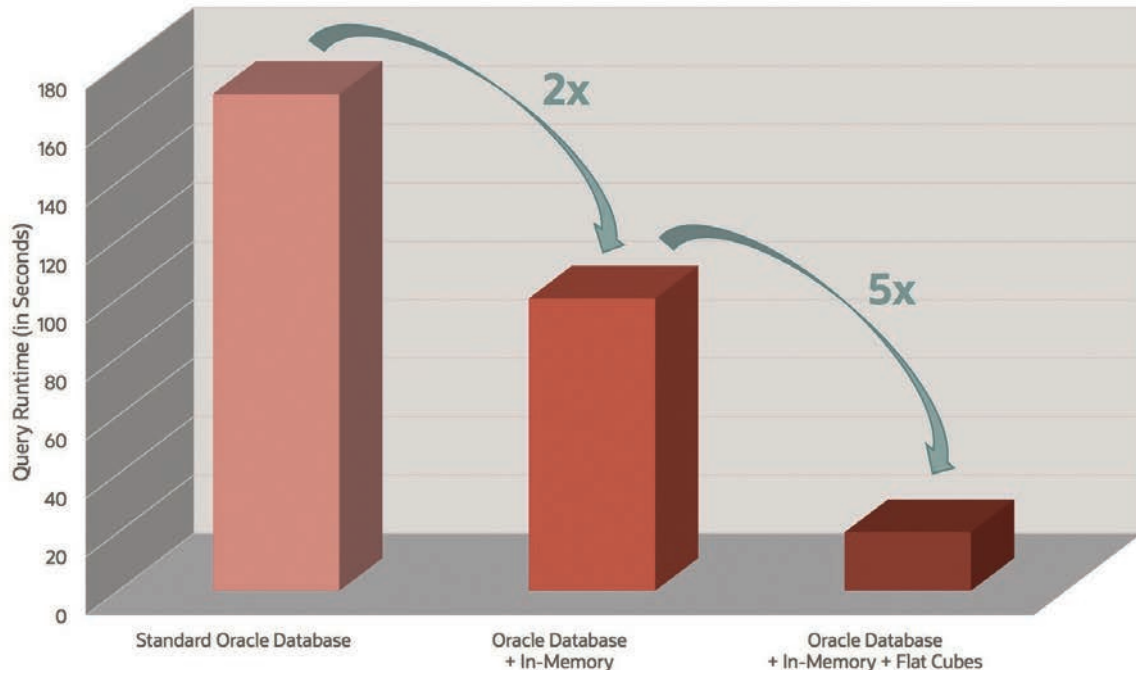


Figure 4: Performance gains with Oracle Database In-Memory and Flat Cubes for SAP BW

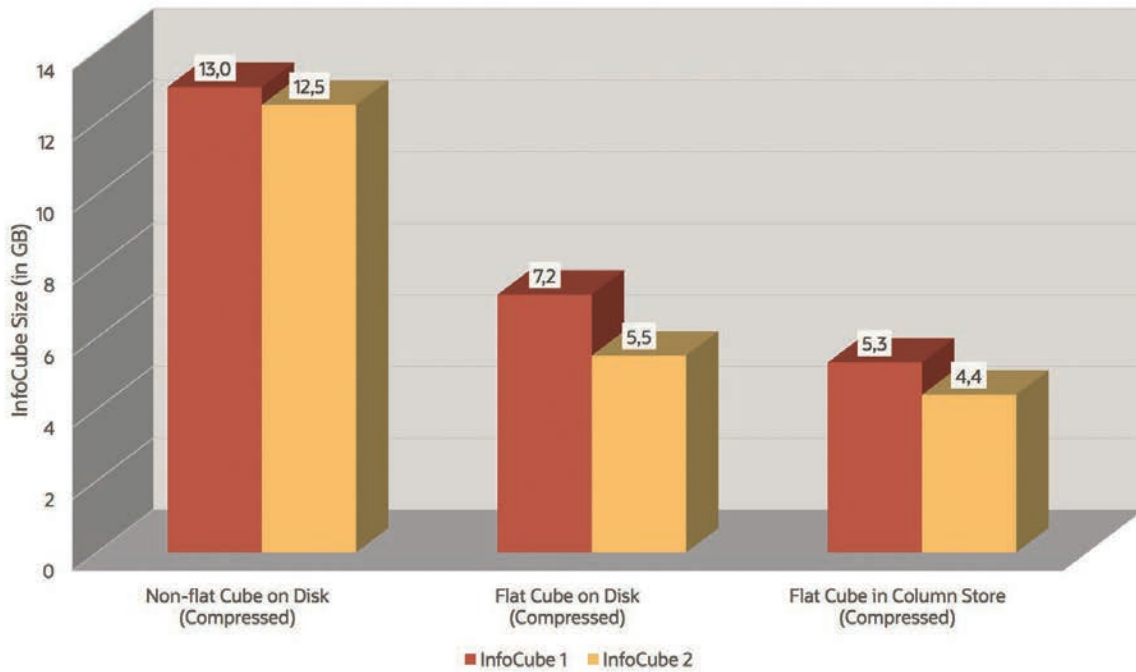


Figure 5: Disk space and memory consumption without and with Flat Cubes for SAP BW



## Oracle Database Features: Deferred Compression and Information Lifecycle Management

Some of the new features in Oracle Database 12c Advanced Compression have already been discussed in the “Base Certification Features” and “Base Certification and Application Optimization” sections. However, two major new features are still missing, because they were not included in the base certification, but certified a few months later for SAP environments: Heat Map and Automatic Data Optimization (ADO). The basic concepts behind these two features are discussed in the article “Implementing a Data Management Infrastructure for SAP with Oracle Database Options and Packs” (see in particular the section “Advanced Compression (Oracle Database 12c and higher)”, page 19). Therefore, we will briefly look at the SAP-specific implementation details.

Oracle Database 12c Advanced Compression allows customers to distinguish between current (“hot”) and historical (“cold”) data. However, it is not clear what exactly the words “hot” and “cold” mean. So this needs to be defined:

```
ALTER TABLE <table_name> ILM ADD POLICY
<action>
AFTER <n> DAYS OF NO MODIFICATION;
```

The third line of this SQL statement answers the question. New data is considered “hot”. If it turns out that they have not been modified for a certain number of days (30, 60, 90 days), they are considered “cold” – assuming that the customer does not want to define intermediate levels such as “warm”. But if we look closer, we find that the only question that has been answered so far is: When do we call data “cold”? What we still do not know (and what the database system still does not know) is: If data have cooled down – then what? What should happen? This is to be defined in line 2:

```
ALTER TABLE <table_name> ILM ADD POLICY
ROW STORE COMPRESS ADVANCED ROW
AFTER 40 DAYS OF NO MODIFICATION;
```

In this example we assume that (in this particular table) hot data is not compressed at all, and we tell the system that (a) any data not modified for 40 days should be considered cold and that (b) cold data should be compressed using the table compression algorithm provided by Oracle Database Advanced Compression.

How do we, and how does the system know that data have not been modified for 40 days? It is the job of Heat Map to provide this kind of information. Heat Map automatically tracks modification and query timestamps at the row and segment levels, providing detailed insight into how data is being accessed. *Automatic Data Optimization (ADO)*, then, automatically moves and compresses data according to user-defined policies (such as that which we have used here as an example) based on the information collected by Heat Map.

So far the ALTER TABLE statement has been used to define the ILM policy. In SAP systems where we have to deal with tens of thousands of tables, this approach would be very cumbersome. Therefore the BR\*Tools (BRSPACE) use a different option provided by the Oracle Database:

```
ALTER TABLESPACE TSX DEFAULT ILM ADD POLICY
ROW STORE COMPRESS ADVANCED ROW
AFTER 40 DAYS OF NO MODIFICATION;
```

In this example we do not define a special policy for an individual table, but a default policy on the tablespace level. It is automatically applied to all tables created in this tablespace, unless a table comes with an individual policy.

Customers running Oracle Database 12c or higher on Oracle Engineered Systems such as Exadata can benefit from Hybrid Columnar Compression – a set of compression algorithms designed for purely historical data as an alternative to archiving. If Advanced Compression compresses data by a factor of 2 or 3, Hybrid Columnar Compression can easily achieve compression factors of 10 or 15.

In this situation, we would call data not modified for 40 days “warm”, and we would reserve the word “cold” for data not changed during a considerably longer period (e.g. 6 or 12 months). We would keep the previous policy as compression tier 1 (for warm data) and add an additional policy as compression tier 2 (for cold data). And we would separate unpartitioned and partitioned tables in different tablespaces, because Hybrid Columnar Compression compresses complete partitions instead of individual blocks:

```
ALTER TABLESPACE TSY DEFAULT ILM ADD POLICY
ROW STORE COMPRESS ADVANCED ROW
AFTER 40 DAYS OF NO MODIFICATION;
ALTER TABLESPACE TSY DEFAULT ILM ADD POLICY
COLUMN STORE COMPRESS FOR QUERY LOW ROW
LEVEL LOCKING SEGMENT
AFTER 6 MONTHS OF NO MODIFICATION;
```

## Oracle Database Option: Oracle Multitenant

Oracle Multitenant helps customers reduce IT costs by simplifying consolidation, provisioning, upgrades, and more. It is supported by an architecture that allows a container database (CDB) to hold and manage many pluggable databases (PDBs) (see article “Implementing a Data Management Infrastructure for SAP with Oracle Database Options and Packs”, in particular section “Oracle Multitenant”, page 24).

With Oracle Multitenant, multiple existing databases may be converted to PDBs and consolidated into a single CDB. A PDB is a self-contained, fully functional Oracle Database. From an application’s point of view nothing has changed in any way, and that’s very important because it means that no application changes are required to adopt this architecture. From an application’s point of view, the PDB is the database. However, from an operational point of view the CDB is the database.

The CDB represents a single, consolidated operating environment. There is a single set of background processes and a single shared memory area (SGA), shared by all of the PDBs in the CDB. This architecture eliminates replication of overheads, making most efficient use of available resources. What this means is that you can minimize capital expenses (CapEx) because you can consolidate more applications per server. From an operational perspective, you can manage all these consolidated PDBs collectively, greatly reducing operating expenses (OpEx). This applies to things like backups, configuration of high availability, application of patches and upgrades. These CapEx and OpEx reductions are part of how Multitenant delivers on the promise of Cloud computing.

Oracle Multitenant is the architecture for the next-generation Database Cloud. Multitenant delivers true *economies of scale*. The expensive model of a VM containing a database is replaced by a pluggable database (PDB). Because there is negligible intrinsic cost to a PDB, the cost of each SAP system’s PDB is reduced to the actual work they do.

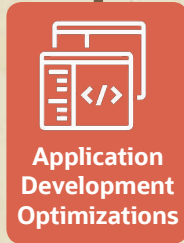
The Oracle Multitenant architecture can be used for all SAP NetWeaver-based applications with the only exception that a mix of SAP OLAP (BW) and SAP OLTP (ERP, CRM, ...) systems in the same container database is not supported. For database administrators, the following tool support is available:

- As of version 1.0 SP 19, SWPM supports the creation of container databases (CDBs) and pluggable databases (PDBs). SWPM must be used for these tasks in order to guarantee compatibility of the created databases (directory paths, file names, etc.) with BR\*Tools. For details see SAP Note 2336881.
- In most cases, customers will not create new databases, but convert existing stand-alone (non-CDB) databases to pluggable databases. SAP Note 2335850 describes the supported procedure for this kind of transformation.
- As of version 7.40 patch 24, BR\*Tools support Oracle Multitenant. New configuration parameters, commands, and command options allow administrators to specify the target database(s) for operations initiated via the familiar BRCONNECT, BRSPACE, BRBACKUP/BRARCHIVE or BRRESTORE/ BRRECOVER commands.



# Oracle Database Support for SAP Application Optimizations

Use optimizations designed for HANA with Oracle Database



## CDS-based Development

Build your own Fiori applications based on CDS views

**White Paper:**  
ABAP Core Data Services.  
Best Practices Guide \*

**NetWeaver Documentation:**  
“ABAP CDS in ABAP  
Dictionary” \*\*

**Core Data Services (CDS)**  
Push data-intensive computations to database layer



## FEMS Pushdown

Push complete FEMS queries to database layer

**White Paper:**  
ABAP Core Data Services.  
Best Practices Guide \*

**SAP Note 2801989:**  
SQL Macros-CDS Views  
with Parameters

**SAP Note 2816467:**  
Support for FEMS Pushdown  
on Oracle

**Flat Cubes**  
Optimize SAP BW InfoCubes for In-Memory Computing



## Declustering/Depooling

Convert clustered/pooled tables to transparent tables

**SAP Note 2335159:**  
Flat Cubes for SAP BW on  
Oracle Database

**SAP Note 2711358:** Conversion of Semantically Partitioned Objects to Flat Format

**SAP Note 1835008:** Activate Database Performance Optimizations for SAP ERP

**SAP Note 1892354:**  
SAP Strategy for Cluster and Pool Tables

## IMPLEMENTING A DATA MANAGEMENT INFRASTRUCTURE FOR SAP WITH ORACLE DATABASE OPTIONS AND PACKS

### Introduction

#### Database Editions

Oracle Database is available in five editions, each suitable for different development and deployment scenarios. However, only Oracle Database Enterprise Edition is certified and supported in SAP environments, as SAP applications are very demanding and cannot be run efficiently without the enterprise computing features provided by Oracle Database Enterprise Edition.

#### Database Options and Management Packs

In addition, Oracle offers several database options, management packs, and other products that enhance the capabilities of Oracle Database for specific purposes. They extend the power of Oracle Database Enterprise Edition to meet customer- or application-specific requirements in the areas of efficient use of disk space, performance and scalability, high availability, security and compliance, data warehousing, big data, and manageability.

#### Options and Packs in SAP Environments

This article is about database options and management packs for SAP customers. There are some differences between a pure Oracle Database and an Oracle Database for SAP perspective:

- Even if an option is certified, the use of some of its features may not be permitted. As this is an overview article, not all details can be discussed. If in doubt, check SAP Note 105047.

- Due to peculiarities of the SAP data model or application design, an Oracle Database option or management pack may not be optional, but required. E.g. SAP Business Warehouse (BW) on Oracle Database requires Oracle Partitioning.
- From a pure Oracle perspective, an option or pack is licensed separately. However, an Oracle Database Enterprise Edition license bought from SAP (ASFU) already includes some (but not all supported) options and packs without additional payment. For details see SAP Note 740897.

#### Structure and Infrastructure

As we said before, database options extend the power of Oracle Database Enterprise Edition in the areas of efficient use of disk space, performance and scalability, high availability, security and compliance, data warehousing, big data, and manageability. In this article, however, we will focus on one single aspect: *Database options help implement structure*. When the amount of data in one single database grows, when data coming from different sources or even multiple, previously independent databases are consolidated in one single data management infrastructure (as in Oracle Multitenant), the unstructured mass of data will become unmanageable at a certain point. Therefore consolidation requires differentiation. Or: *Infrastructure requires structure*.

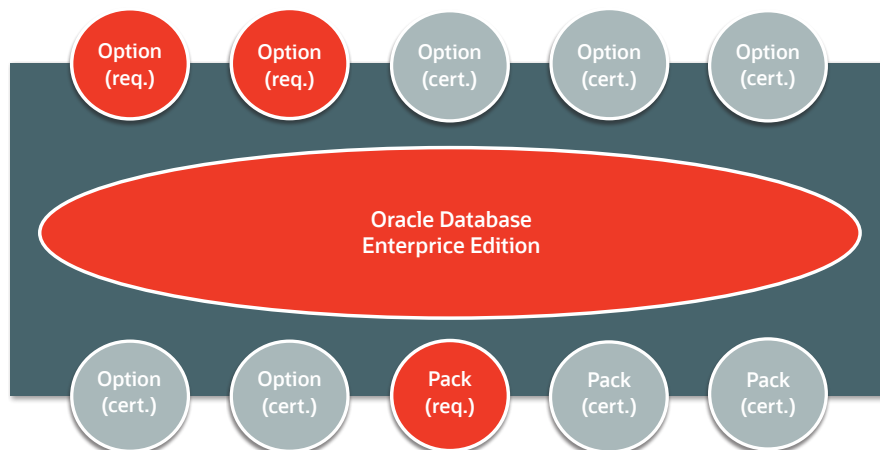


Figure 1: Structure and infrastructure



## Table and Index Partitioning

Challenge: In more and more situations today the distribution of the data on disk turns out to be a problem:

- (a) Single queries or complex batch jobs accessing a certain subset of the table data need too much time to complete.
  - (b) Data load (SAP BW) is either slow, because it must update many indexes; or indexes are dropped and rebuilt, in order to reduce load time, but this slows down user queries.
  - (c) Data archiving results in heavily fragmented databases.
  - (d) Customer wants to implement information lifecycle management Advanced Compression (Oracle Database 12c)
- Value Proposition: Oracle Partitioning divides tables and indexes into smaller units (called partitions) and forces all data to be stored in the appropriate unit. Partitions can be accessed and managed individually and independently from each other. Therefore:
- (a) Ideally a query now finds all relevant data in one single partition and can ignore all other partitions („partition pruning“). This can reduce the runtime considerably.

(b) If the indexes defined on a partitioned table are partitioned as well, individual index partitions can be dropped and rebuilt while all other partitions remain untouched.

(c) The data archiving strategy can be based on the partition structure, and this can avoid disk space fragmentation.

(d) Partitioning is one of the basis technologies for information lifecycle management.

**Certification/Support:** Oracle Partitioning is certified for all SAP NetWeaver applications.

**Versions:** Oracle Database 11g and higher

**Implementation:** Partitioning (range partitioning) is configured and used by default in SAP BW on Oracle. In SAP OLTP systems, it can either be implemented by customers themselves or by Oracle ACS for SAP.

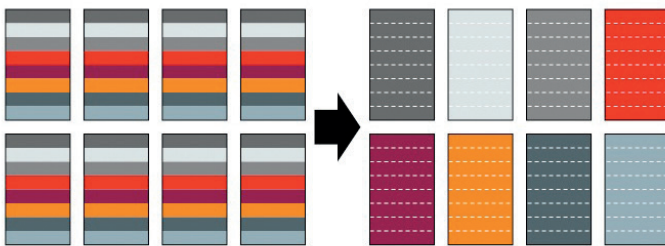


Figure 2: Table Partitioning – Physically store subsets of related data as closely together as possible

Figure 2 explains why storing related data as closely together as possible makes such a difference. It shows database blocks filled with records. The different colors represent criteria such as different months or different locations. And we assume that the applications accessing those data in most cases want to retrieve all records having the same color.

Under these circumstances, the situation shown on the left hand side is the worst that can be imagined: Each database block contains one record of each color. Or, to put it differently, all subsets of records having the same color are distributed over all blocks. This is the worst possible situation from an I/O perspective (a query looking for all records of a certain color needs to read 8 blocks), from a memory perspective (even if all users work with records of the same color, all 8

blocks need to be cached completely in database memory), therefore from a performance perspective (too much I/O means unsatisfactory performance), from a database administration perspective (subsets of records having the same color cannot be managed independently), and from an ILM perspective (“hot” and “cold” data cannot be separated).

The situation shown on the right hand side, in contrast, is optimal (again: under the circumstances described above):

All records having the same color are now stored together in one and the same database block. This is optimal from an I/O perspective (a query looking for all records of a certain color needs to read only 1 block), from a memory perspective (if all users work with records of the same color, only 1 block needs to be cached in database memory), therefore from a performance perspective (significantly less I/O means significantly better performance), from a database administration perspective (subsets of records having the same color can be managed independently), and from an ILM perspective (“hot” and “cold” data can be separated).

Now, multiply the number of records and blocks shown on figure 2. Then a partition is the subset of all blocks containing records of the same color.

## Advanced Compression (Oracle Database 11g and higher)

**Challenge:** In more and more cases today the size and the expected future growth of the database becomes a problem. Aspects of this problem include: Storage cost, performance guarantees (SLAs), cloning and backup of database files within a reasonable time.

**Value Proposition:** Oracle Advanced Compression uses a different format for storing table data. Together with other compression technologies, which come with Oracle Database Enterprise Edition (e.g. Index Key Compression), it helps reduce the database size by 50% or more. This is *the essential* benefit in the sense that this is the effect Advanced Compression is designed for. The benefit from a smaller source database footprint is that the creation of backups and other copies will require less time.

As an *additional* benefit customers using Advanced Compression may see a performance improvement. Additional (as opposed to essential) here means: It may, but it is not guaranteed to happen.

**Certification/Support:** Oracle Advanced Compression is certified for all SAP NetWeaver applications. Implementations are supported by SAP.

**Implementation:** Oracle Advanced Compression can be implemented easily in SAP environments, as SAP provides the tool BRSPACE, which is aware of all SAP-specific requirements. For details check SAP Note 1431296.

On the left-hand side, figure 3 shows a typical Oracle Database which forms an integral part of an SAP (in this case: SAP ERP) system. Approximately one third of the allocated disk space is used for indexes (red), and two thirds contain table data (blue). Table data in turn can be divided into structured data (organized in columns) and unstructured data (PDF or image files, table data „clustered“ by SAP).

Oracle Database 11g and higher can compress all three types of data:

- *Index Key Compression* is available for indexes. *Index-Organized Tables (IOTs)* can be compressed as well. Both features are included in Oracle Database Enterprise Edition, and do not require Advanced Compression.
- *OLTP Compression*, a major feature of Advanced Compression, can be used to compress structured table data. It is not restricted to OLTP systems, but can be implemented in SAP BW systems as well.
- *SecureFiles Compression* (an Advanced Compression feature, too) can be used to compress unstructured table data.

If all features are implemented and all appropriate database objects are compressed, customers have seen 55% disk space savings on average. (This assumes a completely reorganized database. If a fragmented database has not been reorganized, the effects of reorganization and compression are combined, in which case customers have seen up to 80% disk space savings).

The maximum disk space savings which can be achieved depend on the characteristics of the data, and the data characteristics depend on the SAP applications used. Usually SAP BW data can be compressed more efficiently than SAP ERP data, and SAP CRM data permit even higher disk space savings.

Oracle Database Advanced Compression offers more than OLTP and SecureFiles compression. Backup files created by RMAN and export files created by Data Pump can be compressed substantially, even if tables and indexes in the production database are already compressed. Additionally, redo log data can be compressed as well before being shipped from the production to a standby database (see the Data Guard section in this article).

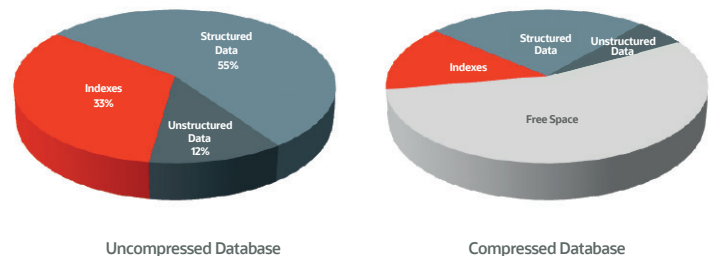


Figure 3: Oracle Database 11g Index Key Compression and Advanced Compression (OLTP Compression, SecureFiles Compression)

## Advanced Compression (Oracle Database 12c and higher)

**Challenge:** (a) Data compression in Oracle Database 11g has several limitations. In particular, tables having more than 255 columns cannot be compressed.

(b) Data load is slowed down, if target tables are compressed.

(c) No support for automated Information Lifecycle Management.

**Value Proposition:** Oracle Database 12c Advanced Compression lifts the 255-columns limitation and allows more tables to be compressed. Completely new features (Heat Map, Automatic Data Optimization) enable customers to implement deferred data compression and sophisticated Information Lifecycle Management (ILM) strategies.

**Certification/Support:** The Oracle Advanced Compression features introduced with Oracle Database 12c are certified for all SAP NetWeaver applications.

**Implementation:** See SAP Note 2258061 – Enhancements for ADO/ILM for table conversions or system copy.

**Related Feature:** Oracle Database 12c Hybrid Columnar Compression (which is not included in Advanced Compression, but is a feature available on Oracle's Engineered Systems) provides stronger compression algorithms particularly suited for "cold" (i.e. historical) data. HCC (with row-level locking) can be used in SAP environments.

### Limitations removed

In Oracle Database 11g, the index and table compression features have several limitations. That is why Oracle Database 12c Advanced Compression offers a new, more efficient index compression algorithm (Advanced Index Compression) and increases the maximum number of columns for tables to be compressed. For details see the article "Oracle Database 12c for SAP – Roadmap and Base Certification Features."

### Heat Map and Automatic Data Optimization

In addition to those improvements, Oracle Database 12c Advanced Compression comes with two completely new features. *Heat Map* automatically tracks modification and query timestamps at the row and segment levels, providing detailed insights into how data is being accessed. *Automatic Data Optimization (ADO)* automatically moves and compresses data according to user-defined policies based on the information collected by Heat Map.

### Deferred Compression

Based on the information provided in the *Advanced Compression (Oracle Database 11g)* section, it might seem that compression simply reduces the disk space needed, and has nothing to do with database structure. This is an illusion. Even in Oracle Database 11g, we need to distinguish between tables that benefit and tables that do not benefit from compression (if this were not the case, compression could be made the default), i.e. between tables that should and tables that should not be compressed.

Nevertheless, this is still a very basic and inflexible distinction. Take, e.g., an SAP BW table that is used for data load. On the

one hand, such a table *could* be compressed, because for most of the time it is accessed in read-only mode. On the other hand, it *should* not be compressed, because this would slow down the load operations considerably. In Oracle Database 11g the recommendation is: Do not compress such a table.

Heat Map and Automatic Data Optimization allow you to introduce a new differentiating parameter: If a table or partition should be compressed, *when* would you like it to be compressed? In Oracle Database 11g compression happens immediately or not at all. In Oracle Database 12c and higher you can specify that data should be loaded today and (automatically) compressed tomorrow.

### Information Lifecycle Management

Even more parameters can be introduced thanks to the new features in Oracle Database 12c Advanced Compression. One of them is location. When you have "hot" (current) and "cold" (historical) data in your database, and you have two different types of storage, too, then you can ask the question: *Where?* Where would you like which data to be stored?

Using Partitioning in addition to Advanced Compression, you can – or rather: you can have the system – move data from one tablespace (= storage tier) to another, when they "cool down", thus freeing up space on a more expensive storage tier for more important ("hot") data. This is called (*automatic storage tiering*

### Hybrid Columnar Compression (HCC)

Finally, if you run Oracle Database 12c or higher on Oracle Exadata, you can introduce the question: *How?* How, i.e. using which algorithm, do you want data to be compressed? Where would you like which data to be stored?

	Oracle Database 11g	Oracle Database 12c
Partitioning	Certified	Certified
Basic Table & Index Compression	Certified	Certified
Hybrid Columnar Compression	Not Certified	<b>Certified</b> (Prerequisite: ADO)
Tool Support for Identifying Relevant Objects	None	<b>Heat Map</b> (requires ACO)
Tool Support for Storage/Compression Tiering	None	<b>Automatic Data Optimization</b> (= ADO; requires ACO)

Figure 4: Oracle Database 12c Advanced Compression – Support for Information Lifecycle Management (ILM)

In addition to OLTP and SecureFiles Compression, these Engineered Systems support Hybrid Columnar Compression. As the name implies, this technology utilizes a combination of both row and columnar methods for storing data. This hybrid approach achieves the compression benefits of columnar storage, while avoiding the performance shortfalls of a pure columnar format. The compression ratios that can be achieved by using HCC are much higher than those seen with “normal” compression. Therefore HCC is particularly suited for “cold” data.

Due to the missing row-level locking feature, it had not been possible to certify Oracle Database 11g Hybrid Columnar Compression for use in SAP environments. In Oracle Database 12c and higher, however, this feature is available on Oracle Exadata and Oracle SuperCluster. On this machine it is now possible to implement (*automatic*) *compression tiering*. This means that, while “hot” data remain uncompressed, “warm” data may be compressed using the standard compression algorithms (Advanced Compression) and “cold” data using Hybrid Columnar Compression.

## Oracle Database In-Memory

**Challenge:** In more and more systems, meeting analytics performance requirements turns out to be a challenge. This is true for long-running queries in BW. However, it can also happen in OLTP systems, e.g. if a very flexible implementation of operational planning/reporting allows users to create many, slightly different query variants.

**Value Proposition:** Oracle Database 12c In-Memory allows administrators to dedicate a certain amount of database server memory to the Column Store – a memory structure

that stores data in column format instead of in row format. Setup of the Column Store is fast and easy. Having data available in column format can improve query performance substantially.

**Certification/Support:** Oracle Database In-Memory is certified for all SAP NetWeaver applications.

**Versions:** Oracle Database 12c and higher

**Implementation:** For an overview and pointers to more detailed documents see SAP Note 2178980.

### Memory: The New Dual-Format Architecture

Oracle Database has traditionally stored data in a row format. This format is ideal for *online transaction (OLTP)* systems, as it allows quick access to all columns in a record. A *column format* database stores each of the attributes about a transaction or record in a separate column structure. This format is ideal for *analytics*, as it allows for faster data retrieval when only a few columns are selected but the query accesses a large portion of the data set.

But what happens, when your system is characterized by a mixed workload? Up until now you have been forced to pick just one format and suffer the trade-off of either sub-optimal OLTP or sub-optimal analytics performance. The only way to optimize for both OLTP and analytics had been to copy data from OLTP systems to analytic systems using complex ETL processes that add a great deal of expense and latency.

Oracle Database In-Memory optimizes both analytics and mixed workload OLTP, delivering outstanding performance for transactions while simultaneously supporting real-time-analytics, business intelligence, and reports. This breakthrough



capability is enabled by the dual format architecture of Oracle Database In-Memory. This architecture eliminates the trade-off by representing tables simultaneously using traditional row format and a new in-memory column format. The Oracle SQL Optimizer automatically routes analytic queries to the column format and OLTP transactions to the row format, transparently delivering best-of-both-worlds performance. Oracle Database automatically maintains full transactional-consistency between the row and the column formats, just as it maintains consistency between tables and indexes today.

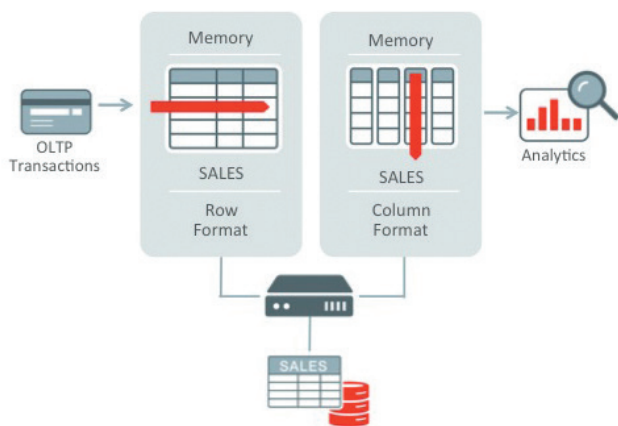


Figure 5: Oracle Database In-Memory – Dual memory format, single disk format

### Disk: Nothing Has Changed

The new column format is a pure in-memory format. Tables are stored on disk using Oracle's existing row-based (or – on Engineered Systems – hybrid columnar) formats. Since there is no persistent columnar storage format, there are no additional storage costs or storage synchronization issues. Nor is there a need to modify the database. Oracle Database In-Memory can be implemented without a database migration or a table reorganization.

As a result, the new Oracle Database In-Memory feature is fully compatible with existing standard or optional database features such as table and index compression, table encryption and table partitioning. It is also compatible with the scale-out architecture provided by Real Application Clusters (RAC) and with all existing high availability technologies (such as Data Guard). These features work exactly the same way with and without Oracle Database In-Memory.

### Easy to Implement and Manage

In addition to being compatible at the database feature and application level, Oracle Database In-Memory is easy to implement and manage. Enabling Oracle Database In-Memory

is easy as setting the size of the in-memory column store and identifying tables or partitions to bring into memory. Background processes populate data from storage into in-memory columns while the database remains fully active and accessible.

### Fine-Grained Control

An easy start based on intelligent defaults for typical situations – this is what Oracle customers expect. In addition, however, Oracle customers expect mechanisms, which allow for fine-grained control and tuning. Oracle Database In-Memory provides such mechanisms. Examples are:

- Tables can contain “cold” data, which are neither up-dated anymore nor accessed by queries. If those tables are very large, it would be a waste of memory to keep them completely in the in-memory column store. Therefore administrators may want to restrict the population process to the data really needed by DSS queries. Table partitioning allows them to make this happen. If the table is partitioned in a useful way (e.g. by month), this internal structure can be used to define a *horizontal* subset of the table data to be kept in the in-memory column store.
- One or several table column(s) may contain data that are not relevant for DSS queries. Again the database administrator may wish to restrict the data to be kept in the in-memory column store, but in this case the goal is to define a vertical subset of the table data, i.e. to exclude one or more columns from the population process. And again it is possible to make this happen, because Oracle Database In-Memory allows administrators to specify different in-memory characteristics for different table columns.
- The Oracle Database has been optimized and tuned for decades to scale-up on SMP servers. Large SMP servers are well suited for in-memory workloads, too, because all memory is accessible to all processors over an extremely high speed Back-Plane. In addition to being able to scale up, Oracle Database In-Memory can also scale out to very high memory and CPU capacities by using all of the memory and processors in a cluster of servers (RAC). In such environments, all objects populated into memory will by default be *distributed* across all in-memory column stores in the cluster. On Oracle Engineered Systems, objects can also be *duplicated*. This means that an object (or part of an object, e.g. a partition) populated into the in-memory column store will have a mirrored copy placed on one of the other nodes in the RAC cluster. Duplicating data provides in-memory fault tolerance as it ensures data is still accessible via the in-memory column store even if a node goes down or is taken down for maintenance.

## Real Application Clusters (RAC)

**Challenge:** When the workload on a database server increases (due to new application versions, additional applications, or more users), the traditional solution is to replace the existing server with a bigger one (scale-up). Big servers, however, are very expensive.

In order to guarantee high availability of the database server, traditionally a failover cluster is implemented. Such a solution, however, has at least two disadvantages:

- (a) A failover cluster relies on the concept that, at any given moment, only one database instance running on one machine can be active. The other machine (most probably an expensive server, too) is always idle.
- (b) When a problem on the primary machine is detected, an Oracle Database Server instance needs to be started on the secondary machine. In this particular situation, startup can take up to 30 minutes – which means: up to 30 minutes unplanned downtime.

**Value Proposition:** Real Application Clusters (RAC) allows multiple instances to be up and running and to access the same database at the same time. As these instances can and in most cases do run on different machines, customers have the option to implement a

scale-out approach: 4, 6, or 8 small servers can handle the same workload as one big server. However, they are much cheaper. And they can be added as needed.

In this architecture, all Oracle instances are up and running at the same time. Therefore no restart is required. If one of the RAC servers fails, the other instances can take over. A reconnect of the affected users is a matter of seconds, not of minutes.

To summarize all this in a few words: The value proposition of Oracle Real Application Clusters combines workload distribution, scalability, high availability, better manageability, and cost savings.

**Certification/Support:** Oracle Real Application Clusters is certified for all SAP NetWeaver applications.

**Versions:** Oracle Database 11g and higher

**Implementation:** Customers can use any general-purpose machine (Unix, Linux, or Windows) certified by SAP to build a RAC system. In addition, Oracle offers Engineered Systems (Exadata, SuperCluster), which make the implementation considerably easier. Oracle Grid Infrastructure provides a set of base technologies that simplify implementation and help save money.

Figure 6 illustrates the RAC benefits which have been mentioned before:

**Scalability:** Using RAC, the scale-out approach, which is always supported on the SAP Application Server level, can be

implemented on the database level too. In this example, 5 SAP Application Server instances, running on 5 different machines, are connected to 4 Oracle Database Server instances, running on 4 different machines.

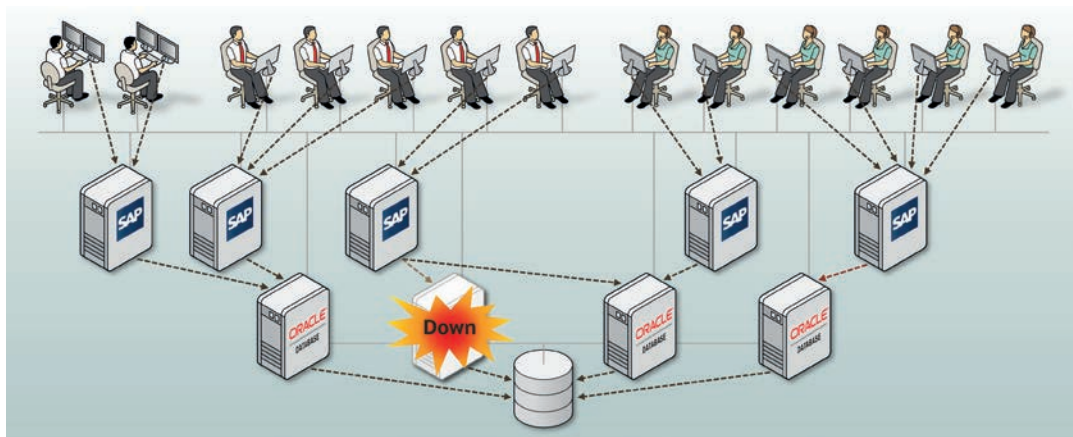


Figure 6: Real Application Clusters (RAC) for scale-out and immediate (instance) failover

High Availability: If one of the Oracle instances goes down, the affected SAP instance(s) is/are automatically reconnected to one of the available Oracle instances. After this operation users can continue their work. The failover occurs within seconds.

*Oracle Grid Infrastructure* provides the base technologies that are required to enable RAC. It can be divided into two main components:

- In order to let multiple Oracle instances access the database files at the same time, a cluster file system is needed. Therefore Oracle provides *Oracle Automatic Storage Management (ASM)*. Unlike other, third-party cluster file systems, it is optimized for Oracle Database files, and it is available for free.
- *Oracle Clusterware* is the cross-platform cluster software required to run the RAC option for Oracle Database. It enables the nodes to communicate with each other, allowing them to form a cluster of nodes which behaves as a single logical server. Similar to Oracle ASM, which eliminates the need for a third-party cluster file system, Oracle Clusterware eliminates the need for third-party cluster management software.

Oracle Clusterware can provide high availability and resource management for SAP resources just as it does for Oracle resources. Therefore Oracle/SAP Development has created an Oracle Clusterware tool, *SAP Control (SAPCTL)*, to enable customers to easily manage SAP high availability resources.

## Data Guard and Active Data Guard

**Challenge:** RAC provides high availability by multiplying the number of Oracle instances. Such high availability, however, is restricted to the instance level. Even in a RAC-based system, the database remains a single point of failure. This means that DBA errors, data corruption, server or data center failures can make the whole system unavailable.

**Value Proposition:** Data Guard removes this single point of failure. The technology allows customers to set up a standby (shadow) database as a copy of the primary (production) database and then keep the two databases synchronized. Please note that *Data Guard* is included in Oracle Database Enterprise Edition. It is not an option.

However, *Active Data Guard* is an option. In Oracle Database 11g it offers additional features such as Automatic Block Repair and Fast Incremental Backup.

Active Data Guard Far Sync, the main new feature with Oracle Database 12c, allows customers to combine high performance (a characteristic of asynchronous log shipping) and zero data loss (a characteristic of synchronous log shipping).

**Certification/Support:** Oracle *Data Guard* is certified for all SAP NetWeaver applications. However, only physical standby databases are supported, logical standby databases are not.

*Oracle Active Data Guard* is certified for all SAP NetWeaver applications. However, Real-Time Query is not possible in SAP environments, because even report generation is not a read-only operation.

**Versions:** Oracle Database 11g and higher

**Implementation:** Standard Oracle setup procedures apply. In the white paper "Oracle Standby Database" SAP describes BR\*Tools support.

Data Guard can provide both zero data loss protection and near-immediate restoration of service should a production database become unrecoverable for any reason. This is accomplished using the combination of Data Guard synchronous redo transport and a replication-aware apply process at the standby database. The impact that any synchronous replication method can have on database

performance, however, often makes it impractical to implement zero data loss protection when large distances separate the primary and replica database(s). Rather than impact database performance, many enterprises will compromise on data protection by implementing asynchronous replication and accept that an unrecoverable outage will result in varying degrees of data loss.

Active Data Guard Far Sync, a new capability with Oracle Database 12c, eliminates the need to compromise by extending zero data loss protection to a replica database located at any distance from the primary database. Far Sync provides zero data loss protection for a production database by maintaining a synchronized standby database located at any distance from the primary location, and can do so without performance impact and with minimal cost or complexity. A new type of Data Guard destination called a far sync instance receives changes synchronously from a primary database and forwards them asynchronously to a remote standby. Production can be quickly failed over, manually or automatically, to the remote standby database with zero data loss.

A far sync instance is a light-weight entity that manages only a control file and log files. It requires a fraction of the CPU, memory, and I/O of a standby database. It does not have user data files, nor does it run recovery. Its only purpose is to transparently offload a primary database of serving remote destinations. A far sync instance can save network bandwidth by performing transport compression using Oracle Advanced Compression.

Take for example an existing asynchronous Data Guard configuration with a primary in Boston and a standby in San Francisco. Upgrade to zero data loss simply by using Active Data Guard to deploy a far sync instance within synchronous replication distance of Boston (less than 150 miles). There is no disruption to the existing environment nor is there any requirement for proprietary storage, specialized networking, more database licenses, or complex management.



Figure 7: Active Data Guard Far Sync – High performance, zero data loss across large distance WAN

### Oracle Multitenant

**Challenge:** Many SAP landscapes consist of a few large and a considerable number of small or very small systems. However, the existence of many small SAP systems based on as many independent database servers has several disadvantages:

- Many small systems (even virtualized ones) use too many hardware resources (memory, CPU)
- Too much time is spent for the administration of so many small database systems

**Value Proposition:** Oracle Database Multitenant introduces a new architecture that enables customers to easily consolidate multiple databases, without changing

their applications. This new architecture delivers all the benefits of managing many databases as one, yet retains the isolation and resource prioritization of separate databases. Oracle Multitenant reduces resource consumption by separating “container” and “pluggable” databases. It simplifies administration by moving standard operations to the “container database” level.

**Certification/Support:** Oracle Multitenant can be used in SAP environments.

**Version:** Oracle Database 12c and higher

**Implementation:** For more information please see SAP Notes 2336881, 2335850, and 2333995.

### Consolidation Approaches

Large enterprises may use hundreds or thousands of databases. Often these databases run on different platforms on multiple physical servers. A database may use only a fraction of the

server hardware capacity. This is an expensive approach which fails to maximize the usage of both the hardware and human resources.



A typical response to the management problem is to place *multiple databases on each server* (either as direct installs or using virtual machines). The problem is that the multiple database instances do not share background processes, system and process memory, or Oracle metadata. Another response is to *logically separate the data into schemas* (schema consolidation). The problem is that these virtual entities are difficult to manage, secure, and transport.

### Oracle Multitenant Architecture

Oracle Database Multitenant is based on an approach called *database consolidation*. It delivers a new architecture that allows one single Container Database (CDB) to hold many Pluggable Databases (PDBs). See figure 8.

An existing database can simply be “plugged into” a CDB. At any time, then, it can be unplugged and plugged into another CDB. Unplug/plug is even supported across Oracle Database software versions.

From the point of view of the client application connecting to the database server via Oracle Net, the PDB is the database. A PDB is fully compatible with a non-CDB – a rule also known as the PDB/non-CDB compatibility guarantee.

### Resource Utilization and Resource Management

The many PDBs in a single CDB *share its memory and background processes*. This enables consolidation of many more databases compared to the old architecture, offering similar benefits to schema-based consolidation but with none of the major application changes required by that approach.

*Horizontal partitioning of the Oracle data dictionary* (a conceptual partitioning, not a physical table partitioning) removes the need to store and manage system-wide metadata in every single database. The “lower” half (implemented in the CDB) holds the *system-wide metadata* – and nothing else, while the

“upper” halves (implemented in the PDBs) hold *application-specific metadata* – and nothing else.

Creating pluggable databases, moving pluggable databases between containers, and cloning pluggable databases are done with new SQL commands and take just seconds. When the underlying file system supports *thin provisioning*, many terabytes can be cloned almost instantaneously.

Sharing of background processes, memory structures, system-wide metadata, and database files results in considerably *decreased resource consumption*. In addition, Oracle Database Resource Manager is extended with specific functionality to *control the competition for resources* between PDBs within a CDB.

### Manage Many Databases as One

By consolidating existing databases as pluggable databases, administrators can manage many databases as one. Benefits include:

- The investment of time and effort to patch one CDB results in patching all of its many PDBs. To upgrade all PDBs hosted in a CDB, simply upgrade the CDB, and all hosted PDBs are upgraded “in-place”.
- Instead of executing separate database backups, administrators only require to back up their database at the CDB level. In other words, all PDBs consolidated into a container will be backed up as one, and administrators retain the flexibility to perform recovery operations at individual PDB level, if required.
- Administrators maintaining standby systems in another data center (using Data Guard or Active Data Guard) will only need to set up a standby configuration at the CDB level, to replicate all PDBs consolidated in that container.

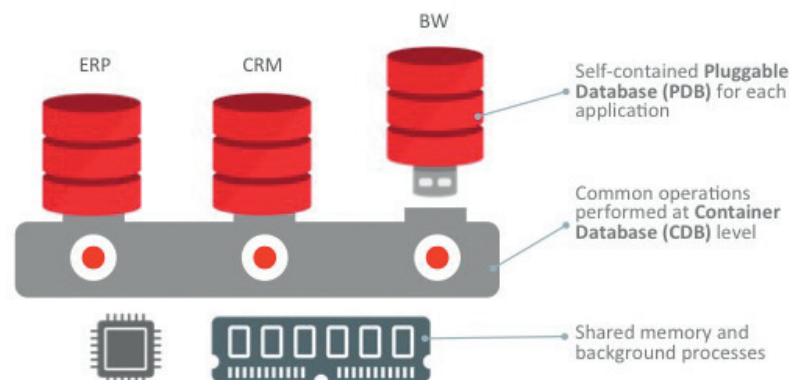


Figure 8: Oracle Multitenant – New architecture for consolidating databases and simplifying operations

## Oracle Advanced Security

**Challenge:** In order to read or update data in an Oracle Database that is the data store of an SAP application, the obvious and only choice for legitimate users is this particular application. Attackers, however, who want to bypass SAP's user management and access control, could use either a network sniffing tool to capture data in transit or some kind of file editor to read data at rest, i.e. in a database file copy.

**Value Proposition:** Oracle Advanced Security is a bundle of features that allow administrators to encrypt data and make it harder for attackers to understand what they see. Oracle Network Encryption can be used to protect data in transit, while Oracle Transparent Data Encryption

and Backup Set Encryption protect data in the production database files as well as their backup copies.

**Certification/Support:** Oracle Advanced Security is certified for all SAP NetWeaver applications. Implementations are supported by SAP.

**Versions:** Oracle Database 11g and higher

**Implementation:** Advanced Security features are activated either via the Oracle Net configuration or using SAP's BR\*Tools. Details can be found in SAP Notes 973450 (all versions), 974876 (11g), 2591575 (12c), and 1324684 (all versions)

### Protecting Data in Transit: Oracle Network Encryption

In SAP environments, users do not directly connect to the Oracle Database server. They connect to an SAP application server instance, and the SAP application server instance in turn connects to the Oracle Database server. So, in this case, the application server instance is the Oracle client, and Oracle's network encryption encrypts all data traveling between application server and database server.

Oracle's network encryption requires Oracle software, which is not installed on end-user devices. Therefore other technologies or products must be used to protect the communication between SAP users and SAP application servers.

However, people do not only attempt to read data in transit, they can also try to intercept and modify them. Therefore, in addition to network encryption, Oracle also supports crypto-checksumming to ensure data integrity. Both encryption and crypto-checksumming are completely transparent to the application, and in both areas the system administrator can choose between several algorithms.<sup>1</sup>

### Protecting Data at Rest: Oracle Transparent Data Encryption

Oracle Transparent Data Encryption (TDE) is applied to data in the files which make up the production database (as opposed to backup files, which will be discussed in the next paragraph). As the name indicates, TDE is transparent to the application; no application changes are required. Starting with SAP NetWeaver version 7.20, you can use BRSPACE to set the encryption attribute on a tablespace level. BRSPACE can also be used to manage the wallet, which stores the encryption keys.

Transparent Data Encryption comes in two flavors. The first one (available since Oracle Database 10g) is called Column Encryption, because you select just a few of the many SAP tables, or even individual columns of these tables that contain sensitive data and encrypt them. Everything else remains unencrypted. The second one (available since Oracle Database 11g) is called Tablespace Encryption. It allows you to encrypt complete tablespaces, which may contain hundreds, thousands, or tens of thousands of tables.

### Protecting Data at Rest: Oracle Backup Encryption

If you decide to use column encryption, consider to use encryption with your database backup. It is generally much easier to steal backups of the database files than directly from the production database itself. Therefore, the third set of features in Oracle Advanced Security is related to backup encryption.

<sup>1</sup>Please note: As of June 2013, network encryption and crypto-checksumming are no longer part of Oracle Advanced Security. They are included without additional cost in all licensed editions of all supported releases of the Oracle database.

If you simply backup your database files, only those columns that are encrypted in the production database files are encrypted in the backup copies. However, combining Oracle Recovery Manager (Oracle RMAN) and Oracle Advanced Security, whole backup sets (that is, all data) can be encrypted.

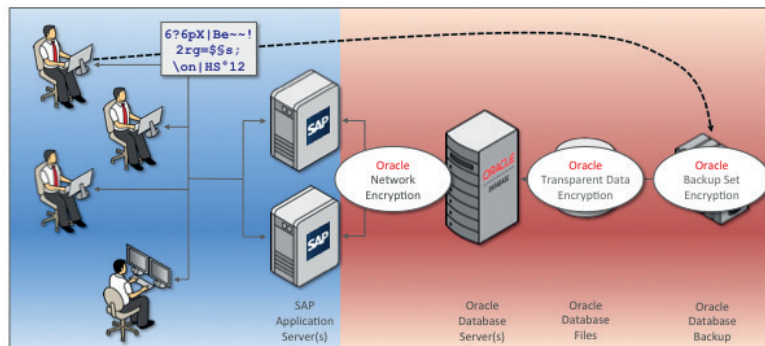


Figure 9: Oracle Advanced Security – Encrypt data in transit or at rest

### Database Vault

**Challenge:** Data encryption does not help, if attackers do not use third-party tools, but Oracle tools to bypass the SAP applications. This is particularly dangerous in the case of privileged database users (database administrators). And it is particularly relevant, if database administration is outsourced or data are stored in the cloud.

**Value Proposition:** Oracle Database Vault replaces the traditional database privilege management strategy with a new, more flexible and more powerful one. It goes far beyond traditional user–privilege or user–role correlations.

Oracle Database Vault allows companies to implement and enforce concepts such as the segregation of duties or the four eyes principle.

**Certification/Support:** Oracle Database Vault is certified for all SAP NetWeaver applications. Implementations are supported by SAP.

**Versions:** Oracle Database 11g and higher

**Implementation:** For detailed instructions see SAP Notes 1597194 (11g) and/or 2218115 (12c and higher).

Privileged database users – like database administrators – can use DBA tools and directly connect to the database, thus bypassing SAP’s security checks (see figure 10). Against this kind of threat, encryption does not help. If someone is able to connect successfully using a sufficiently privileged account, and if he or she then sends a query, the Oracle Database will generously deliver the result set to this user. If the requested data is encrypted, Oracle will decrypt it. From an Oracle Database perspective the request sent by this user seems to be a perfectly valid request.

This can happen, because traditionally, if you were explicitly granted a sufficient number of system privileges, you implicitly received object privileges for all tables as well. For decades people found this acceptable. Recently, however, companies began to ask: Is it really necessary and is it really desirable that a database administrator, who is supposed

to manage the database structure, is by default able to read (and even change) all data in the database?

### Oracle Database Vault

A solution to this problem requires a new privilege management strategy in the database. This strategy should continue to provide system privileges and object privileges, but it should get rid of implicitly granted object privileges.

This is exactly what Oracle Database Vault does. It replaces the traditional, somewhat clumsy privilege management strategy with a new, more flexible one. It eliminates all implicit grants and instead provides a means to explicitly define access rights as well as the circumstances under which they are effective. This goes far beyond traditional user–privilege or user–role correlations.

Oracle Database Vault allows companies to implement and enforce concepts such as the segregation of duties or the four eyes principle.

### Oracle Database Vault for SAP

Oracle Database Vault, as sold by Oracle, is just a tool box. It is true that it comes with predefined realms and roles, but those are realms for system tables and very general (if fundamental) roles. These predefined components allow Oracle Database Vault to be functional and allow you to use it, but they do not protect your application-specific data. That is because Oracle does not know anything about your applications and your data. Oracle can only give you a toolbox, and it is up to you to determine your security requirements and translate these requirements into an access control policy.

But there is an important difference. As long as customers use home grown applications, it is simply not plausible for Oracle to do more. However, if thousands or tens of thousands of companies use a certain standard application and the security requirements of all these companies are (at least to a certain point) identical, because they are results of the application design, then it makes much more sense for Oracle to analyze the requirements and implement a basic security policy.

Oracle has actually done this, saving customers the time that is needed to implement the boring basics of an application-specific security policy, and protecting these companies from forgetting to implement some of the basics. As of today, Oracle provides a whole family of predefined application-specific Oracle Database Vault policies, and Oracle Database Vault for SAP is a member of this family.

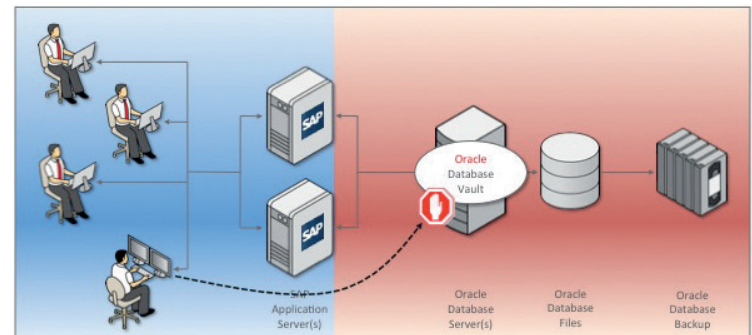


Figure 10: Oracle Database Vault – Privileged user access control and analysis

### Real Application Testing (RAT)

**Challenge:** Database software patches or upgrades, modified database server configurations, and the implementation of new database features/options can influence performance, availability and security of the database server and the whole system. In particular if the implementation must take into account customer- or application-specific characteristics, administrators will want to know in advance how the new feature or configuration works in the production system.

**Value Proposition:** The main problem with many test systems is that the workload applied to them is smaller than or different from the workload of the production system, and that a new feature or configuration works well in the test system, but not in the production system.

Therefore Oracle Real Application Testing allows customers to capture production database workload and replay it on a test system. Combining these two steps, allows for the true effects of the changes to be understood using a real-life workload before they are implemented in production systems.

**Certification/Support:** Oracle Real Application Testing is certified for all SAP NetWeaver applications. Implementations are supported by SAP.

**Versions:** Oracle Database 11g and higher.

**Implementation:** As this is a database-only feature, no SAP tool support is required. For details see SAP Note 1426980.



Oracle Real Application Testing enables you to perform real-world testing. By capturing production database workloads and assessing the impact of system changes before production deployment, it minimizes the risk of instabilities associated with changes. Oracle Real Application Testing comprises two components: *Database Replay* and *SQL Performance Analyzer*.

### Database Replay

Load testing today is generally done using tools that allow testing teams to generate synthetic workloads based on what they expect users to do on a system. These workloads can then be replayed by application virtual users, which simulate the end users by submitting requests to the application. Although widely used, this approach has a number of shortcomings when it comes to testing database level changes:

- Creating the synthetic workload can take a considerable time and requires programming expertise.
- User behavior is not well understood, so many possible workflows are often missed in the synthetic tests.
- Production scale database concurrency is near impossible to simulate with these tools.
- A full application stack is required for testing as these tools simulate end users.

The Database Replay feature included in Oracle Real Application Testing provides DBAs and system administrators with the ability to faithfully, accurately and realistically rerun actual production workloads, including online user and batch workloads, in test environments. By capturing the full database workload from production systems, including all concurrency, dependencies and timing, Database Replay enables you to realistically test system changes by essentially recreating production workloads on the test system. This is something that a set of scripts can never duplicate. With Database Replay, DBAs and system administrators can test:

- Database upgrades, patches, parameter and schema changes, etc.
- Configuration changes such as conversion from a single instance to RAC, ASM, etc.
- Hardware and operating system migrations.

### SQL Performance Analyzer

Database Replay delivers half of what Oracle calls Real Application Testing; the other half is provided by another tool, SQL Performance Analyzer. The main difference between these two tools is the scope involved: Whereas Database Replay applies to the capture and replay of all activities in a database, SQL Performance Analyzer allows you to capture specific SQL statements and replay them. The latter offers a significant advantage for SQL tuning, because you can tweak the SQL statement issued by an application and assess its impact.

SQL Performance Analyzer (SPA) can predict and prevent SQL execution performance problems caused by environment changes. It provides a granular view of the impact of environment changes on SQL execution plans and statistics by running the SQL statements serially before and after the changes.

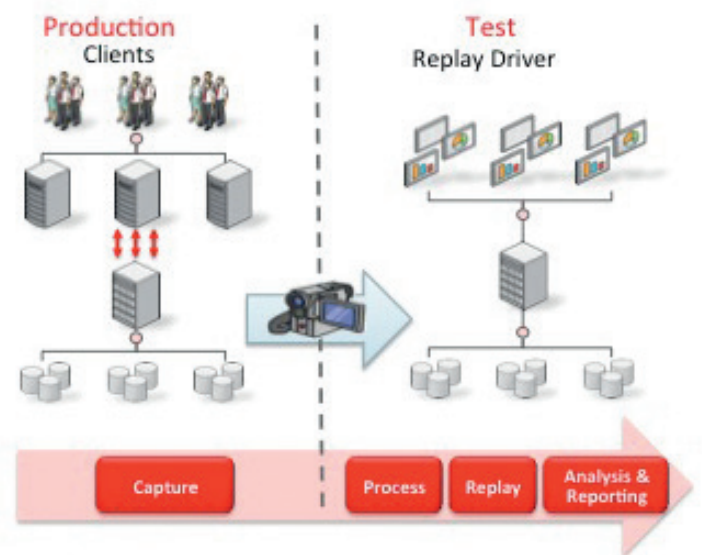


Figure 11: Real Application Testing (RAT) – Capture and replay real database workload

## Enterprise Manager Packs

**Challenge:** Monitoring and managing a complete IT infrastructure often can be challenging. Administrators may end up with a considerable number of management tools designed for this or that particular purpose.

**Value Proposition:** Oracle, being a vendor of the whole IT stack from hardware via databases to applications, realized that there is a need for an integrated enterprise management tool. However, in order to avoid unnecessary complexity, Oracle Enterprise Manager Grid/Cloud Control is divided into a base product and several packs dedicated to special features. With or without packs – Oracle Enterprise Manager always provides a complete view of the IT landscape.

**Certification/Support:** Generally speaking, SAP on Oracle customers have a choice. On the one hand there is the BR\*Tools family of management tools

provided by SAP. These tools include SAP-specific knowledge and are therefore easy to use. On the other hand there are the powerful Oracle Enterprise Manager and its packs. However, in some cases Oracle Enterprise Manager or one of its packs are required – either because there is no BR\*Tools support for an Oracle Database feature (example: Database Vault) or because SAP and Oracle functionality are integrated so completely that the former is not possible without the latter (example: SAP DBA Cockpit and Enterprise Manager Diagnostics Pack).

**Versions:** Oracle Database 11g and higher.

**Implementation:** For general information about using Oracle Enterprise Manager in SAP environments see SAP Notes 355770 and 1028068. Special use cases are discussed in additional notes and white papers.

### SAP DBA Cockpit and Enterprise Manager Diagnostics Pack

The Oracle Diagnostic Pack provides automatic performance diagnostic and advanced system monitoring functionality. The Diagnostic Pack includes the following features:

- **Automatic Workload Repository (AWR):** AWR is a built-in repository within every Oracle Database that contains operational statistics about that particular database and other configuration and usage information. At regular intervals, the Oracle Database takes a snapshot of all its performance statistics and workload information and stores it in AWR. AWR forms the foundation for most of the self-management functionality of Oracle Database. It is the source of information that gives the Oracle Database a historical perspective on how it is being used and enables it to make decisions, which are accurate and specifically tailored for the system's environment. Most of the self-managing features of the Oracle Database rely heavily on the information captured in AWR. The data in AWR is also useful for diagnosing all types of performance issues while minimizing administrative overhead.

- **Automatic Database Diagnostic Monitor (ADDM):** ADDM builds upon the data captured in AWR. ADDM makes it possible for the Oracle Database to diagnose its own performance and determine how any identified problems could be resolved. ADDM runs automatically after each AWR statistics capture and makes the performance diagnostic data available immediately. ADDM examines data captured in AWR and performs analysis to determine the major issues on a proactive basis, recommends solutions and quantifies expected benefits.
- **Active Session History (ASH):** All active database sessions are automatically sampled once every second and stored in the ASH. The data is captured in a rolling buffer in database memory. The ASH data shows where the database is currently spending its time and highlights any performance bottlenecks. As ASH captures the session state with many performance attributes, the in-memory ASH data can be very effectively used to understand the database workload profile and pro-actively diagnose any transient performance issue, such as a CPU spike or an I/O storm, that occurs for a very short duration.

Oracle Diagnostics Pack diagnostics and analysis features such as ADDM, ASH, and AWR are tightly integrated with SAP's DBA Cockpit. Therefore DBA Cockpit has a mandatory requirement for Oracle Diagnostics Pack.

## Database Lifecycle Management Pack

The Provisioning and Patch Automation Pack automates the deployment of software, applications, and patches. It makes critical data center operations easy, efficient and scalable, resulting in lower operational risk and cost of ownership. The ability to provision the entire software stack that includes the operating system, middleware and database, supplemented by comprehensive reporting tools, make the Provisioning and Patch Automation Pack an extremely significant entity in overall system management space.

The Provisioning and Patch Automation Pack includes an end-to-end *patching solution* that works seamlessly across a wide range of products and customer environments. The patching application automates the deployment of Oracle patches for the database and the underlying operating system. The application takes care of pre- and post-patching steps such as shutdown and startup of services, and dictionary changes, if required. It also leverages the flexible Deployment

Procedure framework, that lets users add custom steps for specific actions within the patching process.

The Provisioning and Patch Automation Pack also comes with out-of-the-box Deployment Procedures to *provision* the Oracle Database (both single instance database and RAC), Oracle Clusterware and Oracle Automatic Storage Management from “gold images” following the best practices for maximum availability. The gold images are tested and approved software images and can be patched to any level before deployment.

For SAP environments, the MOPatch utility is integrated with the deployment procedures of Oracle Enterprise Manager to automate the orchestration of patching for Oracle Databases. See white paper “Patching of Oracle Databases in SAP Environments using Oracle Enterprise Manager”.

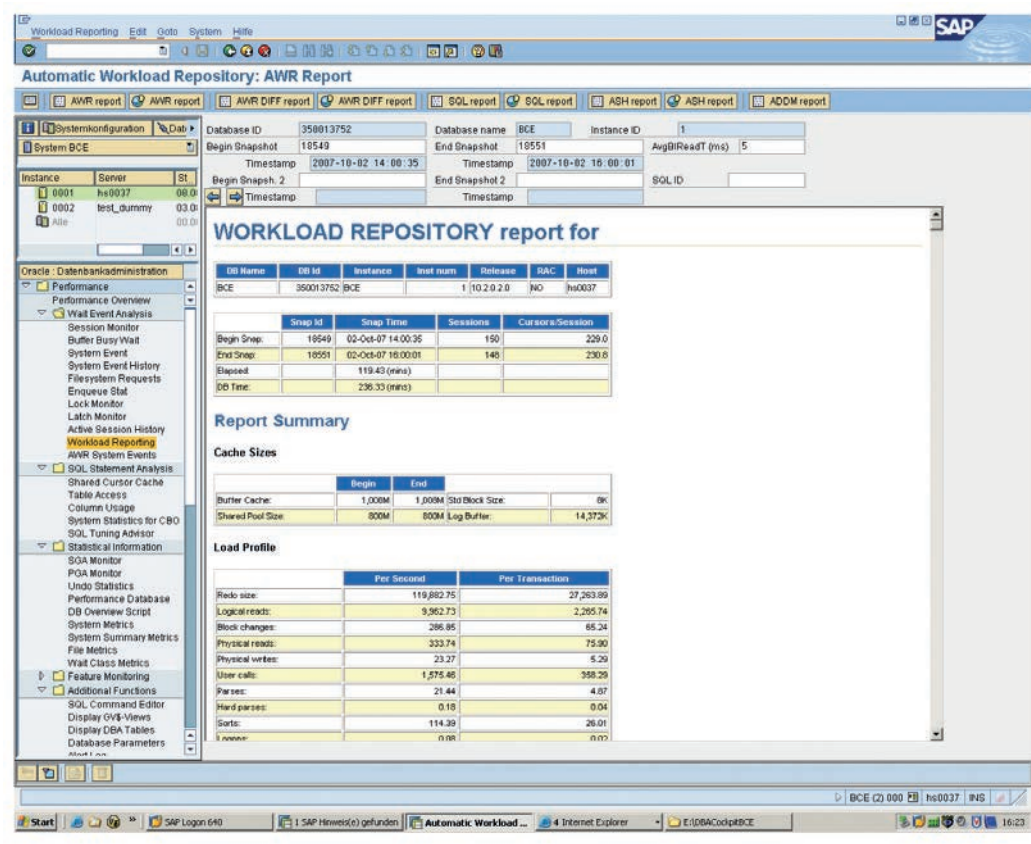


Figure 12: Oracle Enterprise Manager Diagnostics Pack and SAP DBA Cockpit

## Summary

In a certain sense, the Oracle Database has always been a data management infrastructure, and therefore there has always been a need to provide support for two opposite goals: consolidation, and separation or differentiation. Oracle has always been a multi-user, multi-schema, and possibly multi-application database. Therefore – apart from the very basic split of the available data into different tables – there was a need to separate application-specific schemas. For performance reasons, there was a need to separate the files used for user/application data from those used for redo log or undo information. Being a complete data management system, the Oracle Database has nevertheless always provided adapters, gateways, and other means that allow interactive users and batch jobs to join data stored in the Oracle Database with data coming from other, external data sources.

However, as a result of the growing amount of data, increasing workload, and shrinking maintenance windows that many customers experience, Oracle needed to provide additional, more sophisticated solutions. Starting with Oracle Database 11g, this has happened in all recent Database versions (12c, 18c, 19c).

### Defining Subsets of Data

Released for the first time several versions and many years ago, *Table and Index Partitioning* is still a good example of data differentiation and a powerful technology. Therefore it has been discussed at the very beginning of this article. It is used to define subsets of table data which can be accessed and managed independently.

### Subsets and Access Patterns

When determining a specific partitioning strategy, it is important to not only look at the data but to consider the access patterns as well. Partitioning a table by month may turn out to be useless or even negatively impact performance, if most queries access the data by location.

However, distinguishing subsets of data by access pattern in new, previously impossible ways is the main goal of many Oracle Database features and options.

*Heat Map*, a feature included in Advanced Compression, automatically tracks modification and query timestamps, thus providing detailed insights into how data is being accessed. *Automatic Data Optimization* automatically moves and compresses data according to user-defined policies based on the information collected by Heat Map. This means that

storage and compression tiering can be implemented, i.e. the selection of different storage media and different compression algorithms for different subsets of data which are defined by different access characteristics.

*Oracle Database In-Memory* allows administrators to distinguish between different types of transactions as well as different data representations in memory and to avoid the trade-off which results from the requirement to pick one single data format for all types of transactions and applications. Based on the In-Memory option, Oracle Database can provide data used by OLTP transactions in row format, and at the same time data used by analytics in column format.

### Workload Distribution

Other options focus on workload distribution. A prominent example is *Real Application Clusters (RAC)*, which allows customers to split the system workload and let many servers, running at least as many Oracle instances, handle the workload. It is up to the customer to decide whether all instances should handle the same type (or mixture) of workload(s) or different instances should be responsible for different types of workload (e.g. interactive transactions vs. batch jobs).

In addition to enabling workload distribution, RAC increases the system availability. This is even more true for *Data Guard*. Nevertheless, Data Guard does not require the standby database to be idle. It can be used for operations such as backup or – under certain conditions – reporting. In other words: Data Guard helps implement workload distribution as well.

### Data Access Policies

In a somewhat different sense, Oracle's security options are related to access patterns as well. In particular *Database Vault* lets security administrators define and enforce access policies which prevent privileged users from reading or manipulating data they are not supposed to access. Phrases such as “segregation of duties” make it very clear that even here we are talking about the balance between separation and combination.

### Database Administration

*Oracle Database Multitenant* moves the data management infrastructure principle to a completely new level: We do not simply talk about an infrastructure for many tables or many users. We talk about an infrastructure for many databases. Here consolidation clearly requires separation.



To put it simply, Multitenant is about the distinction between those administration tasks that should be executed for every single database individually (because there are differences) and those that can be executed once for all or at least for a certain group of databases (because there are no differences). E.g. to apply a certain patch to 25 database systems means to repeat the very same process 25 times. Therefore Oracle Multitenant moves this operation to the Container Database layer, where it can be done once for all Pluggable Databases.

On the other hand, a point-in-time recovery is an operation to be performed on the PDB level, as it should not affect other PDBs.

In addition, the Provisioning and *Patch Automation Pack* allows administrators to automate those operations which are similar in all cases. Examples are the deployment of Oracle patches or the provisioning of new systems based on “gold images”.

#### **Monitoring and Testing**

Will your systems benefit from these features? How can you be sure? And how should the features be implemented in order to have a positive impact on your systems? *Real Application Testing* will help you to answer these and similar questions.



Advantages for DB consolidations, upgrading / patching or provisioning – cost-cutting or cloud computing tools

## THE WINNING HAND: ORACLE MULTITENANT

The release / availability of the Oracle Multitenant option means that SAP Oracle customers can use the innovative and beneficial feature of the Oracle Database for SAP to their advantage. The key factor in this regard is the simple structure and effective use of DB containers (container databases) with multi-client capability and pluggable databases for the likes of cloud computing based on a new architecture.

The Oracle Multitenant architecture is the basis for using an Oracle database as a multitenant container database (CDB), where a CDB (as a single instance) may contain zero or several (up to 256) usable pluggable databases (PDBs). Hardware resources can thus be minimized significantly in some cases; the management or administrative activities involved when dealing with the likes of DB upgrades / patches, or during backup / recovery tasks, can be reduced considerably too.

For example, when consolidating Netweaver-based SAP systems (such as DEV, QA or test systems), several pluggable databases can be installed and configured in a single container database (one instance), and can then be used or operated for an extremely wide range of purposes. The various database features of a non-CDB Oracle database are also applicable to the pluggable databases to be used too. And, what's more, they can even be applied independently. PDBs are based on a CDB's background processes. Potential uses of the CDB architecture (including data dictionary) in the Netweaver-based SAP environment are outlined in the relevant SAP Notes, (see list on p. 37).

### Numerous potential benefits

Without a doubt, the Oracle Multitenant option offers a variety of benefits for SAP Oracle customers. These include:

- Consolidation measures – with optimized use of resources

Because all PDBs in a CDB share the same Oracle instance (and Oracle Home), system resources (CPUs, memory, processes) are either saved or reduced significantly. From a resource standpoint, so to speak, only one database instance exists despite there being multiple pluggable databases.

- Management of several databases as one

When administering, controlling and operating one database instance, fewer administrative or maintenance tasks are needed as would be for several database instances thanks to the Oracle Multitenant option. This gives rise to time and cost savings. One CDB backup, for example, creates backups of all the PDBs in one go. CDB database parameters are set and can be used for all PDBs, so they are ideal for operating different SAP Oracle PDB databases. For all the (grouped) DEV or QA systems in a container database, for example.

- Efficient upgrades and patches

Additional expenditure for upgrades and patches can in some cases be significantly reduced with the Oracle Multitenant option. If the parameters have been implemented / configured in the CDB once, they exist in all of a container database's established PDBs and are automatically executed.

- Rapid provisioning, extremely short cloning time

For whatever purposes a database or an SAP system has to be set up or cloned, the work needed to do so can be carried out quickly and easily with the Oracle Multitenant option

- Increased protection and availability

If you need to transfer a used database type (RAC or Single Instance, Data Guard) to other SAP Oracle DBs, a CDB can be used as a framework for multiple SAP PDBs. This means, for example, that a single Instance database environment can be easily transferred to an RAC environment, or that a non-Data Guard environment can be transferred to a Data Guard environment.



The SAP BR\*Tools are used for administration of the Oracle Multitenant option for SAP. Additional prerequisites include Oracle Database 12c (12.1.0.2) or higher and the Oracle Multitenant feature, SAP NetWeaver 7.40 (Unicode) and above, SAP SWPM 1.0 SP19 and above, and the SAP BR\*Tools (7.40 patch 24 and above)

Additional information about the Oracle Multitenant option can be found in the relevant SAP Notes.

#### SAP Notes:

2336881 Using Using Oracle Multitenant with SAP NetWeaver-based Products

2333995 BR\*Tools Support for Oracle Multitenant Database

2335850 Transformation of Existing Standalone Database into Pluggable Database

In a typical SAP environment with several production databases, there will be several dozen non-productive SAP databases too (e.g. Dev, QA, Pred-Prod, Training etc). With the Oracle Multitenant option SAP Oracle customers can group similar databases together for the same level of system management functions. For example: group DEV for ECC, BW, CRM, and SCM to manage in one container. All DEV systems have the same backup, patch requirements, and DR requirements. Similarly, all QA system databases can be grouped together. When additional systems (e.g. SRM) must be added, the DEV, QA, test etc. can simply be put into pre-existing containers and SAP Oracle customers do not need to worry about the backup / DR setup at all.

#### Customer requirements – implemented with the Oracle Multitenant option

Typically not all customer requirements are identical. Below are some challenges / tasks that various customers around the globe have overcome with the Oracle Multitenant option:

- Eliminate several small systems (even virtualized ones) using too many hardware resources
- Decrease database implementation and main tenance costs by reducing the complexity of the existing IT infrastructure components to free up IT staff for more strategic tasks
- Reduce footprint and costs by managing the IT infrastructure with fewer servers
- Reduce the time spent on administering many small DB systems
- Goal of management: „Bring applications back up to the current level!“
- Build an environment that is supported, sustainable and reliable
- Enhance business continuity awareness and ensure uninterrupted manufacturing operations in the event of a disaster

## ORACLE DATABASE IN-MEMORY TOOLKIT FOR SAP NETWEAVER

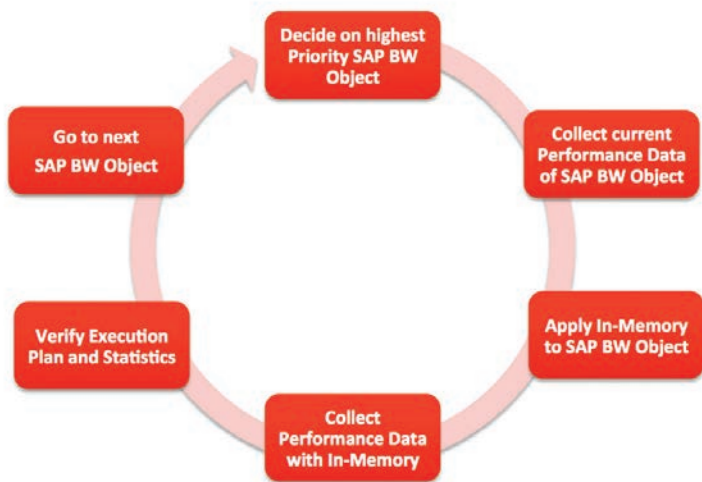
The Oracle Database In-Memory Toolkit for SAP BW provides a systematic method for identifying SAP NetWeaver BW objects or the Oracle Database In-Memory column store. In addition, it generates SQL scripts to enable and disable the In-Memory feature for these objects and to load them into memory.

### The Toolkit

Oracle Database (12c and higher) allows customers to selectively apply Oracle Database In-Memory to individual SAP BW objects. However, identifying and loading the objects (tables) that will yield the largest performance improvements is not always simple and may require a systematic approach.

One approach is to first identify those business queries that are most frequently used, as well as those most in need of performance improvement, and then map these queries to specific business objects, such as MultiProviders, InfoCubes, operation data stores. The next step is to identify the Oracle table names for each of these objects. The candidate tables should then be prioritized, and scripts written for loading them into memory.

Oracle Database In-Memory is certified and released for all SAP applications, including OLTP applications such as SAP ECC, SAP SCM, SAP CRM, etc., as well as OLAP applications like SAP NetWeaver BW. Oracle's In-Memory technology provides SAP customers using Oracle Database with new ways of analyzing data in real time directly in the Oracle database. Oracle In-Memory speeds up data access by factors of up to 1,000, even for complex business models. This makes complicated data extraction and special SAP applications such as SAP BWA or SAP HANA unnecessary.



### How to work with the Toolkit?

SAP provides two ways of using database tables with Oracle Database In-Memory:

- a) Oracle In-Memory Advisor for SAP
- b) SAP NetWeaver BW 7.40 and 7.50 – Flat Cubes

However, the two options mentioned above only cover a fraction of the possible applications, which is why Oracle created a toolkit for SAP applications to purposefully load database objects with Oracle Database In-Memory as long as the application is running on Oracle 12c or higher. All SAP NetWeaver 7.x versions work with the In-Memory toolkit.

The documentation provides an overview of:

- The toolkit's procedures / functions and how it is used
- Application methods
- Case studies – customer results

### Download and additional information

<https://www.oracle.com/downloads/samplecode/in-memory-toolkit-downloads.html>

SAP Notes
2351252 – Oracle Database In-Memory Toolkit for SAP
2335159 – Flat Cubes for SAP BW
2137032 – DBA Cockpit: Monitor for In-Memory Feature
2189163 – Oracle Database In-Memory Advisor for SAP
2178980 – Using Oracle Database In-Memory with SAP NetWeaver-Based Products



## HIGH AVAILABILITY FOR SAP RESOURCES BY SAPCTL

When an application, process, or server fails in a cluster, you want the disruption to be as short as possible, if not completely unknown to users. For example, when an application fails on a server, that application can be restarted on another server in the cluster, minimizing or negating any disruption in the use of that application. Similarly, if a server in a cluster fails, then all of the applications and processes running on that server must be able to fail over to another server to continue providing service to the users. Typically, customers use built-in generic application resource types or customizable scripts and application agent programs with resource attributes that are assigned to applications and processes, Oracle Clusterware can manage all these entities to ensure high availability.

SAP customers are usually very keen to run a highly available infrastructure and deliver a non-disruptive service to SAP end users. This can be a challenging task with many components from many vendors operated by one or many organizations all having to get the products' infrastructure/ecosystem under control. Many SAP customers are trying to reduce the complexity and increasing efficiency by migrating to Oracle Engineered Systems like Exadata and Super Cluster, but others are willing to run the current environment as highly available as possible with minimum effort. An SAP environment has a well known challenge with high availability that includes among others the SAP Enqueue service whose failure could lead to a restart of the entire SAP system.

The SAP Enqueue Service provides distributed lock management for SAP application server instances. It must be available whenever an SAP system uses more than one SAP instance. In order to support SAP application high availability, the Enqueue Service together with the Message Service builds up the "Standalone Enqueue Service" (ASCS) for SAP WebAS ABAP. In case of SAP WebAS JAVA, the Enqueue Service together with the Message Service forms the "Central Services Instance" (SCS). This SCS instance is always required for the JAVA stack of SAP. SAP uses an active/passive approach to enable high availability for the respective Enqueue Service.

There is exactly one Enqueue Service for application type ABAP and one for application type JAVA running in the SAP system. The SAP system comprises multiple application instances on different nodes. One or more SAP Replication Services run on the node on which the active Enqueue Service for ABAP and/or JAVA falls over in the event of a failure or planned outage. The term 'service' is used to signify the SAP process that provides either Enqueue or Replication. The nodes that host these services are termed the 'Enqueue Server' and the 'Replication Server'.

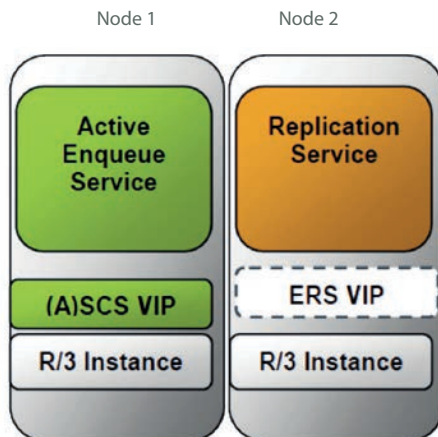
SAP on Oracle Database customers have the choice to use any of the SAP certified failover software depending on their preferred vendor and OS platform. Even better is the usage of Oracle Clusterware which helps to reduce the number of software vendors, complexity, administration effort and even software license costs. Oracle Clusterware is a portable cluster software that allows clustering of single servers so that they cooperate as a single system. Oracle Clusterware also provides the required infrastructure for Oracle Real Application Clusters (RAC). In addition Oracle Clusterware enables the protection of any Oracle application or any other kind of application like SAP within a cluster.

Oracle Clusterware can provide high availability for SAP resources just as it does for Oracle resources. Oracle has created an Oracle Clusterware tool, SAP Control (SAPCTL) to enable customers to easily manage SAP high availability resources. SAPCTL provides an easy-to-use interface to administer the resources, scripts, and dependencies of Oracle Clusterware and SAP high availability components. SAPCTL consolidates the functionality of the Oracle command-line tools by enabling SAP customers to easily manage the SAP Enqueue Service, the SAP Replication Service, and the additional virtual IP addresses used by the SAP Enqueue Service for ABAP and JAVA.



In addition to the critical SAP high availability components, namely the SAP Enqueue and SAP Replication Service, SAPCTL Version 8 provides an interface for the protection of arbitrary number of SAP application instances. The SAP Central Instance (CI) or SAP application instances (DV) are possible candidates to run under SAPCTL supervision. The SAPCTL tool supports SAP Standalone Gateway (GW) and SAP WebDispatcher (W) as independent SAP instances as well.

For all supported SAP instance types, SAPCTL in addition monitors the associated SAP Start Service (sapstartsvdemon process) with an always co-located CRS resource. The SAP Start Service process is started automatically by SAPCTL if the SAP instance gets started on a cluster node or relocated to another node in the cluster.

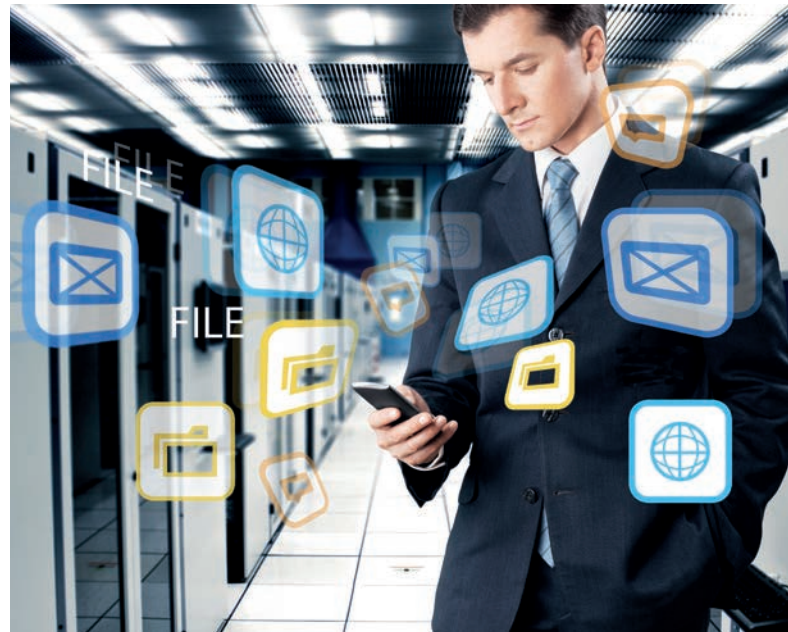


There is no need to bring up all SAP Start Processes on system boot by sapinit procedure as this task is performed by SAPCTL after startup of Oracle Clusterware.

The implementation guide and software needed for SAPCTL is attached to the SAP Note "1496927 – Protection of SAP instances through Oracle Clusterware."

Oracle Exadata, Oracle SuperCluster and Oracle Database Appliance are certified to run SAP Central Services (SCS and ASCS instances and the ER instances) and SAPCTL supports these services when running on above mentioned Engineered Systems. SAP kernels starting with kernel version 7.00 are supported by SAPCTL on LINUX, Solaris and AIX operating system. SAPCTL has been certified for integration with SAP NetWeaver via the SAP integration scenario NW-HA-CLU 7.40.

SAP customers who implemented SAPCTL on top of Oracle Clusterware and RAC can get rid of 3rd party high availability software like IBM PowerHA and HP Service Guard, etc. You save additional money since SAPCTL is free of charge and can dramatically reduce the administration effort. While Oracle Real Application Clusters (RAC) removes the Oracle Database instance as Single Point of failure (SPOF), Oracle SAPCTL removes one more SPOF (Enqueue Service) but this time on the SAP application level. It is the foundation that provides the SAP infrastructure a much higher availability level and better respond to restrictive SLA's. Oracle technology also provides comprehensive disaster recovery solutions by using Data Guard on top of physical standby database. Solutions such as these can replace storage mirroring and again reduce infrastructure costs.



**Bosch GmbH accelerates business processes and reduces costs with Oracle Database In-Memory – no changes to existing SAP application required**

## MAJOR IMPROVEMENT IN SAP CRM USE WITH ORACLE DATABASE IN-MEMORY

The Bosch Group is a leading global supplier of technology and services. It employs roughly 375,000 associates worldwide (as of December 31, 2015). The company generated sales of 70.6 billion euros in 2015. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiaries and regional companies in some 60 countries. Including sales and service partners, Bosch's global manufacturing and sales network covers some 150 countries. The basis for the company's future growth is its innovative strength. Bosch employs 55,800 associates in research and development at roughly 118 locations across the globe. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life."

Bosch GmbH is known for being a market leader and an innovative company. They often use the tagline "technology invented for life" which provides insight into their business objectives to improve the quality of life, and to deliver innovation for a "connected life".

For well over a decade, Bosch has relied on Oracle as their preferred database vendor for use with SAP. The Oracle database is a core element and important cornerstone in the Bosch infrastructure. Oracle databases are operated autonomously in combination with the various SAP applications and ideally respond to the varied needs of this successful and diversified group.

The IT department consists of more than 1,500 IT specialists and process experts. It was only logical as an Oracle/SAP customer to fully explore the features and options of the new Oracle Database 12c at an early stage. In mid-2015, the primary focus was on the features and benefits of Oracle Database In-Memory.

"We wanted to find out exactly how Oracle Database In-Memory could help us to implement optimizations in our use of SAP. This applied to both OLAP and OLTP applications. We quickly realized that we stood to benefit in many ways, especially in terms of SAP CRM usage," explains a project manager and database expert from the IT operations organization.

The Bosch IT team discussed solution scenarios and use cases both in-house and with Oracle. It became clear that Oracle Database In-Memory offered significant advantages when used with SAP BW Analytics.

But even more important to Bosch was the fact that Oracle Database In-Memory also enables planned, prioritized optimizations to be achieved in OLTP systems, and specifically with SAP CRM. This was in fact the most pressing problem. The Bosch IT team needed a suitable solution to eliminate sub-optimum performance when using SAP CRM / OLTP at reasonable cost. Oracle Database In-Memory was the right way to go.

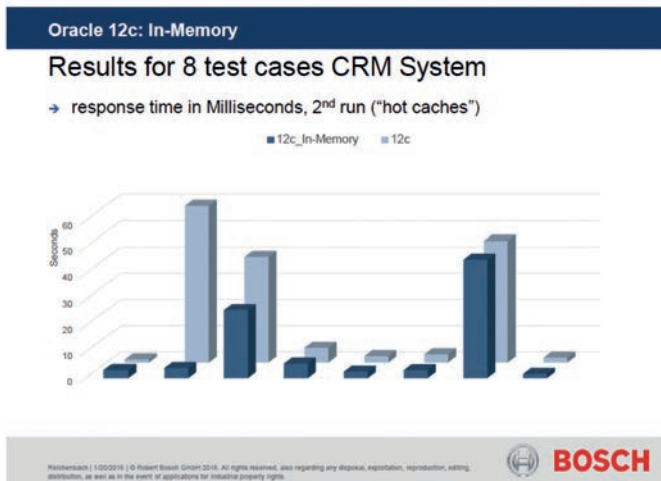
### The challenge of secondary indexes

In this CRM use case it was mainly secondary indexes, as well as the extra custom-made indexes that had to be regularly created, that proved to be problematic. According to Bosch: "As a result of the intensive and distinctive use of SAP CRM functions by users, the IT team was obliged to continually create extra indexes for certain CRM objects and tables. This was the only way to use the system in line with our individual usage requirements. However, it wasn't possible to achieve 100% application coverage in this way, especially in terms of search options and search availabilities in CRM. This is because not all such search options can be supported by additional indexes. Some application functions simply resulted in a timeout."

Approximately, 80 additional indexes were created and accumulated over time. This resulted in a considerable increased need for maintenance demands and performance related tuning as well as cost-intensive resource use. It was also necessary to set aside a large amount of storage capacity for these indexes, which were also large objects.

The SAP CRM system is used by around 3,500 users throughout the Bosch Group, The CRM system being discussed here is one of several CRM systems Bosch operates. The largest of which has a data volume of over 1TB.

Following a PoC and several tests, it became clear that Oracle Database In-Memory is not only effective as a performance enhancer but it is equally as effective as a means of countering problematic secondary indexes. With Oracle Database In-Memory, many of these indexes can be re-moved. This prompted Bosch to put Oracle 12c with Oracle Database In-Memory to productive use in conjunction with the SAP CRM system. A detailed analysis was carried out to find out which tables were suitable for In-Memory. The IT team identified them and the most important ones were able to be replaced. One major advantage is that the benefits of Oracle Database In-Memory technology can be gained without any changes to SAP applications, with the continued use of existing hardware (virtualized and Unix-based servers), and without data migration. It is usually only necessary to provide In-Memory servers / RAM hardware resources (virtualized or non-virtualized) for tables that were to be involved with In-Memory processing.



### High satisfaction with Oracle Database In-Memory

„The improvements achieved in the SAP CRM system through Oracle Database In-Memory have turned out exactly as we planned. User satisfaction has risen considerably and IT-supported business processes are now running smoothly without delays and can be fully utilized as standard. The amount of IT administration has also been noticeably reduced thanks to the substantial reduction in index creation and maintenance, which in turn results in cost savings.

In the use case described, Oracle Database In-Memory eliminated the need for many secondary and custom-made indexes of large tables while accelerating OLAP use. Inserts, Updates and Delete statements processed normally. No negative impact on the system performance was observed.

Additional tuning can be accomplished easily by increasing the cache for the In-Memory Store and assigning specific tables to occupy the space. The Oracle In-Memory Advisor, a component supplied with Oracle Database, also makes it possible to identify tables suitable for use with In-Memory.

### Problems / challenges

- Bosch was looking for ways to optimize its use of SAP CRM. Specific tables having a large number of secondary indexes were causing particular difficulties. These difficulties resulted in frequent user dissatisfaction, costly administration and maintenance, and the provision of additional IT resources (such as storage).

### Solution

- With Oracle Database In-Memory, it is possible to replace additional custom-made indexes. Oracle Database In-Memory is used for the tables that made these indexes necessary.

### Benefits

- Now users can make full and effective use of SAP CRM
- Reduced costs for system / database administration
- In-Memory is only activated for selected tables
- Saving in terms of storage resources for secondary indexes that are no longer needed
- Lower number of indexes means accelerated business processes
- Faster SAP CRM response times and higher system performance
- Use of Oracle Database In-Memory without changes to SAP applications
- Continued use of existing hardware; only In-Memory / RAM must be provided



## SAP BI WITH ORACLE DATABASE IN-MEMORY AT DB MASTERS

In-Memory database technology has been around since the 1990's. Numerous database vendors have come and gone and filled that niche for years. In 2011 SAP came up with the HANA In-Memory concept. The initial idea was to efficiently handle analytical queries through columnar stored data structures. Planned as a BWA replacement, the technology matched well.

Later, SAP expanded the concept to include OLTP. Technically, they chose to mix self-developed and acquired technologies such as P\*Time, TREX Search Engine, MaxDB (livecache), and Sybase ASE for this purpose. Customers wanting to exploit the In-Memory technology from HANA require special hardware to run the system and a migration/conversion from the technology they knew today to the HANA flavor of the day. Nearly at the same time, Oracle fully integrated the In-Memory technology into the Oracle 12c database.

Oracle Database In-Memory promises high performance of complex analytical processing, near transparent implementation, and requires no special hardware or data migration. When done properly, customers will continue to benefit from the performance, scalability, availability, and reliability available today with the added high performance analytical capability.

This article explores the pre-certification testing and findings of one customer's experience with Oracle Database In-Memory. Oracle Database In-Memory has been certified for use with SAP since June of 2015.

We at DB Masters in Austria are focused on solving customer business challenges by proper implementation of the Oracle Database and related technologies. We have experience with many large ERP systems and understand their special needs. However, our focus is Oracle centric - independent of the applications running on it. We are in business since 2000, servicing customers across Europe. Our customer list is long.

When Oracle 12.1.0.2 In-Memory had been initially released by Oracle, one of our customers expressed interest in this technology. The company approved to a proof of concept to evaluate the performance impact for their SAP BW application.

We took the "top" (longest running) SQL statement from their production SAP BI and captured measurements from the following scenarios:

- The "current" query runtimes from the production environment as baseline – which is not entirely accurate as there are a lot of other activities in the database.
- 11gR2 with both the original buffer cache size and 256GB cache. – Statements were executed several times to warm up the cache, so we were able to eliminate the I/O time from the execution. This allowed us to measure performance differences between Oracle 11gR2 and Oracle 12c results.
- 12cR1 with both the original buffer cache size and 256GB cache. – Statements were also executed several times to warm up the cache so we were able to eliminate the I/O time from the execution. This allowed us to measure performance differences between Oracle 11gR2 and Oracle 12c results. The runtime difference between Oracle 11g and 12c were negligible. We can assume there are no performance differences for the test statements.
- Enable Oracle Database In-Memory and put all related objects into the In-Memory Column store. Several configuration settings were tried – like different In-Memory compression options – but at the end all results were done with FOR QUERY LOW compression.



Here are the results over all queries – keep in mind that this is an older SAP BI Version, not utilizing the optimized flat cube model for Oracle Database In-Memory technology:

Type of test	Result
Runtime on production system	Always between 2500 and 2750 seconds depending on the current system load
11g / 12c Test system original buffer cache	About 1455 seconds
11g / 12c Test system 256GB buffer cache	About 382 seconds
Using Oracle Database In-Memory with QUERY LOW Compression	About 118 Seconds

The numbers may not be as impressive as when Larry announced the Oracle Database In-Memory, but depending on the baseline running up to 25 times faster does not look so bad.

There still remains the question often coming: *“Why do you not put the whole database into buffer cache?”* This would speed up the system by a factor of 7-8.

The answer is easy: most customers will not be willing to pay for servers having the required amount of memory. If your SAP BI database is 5, 10 or more TB in size, you would still need up to 50% of the database size for buffer cache. Today, there are servers having up to 32TB and even more memory, but they are very expensive. Current Intel based servers with 2 sockets are able to address up to 3TB memory – typically affordable servers are populated with up to 1.5TB memory.

The advantage of Oracle 12c Database In-Memory is that only table data must fit into the SGA. This typically ranges between 1/3 to 1/2 of the database size, depending on the type of system. The fact that In-Memory table data is stored and accessed in a compressed form means that the footprint will be reduced further. Our tests indicate that most SAP BI tables could be compressed by a factor between 2 to 4x's of the original table size. In other words, the size of the In-Memory table will be 1/2 to 1/4 of the original table size.

A current Intel based server with 2 sockets and 1.5TB memory should be able to put a 10TB SAP BI database completely into the memory! Additionally, you can get rid of indexes only used to speed up lookups – especially bitmap indexes needed for query performance. Fewer indexes to maintain will speed up data loading processes in a dramatic way while reducing disk space and backup sizes.

Another advantage of Oracle Database In-Memory is the short amount of time it takes to implement it. Believe it or not, this customer POC was done within 5 hours – including creating a clone of the database on the test system and running all of our tests! You may compare this to any SAP Feature implementation project you like to.

Deactivating the Oracle Database In-Memory is also quite easy. One simple command line directive dynamically enables and disables the feature. This offers a quick and efficient fallback if any show stopping issues should arise.

Last but not least – how is this effecting HA/DR? With Oracle database In-Memory, you may continue to still utilize all High Availability functionalities like Oracle RAC, Oracle Data Guard, and failover solutions from Oracle or other vendors. No changes. Recoverability remains also untouched. The feature is fully integrated with all of the Oracle HA and DR capabilities.

In summary, experience with this new Oracle feature was very positive. It exceeded to our expectations with respect to the ease of implementation and the performance benefits. It is a certified option and nearly transparent to implement. Customers now have a viable option to explore this technology at a reasonable cost with no business disruption.

#### About the Author:

Christian Pfundtner, CEO of DB Masters, is working with Oracle Databases since 1992 (Oracle 6). One of the first 4 OCMs in Europe. Our focus is on the Oracle Database – but unlike many our competitors we take care of all related layers – from the disk (storage) up to the user. We offer all kinds of evaluations. Business and current database requirements, current licensing state, recommendations on best practices for implementing Oracle to address your needs and to maximize your ROI, performance tuning and troubleshooting.



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## Kommunale Informationsverarbeitung Baden-Franken (KIVBF): Switchover from DB2 Mainframe z/OS and SAP MaxDB to Oracle Database 12c for SAP applications / Huge BW performance increase utilizing Oracle Database In-Memory

### COST SAVINGS AND MANY OTHER IMPROVEMENTS WITH ORACLE DATABASE AND ORACLE DATABASE IN-MEMORY

KIVBF is an IT systems vendor and a complete solutions provider for cities, municipalities and districts.

Being efficient, secure and innovative from a commercial standpoint, the KIVBF portfolio covers the complete range of municipal data management for finance, HR, regulation and reporting with contemporary specialized IT solutions and services.

Extensive ranges of consulting and training services, as well as IT-services and ASP solutions generate sustainable added customer value. We believe that specialized IT procedures and lively dialog with decision-makers and users are critical for meeting the short and long-term business requirements.

As a complete solutions provider, we advise and support our customers from the conceptual design process through implementation, and offer ongoing application and user support. We optimize the workflow through automation and optimized connections to existing procedures or external agencies.

Our customers receive a complete and comprehensive service that satisfies the highest technical standards for the ongoing optimization of their business processes. We analyze trends and respond to current and future legislative requirements and amendments at an early stage. In doing so, **we offer our customers the solutions they need in a timely manner: through working together as partners!**

#### Tool for optimizations using Oracle Database for SAP

In 2015, one of our customers requested our assistance in a campaign to optimize their IT infrastructure with the following goals in mind:

- Migration of the predominantly used MaxDBs to Unicode and replacement of the mainframe and the associated DB2 databases of a larger SAP IS-U.

- Replacement of the existing SAP BW infrastructure (including BWA) with a more powerful and more modern solution.
- Revision of the DB infrastructure. It had been forecasted that there would be a 30% growth in data as a result of migrating the MAXDB systems to Unicode.

KIVBF analyzed the current and future requirements along with the total cost of ownership. The best value for the money was Oracle. After performing some fundamental tests, KIVBF decided to replace the mainframe systems with Oracle Database 12c – which was urgently needed. According to KIVBF, the Oracle DBMS satisfied their requirements with respect to high availability, disaster recovery, security, performance and stability. Oracle was the best option for a powerful, stable, secure, cost-efficient and future-proof database platform for SAP NetWeaver based applications.

As Uwe Bersch from KIVBF's specialist "Databases" division explains, the replacement of the DB2 / zOS mainframe databases with Oracle x64 Windows was a smooth process from both a technical and a time-related standpoint. By using the latest Oracle technologies and "Advanced Compression" in particular, performance was given a considerable boost, the data volume was halved, and the backups were three times smaller. These facts can be presented well in economic terms too!



### Extra added value following migration through use of Oracle In-Memory

Due to its positive experiences and economic situation, KIVBF decided to put Oracle 12c in place as a strategic SAP database. KIVBF also dealt a great deal with the Oracle 12c In-Memory Option, which has been certified by SAP for all SAP NetWeaver-based applications since 2015. The BW NetWeaver (BWA) which had been used up until then was planned to be phased out with the switchover.

SAP HANA was also considered as an alternative to Oracle. The question as to whether the Oracle In-Memory Option or SAP HANA was suitable had certainly been evaluated. "In the end, it was the cost factors in particular that tipped the scales and led us to choose Oracle In-Memory for our SAP BW operations," reported KIVBF.

To be specific, KIVBF would have had to buy new specialized hardware for SAP HANA, and it would also have had to pay extra HANA license costs too. Another technical advantage that Oracle In-Memory has over SAP HANA is that Oracle In-Memory enables the user to upload only selected, performance-relevant tables. The Oracle DBMS can therefore get by with a more streamlined working memory.

The migration of the SAP BW NetWeaver 7.31 database to Oracle 12c, using Oracle Database In-Memory, and the replacement of the SAP BWA took just eight weeks. The solution went live in December 2016, with the DB2 and MaxDB migration processes taking place almost in parallel. A toolkit developed by Oracle was used in conjunction with the Oracle 12c In-Memory Option to optimize the BW data processing. The toolkit essentially creates Materialized-Views\*, which present a mock-up of the InfoCube tables and can thus be loaded to the "In-Memory" in a "denormalized" state. Oracle can now respond to SAP Netviewer inquiries flexibly by means of forwarding the requests or parts of them to the Materialized-Views (RE-WRITE). "Materialized Views" & "Query Rewrite" are a highly flexible technology that has been provided by Oracle for 15 years to optimize complex queries. In parts, the technology is similar to the Flat Cubes introduced with NetWeaver 7.4, which guarantee the In-Memory technology's huge performance gains.

\*<http://www.oracle.com/us/solutions/sap/sap-database/database-in-memory/index.html>  
Please see SAP Note 2351252

### Oracle In-Memory makes SAP BW reports up to 36 times faster

According to the Kommunale Informationsverarbeitung Baden-Franken (KIVBF), the move towards Oracle 12c including the Oracle In-Memory Option was absolutely worthwhile: "We achieved and even exceeded all the goals we set," explains Uwe Bersch, of the Technical Solutions and Database Service division.

The municipal IT service provider is completely satisfied, particularly with the use of Oracle In-Memory. Firstly, it was able to save on license costs – particularly due to the replacement of the SAP BW Accelerator – and substantially reduce the BW data volume (in the backup too) – which ultimately also translated into cost savings. While at the same time they were able to significantly boost performance using the Oracle In-Memory Option.

The BW report response times have become three times better on average in evaluations with runtimes of 10 to 20 seconds with Oracle In-Memory when compared with the SAP MaxDB including BWA used previously. Complex evaluations with runtimes ranging between 3 and 12 minutes have even been made 11 to 36 times faster. The BW Oracle Database now has a (compressed) data volume of less than 1 TB; previously, it was 2.48 TB (with Unicode and MaxDB, the data volume would have increased to 3.2 TB). The backup volume, meanwhile, is just 330 GB – thanks to Oracle. The BW data loading times have been significantly shortened with Oracle too. KIVBF currently has four ERP systems from which the BW system gets its data for reports / evaluations.



**Speed comparison: SAP MaxDB with BWA and Oracle 12c In-Memory**

Σ SAP MaxDB with BWA in seconds	Σ Oracle (Materialized V+IM) in seconds	Speed ratio Oracle(IM) : MaxDB (BWA)
2899	335	8,65

**Comparison of BW database volumes: SAP MaxDB and Oracle 12c in TB**

SAP MaxDB (uncompressed)	SAP MaxDB (uncompressed) with Unicode	Oracle 12c (compressed) with Unicode	Savings factor
2,48	3,2	0,94	3,4



As Brigitte Landwehr, the BW system's specialist manager, explains, her colleagues in new customer projects have told her "that they were amazed at how quick the BW response times are with Oracle In-Memory". She went on to add that some reports for In-Memory processing had not been used because they "achieved a performance in the low single digits using Oracle 12c alone, even without In-Memory".

KIVBF employees certified by SAP are presently (in the middle of March 2017) switching the remaining SAP systems over from SAP MaxDB to Oracle 12c. Yet another priority item on KIVBF's optimization agenda is switching SAP NetWeaver 7.31 to either version 7.4 or version 7.5. In this regard, the support of Flat Cubes in BW In-Memory processing, which supports Oracle 12c with OIM from the version SAP NetWeaver 7.40, is significant. This solution not only optimizes performance for analyses, but considerably minimizes loading times too.

[www.kivbf.de](http://www.kivbf.de)

**Oracle Customer:** Kommunale Informationsverarbeitung Baden-Franken (KIVBF)

**Industry:** Service provider (public service)

**Turnover:** Over 1 billion

**Workforce:** 610

**Oracle Products & Services:**

- Oracle Database 12c (12.1.0.2), with Oracle Advanced Compression and Oracle In-Memory Option for SAP NetWeaver BW
- Oracle RMAN (Compression) for backup
- Oracle ACS Advanced Customer Service

**Key benefits:**

- Cost optimizations
- minimized database footprint
- much better performance
- future-proof database technology

**SAP:**

- SAP Industry Solution IS-U/ERP ECC, NetWeaver BW, and others

**Infrastructure:**

- Cisco server (virtualized VMware)
- NetApp storage systems
- OS Windows Server 2012 V2

“By running Oracle Database 12c with Oracle Exadata Database Machine, we gained the ability to accelerate query performance by 4x and update data 2x faster. The integrated database platform also supported seamless data migration and minimized disruption to our manufacturing operations.”

– MASATOSHI UTSUNOMIYA,  
Director of System Department, Lion Corporation

## LION CORPORATION MAXIMIZES REVENUE OPPORTUNITY AND SUPPORTS GLOBAL GROWTH WITH ORACLE

### Lion Corporation Maximizes Revenue Opportunity and Supports Global Growth with Oracle.

Lion Corporation is Japan’s largest manufacturer of oral care and a wide range of beauty care and household products, including toothpastes, shampoos, body care, and laundry detergent products. It also sells over-the-counter pharmaceutical products, such as aspirin and cold medicine, through a licensing agreement with drug maker Bristol-Myers Squibb. Its goal is to deliver quality products and contribute to customers’ cleanliness, health, comfort, and the environment.

After replacing Teradata five years ago, Lion Corporation had been using Oracle Exadata V2 for multiple applications. The Oracle Exadata machine hosted numerous databases for SAP, production management, and business intelligence. Due to increasing POS data volume and the relocation of data center, Lion decided to upgrade its legacy Oracle Exadata to enhance performance and eliminate the failure of transporting hardware.

### Challenges

- Gain ability to rapidly process over a few hundred million pieces of data, such as toothpaste and laundry detergent products sales transactions, and support business growth
- Upgrade the existing Oracle Exadata in the new datacenter instead of moving the physical machine to avoid the risk of hardware damage and ensure data security
- Complete the database upgrade and datacenter relocation project within the specified timeline and budget
- Ensure smooth data migration for business-critical applications, such as SAP ERP systems, to the new database platform and minimize disruption to critical manufacturing operations

### Results

- Provided executives with accurate business decision data, such as toothpaste sales, by accelerating query performance by up to 4x and processing data updates 2x faster with Oracle Exadata X5
- Gained a flexible licensing model with Oracle Exadata and allowed the business to easily expand database or storage servers, such as upgrading from eighth rack to quarter rack, and improve system performance to support revenue growth
- Achieved zero downtime since the upgrade to Oracle Exadata X5-2 and ensured high availability with the engineered system’s fully redundant hardware
- Enabled big data analysis by using Oracle Database In-Memory’s dual-format architecture to optimize large volume of analytic queries, such as POS data for oral care products
- Simplified system management by providing an integrated platform to manage database servers for purchasing and human resources applications operating in individual environment, thanks to Oracle Database 12c’s multitenant option
- Minimized risk and met the database upgrade and data center relocation project timeline and budget by deploying a pre-configured and pre-tested Oracle Exadata and enabling rapid deployment in the new datacenter
- Reduced IT staff workload by gaining the capacity to consolidate even more databases and easily manage the upgrades and patching with Oracle Multitenant



### Why Oracle

“We upgraded to Oracle Exadata because of its superior performance and capacity on-demand licensing model, giving us the flexibility to support future growth. Oracle Database 12c also helped to ensure seamless migration and minimize disruption to businesses.”

– Akinori Murakami, Engineer, System Department,  
Lion Corporation.

### Execution

Lion Corporation upgraded its database platform with Oracle Database 12c and Oracle Exadata X5-2 and adopted Oracle Database Options including Oracle Multitenant and Oracle Database In-Memory to enable faster analysis and ensure seamless migration of business applications. With assistance from Oracle, Lion Corporation completed the project in less than four months and went live smoothly with the new platform.

### About Lion Corporation

Founded in 1891, Lion Corporation manufactures and sells oral care products, such as toothpaste and mouthwash, and other daily living products – ranging from toiletries to consumer household goods, cooking aids, and pharmaceutical products. It operates six sales offices, four manufacturing plants, and two research institutes locally. Lion Corporation also expanded its business in several Asian countries to promote healthy and comfortable lifestyles in the region.

### Partner Involvement

Oracle Partner, SCSK Corporation worked as the system integrator for Lion Corporation's Oracle Exadata and Oracle Database 12c upgrade project.

“SCSK provided us the most efficient and cost-effective migration plan. With its strong expertise in SAP applications, we quickly resolved various licensing and installation issues as we were the first company in Japan to migrate databases for SAP applications into Oracle Database 12c,” Murakami said.

SCSK Corporation

[https://www.scsk.jp/index\\_en.html](https://www.scsk.jp/index_en.html)

*life.love.*  
**LION**

<http://www.lion.co.jp/en/>

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**Oracle Customer:** Lion Corporation

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**Customer Headquarters:** Tokyo, Japan

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**Employees:** 6,816

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**Customer Revenue:** US\$300Million

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## TREMENDOUS IMPROVEMENT IN PERFORMANCE IN SAP BW WITH ORACLE DATABASE IN-MEMORY AND “FLAT CUBES WITH ORACLE”

### Implemented with a modest amount of work

With an annual turnover of approximately 820 million and over 7,700 employees, Villeroy & Boch is one of the world's leading premium brands for ceramic products. The family business, which was founded in 1748 and is headquartered in Mettlach/Germany, stands for innovation, tradition and exceptional style. As a renowned lifestyle brand, Villeroy & Boch offers products from the sectors Bathroom and Wellness and Tableware, and is active in 125 countries.

Both business areas use an SAP ERP and an SAP BW system as well as other SAP solutions. Villeroy & Boch has also been using Oracle's proven, reliable database to great advantage for around 20 years. Over the years the use of BW/BI has steadily increased. The company has approximately 2,500 SAP users worldwide, including some 1,700 in the SAP BW environment. Certified SAP hosting partner Rödl IT Operation GmbH (with offices in Mettlach, Selb, and Frankfurt) operates and manages a range of systems including all SAP systems on behalf of Villeroy & Boch AG.

### Putting Oracle Database In-Memory to the test

Shortly after the Oracle Database In-Memory technology was officially certified by SAP in the middle of 2015, Villeroy & Boch joined forces with Rödl & Partner, its hosting partner, to put Oracle Database In-Memory to the test. This new database 12c technology for its SAP BW was extensively tested on a sandbox system on the exact same hardware as used with the productive system. During this process, the fact tables (E and F tables) of the biggest InfoCube (COPA) – containing approximately 94 million complete datasets – were loaded in the Oracle database's additional, column-oriented memory area “Column Store”. The tests mainly involved directly comparing pure read times for selected queries with the productive system. The database system needed to be upgraded from Oracle 11g to Oracle 12c to use Database In-Memory. The database's main storage was In-Memory. The database's main storage was expanded by 96 GB. This new memory is only used in the database for column-oriented In-Memory tables. The buffer sizes in the System Global Area (SGA),

such as those for the data block buffer cache and shared pool remained unchanged. The entire test took just 1.5 days. Only three Oracle database parameters are needed to use Database In-Memory.

- `inmemory_max_populate_servers=4`  
(limits the number of database background processes for loading the In-Memory tables, default = 4)
- `inmemory_size=96 GByte`  
(defines the size of the In-Memory Store)
- `inmemory_clause_default = „PRIORITY HIGH“`

The SAP LISTCUBE transaction, to name but one example, was used when carrying out the tests. The database response times were calculated with SQL traces using SAP transaction ST05 (performance analysis). All the database tables were compressed on the productive system using Oracle Advanced Compression technology. The indexes, meanwhile, were compressed with Index Compression, which has been usable in SAP since Oracle 10g. Both compression operations therefore took place using the test system too.

### Expectations exceeded

Comparisons with the productive system were made on identical hardware with various test scenarios on the SAP NetWeaver BW system.

- In the first test, 1 million datasets were selected without database aggregation several times over. While 24 seconds were measured for this query in the productive system, a response time of 160 milliseconds was recorded on the identical test system with Oracle In-Memory.
- These 1 million datasets were aggregated in the second test too. Here, the execution time was shortened from 44 seconds to 11 seconds.
- In the third test, the entire data volume of the loaded tables (94 million datasets) was read and aggregated. While the execution did not give a result in the productive system due to a time-out, it was completed in 22 seconds on the test system.

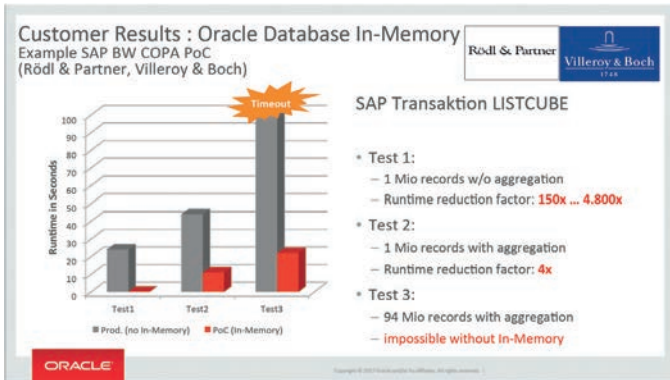


Figure: Performance of Oracle Database In-Memory

In further tests, two existing COPA queries were used and compared without any adaptations.

Here, the execution times were greatly accelerated, going from 50 to 1.5 seconds and from 72 to 2.5 seconds.

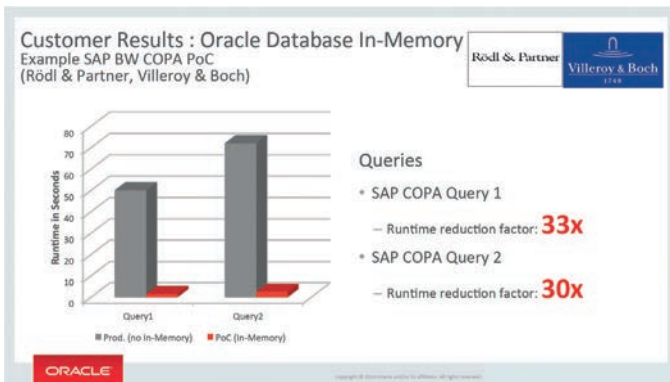


Figure: Performance of Oracle Database In-Memory for COPA queries

The now-shorter execution times are particularly valuable for Villerooy & Boch, as is the modest amount of implementation work required. Use of Oracle Database In-Memory now enables selection and aggregation of extremely large amounts of data in far shorter times.

The moderate amount of implementation work is a key argument in favor of using Oracle Database In-Memory. In a nutshell, only the following was necessary:

- Use of existing hardware, operating system, and virtualization technology
- Database upgrade from Oracle 11g to Oracle 12c

- Activation of Database In-Memory using a few database parameters
- Activation of tables for In-Memory
- No table or database migration
- No adaptations to the SAP application code

**Low resource requirement, many benefits**

Villerooy & Boch was expecting performance to increase substantially. This much has certainly been confirmed – and impressively so. At the same time, it became clear just how much potential the Oracle Database In-Memory technology harbors.

The swift implementation and performance of the tests both make a completely convincing argument. The fact that there was no need to buy any brand-new hardware given the moderate additional memory costs was yet another positive aspect in favor of using the technology. Use of Oracle Database In-Memory is activated only for tables that are useful for this purpose. It is not appropriate to equip all the tables in a database with In-Memory technology. Doing so makes tables smaller, or even creates tables on which a pure single set query is performed. Column-oriented storage with Oracle In-Memory is not necessary for this.

The technology can be used immediately in the existing infrastructure and virtualized environment. No special adaptations or modifications to the existing database or within the SAP application are necessary. The administrative work involved is also very moderate. The minimum risk involved in upgrading the Oracle database is well known due to many years of experience in dealing with the Oracle database.

- Oracle Database In-Memory results in a significantly improved report execution time
- Improvements several times over
- Moderate implementation work
- Implementation on existing hardware
- No modifications necessary in the application
- No data migration required
- Unmodified use of all Oracle database functionalities

### Further developments in the SAP NetWeaver BW now available with Flat Cubes and Oracle too

When it launched SAP HANA, SAP developed the HANA-optimized InfoCubes, which was only possible due to the use of column-oriented In-Memory technology. The “SnowFlake” data model of the existing InfoCubes made up of fact and dimension tables was dissolved and migrated to a flat table.

The same technology has been available to all SAP NetWeaver BW customers since the middle of 2016 along with the Oracle database and the In-Memory option under the keyword “Flat Cube on SAP BW on Oracle” (see SAP Note: 2335159). Existing InfoCubes are converted as needed using the SAP standard program RSANAORA. By means of re-partitioning, the InfoCube (E and F fact tables and all the associated dimension tables) are being created as a single flat table in a partitioned format.

Following the productive launch of Oracle In-Memory technology in the middle of 2016, Villeroy & Boch converted some InfoCubes to Flat Cubes in SAP NetWeaver BW during another test conducted at the end of 2016 / start of 2017.

So, for instance, an InfoCube with 110 million datasets and measuring 13 GB in size (7 GB of which was index) needed one hour and 42 minutes for the conversion process. Once the conversion was complete, the Flat Cube was 7.2 GB in size and had a 0.3 GB index. In addition to the improvement in response time, which again was to be expected, there was also a reduction in database size within storage.

### Further significant increase in performance thanks to Flat Cubes in Oracle

Following the conversion, the execution times of 100 seconds on the previous In-Memory solution could be substantially improved yet again, being shortened to 20 seconds with a Flat Cube and In-Memory. What’s more, the benefits also include approximately 30% faster loading, eliminated aggregates and simplified BW modeling – and all of this is achieved through using a Flat Cube.

**Repartitioning of InfoProviders**

Make sure that you read the corresponding documentation and SAP Note 1008833

Structural Changes to Infoprovider

InfoCube

DataStore Object

Processing Options

Repartitioning of InfoProviders

Attaching Partitions

Merging Partitions

Complete Repartitioning

Conversion (only InfoCubes)

Flat to Non-flat

Non-flat to Flat

Repartitioning Request

Figure: Re-partitioning and activation of the Flat Cube

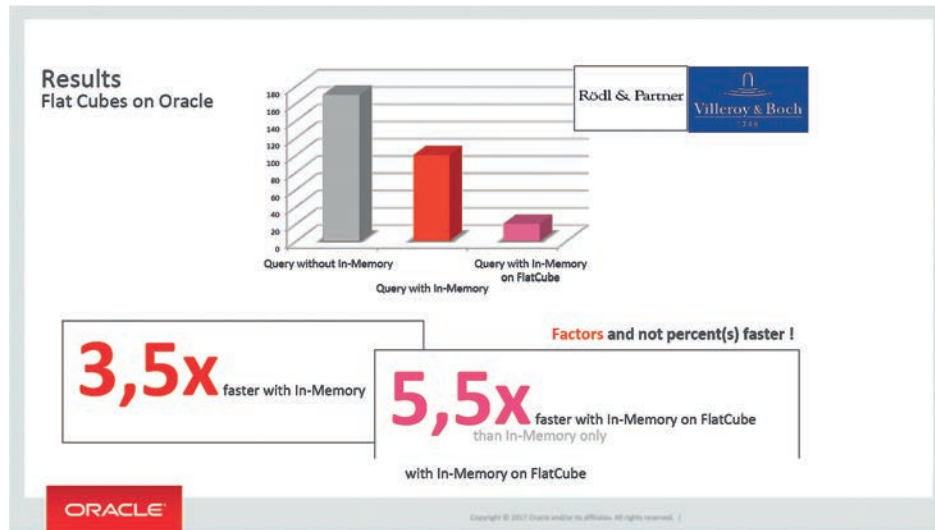


Figure: A comparison of execution times

Oracle recommends using the SAP NetWeaver version 7.40 with SP16 for conversion to Flat Cubes. In 2016, it was still impossible from an SAP standpoint to convert transactional (plannable) InfoCubes or semantically partitioned objects (SPOs).\*

#### Summary of the tests

Using Oracle Database In-Memory, there is currently no need for Villerooy & Boch to replace its Oracle database for the current SAP NetWeaver systems, which has been reliable for many years, with another database system. Villerooy & Boch is successfully using the Oracle Database In-Memory technology for the productive SAP NetWeaver BW as well as SAP CRM systems.

With a reasonable amount of work and acceptable costs for the investments, the following benefits very quickly became a reality thanks to the Oracle Database In-Memory technology:

- several significant increases in the speed of query times for reports
- far more effective analysis options in reporting

The Oracle database is thus once again proving its position as a long-term stability factor for databases in the SAP environment and delivers innovations that can be implemented very quickly and with very little effort.

\* Support for Semantically Partitioned Objects has been added in 2018.

*“With our tests based on Oracle 12c and Oracle Database In-Memory, the PoC produced amazing results in terms of improved performance. From a BI point of view I was also especially pleased with the fact that once SAP applications have been created, they can be used with Oracle Database In-Memory without any modifications. It’s also easy to choose which SAP BW tables are processed with In-Memory and which are not.”*

**HARALD WOLF**  
SENIOR CONSULTANT FOR BI  
VILLEROY & BOCH



## ORACLE-RELATED SAP NOTES (DATABASE)

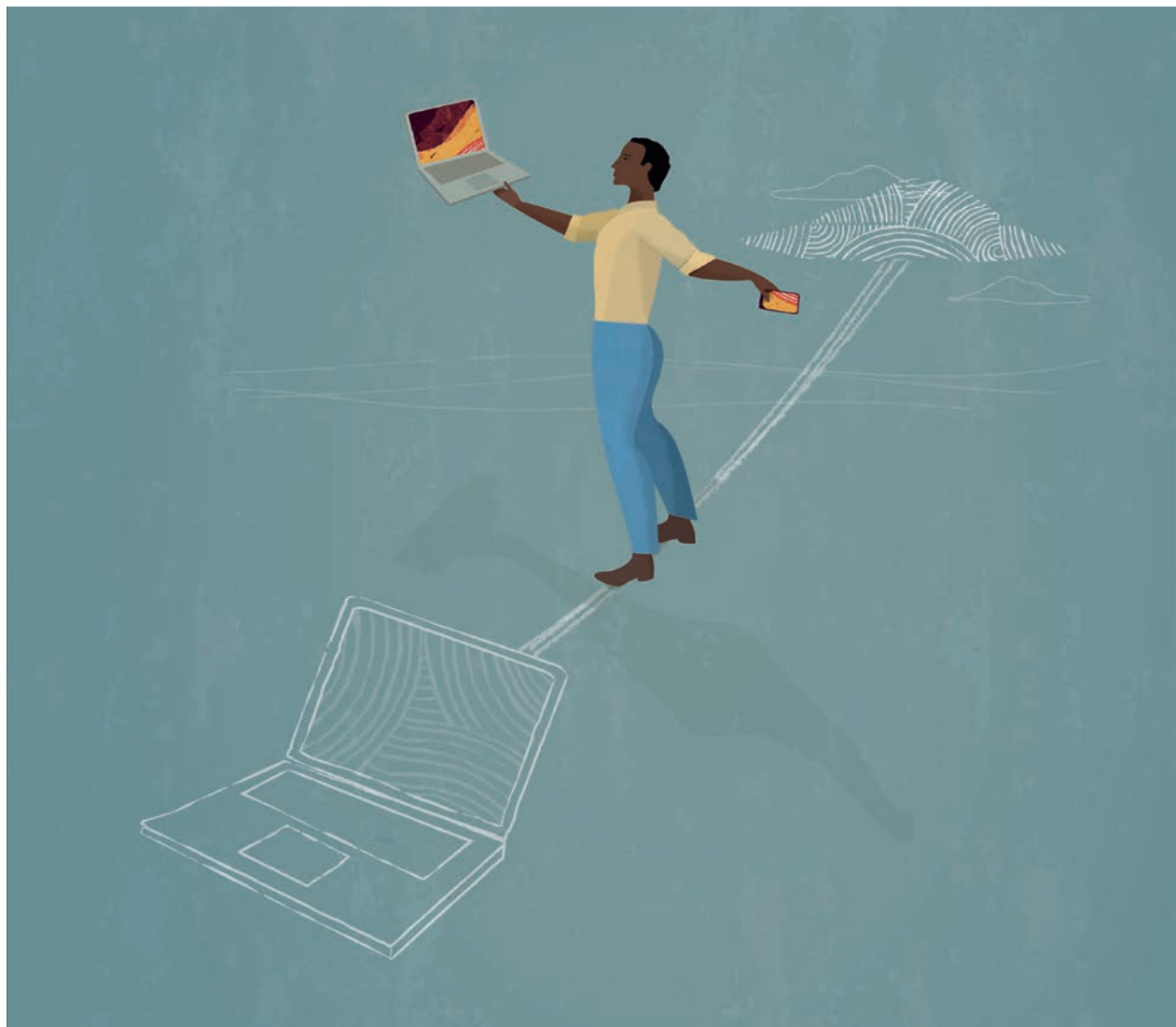
Note No.	Note Title	DB Version
<b>DB : General : Licensing Information</b>		
581312	Oracle Database Licensing Restrictions	12c-19c
740897	Oracle License Scope & Required Oracle Options	12c-19c
1028068	Required Oracle Options for DBA Cockpit	12c-19c
<b>DB : General Version Support</b>		
1174136	Oracle: End of Support Dates	12c-19c
2606828	Oracle Database Roadmap for SAP NetWeaver	12c-19c
<b>DB : General : Oracle Support for HANA-Related SAP Application Optimizations</b>		
1835008	Activate Database Performance Optimizations for SAP ERP	12c-19c
1892354	SAP Strategy for Cluster and Pool Tables	12c-19c
1951491	Minimal DB Platform Requirements for SAP NetWeaver 7.4 SP08	12c-19c
<b>DB : Features : Overview</b>		
105047	Support for Oracle Functions in the SAP Environment	12c-19c
2799900	Central Technical Note for Oracle Database 19c	19c
2817074	Oracle Database 19c: Integration in SAP Environment	19c
<b>DB : Features : File Systems</b>		
155013	Using Oracle ASM with SAP NetWeaver-based Products	12c-19c
1416773	Oracle Direct NFS	12c-19c
1627541	BR*Tools Support for Oracle ASM and Exadata	12c-19c
1738053	SAPinst for Oracle ASM Installation	12c-19c
1825328	Oracle ASM and SAP NetWeaver Master Data Management (MDM)	12c-19c
2163827	LVM support for Oracle RAC and/or ASM	12c-19c
<b>DB : Features : Performance</b>		
741478	FAQ: Materialized Views	12c-19c
<b>DB : Features : Data Storage &amp; Compression</b>		
1109743	Use of Index Key Compression for Oracle Databases	12c-19c
1426979	SecureFiles – The New Way to Store LOB Data	12c-19c
1464156	BRSPACE 7.20	12c-19c
1583303	Deferred Segment Creation	12c-19c
1842044	Dataload Without Dropping Bitmap Indexes	12c-19c
1856270	Performance Improvements for Tables with Single Unique Index	12c-19c
<b>DB : Option : Advanced Compression</b>		
1289494	FAQ Oracle Compression	12c-19c
1431296	LOB Conversion & Table Compression with BRSPACE 7.20	12c-19c
1436352	Advanced Compression for SAP Systems	12c-19c



2138262	Oracle Database 12c Advanced Compression for SAP Systems	12c-19c
2157904	Oracle 12c: Conversion of Compressed Tables	12c-19c
2166836	Oracle 12c: Problem during SAP Upgrade with Compressed Tables	12c-19c
2254836	BR*Tools Support for Oracle ADO/ILM	12c-19c
2254866	Using Oracle Database 12c Automatic Data Optimization	12c-19c
2255992	R3load and R3szchk: New Oracle Feature for Database ILM Policy	12c-19c
2258061	Enhancements for ADO/ILM for Table Conversions or System Copy	12c-19c
2384534	LOB Conversion & Table Compression with BRSPACE 7.40	12c-19c
<b>DB : Option : In-Memory</b>		
2137032	DBA Cockpit: Monitor for In-Memory Feature	12c-19c
2178980	Using Oracle Database In-Memory with SAP NetWeaver-based Products	12c-19c
2189163	Oracle Database In-Memory Advisor for SAP	12c-19c
2335159	Flat Cubes for SAP BW on Oracle DB	12c-19c
2351252	Oracle Database 12c In-Memory Toolkit for SAP BW	12c-19c
2711358	Conversion of Semantically Partitioned Objects to a Flat Format	12c-19c
2816467	Support for FEMS Pushdown on Oracle	12c-19c
2948714	BW Migration to BW on Oracle by Respecting Flat Cube	12c-19c
<b>DB : Option : Multitenant</b>		
2333995	BR*Tools Support for Oracle Multitenant Database	12c-19c
2335850	Transformation of Existing Standalone Database into Pluggable Database	12c-19c
2336881	Using Oracle Multitenant with SAP NetWeaver-based Products	12c-19c
3144616	Using Oracle Multitenant with Real Application Clusters (Pilot Program)	19c
<b>DB : Option : Partitioning</b>		
742243	General Table Partitioning	12c-19c
859841	Deinstallation of Oracle Partitioning Option (SAP BW)	12c-19c
<b>DB : Option : Real Application Clusters (RAC)</b>		
196927	Protecting SAP Instances through Oracle Clusterware (SAPCTL)	12c-19c
527843	Oracle RAC Support in the SAP Environment	12c-19c
1431241	RAC with TAF	12c-19c
1977463	Using Shared or Local Oracle Homes with RAC	12c-19c
<b>DB : Option : Real Application Testing (RAT)</b>		
1426980	The Real Application Testing Option	12c-19c
<b>DB : Features : Security</b>		
1157499	OPS\$ Connect and Security Aspects	12c-19c
1622837	Secure Connection of AS ABAP to Oracle via SSFS	12c-19c
1623922	Connect to Oracle Database	12c-19c
1710997	Using Personalized Database Administrator Accounts	12c-19c
1755636	Database Administrators Segregation	12c-19c
1764043	Support for Secure Storage in BR*Tools	12c-19c

1868094	Overview: Oracle Security SAP Notes	12c-19c
3130747	Apache Log4j vulnerability	12c-19c
<b>DB : Option : Advanced Security</b>		
973450	Network Encryption	12c-19c
1324684	Backup Encryption	12c-19c
2591575	Transparent Data Encryption	12c-19c
<b>DB : Option : Database Vault</b>		
1355140	Using Oracle Database Vault in an SAP Environment	12c-19c
1502374	Database Vault for SAP Policy Scripts	12c-19c
1716939	SAP System Copies with Database Vault	12c-19c
2218115	Oracle Database Vault 12c	12c-19c
<b>Deployment : Software : Installation &amp; Upgrade</b>		
819829	Oracle Instant Client Installation and Configuration on Unix	12c-19c
1915299	Troubleshooting Software Installation	12c-19c
1915317	Migrating to Software Owner ,oracle'	12c-19c
1915323	OS User Concept for Oracle Database 12c and higher	12c-19c
2184253	Maintaining SAP and Non-SAP Databases on one Oracle Installation	12c-19c
2800001	Upgrading to Oracle Database 19c (DBUA)	19c
2800021	Upgrading to Oracle Grid Infrastructure 19c	19c
<b>Deployment : Software : Patches</b>		
1027012	MOPatch – Install Multiple Oracle Patches in One Run	12c-19c
1696869	Patching of Oracle Homes with Minimal Downtime	12c-19c
2011199	SAP Bundle Patches – Structure Changes Starting June 2014	12c-19c
2574651	New Strategy for Oracle Database Patching	12c-19c
2799920	Database: Patches for 19c	19c
2799930	Grid Infrastructure: Patches for 19c	19c
<b>Deployment : Instance Configuration</b>		
1171650	Automated Oracle DB Parameter Check	12c-19c
1431751	Quick Reference for ADRCI and ADR	12c-19c
1589924	SAP Workload Management via Oracle Resource Manager	12c-19c
2470718	Database Parameters 12.2 / 18c / 19c	12c-19c
<b>Deployment : Admin Tools : SAP BR*Tools</b>		
12741	Current Versions of BR*Tools	12c-19c
1428529	Corrections in BR*Tools Version 7.20	12c-19c
1598594	BR*Tools Configuration for Oracle Installation under „oracle“ User	12c-19c
1838850	Corrections in BR*Tools Version 7.40	12c-19c
1844380	Minor Functional Enhancements in BR*Tools (5)	12c-19c
1882182	Functional Enhancements in BR*Tools 7.40	12c-19c
2086966	Minor Functional Enhancements in BR*Tools (6)	12c-19c

Deployment : Admin Tools : Oracle Enterprise Manager		
355770	Oracle Enterprise Manager Database Control	12c-19c
386413	Oracle Enterprise Manager (OEM) in the SAP Environment	12c-19c
Deployment : Data		
646681	Reorganizing Tables with BRSPACE	12c-19c
937492	Oracle Flashback FAQ	12c-19c
966117	Oracle Flashback Database Technology	12c-19c
Database : Services		
1508271	Oracle Lifecycle Migration Service (formerly O2O/Triple-O)	12c-19c



# Oracle Cloud for SAP Customers

Preserve existing investments and free up resources for innovation

## Oracle Cloud: A Great Opportunity



### Same SAP Application, Same Oracle Database

No business disruption. Retain all your customizations.



### Reduce Costs

Transform Capex to Opex. Pay only for what you use.



### Improve Agility and Accelerate Innovation

Focus on SAP software deployments, not infrastructure management.



### Best Price Performance and Transparent Pricing

Get 34% lower infrastructure costs for your SAP/enterprise software data workloads vs leading cloud provider.

## Oracle Cloud: Benefits



### Optimized for Oracle Database

Oracle Database runs up to 7.8x faster on Oracle Cloud Infrastructure vs leading cloud provider.



### High and Predictable Performance

Run SAP applications and Oracle databases on bare metal and virtual machine instances. Leverage high performance resources.



### Exadata Cloud Service and Exadata Cloud@Customer

Most powerful platform to run Oracle Database in the cloud, only available from Oracle.



### Security and Control

Compute and network isolation help ensure data security. Compartment capabilities allow for control of SAP deployments.

## Oracle Cloud: Use Cases



### Dev/Test in the Cloud

Test new customizations or new software versions.



### Backup and DR in the Cloud

Independent data centers for high availability, disaster recovery. Duplicated environment in the cloud for application and database.



### Extend the Data Center to the Cloud

Transient workloads (training, demos). Rapid implementation for acquired subsidiary, Geographic expansion or separate LOB.



### Production in the Cloud

Reduce reliance on or eliminate on-premises data centers. Focus on strategic priorities and differentiation, not managing infrastructure.

## Several options available for SAP-Oracle user companies to reap the benefits of the Oracle Cloud Infrastructure

### DATABASE MIGRATION TO THE ORACLE CLOUD MADE EASY

Oracle Cloud Infrastructure Services enable companies to enjoy significant benefits. Like all Oracle Cloud Services, the use of Oracle Cloud Infrastructure Services is increasing at a rapid pace.

Oracle's Cloud Infrastructure Services offer comprehensive control and the versatility to run both traditional and cloud-native workloads with predictable savings. Oracle Cloud Infrastructure, which is managed, hosted, and supported by Oracle, provides organizations with the tools needed to migrate, build, and run production, business-critical applications in the cloud.

The use of the SAP NetWeaver Application Server ABAP/Java on Oracle Cloud Infrastructure is the start of a new chapter in the long-standing partnership between Oracle and SAP. The focus here is on operating Oracle SAP databases on the basis of powerful computing, network, and storage infrastructure workload services on a secure, stable, predictable and extendable platform.

Database migration to the Oracle Cloud lies at the heart of this collaboration. Usually, this takes place after planning, preparatory work, and various precursors, such as setting up an Oracle Infrastructure account, determining an appropriate workload sizing, choosing the appropriate bare metal shape, use of Oracle Cloud Infrastructure Object Storage, and much more.

More information about database migration for Oracle-SAP customers can be found in the whitepaper „SAP NetWeaver Application Server ABAP/Java on Oracle Cloud Infrastructure“. Please download the whitepaper: <http://www.oracle.com/us/solutions/sap/sap-netweaver-on-oracle-cloud-wp-3931430.pdf>. More information is available in the appropriate SAP Notes (for example 2474949 „SAP on Oracle Cloud Infrastructure“ or 2520061 „SAP on Oracle Cloud Infrastructure: Support Requisites“).

#### RMAN and/or BR\*Tools

There are also several options, procedures, and methods available to SAP-Oracle customers for migrating databases or what is also known as “Lift and Shift into the Cloud” combined

with the Oracle Cloud Infrastructure when using or operating source and target platforms with Linux (Linux x86\_64).

The focus here is on five methods or procedures. The tools used will be very familiar to all Oracle-SAP customers, especially when it comes to backup, restore and recovery (both on the source and target host).

- Firstly, RMAN (Oracle Recovery Manager) Oracle Backup/Recovery Toolset is used,
- and secondly: BR\*Tools (previously sapdba) for administration and management of Oracle databases in the SAP environment.

**Procedure 1:** With the first option, the database is migrated to the Oracle Cloud using Oracle Recovery Manager via Oracle Cloud Infrastructure Object Storage. Object Storage is configured on the source host and backup/recovery is undertaken. The same procedure is followed on the target host, including recovery and restoration.

**Procedure 2:** With the second option, the database is migrated using BR\*Tools via the brbackup tool. The procedure is the same as above but also includes integration/use of BR\*Tools and the corresponding specifications of command functions on the source and target host.

**Procedure 3:** If the source platform is a Linux X86-64 and/or if the process involves a permitted combination from MOS Note 1079563.1, the RMAN command „duplicate database from active database“ can be used to produce an exact copy of the source database on the target in the cloud. If desired, the database is made available in the cloud as a Data Guard standby database so that Data Guard can be used to apply all further changes to the source database on the target database. Migrations can therefore be almost free of interruptions. The RMAN „duplicate“ process can run with an active source database to restrict the migration „downtime“ for the database to a Data Guard role switch and/or failover. Release changes, upgrades or other changes to the configuration or database content are not possible with this option. One benefit of this procedure is that there is no need for a temporary buffer for backups, exports or data.



**Procedure 4:** If the source platform is different from the target platform in the cloud, e.g. as a result of a different endian type, and if the database is able to accept a slightly longer „downtime“, migration across all platforms can be undertaken using the RMAN „cross platform transportable tablespaces“ command. This procedure requires a new minimal database to be created in the cloud. The application data is then migrated by transferring the application tablespaces. This can be done on the basis of RMAN backups where incremental on-line backups can also be used to transfer subsequent changes made to the source database. Only the last backup and a meta data export have to be undertaken with the application and/or SAP stopped. With this procedure, the data (backups) have to be buffered to a filesystem that can be accessed from both the source and cloud.

**Procedure 5:** The most flexible procedure is called Oracle Lifecycle Migration Service (O2O), which is a service provided by Oracle ACS. All supported platform combinations are possible here. There are two steps to the procedure. First, a set of scripts is generated. Those scripts allow for the creation of the new target database, setup of the environment and to perform the data movement. The second step is the actual execution of those scripts to perform the migration.. Large tables are transferred using database links and smaller ones using export/import. A high degree of parallelism is possible if the hardware (compute and network) involved permit it. A new database is created in the cloud, which means that a

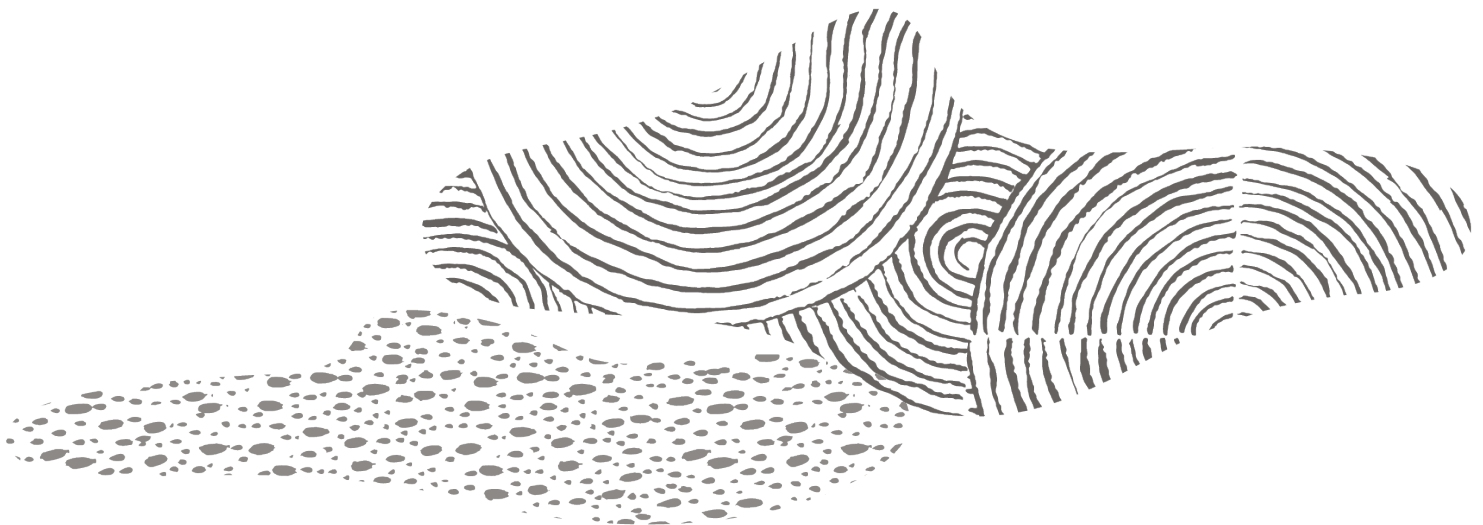
database upgrade can be implemented transparently as part of the migration. Changes to tablespaces and schedule as well as activation or deactivation of features, such as compression, partitioning, encryption, RAC or Database Vault, are all possible as well. The only thing which cannot be done is the SAP-based unicode conversion because this has to be done by the SAP server.

A buffer, which can be accessed from both sides, is needed for the scripts and export files. The application, i.e. SAP, has to be stopped for the duration of the migration process.

If using GoldenGate, the O2O procedure becomes the OOO procedure, and the changes made since the start of the O2O migration are recorded by GoldenGate and applied to the new database in the cloud. OOO is the online variant of O2O with which SAP can remain active with the exception of a short „downtime“ during the switchover.

More information about database migration for Oracle-SAP customers can be found in the whitepaper „SAP NetWeaver Application Server ABAP/Java on Oracle Cloud Infrastructure“. Please download the whitepaper:

<http://www.oracle.com/us/solutions/sap/sap-netweaver-on-oracle-cloud-wp-3931430.pdf>. Further information can also be found“ in the appropriate SAP Notes (for example 2474949 „SAP on Oracle Cloud Infrastructure“ or 2520061 „SAP on Oracle Cloud Infrastructure: Support Requisites“).



## SAP NETWEAVER APPLICATION SERVER ABAP/JAVA ON ORACLE CLOUD INFRASTRUCTURE, ORACLE EXADATA CLOUD SERVICE, ORACLE EXADATA CLOUD@CUSTOMER – IMPLEMENTATION GUIDES

### Abstract:

Three technical white papers are provided as reference guides for deploying SAP NetWeaver® Application Server ABAP/Java onto the Oracle Cloud Infrastructure utilizing Bare Metal shapes, Exadata as a Service and Exadata Cloud@Customer. The guides provide suggested platform best practices as well as details about the individual components of the Oracle Cloud Infrastructure, Oracle Linux, Oracle Database instances, and SAP application instances necessary to run software products based on SAP NetWeaver Application Server ABAP/Java in the Oracle Cloud Infrastructure.

The white papers assume the following knowledge:

- You are familiar with the fundamentals of Oracle Cloud Infrastructure.
- You have a background in SAP NetWeaver Application Server ABAP/Java using Oracle Database and Oracle Linux. For more information, see the following resources:
  - <http://go.sap.com/solution.html>
  - <https://www.sap.com/community/topic/oracle.html>
  - <http://docs.oracle.com/en/operating-systems/linux.html>
- You're familiar with the product documentation for:
  - Oracle Cloud Infrastructure
  - Oracle Database 12c and 19c
  - Oracle Linux 6 and 7 and 8
  - SAP NetWeaver 7.x

Most of the steps described here are the same as in a traditional SAP deployment in a customer data center.

The document also includes details about how to develop a backup and high-availability plan for your SAP installation in Oracle Cloud Infrastructure. With this background and the Implementation Guide it should be no problem to install SAP applications on Oracle Cloud Infrastructure (OCI).

### Additional Training available:

For those who are working hands-on implementing SAP NetWeaver Applications on the Oracle Cloud Infrastructure, the SAPCC and Oracle Solution Center team in Walldorf have developed a Technical Training, which will be available on special request. Additional video tutorials are available with the following topics:

1. Introduction to OCI4SAP
2. Typical reference architecture for OCI4SAP
3. Terraform core setup
4. OCI4SAP Ref Arch based & deployment process
5. OCI4SAP customer prerequisites
6. OCI4SAP OCI Tenant + Virtual Cloud Network (VCN)
7. OCI4SAP Bastion Host
8. OCI4SAP Central Services Installation
9. OCI4SAP DB installation
10. CI4SAP Application server installation
11. OCI4SAP DMZ component installation: Web Dispatcher
12. OCI4SAP DMZ component installation: SAPRouter
13. OCI4SAP Final summary including checklist
14. Additional OCI key features

# SAP NetWeaver Application Server ABAP/Java on Oracle Cloud Infrastructure, Oracle Exadata Cloud Service, Oracle Exadata Cloud@Customer

## Implementation Guides



### SAP NetWeaver® Application Server ABAP/Java on Oracle Cloud Infrastructure



#### Contents:

- Overview of Oracle Cloud Infrastructure
- Overview and Architecture of SAP NetWeaver Application Server ABAP/Java
- Overview of SAP NetWeaver® Application Server ABAP/Java on Oracle Cloud Infrastructure
- Recommended Instances and Topologies for SAP NetWeaver® Application Server Installation
- Planning Your SAP Implementation
- Planning the SAP Deployment
- Implementing Your Plan
- Oracle Database in the Cloud
- Migrating to the Cloud
- High Availability in the Cloud



#### Download from:

- <https://www.sap.com/documents/2018/06/eab0396a-0c7d-0010-87a3-c30de2ffd8ff.html>
- <https://www.oracle.com/us/solutions/sap/sap-netweaver-on-oracle-cloud-wp-3931430.pdf>



### SAP NetWeaver® Application Server ABAP/Java on Oracle Database Exadata Cloud Service



#### Contents:

- Overview of Oracle Database Exadata Cloud Service
- Planning Your Exadata Cloud Services for SAP NetWeaver Application Server ABAP/Java
- Planning the SAP Deployment
- Implementing the Deployment
- SAP Bundle Patch for Oracle Database Exadata Cloud Service: Live Cycle Management for SAP Databases
- High Availability with Oracle Data Guard



#### Download from:

- <https://www.sap.com/documents/2020/04/5ca170cf-8f7d-0010-87a3-c30de2ffd8ff.html>
- <http://www.oracle.com/us/solutions/sap/sap-netweaver-on-exadata-cloud-wp-4428540.pdf>



### SAP NetWeaver® Application Server ABAP/Java on Oracle Exadata Cloud@Customer X9M



#### Contents:

- About Oracle Exadata Cloud@Customer X9M
- Planning the SAP Deployment
- Implementing the Deployment
- Patching Exadata Cloud@Customer X9M: Life Cycle Management for SAP Databases
- Using SAP Transaction DB13
- Migrating Databases
- Database Backup Options with Exadata Cloud@Customer
- High Availability with Oracle Data Guard



#### Download from:

- [https://docs.oracle.com/en-us/iaas/Content/Resources/Assets/whitepapers/sap\\_netweaver\\_app\\_server\\_abap\\_java\\_on\\_exadata\\_cloud\\_at\\_customer\\_x9m.pdf](https://docs.oracle.com/en-us/iaas/Content/Resources/Assets/whitepapers/sap_netweaver_app_server_abap_java_on_exadata_cloud_at_customer_x9m.pdf)
- [http://www.oracle.com/a/ocom/docs/sap\\_netweaver\\_app\\_server\\_abap\\_java\\_on\\_exadata\\_cloud\\_at\\_customer.pdf](http://www.oracle.com/a/ocom/docs/sap_netweaver_app_server_abap_java_on_exadata_cloud_at_customer.pdf)

## AMAGGI BOOSTS UPTIME BY MIGRATING KEY WORKLOADS TO ORACLE CLOUD INFRASTRUCTURE

The Brazilian agribusiness saves 20% in costs and reduces monthly close time 2X by moving to Oracle Cloud Infrastructure.

### Business challenges

Amaggi is a Brazilian agribusiness company active in large-scale soybean, corn, and cotton production with emphasis on sustainable development. The company currently has 362,000 hectares of agricultural production and sells around 16.9 million tons of grain worldwide. Amaggi is present in Argentina, Paraguay, China, the Netherlands, Switzerland, and Norway.

As a major player in the agribusiness sector, which sustains the Brazilian trade balance through exports, Amaggi invests in the development of precision agriculture-techniques that improve crop management and optimize productive areas. Every year the company wins awards and certifications for sustainable development.

With today's agribusiness driven by technology, Amaggi invests continually in integrating its systems for business efficiency. In 2022, with data center equipment and maintenance at end of life, the company decided to migrate to a more robust structure that would guarantee data security and high availability of its IT infrastructure.

**„ Agribusiness is on the cutting edge in Brazil. If you visit a farm, you will be amazed at the degree of technology. A soybean or cotton harvester is practically a computer on wheels. With OCI connectivity, we control the entire process from cultivation to export.“**

*Wagner Biasi, CSC and IT Manager, Amaggi*

### Why Amaggi chose Oracle

Amaggi ran Oracle Exadata Database Machine and associated technologies in its data center for years. While evaluating other cloud providers, Amaggi selected Oracle as a known quantity that understood the business challenge and propo-

sed the most responsive solution for the company's move to the cloud.

### Results

By migrating to Oracle Cloud Infrastructure (OCI) with Exadata Cloud Service, Amaggi reduced costs 20% by not having to refresh its data center through the arduous cycle of negotiating the purchase and delivery of expensive imported hardware.

OCI now runs the entire Amaggi production environment of 46 terabytes, including the critical grain processing, grain origination, agricultural support, weights and measures, and credit systems. The platform also supports the company's SAP enterprise resource planning (ERP) system, which was migrated over a weekend.

**„ Moving from our data center onto Oracle Cloud Infrastructure has reduced costs, eliminated hardware refresh bottlenecks, and has given our producer and logistics ecosystem a tremendous boost in availability.“**

*Wagner Biasi, CSC and IT Manager, Amaggi*

Previously hampered by database unavailability due to memory or disk space overflow, Amaggi now has 99.999% uptime through OCI's high availability, monitoring service, and load balancing. Billing disruption caused by downtime has been eliminated with OCI's high availability and lower latency, which ensures greater speed in grain shipment and delivery for Amaggi and its producers.

Efficiency gains also include 3X faster database provisioning, enabling DevOps teams to support the complex demands of crop picking, storage, loading and unloading, interconnectivity of farm machinery, logistics contractors, traceability, compliance, and cash flow.

The agricultural producer has trimmed monthly closing processes from 40 minutes to 5 minutes, positively impacting business operations that span 100 branch offices in Brazil and subsidiaries abroad.

Amaggi uses OCI FastConnect to link with its Cuiabá data center, which still runs some quality assurance, testing, and business continuity modules. Disaster recovery also sits in Cuiabá, managed by Oracle Exadata Cloud@Customer, combining the power of Exadata and Oracle Cloud. Amaggi is considering moving the environment to Oracle's São Paulo cloud region once it realizes the full benefits of OCI for its production workloads.

Oracle Cloud Governance also supports the fiscal complexity and controls Amaggi deals with in the import of farm inputs

and export of grain. International Ship and Port Facility Security Codes for receiving and shipping merchandise, bills of lading, shipping manifests, toll payments, freight payments, and more all need maximum available connectivity as well as the checks and balances within OCI governance and security.

#### Partners

Amaggi went live with OCI in six months, assisted by Oracle Consulting and Oracle Partner Lanlink.



<https://www.amaggi.com.br/>





## SAP ON ORACLE CLOUD INFRASTRUCTURE IMPROVES PERFORMANCE AND ELIMINATES \$2.5M ON-PREMISES TECHNOLOGY

Oracle partner Cintra delivers production SAP system in the Oracle Cloud Infrastructure – and establishes repeatable RapidCloud for SAP migration process to deliver future Oracle Cloud transformations for SAP customers.

### Business problem

A B2B retailer's mission-critical SAP system was running on end-of-life technology in a data center. Replacing the technology was going to cost more than \$2.5 million. The retailer wanted to avoid this cost and move from a traditional capex cost model to an opex one.

The new platform needed to be capable of delivering high-availability, as well as the same or improved performance as on-premises.

### How we won

Customer was familiar already with Oracle Exadata – both for SAP and non-SAP databases. In order to consolidate and standardize underlying infrastructure a move to Oracle Cloud Infrastructure and Exadata as a service (ExaCS) in OCI was a natural next step. The company chose Cintra to deliver this critical transformation project due to the credibility of Cintra's RapidCloud transformation methodology, which looks after every stage of the transition, from an early discovery and assessment, through architecture design, provisioning, migration and optimization, to ongoing cloud managed services. They also recognized the additional benefit of running SAP on Exadata in Oracle Cloud Infrastructure.

With one partner to deliver the entire journey, RapidCloud makes the transformation easy for customers. Moreover, the detail and credibility of the cloud design means we avoid the need for a proof of concept (POC). With Cintra and RapidCloud, customers have the confidence to go immediately to a real project, thereby accelerating their use of Oracle Cloud Infrastructure.

The customer asked Cintra for two technology options, one using a hybrid of Oracle Cloud Infrastructure and AWS, the other using purely Oracle Cloud Infrastructure. Cintra quickly created two fully costed designs using our RapidCloud tooling, then presented them to the customer. They explained why pure Oracle Cloud Infrastructure was the best option to meet the retailer's needs. Reasons included:

- **High-availability:** The best way to achieve high-availability was using Oracle RAC, which is only available in the Oracle Cloud
- **Consolidation:** The Oracle Cloud would enable them to consolidate multiple standalone servers and RAC clusters into a single Exadata
  - **Exadata PaaS benefits:** Oracle Exadata Cloud Service has the added benefits of being a PaaS service, so the customer will not be responsible for monitoring and patching the platform, thereby freeing up valuable resources
- **Enterprise-grade cloud:** The Oracle Cloud is the only true enterprise-grade cloud, capable of running mission-critical production workloads at scale
- **Performance:** The Oracle Exadata Cloud Service would additionally provide a performance improvement, enhancing user experiences and business-critical processing

### Lessons learned

We delivered the retailer's complete SAP-to-Oracle-Cloud-Infrastructure transformation in less than 90 days. The project delivered a design and provisioned cloud in 30 days, an SAP test environment in 60 days, and the final production deployment within 90 days.

Cintra created repeatable RapidCloud designs and blueprints that can be used to move other SAP customers to the Oracle Cloud Infrastructure quickly, predictably and with minimal risk. SAP to Oracle Cloud Infrastructure transformation is now a strategic focus for Cintra.

The customer's SAP system went live on-time, and performance has been markedly better in the cloud than on-premises.

By successfully deploying SAP in the Oracle Cloud Infrastructure, we have enabled the B2B retailer to avoid its \$2.5 million legacy on-premises technology refresh costs and move to its desired opex cost model. We also paved the way to move further critical applications at this customer to Oracle Cloud

Infrastructure, which we are currently delivering.

By successfully deploying SAP in the Oracle Cloud Infrastructure, we have enabled the B2B retailer to avoid its \$2.5 million legacy on-premises technology refresh costs and move to its desired opex cost model. We also paved the way to move further critical applications at this customer to Oracle Cloud Infrastructure, which we are currently delivering.

#### Products

- Oracle Cloud Infrastructure IaaS
- Oracle Exadata Cloud PaaS services
- Oracle RAC on Exadata
- Load Balancer as a Service (LBaaS)
- Oracle Cloud archive storage

- SAP ERP 6.0
- SAP ECP - Easy Cost Planning - EHP7 (Enhancement Pack 7)
- SAP BW - Business Warehouse
- SAP Solution Manager
- SAP EP - Enterprise Portal



For more information, please contact [sales@cintra.com](mailto:sales@cintra.com)



## ENECO MOVES APPLICATIONS TO ORACLE FOR FASTER PERFORMANCE

By completing a migration to Oracle Cloud Infrastructure in just four months, the energy provider minimized business impact and cut project costs by 50%.

### Business challenges

The leader in the sustainable energy market since 2007, Eneco Group provides 2 million customers in the Netherlands with innovative energy products and services to make it easy for consumers to join in the transition to sustainable energy.

Eneco wanted to invest more in important projects, but spent too much time managing IT infrastructure. The company also faced IT lifecycle management challenges. Instead of just adopting a cloud-first strategy, like so many companies, Eneco not only embraced that strategy, but immediately began working with Capgemini, a trusted partner, to make it happen.

Three of Eneco's Oracle Exadata systems in Capgemini data centers were due for replacement. The company identified 19 mission-critical applications that make use of Oracle Database on Exadata hardware.

The energy company wanted to maintain its custom-developed billing application and associated data warehouse. Despite an established Microsoft Azure-first policy for cloud solutions, Capgemini and Eneco determined that Oracle's Exadata Cloud Service would make the best destination for these workloads.

**“ We wanted to achieve a better digital experience for our customers, and we did that by providing higher availability with better performance with Oracle Cloud Infrastructure.”**

*Mark Edelbroek, Head of BTO IT Operations, Eneco*

### Why Eneco Chose Oracle

Eneco chose Oracle for its reliable Exadata technology and reduced risk and business impact during the migration.

The company selected the Frankfurt Oracle Cloud Infrastructure region to maximize flexibility and disaster recovery

options across the three availability domains there. Eneco is also using Oracle GoldenGate for data replication.

**“ In 2019, we migrated our applications to Oracle Cloud Infrastructure. The benefits are lower costs, higher availability, better performance, and a higher degree of security. We also see increased availability for our business users, especially during patching, due to the introduction of RAC and rolling upgrades.”**

*Mario Suijkerbuijk, CIO, Eneco*

### Results

The initial project was completed over a nine-month period. Moving from one Exadata platform to another made the migration easy, and the close partnership between Capgemini and Oracle ensured that any issues encountered were quickly overcome. Capgemini was able to help Eneco migrate nine of its critical applications to Oracle Cloud Infrastructure (OCI), as well.

This enabled Eneco to use Exadata Cloud Service and reduce software licensing maintenance and support costs.

The success of the project resulted in expanded scope. Halfway through the migration, the company decided to shut down a data center that contained a small but important SAP on Oracle Database environment. It was deployed on two additional Exadata Cloud Service instances plus Oracle Cloud Infrastructure Compute instances for the SAP application servers. The migration took just four months from idea to completion.

### Products

- Oracle Cloud Infrastructure
- Oracle Exadata Cloud Service

### Partners

Capgemini, the preferred outsourcing partner of Eneco, led the migration to Oracle Cloud Infrastructure and was vital to the successful go-live. Capgemini helped migrate the most important 32 of 54 Oracle Databases and 100 TB of data to Oracle Exadata Cloud Service.



<https://www.eneco.com>



## GOODBYE DATA CENTER, HELLO CLOUD!

**Media-Service Schlütersche strengthens performance and sustainability by migrating SAP financial applications into the Oracle Cloud**

Small and medium sized businesses (SMB), often described as too hesitant and risk-averse, have put many automation projects on their agenda for the immediate future. An important topic in this context is the migration of applications and data to the cloud. The industry association Bitkom has come to the conclusion that currently around three out of four companies (73 percent) use computing power from the cloud in one form or another. However, the current digitalization report for small and medium-sized businesses has found that about two thirds of SMB in Germany are still delaying the implementation of their digitization projects. Schlütersche Media Group, or Schlütersche for short, a medium-sized media service headquartered in Hanover, wanted to position itself for the future and demonstrate their innovative strength. This is why the long-established company, founded in 1747, became the first German medium-sized company to consolidate both its Production and Development SAP ERP systems onto the Oracle Cloud Infrastructure (OCI). The project and implementation partner was DXC Technology Deutschland GmbH.

### OCI supports future strategy

From printed hymnbooks to digital content: Schlütersche's products and services have undoubtedly changed over the past 270 years. Then as now, the company focuses strongly on the needs and requirements of its customers. The company offers Marketing and Publishing support for small and medium sized businesses in the form of industry and service directories, web publishing and online-media. In addition, Schlütersche develops cross-channel media content for subject matter experts as well as learning platforms for special interest groups, including organizing and holding networking events and meetings for their customers.

The overarching company slogan: Expert knowledge and Marketing all in one-stop. What distinguishes the publishing house are its innovative strength and the courage to venture into the digital transformation. The company has now transferred its processes controlled via SAP such as finance (FI/CO) and HR (HCM) to the Oracle Cloud. It covers financial accounting data such as dunning as well as information relating to employees such as payroll accounting and personnel administration. For Schlütersche, the SAP migration to the Oracle cloud is the first step towards departing from their own data center.

### Optimize processes, keep costs low

For many years, Schlütersche has been increasingly asking itself how it can make its own IT more highly available, cost-efficient and reliable on its own computers in their own data center. While they were able to do so for a long time, they now felt that they were beginning to be overstretched and faced limitation of growth without major hardware investments. When it came to modernizing the SAP system, a new solution had to be found. (Background: Schlütersche uses direct Full Use Oracle licenses which were restricted to a fixed number of cores, so they could not just add more servers to the SAP systems without changing the licensed core count). The company was looking for a service provider who could provide virtual computers and thus ensure the future viability of the publisher's IT. In order to guarantee clean and transparent processes and keep costs low, the project team ultimately opted for OCI.

### Small IT team benefits from Cloud

The DXC consultants have both SAP and Oracle know-how, which was essential for a project of this kind. Schlütersche was no longer able to carry out necessary upgrades and updates in a timely manner with the old system. A database migration to SAP HANA was discussed, but it turned out to be a complex and costly undertaking for the medium-sized publishing house. Since the existing environment ran on Oracle and a modernization was planned, the topic soon came to the Oracle cloud. With only a small IT team, the OCI advantages were convincing.

It was also the first project of this kind for DXC: „We had no previous experience with the Oracle cloud. That's why we had to familiarize ourselves with it,“ reports Antonio Steinhäuser, SAP Technical Architect for DXC Technology. He praises collaboration, test migration and integration. „Anyone who does such a project for the first time always has a few questions, but“working together with Oracle, they can be quickly resolved,“ says Antonio Steinhäuser.

### Smooth migration

First discussions took place in December 2018. This was followed by testing of the OCI in a test environment. The project phase and installation proceeded smoothly and in a spirit of partnership. „One challenge, however, was to find a solution that matched the size and requirements of the Schlütersche,“



explains Michael Eisner, Head of IT Services Operations. Other cloud transformations were larger and more complex, and the standard timetable had to be adapted accordingly.

What was required was a more modern and significantly more powerful as well as scalable hardware. „All in all, the migration went smoothly,“ says Eisner. He also praises the cooperation with DXC and Oracle: „The support went really well.“ Overall the whole project took less than a year to close.

#### **Infrastructure as a Service (IaaS) improves flexibility**

Oracle Cloud Infrastructure (OCI) has been certified for SAP NetWeaver-based applications in 2017. This enables SAP users such as Schlütersche to deploy ERP and other Netweaver-based applications such as BI, CRM, and SCM, running on Oracle databases, in the Oracle Cloud Infrastructure (Infrastructure as a Service, IaaS). In this context, the performance of the OCI is considerably higher than the compute services of other providers. Memory processing, block storage and network processing are also significantly better.

#### **Central goal: Optimized performance**

And what had to be changed as a result of the move of the financial systems to the cloud? „For our SAP users and the business processes, nothing,“ Eisner replies. „And that’s a good thing. At the same time we improved our ability to cope with future changes and performance in general. The response times got much better“. In the long run, OCI offers Schlüterschen the opportunity to reduce operating costs. A few examples: Costs are always incurred in the data center, like power, air conditioning or maintenance. These are all investments that companies can save using the cloud.

#### **Cloud offers secure and strong IT support for SMEs**

When German SMEs are asked what is preventing them from cloud transformation, many people say that security concerns are the biggest hurdle. IT manager Eisner would like to rebut these concerns on the basis of his experience: „SMEs are always under massive cost pressure. What small and medium-sized businesses can afford in the area of security and data protection must be set in relation to what reasonable cloud providers offer. In my opinion, we are positioning ourselves well in terms of security by moving servers to the cloud, because a large provider like Oracle can offer much more in this respect than most companies can do with their know-how and their own resources. Therefore, in many cases the cloud offers even more security. The cloud is gradually replacing in-house data centers. However, this development is not negative, but above all offers advantages“. Eisner feels it is important to emphasize another aspect: „Virtualization does not cost any jobs, because the work of the IT staff is not tied to a piece of hardware. It lies in the number and com-

plexity of systems and applications“. No matter where this system runs - in their own data center or in the cloud: the support is the same. The primary goal for Schlüter’s IT is: „In the next five years, all systems, not just ERP, BI and CRM, are to be moved onto the cloud.“

Schlütersche is a good example of how a medium-sized company can automate and modernize IT and systems. Many other companies are currently in a similar situation: they need to standardize and digitize. IT should be less costly, but at the same time new, innovative leaps are always needed. Schlütersche and companies like them can rely on the ability of Oracle Cloud Infrastructure to automate tasks, scale easily, and allow IT teams to concentrate on higher, value-added activities.

#### **About Schlütersche:**

The Schlütersche Verlagsgesellschaft mbH & Co. KG, Schlütersche for short, is a media-service company for small and mid-sized customers. With its holdings and subsidiaries it forms the Schlütersche Media Group, in which about 600 employees support 70.000 customers. Schlütersche develops Advertising and Marketing concepts for those customers – in digital, print or cross-channel, all in one-stop. Its service offerings consist of, among others, classified directories and associated online services such as website creation, search engine and social media marketing as well as digital reach. Furthermore Schlütersche offers an expert knowledge in a number of industries and branches. The portfolio consists of over 30 technical periodicals, as well as books and online media plus focused industry events and meetings and roundtables for special experts. It is the goal of Schlütersche to create an optimal Market-presence for their customers by using this industry expertise in combination with the media services mentioned. Therefore the company slogan is: Industry expertise and Marketing expertise all in one-stop.

<https://schluetersche.de/unternehmen/>

 **schlütersche**  
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Website: <https://schluetersche.de/>

## ORACLE-RELATED SAP NOTES (CLOUD)

Note No.	Note Title	DB Version
<b>Cloud Platforms : General Information</b>		
1380654	SAP Support in Public Cloud Environments	n/a
<b>Cloud Platforms : Oracle : Cloud Infrastructure</b>		
2474949	SAP NetWeaver on Oracle Cloud Infrastructure	12c-19c
2520061	SAP on Oracle Cloud Infrastructure – Support Prerequisites	12c-19c
2588124	How to protect against speculative execution vulnerabilities on OCI?	12c-19c
<b>Cloud Platforms : Oracle : Exadata Cloud Solutions</b>		
2614028	SAP NetWeaver on Oracle Database Exadata Cloud Service	12c-19c
2614080	SAP on Linux with Exadata Cloud Service: Enhanced Monitoring	n.a.
2799970	Oracle Exadata Cloud Service: Patches for 19c	19c
2884306	Managing SAPDATA_HOME and ORACLE_BASE on Engineered Systems	19c
2956661	SAP NetWeaver on Oracle Database Exadata Cloud@Customer	12c-19c
2992680	Managing shared and multiple Oracle Homes on Engineered Systems	12c-19c
<b>Cloud Platforms : Oracle : Non-NetWeaver-Applications</b>		
2650732	Support of SAP BusinessObjects BI Platform for Oracle Cloud	12c-19c
<b>Cloud Platforms : Non-Oracle</b>		
1656099	SAP Applications on AWS: Supported DB/OS and AWS EC2 Products	12c-19c
2039619	SAP Applications on Microsoft Azure Using the Oracle Database	12c-19c
2358420	Oracle Database Support for Amazon Web Services EC2	12c-19c
2650732	SAP Applications on Azure: Supported Products and VM Types	12c-19c



For more information on why and how to run SAP applications on Oracle Database download the Oracle for SAP Database Update from <https://www.oracle.com/a/ocom/docs/ora4sap-dbupdate-5093030.pdf>

# Oracle Engineered Systems for SAP Customers

Engineered for innovation, efficiency and simplicity



Oracle Exadata Database Machine



Fastest database machine for data warehousing and OLTP



Ideal platform for consolidating databases



Combines industry standard hardware and smart storage software



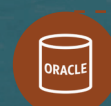
Engineered for cloud computing



Oracle Database Appliance



Simple and affordable for departments and mid-size companies



Optimized for Oracle Database



Reduce Oracle software licensing cost with capacity on demand



Built-in expertise for single-instance and high-availability deployments



Oracle Private Cloud Appliance



Supports a broad range of application workloads



Mission-critical virtualization technologies already built in



Extreme reliability, scalability, and performance



Application isolation protects sensitive data at software and hardware levels

## WHY ORACLE DATABASE AND ENGINEERED SYSTEMS FOR SAP?

**From SMEs to the largest companies around the world, tens of thousands of customers benefit from using the Oracle Database for SAP. There are many good reasons for this. Have a closer look at the outstanding differentiators which make Oracle Database for SAP the primary choice for the majority of SAP customers.**

For more than 30 years Oracle and SAP have collaborated to optimize the Oracle Database for SAP customers. Renewing commitments and agreements underline the long-established relationship and partnership. Above all: SAP customers benefit from Oracle innovation. Oracle innovation provides flexible solutions which allow you to meet your business needs and requirements. On the other side, SAP customers value the great sustainability and protecting investments using Oracle Database for SAP applications.

As we look in more detail, it will be clear why Oracle Database for SAP is the leading and best RDBMS running SAP applications. In this context, let's have a closer look at the key differentiators between the Oracle Database for SAP as compared against other databases which can be used in combination with SAP applications. There are no less than 8 differentiators regarding Oracle Database.

### 1 Best Performance & Scalability

Oracle has leading SAP SD and BI-D (BI-Data Mart benchmark results, with exceptional scaling and performance across SMP and Cluster environments on Unix and Linux.

Oracle Real Application Clusters (RAC) provide a flexible way to achieve near linear scalability of SAP applications. With RAC, customers have a choice to either scale up or scale out the database server layer. Since all RAC nodes are active, it helps SAP customers to meet the demands of production workload requirements. Widely adopted by customers, Oracle RAC is the only generally available active-active clustered database solution certified for all SAP products. RAC makes SAP resources highly available based on Oracle Clusterware and removes the need for 3rd party clustering software.

Oracle Automatic Storage Management (ASM) is a volume manager and a file system for Oracle Database files that supports single-instance Oracle Database and Oracle Real Application Clusters (Oracle RAC) configurations. ASM is Oracle's recommended storage management solution that provides an alternative to conventional volume managers, file systems, and raw devices.

The Oracle Database In-Memory Option accelerates Analytics, Data Warehousing, Reporting and OLTP performance. The In-Memory Option of Oracle Database is 100 percent compatible with existing applications and leverages all existing Oracle Database functionality. Every Application that runs on Oracle Database can automatically and transparently take advantage of Oracle Database In-Memory Option. Existing applications will retain full functionality while experiencing effortless speedups. New applications can be developed that were previously impractical due to performance limitations.

SAP BW Flat Cubes with Oracle Database In-Memory: The data modeling technique Flat Cubes (also called "HANA-Optimized InfoCubes" by SAP), allows customers to simplify the SAP BW data model. Benefits for SAP on Oracle customers: Cost savings through higher performance and optimized integration of SAP BW with Oracle Database 12c and above, no indexes and aggregates required, faster query response times and faster data loads.

With Oracle Exadata Database Machine customers can scale up/out incrementally and on demand. Start with the appropriate Exadata size – eighth, quarter, half, or full rack. Exadata can be easily upgraded to the next larger size whenever more processing power or capacity is needed. No need for a forklift upgrade, simply scale up/out the existing system.

Exadata includes a unique technology to offload data intensive SQL operations into the Oracle Exadata Storage Servers and only the data matching the selection criteria are sent from the storage to the database server for final consolidation before the database server sends the results back to the requester.

With Oracle Database 19c, persistent memory of Exadata X8M can directly be accessed and thus provides even better performance.



As a result, it provides outstanding performance for transaction-processing and data warehousing. SAP transactions requesting data will likely be serviced from flash memory for ultra-fast retrieval. Reporting and Batch users will not interfere with SAP transactional users. SAP BW/BI data warehouses will return queries to users orders of magnitude faster.

## 2 Best Deployment Flexibility

Widest range of supported platforms; Unix – Linux – Windows – “Oracle is Oracle is Oracle”. The same code base across all operating systems means, Oracle has the same features, tools and functionality on all hardware platforms and operating systems, so customers can choose the most cost effective platform for their implementations.

Should customers require a change in operating systems, Oracle offers fast and efficient Oracle Lifecycle Migration Services (previously known as O2O and Triple-O Services). These services provide either offline or online migration of the customers databases depending on the downtime acceptable to the customers’ business operation. Oracle Lifecycle Migration Service is a near zero downtime online Oracle to Oracle migration. The outage requirements are then cut from hours to minutes independent of the database size.

A new option for Oracle Database, Oracle Multitenant helps customers reduce IT costs by simplifying consolidation, provisioning, upgrades, and more. It is supported by a new architecture that allows a Multitenant container database to hold many pluggable databases. An existing database can be simply adopted, with no change, as a pluggable database. No changes are needed in the other tiers of the application.

Traditionally, Oracle has provided Oracle Database Server software to be installed on systems made up of third-party hardware and a third-party operating system. This approach is still possible. However, in addition, Oracle provides “Engineered Systems”, where Oracle manufactures the machine, the operating system and the database. All the embedded components to run an Oracle Database are pre-configured, pre-tuned and pre-tested by Oracle experts, eliminating weeks or months of effort typically required to deploy a high performance system.

## 3 Best Availability and Reliability

Real Application Clusters (RAC) for SAP removes the database server as a single point of failure. The database remains online as long as one or more database instance is still up and running. Oracle Data Guard complements Oracle RAC, providing a disaster recovery solution that requires no SAP downtime in case of failure. Data Guard is often used in combination with Flashback (technology to rewind database changes without any restore to dramatically minimize downtime). Online Patching allows customers to install single or bundle patches completely online, without requiring the database instance to be shut down.

SAP customers are able to use Oracle Cloud File System (ACFS), which is part of Oracle Database. It complements Oracle Automatic Storage Management (ASM) in order to store non-Database files on ACFS. This option is also available on Exadata X5 and higher. It allows administrators to store SAP-related files like/sapmnt and/usr/sap/trans and avoid using external NFS file systems.

Oracle Exadata Database Machine for SAP customers is a highly engineered and pre-validated configuration. It provides built in High Availability, ‘out of the box’. With Exadata’s redundant architecture, all single points of failure are eliminated. Familiar features such as mirroring, fault isolation, and protection against drive and cell failure have been incorporated into Exadata to ensure continual availability and protection of data.

Exadata is prebuilt, reducing time and costs for deployment, installation, and configuration (HW, OS, DB, RAC, Clusterware etc.).

## 4 Best Support for Very Large Databases

The Oracle Database is well known for providing the most efficient use of disk space. This is extremely important to SAP customers as the size of their databases continue to grow dramatically.

Compression of B Tree indexes, which make up to one third of disk space allocated to databases in SAP environments, reduces I/O and improves overall performance by allowing more index information to be stored in the same amount of memory (cache).



Table compression, implemented in Oracle's Advanced Compression, uses a unique algorithm that eliminates duplicate values within a database block, even across multiple columns. This approach combines disk space reduction, performance benefits and ease of management.

Oracle Database Advanced Index Compression uses an unique algorithm to optimize space for index entries at a block level resulting in less amount of disk space needed, faster access to data and higher throughput of the SAP system.

Out-of-line LOBS (SecureFiles) Compression, Client- Server Network Compression, Data Guard Compression, Expdp Compression and RMAN Backup Compression are further enhancements to the compression features SAP customers can benefit from.

The complete unload and load of data during a Unicode migration (required by all new SAP releases) was optimized by Oracle to achieve the fastest SAP Unicode Migrations, with up to 1 terabyte/hour data transfer rates and it is fully integrated with SAP products. Even the largest multi- terabyte databases have been migrated in one weekend.

SAP customers using Oracle Databases also take advantage of a rich collection of table partitioning types to reduce I/O and improve performance. Oracle Database enriches this list with sub-partitioning and interval partitioning meant to enhance design flexibility and application performance.

In Oracle Database 12c and above, several new features have been added to the Advanced Compression Option (ACO) which enhance the storage management capabilities of Oracle Database. Heat Map automatically tracks modification and query timestamps, providing detailed insights into how data is being accessed.

Hybrid Columnar Compression – available on Oracle Engineered Systems (Exadata platform) – enables the highest levels of data compression and provides enterprises with tremendous cost-savings and performance improvements due to reduced I/O. Average storage savings can range from 10x to 15x depending on which Hybrid Columnar Compression level is implemented.

Many environments are reaching the end of their useful life and are costly to maintain. Exadata and Exalogic provide a simple and easy way to manage an environment – a viable option for a private cloud.

SAP Business Warehouse:

- Huge and complex infocubes, queries or transactions with large database time
- Large daily extracts with a limited time window
- Large extracts can flood the network

## 5 Best Database Security

Compliance and security are more important now than ever before.

Oracle's Advanced Security Transparent Data Encryption (TDE) makes encryption of sensitive data simple by transparently encrypting data when it is written to disk. Oracle Database provides; Tablespace Encryption (encrypts all data within one tablespace), RMAN Backup encryption, Data Guard Secure Network, Expdp, and SecureFile Encryption.

With Oracle Database Vault, protective realms around SAP application database objects can be established to prevent privileged database users from accessing sensitive data and to enforce separation of duties among privileged database users.

Oracle Database Vault helps customers meet regulatory compliance requirements by enforcing separation of duties. Database Vault privilege analysis minimizes the number of granted roles.

All Oracle Security features are available for all database configurations (single instance, RAC) and all Hardware/OS platforms – including the Exadata Database Machine.

Exadata for SAP satisfies even the most stringent security and high-availability requirements. It is a complete, pre-built, balanced and secure cloud-based machine for mission critical databases with all available high security features of Oracle, like Database Vault.

## 6 Best Manageability and Self-Management

Oracle Enterprise Manager Grid Control (EM), SAP DBA Cockpit, and SAP BR Tools rely on Oracle Automatic Workload Repository (AWR) that automatically stores workload and performance statistics. So administrators and support engineers can analyze and quickly resolve performance issues, whether the root cause happened hours or days before.

Real Application Testing (RAT) to evaluate and implement changes in the customer data center infrastructure e.g. operating system, hardware migrations, patches and upgrade changes. Database Replay (part of RAT) enables customers to realistically test system changes essentially recreating production workloads on the test system.

A very exciting functionality for SAP customers in Oracle is Information Lifecycle Management (ILM) and Automatic Data Optimization (ADO). These features combined along with the Heat Map can be utilized to build a robust ILM strategy. This strategy incorporates automatic tiering and compression of your data to meet the policies you define.

Bundle Patches are created and certified in conjunction with SAP and bundled for simplicity. Applying the Exadata Bundle Patches and the SAP Database Bundle Patches is all that is required. BR TOOLS have been expanded to support ASM and Exadata.

**Exadata for SAP:**

- Makes complex integration work and manual tuning (database, storage, network, and server) superfluous
- Optimally supports implementations, migrations, and consolidations for quick, inexpensive project runtimes
- Enables users to implement a highly efficient centralized data pool featuring a multitude of system databases

## 7 Best Support for DB Consolidation

Oracle supported traditional DB consolidation methods like virtual machines or schema consolidation for a long time. And SAP customers benefitting from saving costs and effective infrastructure optimization.

Oracle Engineered Systems such as Exadata Database Machine gave customers new opportunities for DB consolidation and infrastructure cost savings with reduced complexity. More-and-more SAP customers are using Exadata for this stated purpose: the consolidation of their numerous “SAP databases”.

Oracle Engineered Systems like Exadata Database Machine gave customers new opportunities for DB consolidation and infrastructure cost savings with reduced complexity. More-and-more SAP customers are using Exadata for this stated purpose: the consolidation of their numerous “SAP databases”.

SAP can be included in enterprise-wide database consolidation plans on Oracle Exadata Database Machine. Consolidate all databases on a modernized database platform and lower overall database costs due to consolidation; there are great advantages with the opportunity to consolidate multiple dispersed Oracle Databases into one Exadata environment. Administrators can focus on managing Exadata, not on maintaining multiple unique configurations.

Oracle Database Multitenant gives DB consolidation projects massive additional advantages. The Multitenant Option provides higher productivity and resource/cost savings for customers who realize DB consolidation projects by significant simplification. Oracle Multitenant introduces a new architecture that enables customers to easily consolidate multiple databases, without changing their applications, but allowing the management as one grouped resource with minimized memory resources. SAP customers can manage many databases as one (patching, backup, etc.). More efficient utilization of system resources/resource management can be realizing in an easy and very efficient way.

## 8 Best Integration of Hardware and Software

For years Oracle Database Server Software checks the ability of relevant hardware components. E.g. for using flash, encryption etc. With Oracle In-Memory, scans use super-fast “Single Instruction Multiple Data Values” (SIMD) vector instructions, when supported by the CPU. So, the get together or the integration of hardware and software will be reached by using Oracle 12c and above as a new step to higher quality and effectiveness.

Exadata, being an Oracle Engineered System, is prebuilt, thus reduces the time and costs for deployment, installation, and configuration (HW, OS, DB, RAC, Clusterware etc.). Exadata enables SAP customers to have a consolidated platform for databases, and provides the best integration of hardware and software, while reducing the demand for power and cooling for the SAP system operations.

## ENGINEERED FOR INNOVATION, EFFICIENCY AND SIMPLICITY: ORACLE ENGINEERED SYSTEMS FOR SAP

Companies need to optimize their IT infrastructure to achieve best performance at reasonable cost. Oracle innovates at every layer of the stack to design engineered systems that reduce the cost and complexity of IT infrastructures while increasing productivity and performance.

Oracle engineers systems that are integrated across the entire technology stack, – so you don't have to do this. Reduced IT complexity frees up time and money, leaving more to spend on innovation and new opportunities.

Oracle's Engineered Systems combine best-of-breed hardware and software components with game-changing technical innovations that simplify operations and lower total cost of ownership (TCO). With Oracle Engineered Systems for SAP, that extreme performance is optimized for SAP applications.

### Engineered for Extreme Performance

Extreme performance means everything you're doing now gets kicked up a notch or two – or more. Oracle describes its engineered systems with words such as *faster, better, lower* and *fewer*. Put them together and you start to understand the Benefits of extreme performance.

- **Faster processing**
- **Lower costs**
- **Less risk**
- **Faster deployments**
- **Higher throughput**
- **More storage capacity**
- **Smaller footprints**
- **More transactions**
- **Better analytics**
- **Faster data loading**
- **Better data compression**
- **Higher availability**
- **Less downtime**
- **More choices**

Where competitors stop with “ultra”, “highly” or “xy” converged systems, Oracle does not stop there, but moves one step ahead by really engineering all layers and integration of all layers into one solution which is designed, tested, built and delivered based on own IP and industry standards.

Oracle starts with the world's most complete, open, and integrated technology stack – including database technology, management software, operating systems, servers, and storage.

### Oracle Engineered Systems

While each of the IT infrastructure layers provide leading-edge technology in itself, Oracle went one step further and designed engineered systems that are pre-integrated to reduce the cost and complexity of IT infrastructures while increasing productivity and performance.

Only Oracle can innovate and optimize at every layer of the stack to simplify data center operations, drive down costs, and accelerate business innovation.

Each system integrates Oracle's applications-to-disk technology stack – servers and storage, operating systems, database software, middleware, networking, and built-in virtualization features – to reduce the time and cost associated with purchasing, provisioning, deploying, and maintaining SAP infrastructure.

Oracle and SAP have jointly tested and certified Oracle's Engineered Systems for SAP, making them available as a family of engineered systems that are pre-integrated, pre-tested, and pre-configured to simplify data center operations, ensure fast and easy SAP infrastructure deployment, and accelerate business innovation.

Optimized for Oracle Database and SAP applications, Oracle's Engineered Systems for SAP reduce the time needed to get SAP landscapes up and running.

### Oracle Engineered Systems in the Datacenter

Once deployed, consolidating SAP landscapes on Oracle's Engineered Systems reduces data center management complexity.

Administrators can use SAP's BR\*Tools and Oracle Enterprise Manager Ops Center to manage SAP landscapes and SAP infrastructure. Built-in automation features simplify administration tasks and reduce day-to-day management demands.

The Oracle Exadata Database Machine, the Oracle Database Appliance, and the Private Cloud Appliance are designed to achieve enterprise performance levels that are unmatched in the industry.

Designed to deliver extreme performance to data warehousing, online transaction processing (OLTP), and mixed-load database applications, the Oracle Exadata Database Machine is tailor-made to improve SAP performance and manageability.

A "data center in a box", the Exadata Database Machine is an easy-to-deploy system that includes all the hardware needed for running the Oracle Database. From there, it adds Oracle Real Application Clusters (RAC), Oracle Grid Infrastructure, storage management tools, and administration software – and optimizes the entire system for extreme performance, mission-critical availability, and reliability.

### Using Exadata in SAP Environments

The Oracle Exadata Database Machine is the perfect choice for SAP environments on several levels.

- It delivers outstanding I/O and SQL processing performance for online transaction processing, (SAP ERP), business warehouse, (SAP BW) and consolidation of mixed workloads
- A massively parallel grid architecture using RAC and Exadata storage delivers extreme performance with linear I/O scalability, dramatically increasing data bandwidth between the database server and storage. Intensive query processing and data mining scoring are offloaded to storage servers, bringing processing closer to SAP data to improve query performance and concurrency

- All servers, storage, and networking components are pre-cabled in racks, and the complete package is pre-integrated and pre-tested, cutting weeks or months from deployment schedules. It cuts management and maintenance chores by simplifying tasks such as patching with single vendor bundled patches.
- SAP customers can easily migrate their database to Exadata, which runs SAP applications unchanged. Depending on the source platform, the migration could be as smooth as an operating system platform upgrade.

### Using Private Cloud Appliance in SAP Environments

Private Cloud Appliance is an engineered system that radically simplifies the way customers install, deploy, and manage converged infrastructures for Oracle Linux or Oracle Solaris applications.

It offers a highly available, fully redundant converged infrastructure system combining networking, compute, management and storage elements. It comes with one price for all the hardware in the system and all needed software. It supports Oracle Trusted Partitions that allows you the flexibility to license Oracle software on a virtual CPU basis. Additionally, it connects connects to your existing or new Oracle storage or third-party storage. It provides Software-Defined Network Infrastructure with Oracle Fabric Interconnect and Oracle SDN. You will benefit from a single point of support for the entire stack, including Oracle hardware and software.

All SAP products based on SAP NetWeaver 7.x available on Oracle Linux 6 and Oracle Linux 7 can now be used on the Oracle Engineered System designed for virtualization – the Private Cloud Appliance.

Three-Tier and Two-Tier installations (Oracle Database and SAP applications) are supported to run on the Oracle Private Cloud Appliance.

Private Cloud Appliance can be used in SAP environments when the following conditions are met:

- Minimum use of Private Cloud Appliance Release 2.3.3.
- Private Cloud Appliance is based on Oracle VM. Please follow the related Oracle VM information from SAP Note 1808268
- The following Operating Systems in VMs are certified and supported for the use in SAP environments
  - Oracle Linux Release 6.x with UEK
  - Oracle Linux Release 7.x with UEK
  - Oracle Solaris

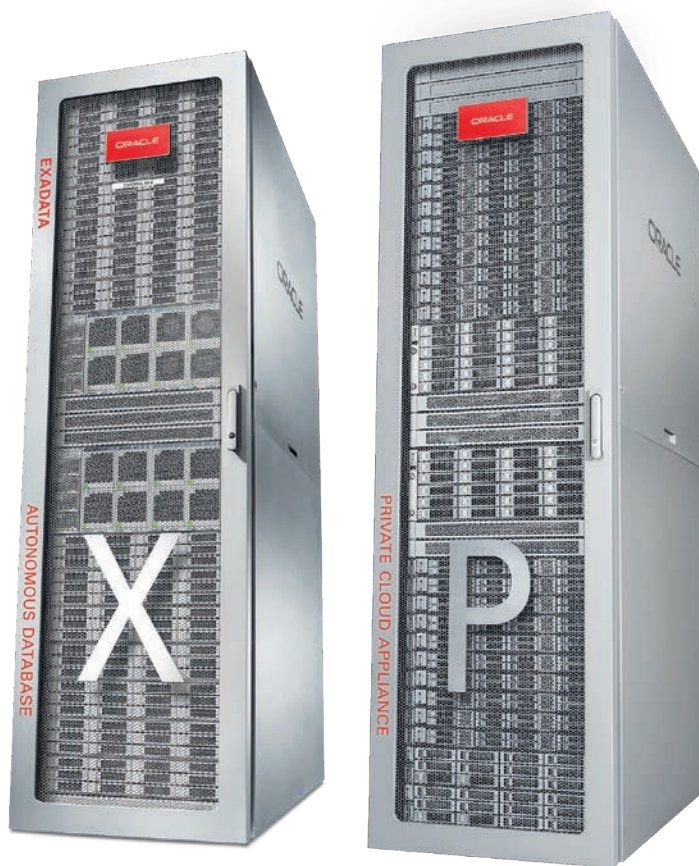
The Oracle Database Appliance is a 4U rack-mountable system specifically designed to run Oracle Database Enterprise Edition. It supports high availability and accelerated database performance requirements with redundant hot swappable

components, triple-mirrored shared disk and flash storage. Pre-installed with Oracle Linux and Oracle appliance manager software, this appliance saves time and money by simplifying deployment, maintenance, and support of a highly available database solution.

### Using Oracle Database Appliance in SAP Environments

The Oracle Database Appliance provides the following capabilities for an SAP environment:

- Highly available active-active clustered database server for SAP applications
- Highly available file server for SAP-required shared file systems
- Complete clustering solution for SAP high-availability resources such as central services for both ABAP and JAVA stack.





## A CLEAR PATH TO HIGHER SAP PERFORMANCE

### Oracle Exadata X8M-2 demonstrates significant performance improvements in proof of concept

#### Overview

The Oracle Exadata Brazil team performed a very successful proof of concept (PoC) with a large local textile and retail clothing company running their SAP workloads on Exadata X8M. The company is extremely pleased with the results: an over **50% reduction in execution time** and over **60% improvement in SD (Sales and Distribution) transactions** while running on **30% less infrastructure**.

#### Follow the Performance Leader

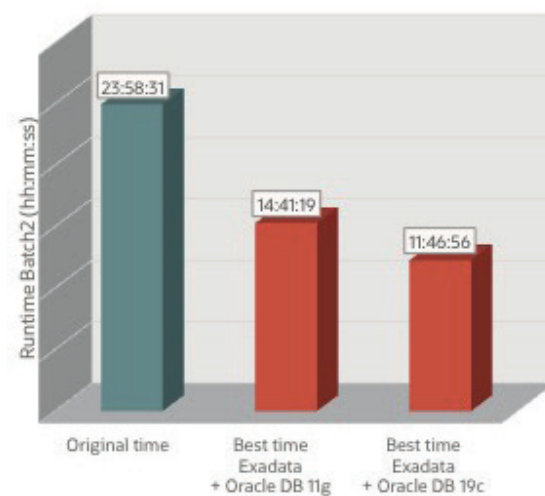
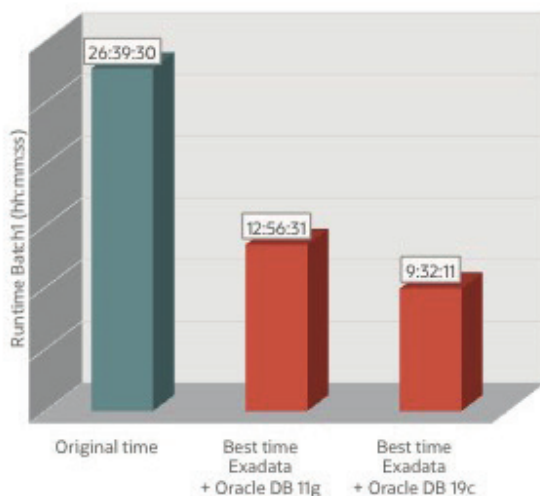
Customers have grown accustomed to performance leaps with every new generation of Oracle Exadata Database Machine due to improved processor speeds, architectural enhancements, and specialized algorithms in system software. With the introduction of the Exadata Database Machine X8M, performance gains are now orders-of-magnitude better than the previous generation largely due to the unique use of Intel® Optane™ Persistent Memory and a 100Gb RDMA over Converged Ethernet (RoCE) internal fabric. The result is, indeed, a leap in performance: 16 million OLTP read IOPS, <19 microseconds OLTP IO latency, and 560GB/sec analytic scan throughput.

### The SAP Customer Journey with Exadata

How can this new Exadata generation help SAP customers? SAP ERP Central Component (ECC) systems often run mixed workloads of varying types. These differing workloads are where the Exadata X8M architecture leveraging persistent memory excels. This innovation is essential to keep batch chain jobs executing at consistently high performance, while maintaining user transactions at satisfactory response times for the business.

Let's see how SAP workloads are handled by a typical do-it-yourself (DIY) system and Exadata. In the DIY system, there are application, database servers, and external storage all connected via an Ethernet LAN. None of these components are optimized for Oracle Database and the LAN introduces delays. In contrast, Exadata is a full-stack, engineered system whose technology, including persistent memory and RoCE in the latest generation, are optimized and finely tuned to maximize Oracle Database performance.

How this works to enhance performance of SAP workloads: Exadata Storage servers transparently add persistent memory accelerators in front of flash memory. The Exadata Database servers uses Remote Direct Memory Access (RDMA) instead of I/O to read remote PMEM, which is automatically tiered and shared across databases using a cache for the hottest data.



Runtime comparison for two different batch jobs: existing hardware vs. Oracle Exadata Database Machine with Oracle Database 11g or Oracle Database 19c

With the use of Oracle Database 19c on Exadata X8M-2 (used in this PoC) we have the use of a third tier of information storage, in front of flash and behind the Database Nodes' memory. This is based on the new technology of Persistent Memory Data & Commit Accelerator that make use of Intel® Optane™ modules, associated with RDMA over Converged Ethernet (RoCE) 100GbE.

This technology also allows for lower log write latency, which is critical to OLTP performance, such as SAP applications. Faster log writes give way to faster transaction commit times and minimize any log write slowdown that may cause a commit backlog. The Automatic Commit Accelerator allows databases to perform “one-way” RDMA writes to PMEM on multiple Storage Servers, bypassing network and I/O software, interrupts and context switches. The performance

benefits of the Exadata X8M are clearly demonstrated in the proof of concept (PoC) results below.

#### Clear Path with a PoC

Customers upgrading from legacy systems to an Exadata X8M often like to know in advance what performance gain they can expect. To address this need, the Oracle for SAP development team has run a series of benchmarks and published the results, in SAP Application Performance Standards (SAPS) values, in Oracle documentation and in SAPnotes. There are also special cases where a customer may request a PoC to help make the decision on which model and size of an Exadata they should invest in. In these cases, Oracle collaborates with the customer to design a test scenario involving a workload and real data to match the customer's specific requirements.

The complete test scenario and results of the PoC are documented in a White Paper “SAP on Exadata X8M-2 - SAP ECC with Oracle Database on Exadata X8M-2 POC Results.”

You can download the new white paper here: <https://www.oracle.com/a/ocom/docs/sap-on-exadata-x8m-2-white-paper.pdf>.

**Note:** When using Exadata X8M for SAP applications, it is extremely important that all SAP Bundle-Patches (SBP) and upgrade procedures cascading from SAP Note 2799900 for Oracle Database 19c local to the Exadata are also applied accordingly – which was the case for this PoC.

For more information on SAP on Oracle, please visit <https://www.oracle.com/solutions/sap/>.

For more Exadata-specific information <https://www.oracle.com/engineered-systems/exadata/>, or simply ask your Oracle Representative.



## ORACLE EXADATA MACHINE HELPS AMERISOURCEBERGEN RUN ITS BUSINESS AT PEAK LEVELS WITH SAP

AmerisourceBergen is a global pharmaceutical sourcing and distribution-service company that helps healthcare providers, pharmaceutical companies, and biotech manufacturers to improve patient access to products and enhance patient care. Services range from drug distribution and niche premium logistics to reimbursement and pharmaceutical consulting services. AmerisourceBergen delivers innovative programs and solutions across the pharmaceutical supply channel. The company is ranked no. 12 on the Fortune 500 list.

### Challenges/Requirements

- A consistently stable database infrastructure platform capable of supporting an extremely high-volume and mission-critical SAP architecture. The SAP ECC application currently processes 1.7 million line items daily to their existing, incrementally growing, 70TB database
- A reliable and high availability IT environment that can be scaled as needed with near zero downtime. Ideally the environment is easily extendible, flexible, and supports their ambitious future business requirements. Near term growth analysis estimates processing a significant increase in line items by the end of 2017
- Achievement of performance gains taking into account end-to-end processing
- Successful and sustainable total cost of ownership requirements

### Solutions

AmerisourceBergen chose to deploy the Oracle Exadata Database Machine Platform as the critical infrastructure foundation for the company's core SAP architecture. The reason for this was for significant scalability & stability improvements in the mission-critical SAP ERP ECC application and other core SAP modules.

Oracle Exadata Database Machine is a highly optimized engineered system capable of handling the most intense I/O workloads. It also serves as a great consolidation platform. AmerisourceBergen has replaced over 50 classical database servers into a small number of Exadata machines. A much higher density of database per server was achieved.

AmerisourceBergen has improved system stability for all mission-critical SAP applications: especially SAP ECC. Their business volume increase from processing 1 million to 1.7 million line items per day was a non-event. The system performed as expected without scalability issues.

Unplanned downtimes were eliminated for their business-critical SAP ECC environment. Both local and remote high availability (near zero downtime) are applied for disaster recovery coverage with faster backup time.

Optimized IT management ensured high performance with proactive monitoring and accelerated issue identification and resolution. This spans the entire Oracle technology solution (e.g. database, RAC, operating system, server, and storage) thanks to Oracle Advanced Customer Service (ACS) and Oracle Advanced Monitoring and Resolution Services (AM&R).

### Why Oracle?

Oracle Exadata Database Machine is a unique and comprehensive database tier solution: engineered and optimized for SAP and non-SAP database workloads. The ability to scale up to meet future needs is outstanding. Oracle AM&R and Oracle ACS have provided excellent support and great value for the mission-critical IT operation.

### Implementation process

AmerisourceBergen first went live with Oracle Exadata Database Machine for SAP in September, 2013. The transition to Oracle Exadata was done in two phases. The first phase focused on the core SAP ECC system. SAP ECC went live in the first 12 weeks of the project. The remainder of the SAP applications including CRM, PI or Portal followed in early 2014.

The 70TB SAP ECC database environment has been running successfully for three and a half years on a dual-rack X3-8 Oracle Exadata Database Machine. The remaining SAP applications on approximately 20 databases run on a separate X3-2 Exadata machine. Recent expansions of the SAP architecture will introduce Oracle Database In-Memory.

AmerisourceBergen is in the process of consolidating their existing 20 datacenters down to two locations. This process will be finalized in 2018. The company also plans to upgrade the existing X3 Oracle Exadata Database Machine to X6 Oracle Exadata Database Machines this year.

“Oracle proactively assists with infrastructure monitoring to recognize any concerns from a performance perspective. With the North America Oracle SAP team, Oracle Advanced Customer Service (ACS) and Oracle’s AM&R we can proactively look at what we need to do specifically to the SAP ECC environment to keep up with the high volumes,” says Milt Simonds, Vice President Enterprise Platform Delivery, AmerisourceBergen Corporation.

#### A word from AmerisourceBergen Corporation

**“In three and a half years of productive use, we have benefited from Oracle Exadata Database Machine in numerous ways. The Oracle Exadata Machine ideally supports stability, high availability, and performance in high-volume SAP use and facilitates our ever more ambitious business plans. We have been able to drastically simplify and consolidate our database environment as well as minimizing the TCO – with a greatly optimized support model. The Oracle services ACS and AM&R allow us to effectively focus on core tasks and help us to make optimum use of our own resources.”**

– MILT SIMONDS,

Vice President Enterprise Platform Delivery, AmerisourceBergen Corporation.



[www.amerisourcebergen.com](http://www.amerisourcebergen.com)

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**Oracle Customer:** AmerisourceBergen Corporation

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**Location:** Chesterbrook, Pennsylvania, United States

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**Employees:** over 19,000

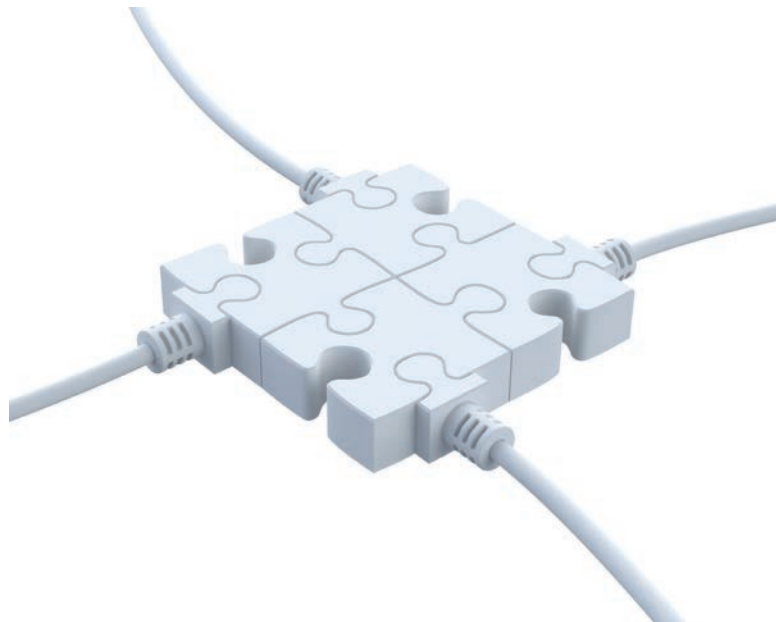
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**Annual Revenue:** \$146.8 billion (FY16)

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**Oracle Products & Services:**

- Oracle 12c Database
  - Oracle 12c Database In Memory
  - Oracle 12c Database Tuning & Diagnostics
  - Oracle 12c Real Application Clusters (RAC)
  - Oracle Exadata Database Machine
  - Oracle Advanced Compression
  - Oracle Data Guard
  - Oracle Advanced Customer Support Services (ACS)
  - Oracle Advanced Monitoring and Resolution (AM&R)
- 



Italy's biggest dairy production chain reaps massive benefits from new Oracle Database infrastructure platform – tangible cost savings achieved

## GRANAROLO: ORACLE EXADATA MEETS THE MANY STRINGENT REQUIREMENTS

With an annual revenue of 1 billion, close to 2,500 employees, 14 production sites, and an output of more than 8.5 million liters of milk, Granarolo is Italy's biggest milk producer. Granarolo works with local milk production companies integrated in the production chain in a way that no comparable company has achieved. At Granarolo, the emphasis is on supplying high-quality dairy products on the basis of defined process standards, from the selection of raw materials to production and the supply of both existing and new products at the point of sale. Well known in Italy and expanding internationally, the company has launched no less than 19 new dairy products on to the market in the last two years.

Without effective and sophisticated IT, Granarolo's business and business model would be simply impossible. For years the group of companies – which operates throughout Italy – has used Oracle Database as its core IT component.

Twelve Business Critical applications run on Oracle Database, among which are SAP's ERP, Transportation Manager and the WH manager. Additionally, they also run 28 applications such as CRM, the Identity Manager and several customs.

"In 2015 we established a multiple year strategy to renew our storage platform infrastructure with specific focus on the Oracle infrastructure. Our requirements have been consolidation, simplification, business continuity and obviously performance. An additional key factor has been the requirement to have a seamless migration, since we did not want to face any upgrade or application modification."

Following a detailed evaluation of all the options, including an examination of the defined requirements that the new database server platform for SAP would have to fulfill, Granarolo chose the Engineered System Oracle Exadata in November of 2015. As Granarolo explains, "the Oracle Exadata Database Machine solution met all of our stringent requirements."

*Migration project has been smoothly completed in 6 months, with a roll-out with no regressions by maintaining 24H 7\*7 business operations for the whole group.*

*Strategic was the cooperation among internal IT resources which actively worked with project consultants, by acquiring knowledge and autonomy with the use of the new platform.*

Expected results in terms of performances have been achieved and in some situations they have greatly exceeded our expectations.

Oracle Exadata Database Machine for SAP is a complete package of servers, storage, network, and software, delivering above-average scalability, reliability, and redundancy. Through consolidation, Exadata allows customers to reduce their IT costs, achieve a higher level of administrative optimization, increase the performance of all applications, and enabled us to make better and faster business decisions. As a database platform, Exadata makes it possible to achieve maximum performance in both data warehousing and OLTP (online transaction processing) like SAP ECC 6.0 application. Exadata also fully supports cloud computing.



### A system for now and the future

Thanks to Oracle Exadata, the billion-euro turnover group has achieved a large range of advantages and improvements both in technical performance terms and in terms of hard business facts.

For one thing, users are reporting a *significant* improvement in overall system performance, with a corresponding rise in user satisfaction. **For a range of queries (and their extraction via OTM), Oracle Exadata has significantly reduced the response times. For one query the response time was reduced from 8 minutes to just under 60 seconds.** The response time for the selection of orders in one case was slashed from 10 minutes to a few seconds. Focusing on different SAP ERP Z queries the overall response time massively reduced. Many of the reports finish 3 to 6 times faster without SAP application changes or database tweaking.

By choosing the Engineered System Oracle Exadata, Granarolo has also simplified its IT infrastructure and in such a way that the system can easily be expanded whenever required. It has also implemented substantial database consolidation (as fewer CPUs are needed for the same workload), which has resulted in tangible cost savings in database licenses. This kind of consolidation simply would not have been possible with any other solution.

Switching to Oracle Exadata Database Machine (X5-2 Eighth Rack High Capacity each in one data center, connected via LAN/WAN, and use of Oracle Data Guard) wasn't a large or lengthy project involving changes to the applications already in use.



Massimiliano Cusumano, Granarolo's Group IT Manager (CIO) and Fabrizio Bracco (Granarolo's Group Technical Infrastructure Manager - CTO ) recap the switch to Oracle Exadata Database Machine positively: "The team from Oracle Consulting and other IT service partners gave us outstanding support during the infrastructure changeover and played an important role in enabling us to implement all the goals we set ourselves. We're extremely pleased with the result. Also Oracle Database/ Oracle Exadata provides options that will allow us to benefit from in years to come. Expert reports and studies into the Oracle 12c features like Oracle Database In-Memory and Oracle Multitenant are already underway."



[www.granarologroup.com](http://www.granarologroup.com)

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**Industry:** Food & beverage

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**Turnover:** Over 1 billion

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**Workforce:** Around 2,500

#### Oracle Products & Services:

- Oracle Database Machine Exadata 2x X5-2 Eighth Rack HC (Oracle Database 11g -> 12c)
- Oracle Data Guard
- Oracle Consulting

#### Key benefits

- Effective support and future-proof protection of business continuity and expansion both now and in the future
- Extreme performance, stability / high availability / basis for consolidation, cost savings, simplification of system management throughout the data center
- Basis for further optimizations of SAP use, e.g. with Oracle 12c Database In Memory, Multitenant

#### Solution

- SAP ECC 6.0 (FI, CO, PP, MM, and SD as well as SAP PI and SAP Solution Manager), non-SAP software, e.g. an Oracle-based Business Warehouse, Oracle OTM (Oracle Transportation Management) and Oracle Database Repositories for customer and web applications and identity management.
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## NAGASE ESTABLISHES AN INTEGRATED DATABASE INFRASTRUCTURE FOR THEIR SAP APPLICATIONS UTILIZED ACROSS THEIR GLOBAL OFFICE NETWORK USING ORACLE EXADATA

**Nagase & Co. Ltd. a long-established trading company that has been in business for 183 years, renewed their SAP applications that are being used across their global office network into a global single instance. After comparing Oracle Exadata vs. SAP HANA, Nagase has adopted Oracle Exadata X4 as its integrated database infrastructure for their backend operations. This has reduced data load times in SAP BW to 48% as compared with their conventional approach and has drastically cut their DWH batch processing times. Nagase is also planning to migrate the database of SAP applications that will be used by their domestic office network to Oracle Database X4 in order to forge ahead with the globalization project.**

### **Nagase integrated databases for their various SAP applications used across their global office network on Oracle Exadata**

Nagase, a 183-year-old trading company founded in 1832, which engages in importing, exporting, domestic sales of chemicals, plastics, electronics materials, and other products now runs their business globally through a number of offices in North America, Asia, the Middle East, Europe and Latin America.

In 2009, Nagase deployed the first generation of Oracle Exadata, V1, to replace its aging Teradata. In May 2014, the V1 was switched to the latest Oracle Exadata X4. Mr. Kenji Yoshizawa, the Development Headquarters at Nagase Information Development - General Manager of the Second System Dept., who played a leading part in the migration explained the background of the move.

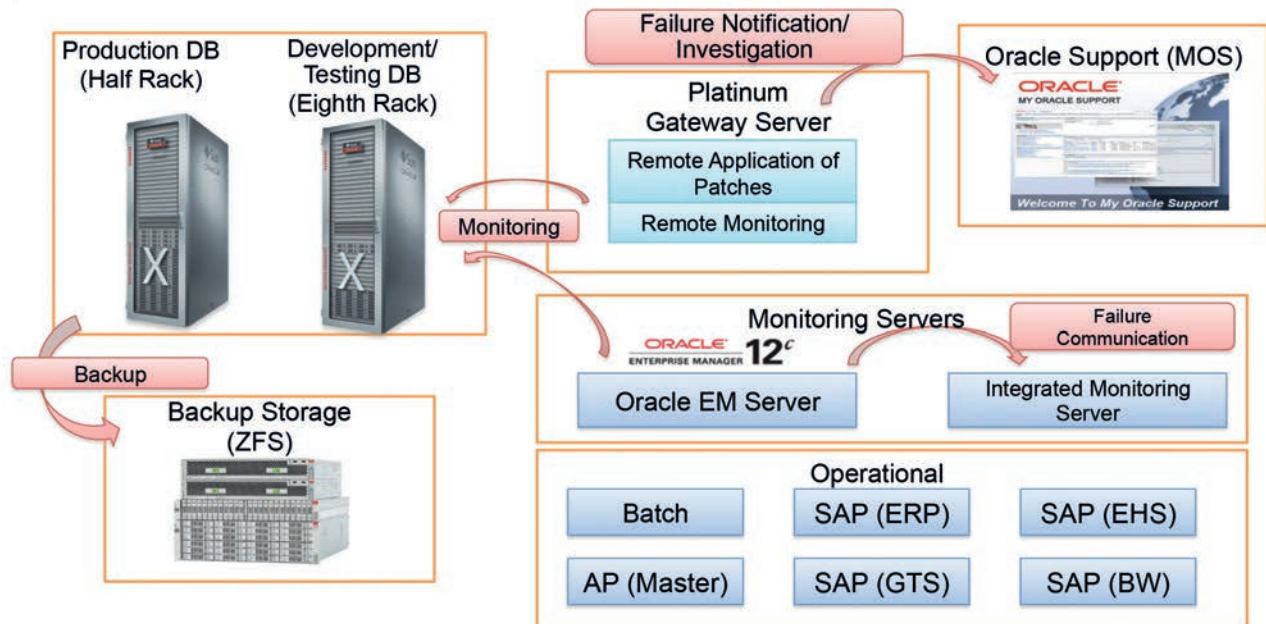
“Since 2009, Nagase has been launching SAP applications at subsidiaries in various countries such as China and ASEAN nations. In October 2014, we launched SAP applications at our affiliates in the U.S. We considered Oracle Exadata X4 and SAP HANA as candidates for our system infrastructure for a global single instance to run our SAP applications, and to consolidate many scattered databases. In the end, we decided to introduce Oracle Exadata X4 due to the fact our Oracle Exadata V1 license was able to be migrated which saved costs, and because we would be able to leverage the experience we gained from using Oracle Exadata V1”.

On their existing system, databases of various systems run on three Oracle RAC (Real Application Clusters) environments on Oracle Exadata V1. Furthermore, they built and operated separate Oracle databases for SAP’s ECC (ERP Central Component), GTS (Global Trade Services), BW (Business Warehouse), FI (Financial Accounting), CO (Controlling), SD (Sales and Distribution), MM (Material Management), TM (Transportation Management), and other applications.

Approximately 1,500 people use these applications at their offices all over the world. Nagase plans to integrate all these databases onto the Oracle Exadata X4. If the Oracle Exadata X4 fails, services at all their offices around the world would stop. However, Mr. Yoshizawa and his staff members did not have any serious concerns due to the operational results of Oracle Exadata V1.

**ORACLE**  
Exadata

## System Configuration Using Oracle Exadata



### Performance of BW and SAP applications dramatically improved

Their migration to Oracle Exadata X4 delivered improved performance for SAP applications. Mr. Koji Ikeda in the Infrastructure Management Department, Operations Division, at Nagase Information Development – Chief of the Infrastructure Management Section told us about the effects.

“For example, data loading to SAP BW used to take five hours and 38 minutes. Now, it takes only two hours and 44 minutes. The time period has been reduced down to 48% of what was previously required. Thus, we successfully solved the problem of overnight batch processing that used to run into the next business day. The batch processing time on the DWH was reduced from 70 to 50 minutes. We also enjoy greater improvements in the response time of the performance query system, the cost and profitability management system, and more. Furthermore, consolidating dispersed databases onto Oracle Exadata X4 and implementing integrated management via Oracle Enterprise Manager delivered cost savings and greatly improved the manageability of the database infrastructure.”

Nagase completed the database consolidation process at 16 global offices into Oracle Exadata X4 in 2014. The performance and capacity of Oracle Exadata still has plenty of latitude. Nagase is now proceeding to migrate databases in the 17th office, in Germany. They are also working to migrate databases for SAP applications used by domestic offices to Oracle Exadata X4.



– Mr. KOJI IKEDA,

Mr. Koji Ikeda, Chief of the Infrastructure Management Section in the Infrastructure Management Department, Operations Division, at Nagase Information Development



– Mr. KENJI YOSHIZAWA,  
General Manager of the Second System  
Dept., Development Headquarters at  
Nagase Information Development

Mr. Yoshizawa said, “Oracle staff told us that there would be no problems. Based on our previous experience with the Exadata machine and Oracle services we fully trusted them. Once implemented we experienced an immediate and significant performance increase. On our old system, data loading to SAP BW (DWH) during monthly overnight batch processing sometimes ran into the following day. This interfered with our business operations. We had an urgent need to resolve this problem.”

Nagase Information Development plans to migrate their databases to Oracle Exadata X4 in two major steps. In the first step, they planned to migrate the existing systems running on the Oracle Exadata V1 run to Oracle Exadata X4. The second step, was to migrate the databases for SAP applications to Oracle Exadata X4.

### **Nagase introduced Oracle ZFS Storage to back up the Oracle Exadata Database Machine, eliminating concerns about delays in backing up large amounts of data**

Nagase Information Development made the fullest possible use of Consulting Services and a variety of support services offered by Oracle Japan to ensure that they proceeded with these tasks efficiently. Mr. Yoshizawa thought “Oracle Exadata X4 offered the best of the latest mission critical technologies and that it was difficult to make full use of it if it were managed like an Oracle database on a Windows Server.” Specifically, they utilize the support for initial building of Oracle Exadata X4 and building of SAP on Exadata that is offered by Oracle Consulting Service (OCS), and the support for data migration to Oracle Exadata X4 and the patch application service that is offered by Oracle Advanced Customer Support Service.

In addition to the two Oracle Exadata X4s - the Half Rack for production and the Eighth Rack for development and testing, Nagase adopted the Oracle ZFS Storage to back up Oracle Exadata in the new database environment.

“We initially planned to back up all databases by connecting them to the existing storage servers over the 10 Gbps network. We came to the conclusion that this would not be sufficient given the adoption of SAP and the associated data growth of multiple terabytes. Therefore, we introduced the Oracle ZFS Storage and were able to reduce the backup time to one-fifth of what we initially expected by connecting to Oracle Exadata via a 40 Gbps InfiniBand.”

Nagase also introduced Oracle Enterprise Manager to provide integrative monitoring. In addition, they deployed gateway servers for Oracle Platinum Services to provide remote patch application and fault monitoring capabilities.



## Comparison of Processing Times Before and After Introduction of Oracle Exadata

Processing	Before introduction	After introduction	Time reduced by	Remarks
Data load on BW	5 hours and 38 minutes	2 hours and 44 minutes	2 hours and 54 minutes	* Processing time on one job network
Batch processing on DWH	70 minutes	50 minutes	20 minutes	
Performance Query System	6 seconds	3 seconds	3 seconds	
Cost and Profitability Management System	7 seconds	3 seconds	4 seconds	
Access Journal System	140 seconds	78 seconds	62 seconds	Amount per date/store dept./account in 6 years
Client copy	79 hours and 20 minutes	20 hours and 12 minutes	59 hours and 8 minutes	Machine for production use - Machine for verification
ZLOG Report	24 seconds	11 seconds	13 seconds	Stock Balances
ZLOG Report	50 seconds	21 seconds	29 seconds	Transaction History
ZLOG Report	50 seconds	5 seconds	45 seconds	Billing for 18 months (per overseas subsidiary)

Mr. Yoshizawa said, "The databases used for SAP applications at all of our offices, including domestic ones, will be consolidated into Oracle Exadata X4 at some point. In the future, we will drive the unification of various systems codes globally on this integrated database infrastructure and will further improve business efficiency. Since the support for Windows Server 2003 will be discontinued from July 2015, we will abolish or merge the Oracle Databases that are running on them before consolidating them into Oracle Exadata X4."

By sharing one enterprise application among all their offices, Nagase will be able to increase enterprise agility and enhance global management capabilities. A key issue in implementing this global single instance is the building of a powerful database infrastructure that supports fast and stable processing of huge volumes of data. Nagase has solved this issue by introducing Oracle Exadata X4, and plans to accelerate growth of the company that has been steadily expanding since the Tenpo Era.



<http://www.nagase.co.jp/english/>

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**Oracle Customer:** Nagase & Co., Ltd.

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**Business type:** General trading company

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**Number of employees:** 1,009 (Consolidated: 6,293) (As of April 1, 2015)

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**Capital:** 9.699 billion yen (as of April 2015)

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**Sales:** 723.2 billion yen (Consolidate) (As of March 2014)

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**Main business:** Import/export and domestic sales of chemicals, plastics, electronics materials, cosmetics, and health foods. Nagase has five offices in Japan and dozens of subsidiaries worldwide.

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**Consolidation of several hundred database servers for SAP and non-SAP use, significant optimization of lifecycle / IT management / Intended benefits surpassed**

## ICT AT SWISS POST NOW MORE EFFICIENT THANKS TO ORACLE EXADATA DATABASE MACHINE

**Swiss Post aims to make customers' lives easier through high-quality, innovative services. The growing digitization of the business world means that a dynamic and optimized IT infrastructure is more important than ever. Since the start of the year, Swiss Post has been relying on Exadata Database Machine from Oracle to optimize their infrastructure.**

A variety of digital applications support a wide range of business processes at Swiss Post. The highly developed IT landscape has both decentralized as well as local elements and database management systems (DBMS) are essential to performance, SLA compliance, and security. This is mainly due to the fact that data from virtually every application is centrally processed in one or more of the several hundred databases for a variety of purposes.

For years, the company has been using Oracle databases to service their SAP and non-SAP applications. The move toward Engineered Systems based on Oracle Exadata Database Machine represented a major step forward to achieving their infrastructure optimization goals. The benefits were many. Through database and server consolidation the Swiss Post improved both their cost and resource efficiency. They experienced a significant simplification and optimization of DBMS lifecycle management. Users experienced a considerable boost in performance and system administrators found improvements as well.

### DB server consolidation

The plan was to first implement a database server consolidation on the basis of Oracle Exadata Database Machine in the non-SAP domain. Drawing on the insights, experience gained and the results achieved, Oracle Exadata was then planned to be rolled out in the SAP environment too.

Valeri Minkov, Senior Oracle Database Engineer at Swiss Post, explains, "For the database server consolidation, it was mainly the resource-, time- and cost-intensive lifecycle management that prompted the move to Oracle Exadata.

Whenever upgrades or patches needed to be implemented, about ten different IT departments had to sit down together and analyze, coordinate, define activities, and then carry them out. This involved server, OS, network, storage experts, database and interface specialists, and others as well. This process and the coordination involved were unsatisfactory for us because it simply took up too much time. Oracle Exadata allowed us to massively simplify this procedure in a number of ways."



In the non-SAP environment, no less than 480 Oracle databases with over 100 physical and 30 virtual servers were transferred to three Oracle Exadata X4-2 half racks. Swiss Post has been using Exadata in the non-SAP domain since the second quarter of 2015, to great effect. The company uses four computing nodes, 8x12 CPU cores, 2 TB RAM, four storage cell nodes, a 12.8 TB flash cache, four admin-managed RAC One nodes, and Oracle Data Guard for high availability (HA) as well as disaster recovery (DR).

The non-SAP experience proved to be extremely positive. In fact, the business case results actually exceeded expectations. Upon seeing these results, Swiss Post was keen to leverage the benefits of using Oracle Exadata for SAP as quickly as possible.

In the SAP environment, 96 Oracle databases (TEST, QA/INT, PROD) with a total of 47 physical and 15 virtualized database servers (from HPE on Suse Linux; VMware) were migrated to Exadata (quarter rack). Exadata went into productive use for SAP in the fourth quarter of 2016. This consisted of two Exadata X5-2, each with two computing nodes, 4x18 cores, 1.5 TB RAM, three storage cell nodes, a 9.6 TB flash cache, and two admin-managed RAC nodes for HA. The application servers (from HPE and other manufacturers) continue to run on Microsoft Windows.

Swiss Post has more than 10,000 SAP users. They utilize many SAP NetWeaver-based business suite components such as ERP, BW, SRM, CRM, and HCM. Each system being customized with an array of ABAP programs developed-in-house.

### Oracle Exadata delivers massive benefits

For SAP, as before, the Oracle 11g database was fully migrated to Oracle Exadata.

The high-performance Exadata systems are operated firstly in a high-security data center in the Swiss capital Bern, where there are two connected Exadata cells with a (cross-connected) two-node RAC cluster, which run in separate rooms around 150 meters apart to ensure high availability. Another linked Exadata cell is operated in a backup data center some 120 kilometers away. In the interests of business continuity and disaster recovery, data replications are performed almost continuously in all locations with Oracle Data Guard.

Commenting on the benefits achieved with Oracle Exadata, Minkov says, “The cost and time savings are significant. Before Exadata, we needed around 100 person-days to implement a patch or upgrade. Now we need three to four. We can implement a new Exadata patch in perhaps two weekends. What’s more, we now only have one DBMS and Engineered Systems team.”

Other key advantages for Swiss Post include server and storage savings. “Obviously it makes a difference when, instead of upgrading or acquiring over 100 servers, you virtually have a system with 12 computing nodes.”

As part of the consolidation in the SAP environment, the number of databases was reduced from 96 to 85. The consolidation with Exadata also made it possible to save around 300 TB in storage (SAN) volume. In addition, Swiss Post has reaped significant benefits through savings in the physical space needed for servers and storage and reduced energy costs.

Meanwhile, users have noticed the improved performance with Oracle Exadata, reports Minkov, “SAP users are reporting that response times feel like they’ve been cut in half.”

And that's not all: "There are proven benefits to working with a one-vendor model. Before, we were dealing with around 10 manufacturers. Now it's just one – namely Oracle. This means we now need much less time to handle things such as outages. The handling and administration of the current DBMS server environment is also much more straightforward."

All in all, database server consolidation in the SAP and non-SAP environments on the basis of Oracle Exadata Machine has certainly paid off. At the time of writing (February 2017), the Swiss company is switching from Oracle 11g to 12c. The planned deployment of expansion level X6 for Oracle Exadata Database Machine will increase the current processing capabilities. The X6 Exadata Machine contains more CPU cores, more RAM, and more storage.

#### Oracle Exadata: "Unique flexibility"

For more than two and a half years that Swiss Post has been using Exadata, the company has built up a wealth of knowledge and expertise. Its experts carried out the Exadata migration in the SAP environment without any external assistance. The secret is that Swiss Post uses the Engineered System as a combined system so to speak. They run Exadata X4-2, X5-2, and X6-2 components on a combined basis with all components (SAP and non-SAP workloads) using the same Exadata Infiniband network. Minkov says, "From the perspective of Swiss Post, Exadata as an Engineered System from Oracle offers unique flexibility and possibilities for system usage and expansion which are unavailable from any other database provider."

#### Profile

##### Schweizerische Post (Swiss Post)

Swiss Post ([www.post.ch](http://www.post.ch)) is a diversified company with activities in communications, logistics, retail finance, and transport. With around 62,000 employees, it is one of the largest employers in Switzerland. In 2016 it generated a revenue of around CHF 8.2 billion. The company is represented in around 25 countries and is 100% owned by the Swiss federal government. [www.post.ch](http://www.post.ch)

#### Key benefits:

Modern scale-out database infrastructure for SAP and non-SAP workloads, cost savings, optimized lifecycle management, faster business processes/higher performance, better manageability, single point of accountability, high security, high availability, higher stability, extensive scalability options.



[www.post.ch](http://www.post.ch)

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**Oracle Customer:** Swiss Post

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**Location:** Switzerland

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**Industry:** Postal services, financial services, logistics and more

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**Workforce:** approx. 62,000

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**Revenue:** CHF 8.224 bn (2015)

#### Oracle Products & Services:

- Oracle Exadata Database Machine for Sap and non SAP (11g/12c, RAC, ASM) 3x X4-2 half rack; 2x X5-2; 3x X6 node
  - Oracle Enterprise Manager 12c
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## RCNTEC COMPLETES SAP SYSTEMS MIGRATION TO ORACLE EXADATA FOR UTKONOS ONLINE HYPERMARKET

RCNTEC (АПСИЭНТЕК), a Russian IT business solution provider, has completed the migration of high-workload SAP systems from SPARC platform to Oracle Exadata/x86 for Utkonos online hypermarket, the leader in Internet retail of food and related goods.

Recent developments in the Retail Industry of Russia have resulted in intense competition in the market and created several new essential focus areas especially in terms of IT.

SAP systems are used in many different business scenarios, such as accounting, warehousing, logistics, costing, and also analytics etc, in addition to business process automation. SAP systems are used by leading retailers all over the world to improve their performance indicators. They also provide support of online trading and Internet-based stores.

“Utkonos” is the largest Russian online retailer that has implemented SAP systems in their business since 2002. The migration of SAP systems to Oracle Exadata/x86 has increased performance and reliability of the systems significantly.

RCNTEC has solid experience in terms of implementation and management of SAP systems. They also have firm background in design new system solutions, architect SAP system landscapes, and SAP performance optimization. Our specialists have completed courses in SAP training centers and implemented dozens of projects with SAP-based systems.

Total production databases volume of “Utkonos” at the time of migration to new platform was 11 TB. Some of the SAP systems to be migrated are business-critical. For those systems, the downtime window approved by the customer was no more than 90 minutes for all databases combined. With a network capacity of 1Gbps at most, the standard export/import migration or use of transportable tablespaces could in no way fit in the given constraints. RCNTEC specialists decided to make use of Oracle GoldenGate to execute the cross-platform migration. Test migrations were done prior to actual migration, and a post-migration consistency check procedure was also developed and optimized to verify the success of the production migration.

“As a result, the project of databases migration to Oracle Exadata/x86 platform has been successfully completed with downtime under approved 90 minutes” – says Vice-President of Data Centers of RCNTEC Anton Usanov.

“Operating information systems serving high amounts of customers’ requests round-the-clock provides one of the key advantages of the market. It’s crucial to us to have our systems operating faultlessly. The migration of production SAP systems with less than 90 minutes of downtime, considering the amount of our uninterruptible on-line operations, was a sophisticated problem, which was solved by RCNTEC specialists successfully.

There are few companies in Russia at the moment experienced enough to perform such job while the costs of involvement of foreign specialists, especially in current economic situation, in most cases is order of magnitude higher” – says Head of Information Systems Department of “Utkonos” online-hypermarket Sergei Husainov.

RCNTEC operates SAP systems of “Utkonos” since September 2016.



### Press service of LLC RCNTEC

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Open up new horizons and boost your business by migrating from MS SQL Server on standard hardware to an Oracle database and Oracle Exadata for SAP

## ORACLE DATABASE AND EXADATA – THE PROBLEM SOLVERS FOR BW ISSUES – A SUCCESSFUL MSSQL MIGRATION TO ORACLE DATABASE ON EXADATA

**By replacing the database server of their SAP system running MS SQL Server on standard hardware with Oracle Exadata running Oracle Database, a global provider of infrastructure supply managed to resolve multiple issues on their SAP Netweaver BW/BI that had been affecting their business operations. The move also fixed their previous inability to fulfill business-relevant BW application extension requirements.**

The company, an SAP customer for many years, engaged the global Oracle Advanced Customer Services (ACS) team to migrate and transition to the new Exadata environment. Compared with the previous MS SQL Server and standard hardware setup, the new SAP Oracle 12c database (including RAC) and the high-performance Oracle Exadata for SAP engineered system have tripled BW reporting performance and doubled the extraction speed of critical data. At the same time, scalability, capacity and high availability (HA) of the system was increased. All without a single change to the existing BW applications.

### Rock-solid reasons for Oracle Database and Exadata

It is a well-known fact that, in order to work efficiently, be future-proof and provide flexible scalability, SAP BW/BI Netweaver greatly depends on its infrastructure components, i.e. the underlying database and hardware environment. However, while the use of BW almost continually increases over time, the existing infrastructure environment quickly can outlive its ability to support the increase in utilization as required. Emerging BW application requirements, such as the use of new BW reports driven by business needs, sometimes cannot be implemented at reasonable cost – or at all. Performance limitations of the existing SAP infrastructure may even prevent the addition of smaller new reports of high business value.

This was also the case with the above mentioned company that encountered several performance issues preventing them from using BW for normal system operation. At the same time, the existing SAP BW environment was unable to keep up with the increasing BW application requirements and provide the business with new BW functionality. Therefore, it was concluded that „optimizing BW was inevitable“.

Various options were developed and evaluated in detail. Eventually, two options for implementing the planned BW optimization emerged from the evaluation process: either switch to SAP HANA or migrate the existing BW landscape based on SAP Netweaver from the MS SQL Server database and its standard hardware environment to Oracle Database and Oracle Exadata. According to a company spokesperson, the scales eventually turned away from the SAP HANA option due to the impact of the expected amount and diversity of changes that would have been required to make their existing applications work in the new environment. The SAP Netweaver BW/BI with Oracle Database and Exadata optimization option was the simpler path and had been thoroughly checked and verified multiple times before the final decision was made.

### Qualified support by the Oracle ACS team

The migration project was backed by a dedicated Oracle Advanced Customer Services team, giving advice as well as providing hands-on assistance. The team was not only involved in the design and planning but also in all relevant project steps such as system sizing, installation of the Oracle database including RAC implementation, Exadata installation, database migration and transition, fine tuning, testing, training and go-live. According to the customer, „Oracle ACS supported us with its vast experience and in-depth know-how at all times and played a crucial part in the timely realization and successful outcome of the project.“



Migrating from the MS SQL Server database and a standard hardware environment to Oracle 12c database and an engineered system based on an integrated hardware / software / storage / network system was a huge success for the customer. „The manifold performance issues we had with SAP Netweaver BW/BI have simply vanished into thin air – without a single change to the SAP BW application logic. The use of BW with the new environment enables us to further enhance our business and focus on our goals,“ the customer explained.

The combination of Oracle 12c and Exadata for SAP has tripled reporting performance and the speed of data extractions has doubled. The new environment is also future-proof as it provides sufficient scalability and capacity resources to implement future change requests or new BW application features (such as the use of big data features) – something that would not have been possible before the introduction of Oracle 12c and Exadata. What’s more, the use of Oracle Real Application Clusters has led to significant high availability improvements.

Future expansion of the current Exadata system for extended uses of SAP Netweaver BW/BI is now possible at any time without problems.

#### Results / improvements achieved through Oracle 12c and Exadata for SAP

Reporting performance **3x**

Extract criticals **2x**

Scalability / capacity **2x**



## ORACLE-RELATED SAP NOTES (ENGINEERED SYSTEMS))

Note No.	Note Title	DB Version
<b>Engineered Systems : Exadata</b>		
1590515	SAP Software and Oracle Exadata	19c
1619343	SAPinst for Oracle Exadata on Oracle Linux and Solaris X86	12c-19c
1677978	Mixed GI/RDBMS Versions or Mixed SAP/Non-SAP Environments	12c-19c
1996481	Using Correct Hostnames for Oracle Exadata Database Nodes	12c-19c
2007980	SAP Installation with Oracle Single Instance on Exadata and ODA	12c-19c
2799940	Exadata / Supercluster: Patches for 19c	19c
2846518	Exadata X8M - Virtualization DBs for SAP NetWeaver Products with KVM	12c-19c
2847437	Older Versions: SAP Software and Oracle Exadata	12c-19c
2848997	Additional Patches Required for Using Exadata Software 19.3.0	12c-19c
2884306	Managing SAPDATA_HOME and ORACLE_BASE on Engineered Systems	19c
2992680	Managing shared and multiple Oracle Homes on Engineered Systems	12c-19c
<b>Engineered Systems : Database Appliance (ODA)</b>		
2007980	SAP Installation with Oracle Single Instance on Exadata and ODA	12c-19c
2345633	Oracle Database Appliance: Mixed SAP and Non-SAP ORACLE_HOMES	12c-19c
<b>Engineered Systems : Private Cloud Appliance (PCA)</b>		
2052912	SAP Software and Oracle Private Cloud Appliance (PCA)	n/a
<b>Engineered Systems : Services</b>		
1983678	Platinum Services for Exadata and SuperCluster running SAP	12c-19c



# Oracle Support and Services for SAP Customers

Seamless data availability, optimal performance, reduced risk



## Configuration Services



Performance Analysis & Optimization



High Availability Architectures



Security & Compliance



Data Model & Disk Space Optimization



## Migration Services



Non-Oracle to Oracle



Oracle to Oracle



Oracle to Oracle close to Zero Downtime



On-Premise to Cloud



## Technical Skill Workshops



Oracle Database Fundamentals



Oracle Database Tuning



ABAP® Tuning with Oracle Database



Database Security



## MISSION-CRITICAL SUPPORT SERVICES FOR SAP CUSTOMERS

For organizations using SAP for critical operations, seamless data availability, optimal performance, and reduced IT risk are essential for business success. Oracle Advanced Customer Services delivers mission-critical support to help you maintain and maximize the performance of your Oracle systems. With a unique service approach focused on building a long-term relationship with your IT team and collaborative support within Oracle's support and engineering teams, Oracle Advanced Customer Services provides a highly integrated, end-to-end service offering. A single contact for all Oracle and SAP issues and access to Oracle and SAP experts allow problems to be resolved faster and more efficiently. Proactive, preventative support services use diagnostic tools to help you increase system availability, optimize performance, reduce risk, and accelerate return on investment (ROI) across the Oracle and SAP stack. Planning, migration, configuration, and installation services enable you to take advantage of advanced features and new technologies faster and more effectively. Customized workshops train you with best practices on how to operate and maintain your SAP environment for the maximum performance and availability. All of this adds up to services that allow you focus on delivering business value, not on day-to-day IT support.

Oracle has the deep SAP expertise you need to get the most out of your SAP environment. With over 30 years of collaboration with SAP, Oracle is the top database provider for SAP deployments and has the longest experience with SAP R/3 and SAP NetWeaver of any database provider. Dedicated engineering and support resources from both companies work together on end-to-end development, integration, and optimization, and ensure fast customer issue resolution, so you can operate your SAP and Oracle environment with confidence. Highest availability for your SAP landscape with Oracle high availability (HA) and disaster recovery (DR) development, integration, and optimization, ensures fast customer issue resolution.

### Oracle Advanced Customer Services Systems Optimization and Transition Support for Oracle Databases

Whether you need to migrate your database to stay up to date with the latest technologies, consolidate legacy systems onto modern hardware, or improve the performance of your SAP workloads, Oracle Systems Optimization and Transition Support delivered by Advanced Customer Services helps you optimize your Oracle Database for SAP.

### Oracle Advanced Customer Services Transition Service for SAP Migration

Through automation, advanced support tools, and more than 14 years of Oracle Database transition experience, Oracle Transition Service delivers transition planning, validation, and execution services that allow you to transition your SAP database faster, with lower costs and less downtime. Oracle experts assess your SAP environment, guide you in choosing from multiple transition approaches, resolve potential issues, perform test runs to reduce risk, and move your database through a secure online gateway. Oracle's efficient process, based on the latest industry best practices, allows you to transition your SAP database in a matter of days, not the weeks or months typically required.

### Oracle Consolidation Planning Service

Consolidating legacy systems onto modern hardware can reduce costs, improve performance, and simplify operations. The Oracle Consolidation Planning Service helps you quickly identify the most optimal consolidation and migration scenarios for consolidation onto Oracle's hardware platforms and engineered systems. Oracle experts assess the current configuration, workloads, patch levels, and security requirements of your SAP environment to develop a comprehensive consolidation plan, including detailed projections and actionable recommendations to lower transition and operational risks.

### Oracle Performance Tuning and Benchmarking Service

Through ongoing monitoring and quarterly assessments, the Oracle Performance Tuning and Benchmarking Service helps you maintain consistent, optimal performance for critical SAP databases. Key performance metrics are monitored to proactively identify issues before they impact operations. Quarterly performance assessments include recommendations based on industry standards, Oracle best practices, and ongoing experience with customers that have similar SAP database configurations and usage scenarios.

Adding the Oracle Load Testing and Analysis Service further increases uptime, lowers costs, and reduces risk through comprehensive database testing. Oracle Database load testing experts evaluate the performance impact of planned technology changes, recommend configurations to optimize performance, and identify and address issues before go-live.

Oracle Advanced Customer Services Systems Optimization and Transition Support Services enable faster database transitions, reduce transition and consolidation risk and costs, and help you optimize database performance and availability.

For more information visit:

<https://www.oracle.com/support/advanced-customer-services/products/database.html>

### Oracle Advanced Customer Services for Engineering Systems

For SAP environments based on Oracle hardware, Oracle Advanced Customer Services provides planning, deployment, optimization, and support services based on deep expertise for servers, storage, and engineered systems. These services improve the performance and availability and reduce new hardware implementation times for your SAP environment.

### Oracle Advanced Customer Services for Servers

Oracle Advanced Customer Services offers several services to help you improve the performance and availability of your Oracle servers and reduce deployment time for new systems. Installation and configuration assistance includes preproduction readiness reviews to speed deployment of new Oracle systems and ensure your resulting SAP environment is stable and supportable. Tailored services for server performance tuning and availability configuration optimize your SAP environment. Additionally, customized workshops provide best practices and knowledge transfers to help you operate your servers with confidence.

To learn more about Oracle Advanced Customer Services for servers and storage, visit:

<https://www.oracle.com/support/advanced-customer-services/products/servers-storage.html>

### Oracle Advanced Customer Services for Engineered Systems

Through a complete lifecycle approach, Oracle Advanced Customer Services delivers mission-critical support for Oracle engineered systems that help you maximize the return on your engineered systems investment.

Advisory and planning, design and build, and deployment services ensure a smooth transition to Oracle engineered systems and operational readiness within your SAP environment. Ongoing production support reduces risk and gives you a single point of contact for both Oracle and SAP issue resolution.

For more information on Oracle Advanced Customer Services for engineered systems, visit:

<https://www.oracle.com/support/advanced-customer-services/products/engineered-systems.html>

### Oracle Platinum Services for SAP Environments

Through Oracle Premier Support program, Oracle Platinum Services offer the customers additional enhanced support features for their SAP environments. Using the secure Oracle Advanced Support Gateway, continuous, remote fault monitoring of your entire Oracle and SAP environment—hardware, database, operating system, and networking—enables accelerated response times. Notification of faults is delivered within 5 minutes of occurrence, with restoration or escalation to development within 15 minutes. Joint debugging of escalated faults starts within 30 minutes of occurrence. The result is a decreased downtime through the prevention of critical issues and faster issue resolution. On average, Oracle Platinum Services customers experience 50% fewer high-severity issues and 31% faster response times, and reduced support-related workloads within their organization. Additionally, quarterly patch deployment services, including both Oracle and SAP patches, ensure your SAP environment is always up to date.

Oracle Platinum Services are included in Oracle Premier Support contracts for Platinum-certified configurations of Oracle Exadata, Oracle Exalogic, and Oracle SuperCluster.

For more information about Oracle Platinum Services for SAP environments, visit:

<https://www.oracle.com/support/premier/engineered-systems/platinum-services.html>

### Oracle Workshops for SAP Customers

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