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Session Abstract

CON8260

The need to reduce IT costs and increase business agility and focus is driving businesses to consolidate to Oracle Database Cloud and deploy a database as a service (DBaaS) model. However, given the many challenges and choices available in this process, the road to DBaaS requires a systematic approach, from planning, testing, and capacity planning to deployment. This session discusses proven strategies; various tools such as Oracle Enterprise Manager’s Consolidation Planner feature and Oracle Real Application Testing; and how best to use them for a successful deployment of DBaaS.
Program Agenda

1. Current Challenges
2. EM 12c Solution
3. Summary
Key Challenges and Solutions

- **Unmanaged asset sprawl**
  - 28% have an annual database instance growth of more than 20%
  - Less than 50% have consolidated

- **Configuration Pollution**
  - Too many versions, patch levels and sizes
  - 400 variants out of 1400+ across 3 major releases for a large telecom customer

- **Slow time to delivery**
  - Days to Weeks to provision new database services or clone production databases for key projects

**Consolidation**

**Standardization**

**Automation**

*IOUG Survey, 2013*
Consolidation Planning, Validation and Sizing

Enterprise Manager 12c provides
✓ Consolidation Planning for physical to virtual, commodity to Engineered Systems and dedicated to multitenant database
✓ Validation of the database consolidation architecture with Consolidation Planner
✓ Validation of SQL performance and identification of regressions using SQL Performance Analyzer
✓ Validation of consolidated workload by capturing and replaying real workload using Real Application Testing

Allied Irish Bank (AIB) consolidated its Oracle Database platform with the help of Real Application Testing and 25% less testing resources
Consolidation: DBaaS Architectures

EM12c Supports Database Versions 10gR2 to 12c

Virtual Machines

Dedicated DBs

Dedicated Schema(s)

Pluggable DBs

Share servers

Share servers and OS

Share servers, OS and database

Share servers, OS and database

Increasing Consolidation
## EM12c DBaaS: Unmatched Architectural Choices

<table>
<thead>
<tr>
<th></th>
<th>Virtual Machines</th>
<th>Dedicated DB</th>
<th>Dedicated Schemas</th>
<th>Pluggable DB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consolidation Density</strong></td>
<td>Low-Moderate</td>
<td>High</td>
<td>Highest</td>
<td>Highest</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>Very complex (VM Sprawl)</td>
<td>Easy</td>
<td>Easy to Involved (based on required resource isolation)</td>
<td>Easy</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>Excellent</td>
<td>Good</td>
<td>Least</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Implementation &amp; Onboarding</strong></td>
<td>Easy</td>
<td>Easy</td>
<td>Difficult</td>
<td>Easy</td>
</tr>
<tr>
<td><strong>Application Suitability</strong></td>
<td>Some (workload dependent)</td>
<td>All</td>
<td>Home grown; requires app validation</td>
<td>All but have to be certified for Database 12c</td>
</tr>
</tbody>
</table>
Consolidation: Challenges

- What consolidation strategy and platform to use?
- How to test the chosen consolidation strategy?
- Can the system handle peak workloads, can workloads co-exist together?
- How to minimize consolidation risk?
Recommendation: Use Consolidation Planner

- Collect Data from Source Servers
- Select Resources to be Analyzed
- Define Constraints
- Specify Target Servers
- Review Consolidation Plan Results

Extract Resource Utilization Data

Use CPU, Memory, Disk Storage, Disk IO, Network IO

Use Business Constraints
Use Technical Constraints

Specify Physical or Virtual
Specify Existing or Planned

Review Consolidation Ratio
Review Target server utilization
Recommendation: Use Consolidation Planner

Use Consolidation Scenario Report to pick the best strategy for consolidation.

Use the following in the Consolidation Report:
- Consolidation ratio
- Destination server utilization
- Source to Target server mapping
- Confidence of meeting requirements based on historical samples
- Manually mapped consolidation constraint violations
- Servers that cannot be consolidated (Exceptions)

Recommended to do few trials & scenarios to come up with best strategy.
Recommendation: Use Consolidation Planner

- Identify under-utilized or over-utilized servers
  - Use Enterprise Manager target performance and configuration data

- Determine candidates for consolidation
  - Maximize server density
  - Maintain performance commitment
  - Satisfy business, compliance, and technical constraints

- Work for physical and virtual environments
- Lookup of SPECint® data which is integrated
- Lookup for out of the box support for Exadata
Use Real Application Testing for Validation

End-to-end validation with real workloads

<table>
<thead>
<tr>
<th>Consolidation Type</th>
<th>Tool</th>
<th>Validation Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server, OS, Schema, CDB</td>
<td>SQL Performance Analyzer</td>
<td>SQL unit testing for response time in consolidation scenario</td>
</tr>
<tr>
<td>Server, OS</td>
<td>Database Replay</td>
<td>Load, performance validation for throughput</td>
</tr>
<tr>
<td>Schema, CDB</td>
<td>Consolidated Database Replay</td>
<td>Replay multiple workloads against one database for throughput and scalability validation</td>
</tr>
</tbody>
</table>
Recommendation: Use SQL Performance Analyzer for Consolidation Validation

- Validate SQL performance for consolidated database
- Capture SQL workload for each database in STS
- Merge STS
- Execute SPA for all workloads together in consolidated environment using merged STS
- Identify errors & SQL regressions
- Review response time
- Remediate
- Validate auto-implement of SQL Profiles on each PDB on a day to day basis
Recommendation: Use Consolidated Database Replay

Test System

Production Systems

DB1
Windows DB 10.2

DB2
AIX DB 9.2.0.8

DB3
HP-UX DB 11g

Directories

Capture 1
May: Month-end Close
June 15: Daily Peak
June 18: DW - ETL

Capture 2

Capture 3

Consolidated Replay Directory

Capture 1
Capture 2
Capture 3

Replay on CDB OR Non-CDB

CDB – DB12c

Datafiles
Control files
Redo Log files

root

Datafiles
MFG PDB

Datafiles
CRM PDB

Datafiles
HR PDB

Non-CDB (11.2.0.2+)

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Recommendation for Sizing: Use Database Replay

Strategies for Scale Up

- Scale up with multiple PDBs
- Scale up multiplier
- Scale up by scheduling concurrent replays
- Scale up by workload folding
- Scale-up with Schema Remapping
## Recommendation for Sizing Techniques

<table>
<thead>
<tr>
<th>Objective</th>
<th>Recommended Technique to be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response time unit testing when consolidation</td>
<td>Consolidated SPA trials</td>
</tr>
<tr>
<td>Stress Testing</td>
<td>Scale Up Multiplier, Connect Time, Think Time</td>
</tr>
<tr>
<td>Server Consolidation</td>
<td>Database Replay</td>
</tr>
<tr>
<td>Database Consolidation</td>
<td>Consolidated Database Replay</td>
</tr>
<tr>
<td>Workload Scale Up</td>
<td>Time-Shifting, Workload Folding</td>
</tr>
<tr>
<td>Schema Consolidation</td>
<td>Scale-up With Schema Remapping, Consolidated Database Replay</td>
</tr>
<tr>
<td>CDB/ PDB Consolidation</td>
<td>Consolidated Database Replay with service name mapping to each PDBS</td>
</tr>
</tbody>
</table>
Recommendation for Database Replay Methodology

Group databases based on common attribute like type of application, OLTP, DSS, Mixed workload

Consolidating less than 10 databases, capture workload across all databases and replay

Consolidating greater than 10 databases, capture workload for one database per group and replay
Recommendation for Database Replay Methodology (Cont)

1. Capture peak workload or critical workload of interest

2. Replay workload individually before replaying concurrently & establish a baseline

3. Tune the system and workload based on this individual replay
Recommendation for Database Replay Methodology (Cont)

Use multiple sizing techniques for same workload (see slide 11 for techniques)

Tune the system based on this consolidated replays and sizing technique

Re-run the same test and observe key metrics like DB time, CPU time, memory usage, response time & other SLA’S as applicable
Recommendation for Database Replay Methodology (Cont)

Scale up & replay workload to the number of databases in the group

Follow the same steps for each group

Replay scaled up workload for all groups concurrently
Recommendation for Database Replay Methodology

Group 1 - OLTP
- 100 Databases
- Capture Workload for 1 database
- Replay workload Individually
- Scale-up Replay workload

Group 2 - DSS
- 15 Databases
- Capture Workload for 1 database
- Replay workload Individually
- Scale-up Replay workload

Group 3 - Mixed Workload
- 20 Databases
- Capture Workload for 1 database
- Replay workload Individually
- Scale-up Replay workload

Replay all Groups and Scale-up workload concurrently on CDB or non-CDB

CDB – Oracle 12.1.0.2
Configuration Standardization

Enterprise Manager 12c enables
✓ Single *Service Catalog* with predefined configurations and sizes to minimize variants
✓ Ongoing Compliance checks to detect violations and mapping to industry standards like STIG and PCI
✓ Drift management to detect differences across a fleet of databases
✓ Automated patch management under minimum downtime to bring configurations back to compliance

Telecom Italia has created a single Service Catalog to streamline operations that previously hosted 700 different configurations across 1000+ databases.
Service Catalog

Definition

• A collection of standardized services available to selected consumers for on demand, self service provisioning

Benefits

• Establish and enforce effective standardization
• Repeatable and predictable deployment
• Helps identify service costs
• Helps reduce the database management overhead
EM12c DBaaS Service Catalog for Provisioning

Service Definition

Define service tiers to simplify your offerings

- Bronze
- Silver
- Gold

Technical Service

Establish the technical footprint of each service tier

- RAC
- Data Guard
- Backups

Service Model

Determine the individual services to be provisioned

- PDB
- Database
- Schema

Resource Pools

Align services with resource pools

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Database Service Levels and Sizes

A. Define your own service levels

<table>
<thead>
<tr>
<th>Primary</th>
<th>Standby(s)</th>
<th>EM12c R4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SI</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>SI</td>
<td>SI</td>
</tr>
<tr>
<td>3</td>
<td>RAC</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>RAC</td>
<td>SI</td>
</tr>
<tr>
<td>5</td>
<td>RAC</td>
<td>RAC</td>
</tr>
<tr>
<td>6</td>
<td>RON</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>RON</td>
<td>RON</td>
</tr>
</tbody>
</table>

SI – Single Instance
RAC – Real Application Clusters
RON – RAC One Node

B. Set your own sizes

<table>
<thead>
<tr>
<th>Size</th>
<th>CPU Core</th>
<th>RAM GB</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>1</td>
<td>6</td>
<td>50 GB</td>
</tr>
<tr>
<td>M</td>
<td>2</td>
<td>12</td>
<td>250 GB</td>
</tr>
<tr>
<td>L</td>
<td>4</td>
<td>24</td>
<td>1,250 GB</td>
</tr>
<tr>
<td>XL</td>
<td>16</td>
<td>48</td>
<td>5 TB</td>
</tr>
</tbody>
</table>

ORA**CLE**
Self Service Software Maintenance

• Process
  – Pools subscribe to DB and GI images
  – New images automatically get deployed to servers in the pool
  – Self Service users or Admin can choose to migrate DBs over to the new home

• Benefits:
  – Out of place patching and upgrade with reduced downtime
  – Subscription based, and at mass scale
  – Flexibility to users to move to new software version on their terms
  – Track compliance across cloud and non-cloud environments
Automation for Database

Enterprise Manager 12c enables

✓ Single click deployment of single instance, RAC, pluggable databases and schemas, optionally with DR setup
✓ Intelligent placement and governance through access control, quota and showback
✓ Instant, storage efficient cloning of databases using Snap Clone
✓ Automation of lifecycle operations like backup, restore, patching, upgrade
✓ RESTFUL APIs for integrating with orchestration services

NAV reduced new database provisioning time from 6-7 days to 18 minutes using Enterprise Manager 12c
Process Challenges

70,000 refresh/year

2,000+
Dev/Test DB

3 – 5 TB
Typical DB size

RMAN
full clones

10 - 20
issues/day

EMC & NetApp
storage

“Database Refresh is a necessary evil!”

- Christian Bilien, Global Head of Database Team
Automation for Database: Optimized Data Refresh
Using Enterprise Manager Snap Clone

**Features**

- Rapid and space efficient clones of large databases, from version 10g to 12c
- Supports ALL storage vendors and configurations (SAN and NAS)
- Integrated lifecycle management (lineage and association tracking)
- “Rewind” and “Refresh” capability suited for continuous development and testing

**Benefits**

- Agile provisioning (minutes to clone TB sized databases)
- Over 90% storage savings (KBs of additional space for cloning TB sized database)
- Reduced administrative overhead for ongoing administration of clones
Data Refresh Strategies

<table>
<thead>
<tr>
<th>NAME</th>
<th>SSN</th>
<th>SALARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGUILAR</td>
<td>203-33-3234</td>
<td>40,000</td>
</tr>
<tr>
<td>BENSON</td>
<td>323-22-2943</td>
<td>60,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NAME</th>
<th>SSN</th>
<th>SALARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILLER</td>
<td>112-23-4567</td>
<td>40,000</td>
</tr>
<tr>
<td>SMITH</td>
<td>111-22-3333</td>
<td>60,000</td>
</tr>
</tbody>
</table>

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DB Clone and Refresh – Admin Flow

- Mask
- Update [Patch or Upgrade]
- Change Configuration [SI / RAC]
- Use as Test Master
- Production Database

Clone / Test Master

- Version: 11.2.0.4
- Config: Single Instance
- Data: RMAN Backup1

RMAN Backup / Data Pump / Storage

Snapshot

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Self Service Provisioning and Service Catalog

- Out-of-box self service portal
- Catalog of different database configuration with varied datasets
- Resource quota based on role
- Integrated monitoring, snapshot/rollback, etc
Data Movement

Activity Breakdown

- Prod DB – Identify production database for cloning
- Backups – Take regular backups [RMAN, datapump exports, etc]
- Mask / Subset – Mask sensitive data. Optionally, subset to reduce storage footprint
- Test Master – Sanitized copy of production data for use in dev / test environments OR a Data Guard Standby database
- Clones – Full clones for performance / stress testing; snap clones for functional testing
- Refresh - Keep in sync with data changes in production
Cloning Options for Data Refresh

<table>
<thead>
<tr>
<th>Full Clones</th>
<th>Snap (Thin) Clones</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database Native</strong> [Storage Agnostic]</td>
<td><strong>Software Solution</strong> [Vendor Agnostic]</td>
</tr>
<tr>
<td>RMAN Restore</td>
<td>Solaris ZFS File System</td>
</tr>
<tr>
<td>RMAN Duplicate</td>
<td>CloneDB</td>
</tr>
<tr>
<td>Data Pump</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Hardware Solution</strong> [Vendor Specific]</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAS</td>
</tr>
</tbody>
</table>

- Leverage your existing investments
- Cater to both functional and stress testing needs
- Maximize for best performance
Deployment Scenarios

**Continuous or Discrete Replication**

**Standby / Test Master Database**

**Snap Clones using Standby**

- Private backups (snapshots) for SSA user

**Replication Types:**

<table>
<thead>
<tr>
<th></th>
<th>Continuous</th>
<th>Discrete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td>Data Guard, Golden Gate</td>
<td>RMAN, Snap Mirror, import/export ...</td>
</tr>
<tr>
<td><strong>Data Refresh</strong></td>
<td>Automatic and instantaneous</td>
<td>Manual and at scheduled intervals</td>
</tr>
<tr>
<td><strong>Masking and Subsetting</strong></td>
<td>Not possible</td>
<td>At source (in production), or in place at test master</td>
</tr>
</tbody>
</table>
Complete APIs for Automation or Integration

- List Zones
  - List Service Templates
  - List Service Instances
- Delete Service
  - Extend reservation
- Request DBs
- Request PDBs
- Request Schemas
- Track request progress
- Service Control (start/stop)
- Backup
- Restore
- Snapshot
- Get Chargeback info

**DBaaS Providers:**
- CRUD on Zones / Pools / Service templates / Profiles / Quota / etc
Complete REST API for Automation or Custom Portals

**POST**
https://example.oracle.com/em/cloud/dbaas/zone/82CF1C28FA20A183C99D138FP8065F19
Authorization: basic ZGVtb3VzZXI6ZGVtb3VzZXI=
Content-Type: application/oracle.com.cloud.common.DbPlatformInstance+json
Accept: application/oracle.com.cloud.common.DbPlatformInstance+json

**Body:**

```
{
    "based_on": "/em/cloud/dbaas/dbplatformtemplate/CC3BBB665A6BC6FFE040F00AEF252456",
    "name": "<Request name>",
    "description": "<Request Description>",
    "params":
    {
    "username": "Master Account username for the DB",
    "password": "Password for the Master Account on the DB"
    }
}
```

OR

Out of box Self Service Portal
Metering and Showback
Tailored for different use cases and user types

- Showback based on fixed, utilization or configuration
  - Database performance metrics, configuration items, feature-usage
  - Can be extended to leverage other metrics, e.g: business transactions
- Rollups based on LDAP
- Tailored reporting for different user personas

Chargeback Administrator  Self-Service Portal User  Line of Business User
Summary

• Jumpstart your journey to Private DBaaS
• Choice of architecture: VMs, physical, schema, multitenant databases
• Support for various service levels (single instance, HA, DR)
• Consolidation for compute, storage, and database using RAT
• Data cloning for performance testing (full clones), and functional testing (Snap Clone)
• Native storage based cloning support; no impact on performance (also supports ZFS filesystem based cloning)