Delivering Database as a Service with Enterprise Manager 12c
Agenda

- Cloud Overview
- Current challenges
- Delivering DBaaS
  - Lifecycle-driven approach
- References and Case Studies
Service Types: IaaS, PaaS, SaaS

Different Users

IT Professional
- Customizations
- Application
- Platform

Developer
- Customizations
- Application

Business End User
- Customizations

Key Driver
- Consolidation
- Cost Savings
- App Development
- Focus
- New Capability
- Speed

Service Provider

Consumer

IaaS Cloud

PaaS Cloud

SaaS Cloud
Deployment Models: Private, Public, Hybrid

- Private Cloud
  - CapEx & OpEx
  - Control & visibility
  - Not shared

- Hybrid Cloud
  - Cloudbursting – overdraft for peak loads
  - Dev/Test & production
  - B2B integration

- Public Cloud
  - OpEx
  - Outsourced services
  - Shared by multiple orgs
What Are Customers Doing?
Cloud Adoption Is Rising


Percent of Customers

2010 2012

0% 10% 20% 30% 40%

14% 26% 29% 37%

Private Cloud
Public Cloud
PaaS Outpacing IaaS

Platform as a Service (PaaS)

- Application Server as a Service
- Database as a Service
- Identity as a Service
- Storage as a Service
- Compute as a Service
- Dev/Test as a Service

Infrastructure as a Service (IaaS)

Roadmap to Cloud

Traditional Silos
• Physical
• Dedicated
• Static
• Heterogeneous

Consolidated
• Virtual
• Shared platform & shared infrastructure
• Dynamic
• Standardized platform & infrastructure

Private Cloud
• Self-service
• Auto-scaling
• Metering & chargeback
• Capacity planning

Public Cloud
• Specialized
• Shared
• Standardized

Hybrid Cloud
• Federation across public & private clouds
• Interoperability
• Cloudbursting

Start with consolidation • Extend to private cloud • Use public cloud where appropriate
Current Challenges
Current State of Database Deployments
Siloed, Dispersed, Varied and Complex

- Ever growing database population
  - Multiple versions and patch levels
  - Compliance challenges
  - Poor resource utilization
  - High cost of deployment and operation

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

*IOUG Survey, 2013
### Current Database Provisioning Process

**Time-consuming and Inefficient**

<table>
<thead>
<tr>
<th>Role</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer</td>
<td>Request DB</td>
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<tr>
<td>Manager</td>
<td>Approval</td>
</tr>
<tr>
<td>DBA</td>
<td>Request HW and Storage</td>
</tr>
<tr>
<td>System Admin</td>
<td>Setup OS &amp; Network</td>
</tr>
<tr>
<td>Storage Admin</td>
<td>Allocate Storage</td>
</tr>
<tr>
<td></td>
<td>Configure Cluster and create DB</td>
</tr>
</tbody>
</table>

... Days to Weeks ...

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DBaaS Goal - the Best of On-Premise & Cloud
Give Everyone What They Want Most

Users Want
- Easy self-service DBaaS
- Metered use
- Performance optimized for service levels

IT Wants
- Simplified deployment on standardized platforms
- Less maintenance and better support
- More budget and time for innovation
DBaaS: Key Features

- Database-as-a-Service provides
  - A shared, consolidated platform to provision database services on
  - Service Catalog
  - Self-Service provisioning
  - Scale-up/out, scale-down/back and retirement services
  - Chargeback based on database usage

- Database-as-a-Service needs to cater to various use cases
  - A Developer or a Project Owner requiring a new database service with(out) seed data
  - QA requiring a full database refresh for intense load testing
  - QA requiring to create multiple clones for functional testing on subset of data
Deliver DBaaS

With Oracle Enterprise Manager 12c
Deliver DBaaS via a Lifecycle Approach

1. Plan & Setup the DB Cloud
   - Design Service Catalog
   - Capacity & consolidation planning
   - Asset discovery
   - Setup Resource Pools
   - Setup Policies

2. Enable Self-Service
   - Implement Service Catalog
   - Enable Service Governance
   - Enable integration via APIs

3. Manage & Monitor
   - Database monitoring
   - Configuration management
   - Full stack management

4. Meter, Charge, Optimize
   - Meter resource utilization
   - Chargeback/Showback
Deliver DBaaS

1. Plan & Setup the DB Cloud
Database Service Catalog Design Process

1. **Service Definition**: Define service tiers to simplify your offerings
   - Bronze
   - Silver
   - Gold

2. **Technical Service**: Establish the technical footprint of each service tier
   - RAC
   - Data Guard
   - Backups
   - Small | Large
   - Medium | X-Large

3. **Service Model**: Determine the individual services to be provisioned
   - PDB
   - Database
   - Schema
   - 11.2.0.4
   - 12.1.0.1
   - 10.2.0.5
   - 11.2.0.4

4. **Resource Model**: Align services with homogeneous resource model
Sample Scenario

- 4 Service Levels
- 3 Sizes
- 2 Datacenters

<table>
<thead>
<tr>
<th>Service Level</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Bronze</td>
<td>Single Instance (SI) Databases</td>
</tr>
<tr>
<td>Silver</td>
<td>Single Instance with SI Standby</td>
</tr>
<tr>
<td>Gold</td>
<td>RAC Database with RAC Standby</td>
</tr>
<tr>
<td>Platinum</td>
<td>RAC Database with Multiple Standby</td>
</tr>
</tbody>
</table>

Salt Lake City DC

Austin DC
Consolidation: DBaaS Architectures

EM 12c Supports Database Versions 10gR2 to 12c

Virtual Machines
- share servers

Dedicated DBs
- share servers and OS

Dedicated Schema(s)
- share servers, OS and database

Pluggable DBs
- share servers, OS and database

Increasing Consolidation
## Comparison of DBaaS Consolidation Models

<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</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Density</td>
<td>Low-Moderate</td>
<td>High</td>
<td>Highest</td>
<td>Highest</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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></td>
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<td></td>
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<tr>
<td></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>
Modeling DBaaS Resources

- **Database Resource Pool**
  A group of homogeneous clustered or non-clustered resources exhibiting common characteristics. Example:
  - Pool of 11.2 Database Oracle Homes (for dedicated databases)
  - Pool of 12c Container Databases (for PDBs)

- **Zone**
  A logical grouping of cloud infrastructure resources based on QOS, functional, departmental or geographic boundaries. Example, Finance Zone, East Coast Zone
  - Self-Service users provision into a Zone
  - Zones can also be used to enforce access control and chargeback
Deliver DBaaS

2. Enable Self-Service
Identifying Use Cases for Provisioning

1. User needs a new database service with or without seed data
   - User deploys a dedicated database inside a VM or on physical
     Pros: Resource isolation, ideal for enterprise applications like ERP
     Cons: VM and database sprawl, administrative overheads, compliance challenges
   - User deploys a database schema or a pluggable database
     Pros: High consolidation, minimal administrative and maintenance overhead
     Cons: Limited isolation for schemas

2. User needs a clone of an existing database for testing
   - User makes a full clone of database
     Pros: Ideal for load-testing with significant data updates
     Cons: Time and space consuming
   - User makes a thin-clone (using ‘Copy On Write’) of database
     Pros: Minimal additional space, instantaneous cloning, ideal for functional testing
     Cons: Reduced benefits in case of significant data updates
Data Guard Provisioning Support

- Data guard based standby databases across cloud zones & pools
- DB versions certified: 10.2.0.5, 11.1.0.7, 11.2+, 12.1
- SI and RAC standby
- Multiple standby environments allowed across same/distant datacenters
- Support for all 3 protection modes
- Optionally, enable Active Data Guard
I need a new schema to track our upcoming campaign

We need the best performance so we can reply in real time

I need a database for the new HR system

I’m willing to pay for near-continuous availability

I need to copy a production database for testing

The cheapest configuration is fine. This is just for testing

### Service Catalog

\[ \text{Service Catalog} = \sum (\text{Pre-approved and pre-configured service templates}) \]

### Service Template

- Full 1.5 TB Database Clone: Full 1.5 TB Database Clone of production database
- Generic Application Schema: Generic schema on database 11.2.0.3
- HR Sample Schema: Creates the HR sample schema with data.
- Small 200 GB database from RMAN backup: Small clone of database using RMAN backup
- StoreFront Application Schema: Schema for the StoreFront Application with seed data on data...

- One catalog for multiple users; role based access
Self-Service Provisioning
Oracle Enterprise Manager 12c

- Comprehensive support for consolidation
  - Dedicated databases, schema, pluggable
- Automated, intelligent placement
  - Workload and configuration
- Complete self-service catalog
  - Governance, quotas, policies, showback
- Flexible cloning architecture
  - Full data cloning by leveraging backups
  - Instant database provisioning using “SnapClone”
- Integrated database lifecycle management
  - Monitoring, backup, patching
- API-driven (RESTful and command line)
Data Cloning
Challenges with Data Cloning

- Storage explosion
- Time Consuming
- Lack of Automation
- DBA Unfriendly Solutions
- Low Rate of Refresh
What is Snap Clone?

Snap Clone is a storage agnostic & self service approach to creating rapid & space efficient clones of large (~TB) databases.

<table>
<thead>
<tr>
<th>Storage Agnostic</th>
<th>Self Service</th>
<th>Rapid</th>
<th>Space Efficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports ALL storage vendors (NAS &amp; SAN)</td>
<td>Empower the user to make adhoc clones</td>
<td>Clone DBs in minutes not days/weeks</td>
<td>Significantly reduce the storage footprint</td>
</tr>
</tbody>
</table>
Customer Scenarios with Snap Clone

Customer Scenario 1 [Telecom Industry]
- Prod DB = 12 TB
- Standby DB = 12 TB
- 7 Clones (7 * 2 GB of writable space) = 84 TB 14 GB
- Total = 108 ~24 TB
- Time = days/weeks minutes

Customer Scenario 2 [Banking Industry]
- 5 Prod DB = 30 TB
- 5 Standby DB = 30 TB
- 5 Masked DB = 30 TB
- 6 Clones (6 * 5 * 2 GB of writable space) = 180 TB 60 GB
- Total = 270 ~90 TB
- Time = days/weeks minutes

Over 99.97% Storage Savings
**Features**
- Rapid and space efficient cloning of large databases; versions 10g to 12c
- Supports **ALL** storage vendors and configurations (SAN and NAS)
- Integrated lifecycle management (lineage and association tracking)
- "Rewind" capability to restore and access past data

**Benefits**
- Agile provisioning (minutes to clone TB sized database)
- Over 90% storage savings (KBs of additional space for cloning TB sized database)
- Reduced administrative overhead from integrated lifecycle management
Snap Clone: How it Works?

Scheduled or Manual Snapshots of the test master database, called Profiles

- Snap Clones can be created from any profile.
- Each user gets a personal read-write database clone

Standby / Test Master

Test master is regularly refreshed with current data from production
DBaaS “Snap Clone” Storage Options

- Storage Management Framework (SMF) plug-in:
  - Abstracts different storage vendors and technologies from DBAs
  - Analyze storage utilization and track lineage of clones

Software Solution [Vendor Agnostic]

Hardware Solution [Vendor Specific]
# Comparison between Storage Options

<table>
<thead>
<tr>
<th>Vendors supported</th>
<th>Software Solution</th>
<th>Hardware Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL Storage Vendors, SAN or NAS</td>
<td>... and others</td>
<td>NFS+NAS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-requisites</th>
<th>Software Solution</th>
<th>Hardware Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Solaris 11 file system (ZFS) on physical or virtual server</td>
<td></td>
<td>• Network access, and credentials &amp; privileges to Storage appliance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage Licenses</th>
<th>Software Solution</th>
<th>Hardware Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does NOT require storage licenses from vendor for snapshot and clone capabilities</td>
<td>• Need to license snapshot and clone capabilities*</td>
<td></td>
</tr>
<tr>
<td>• Additional benefits include compression, deduplication, I/O caching, etc</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High Availability</th>
<th>Software Solution</th>
<th>Hardware Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Managed externally – Solaris clusters, hypervisor clustering</td>
<td></td>
<td>• Managed by the storage appliance</td>
</tr>
</tbody>
</table>

*License for ZFSSA are included with snap clone
CloneDB using DNFS

- Ability to create thin databases from RMAN image copies
- Uses NFS v3 client embedded in database
- Supported configurations
  - Single instance databases
  - Note: Only file system support for this setup (No ASM)
- Supported Versions: 11.2.0.3+, 12.1

Advantages
- Easy to setup
- No special storage software needed
- Works on all platforms
- Time efficient: Instantaneous cloning
- Space efficient: Create multiple clones based on one backup
- Uses dNFS to improve performance, high availability, and scalability of NFS storage
# Deployment Scenarios

**Continuous or Discrete Replication**

## Replication Types:

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

Snap Clones using Standby

Private backups (snapshots) for SSA user
Snap Clone Vs Competition

- Scale, Scale, Scale
  - Supports 1000s of clones
- Protects your existing investments
  - Choice between hardware and software solution
  - Use of trusted technologies like data guard for test master refresh
- Part of Enterprise Manager 12c
  - Oracle’s flagship management product for all your database needs
  - In sync with DB releases (support for PDBs on day 1)
  - Secure and role based access control; used by Fortune 1000 customers
  - Protection from unnecessary point tools; reduce TCO
Snap Clone with Oracle Engineered Systems

**Exadata**
- **Compute nodes** are used to run snap clone databases
- The storage is external to Exadata and served over **NFS**
- In case of ZS3 storage, all traffic over **infiniband**

**SuperCluster**
- Solaris **Zones or LDOMS** used to run snap clone databases
- Embedded ZS3-ES storage served over **infiniband**

**Oracle Virtual Compute Appliance**
- Oracle VMs used to run snap clone databases
- Embedded ZS3-ES storage served over **infiniband**
Snap Clone: Key Usage Scenarios

Snap Clone is most useful when creating clones of large databases (~TBs) for the following purposes:

- **Application upgrade testing**
  - Example: EBusiness Suite upgrade to R12

- **Functional testing**
  - Example: Test with production datasets

- **Agile development**
  - Example: Maintain parallel streams of development on same dataset

- **Data analysis and reporting**
  - Example: Analyze stock market trends on a daily basis

Oracle Development uses Snap Clone across **9000** environments for testing of products like EBS, Fusion, PeopleSoft, MOS, RDBMS, and EM.
Self-Service Portal APIs
Comprehensive RESTFUL APIs for Integration and Orchestration

- 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
Deliver DBaaS

3. Manage & Monitor
Cloud Resource and Request Management

- Manage Cloud Zones and underlying resources
  - Database Pools, servers, storage
- Track resource flux, tenants, policy violations, etc
- Drill down into individual resources for deeper monitoring
- Monitor requests and failure rates and remediate bottlenecks
- Deep software and hardware management for Exadata
  - Hardware schematics, Software Topology, ASRs..
Incident Management
Monitoring by Exceptions

- Setup and apply monitoring templates based on desired SLAs
- Manage exceptions
  - View, manage, diagnose and resolve incidents from one console
  - Assign, acknowledge, prioritize, track status, escalate, suppress
- Accelerated resolution with “My Oracle Support” integration
- Integrated with external Helpdesk Systems
  - Out of box connectors for Remedy, HP Service Center
Compliance and Patch Management
At-scale management of thousands of targets

- Compliance Management Dashboard
  - Maintains and displays up to date compliance score
  - Automated reporting of compliance against Oracle Best Practices and internal standards covering Exadata, RAC, Single Instance, Pluggable databases and underlying infrastructure
  - Automated drift control against golden standards
  - Can be mapped to CIS, PCI or other frameworks

- Comprehensive Patch Management
  - Advisories, pre-flight analysis, execution, reporting
  - Minimize downtime by applying many patches to many database targets at a time
Deliver DBaaS

4. Meter, Charge, Optimize
DBaaS Metering and Chargeback

- **Flexible** metering and chargeback based on:
  - Configuration and monitoring information
  - Host, Database, DB Service, and PDB level
- **Automated** rollup using LDAP hierarchy
- **Tailored** reporting for different user personas
- Extend coverage via **custom** charge items
- **APIs** for integration with billing systems
## DBaaS Chargeback Metrics (Out-of-the-Box)

<table>
<thead>
<tr>
<th>Fixed</th>
<th>Database Instance</th>
<th>DB Service (*)</th>
<th>Pluggable Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Charge</td>
<td>Base Charge</td>
<td>Base Charge</td>
<td>Base Charge</td>
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</tbody>
</table>

### Configuration

<table>
<thead>
<tr>
<th>Allocated Memory</th>
<th>Memory Usage</th>
<th>Option</th>
<th>RAC Node Count</th>
<th>Release</th>
<th>Storage Usage</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Storage</td>
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<tr>
<td>HA</td>
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<tr>
<td>IP Address</td>
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<td></td>
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<tr>
<td>Size</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>vCPU Count</td>
<td></td>
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</tbody>
</table>

### Usage

<table>
<thead>
<tr>
<th>CPU Time</th>
<th>CPU Utilization (%)</th>
<th>DB Time</th>
<th>Disk Read (Physical) Operations</th>
<th>Disk Write (Physical) Operations</th>
<th>Network IO</th>
<th>SQL Executes</th>
<th>User Transactions</th>
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Case Studies
Management of Oracle (Public) Cloud

Secure, Scalable, Versatile

- Single Instance of Oracle Enterprise Manager
  - Tailored for all-user personas
  - Self-service provisioning for tenants
  - Diagnostics for support and IT analysts
  - Service level reports for executives

- Unprecedented scalability*
  - 9216 hosts, 632437 targets
  - 6222 database instances on 2802 clusters and 67 Exadata
  - 89724 J2EE apps on 38833 WebLogic servers
  - 32894 jobs per week
  - 125,983,703 page views per day

* As of September, 2013, for USA Data Center only (1 of 9 global data centers)
**Database as a Service**

India’s second largest Private Bank with nearly 2800 branches, 11,000 ATMs
20 million customers
Employees: 56,000
Revenue: USD 5 Billion

**FOCUS ON**

Consolidation, Self-Service Provisioning, Lifecycle Management

**Challenge:**

- Database sprawl over 168 racks of real estate
- Hitting performance ceiling on existing infrastructure
- Rollout of new database services often wait on infrastructure; taking and average time of 3 days

**Solution:**

- Run new database applications on Exadata while legacy applications run on IBM AIX
- EM 12c based Self-Service Provisioning of databases
- EM 12c Lifecycle Management features for Discovery, Compliance, Patching, etc

**BENEFITS**

- Reduced new database rollout time from **3 days to 3.5 hours**
- Standardized database offering for Developers and QA reducing any significant configuration drift and compliance challenges
### Database as a Service
**Norwegian Labor and Welfare Administration**
Pension services, Sickness/Unemployment benefits & Occupational rehabilitation for entire Norway population
450 local offices all across Norway - 14,000 Employees
Administers one third of the national budget

---

### Challenges:
- Lack of consolidation due to heterogenous platforms
- High complexity and disproportionate costs of legacy systems
- Database provisioning average time: 6 – 7 days
- Database Sprawl – Non-standard configurations and licensing needs
- Lack of accountability at department level for resource demand and usage

### Solution:
- Consolidate databases on Oracle Exadata and Sun Server X2-8 (8) w/HP 3PAR storage on Oracle Linux
- EM 12c with High Availability Level III
- Self-Service Provisioning of databases with a well-defined service catalog of pre-defined configuration [Small to Large]
- Migrate existing databases into the cloud platform

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### BENEFITS
- Time to provision databases reduced from **6.8 days to 18 minutes**
- Funding for additional resources is now targeted at the actual divisions/groups consuming them

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**Case Study**
**Database as a Service**
Norwegian Labor and Welfare Administration
Pension services, Sickness/Unemployment benefits & Occupational rehabilitation for entire Norway population
450 local offices all across Norway - 14,000 Employees
Administers one third of the national budget

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**FOCUS ON**
Consolidation, Standardization, Self-Service and Chargeback
Case Study

**RAC PROVISIONING, PATCH MANAGEMENT**

- $11.5 Billion in Net License Revenue
- 66,000 Employees
- 2,004 Managed Targets

**Challenge:**
- Mandatory corporate and industry regulations meant strict auditing requirements
- Patching was manual and resource intensive
- Needed to patch 1,200 production and non-production databases every quarter

**After Oracle Enterprise Manager:**
- Leverage the comprehensive integration between My Oracle Support and Enterprise Manager for end-to-end patch automation and provisioning
- Increased admin productivity by removing manual error-prone tasks
- Adherence to security and compliance requirements

**BENEFITS**
- Cut total DBA efforts from **3,600 hours** down to **540 hours** per year
- Using EM, Cisco lowered their downtime for maintenance by **50%**
- Reduced human error and incidents during patching and upgrades
- Systems are now highly scalable and automated
- Saved over **$200K** per year in IT operational costs with patching automation

**FOCUS ON**

- Provisioning, Patch Management, Security and Compliance
Summary
Oracle Database as a Service
Everybody wins…

Users Get
- Easy self-service DBaaS
- Metered use
- Performance optimized for service levels

IT Gets
- Simplified deployment on standardized platforms
- Less maintenance and better support
- More budget and time for innovation
References

- Enterprise Manager Page on O.com
- Cloud Management Page on OTN
- Cloud Administration Guide (Documentation)
- MOS Note: EM12c Recommended Plug-Ins and Patches for DBaaS (1549855.1)
Hardware and Software
Engineered to Work Together