Technology Summit 2014

Aligning Infrastructure to Meet New Needs – A Roadmap to Successful Private Cloud Services

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Public Sector Enterprise Strategy Team
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A Roadmap to Successful Private Cloud Services

Agenda

• Private Cloud Strategies
• Database-as-a-Service Architecture
• DBaaS Strategy Execution
• State of Georgia Examples
Private Cloud Strategies
It All Starts With The Business

I need to modernize our citizen services and provide better citizen access to the services

I need to roll out additional citizen services, but my budget continues to shrink

I want to consolidate and standardize my IT resources

I need a more efficient, cost-effective, and secure way to collaborate and share with other agencies

My employee productivity is bogged down by slow and outdated procedures and processes
Patterns: Business and IT Pain Points

Redundancy

• Business projects with similar IT requirements
• “Color of Money” budgeting constraints
• Applications and databases with similar workloads and data
• Redundant product capabilities across IT vendors
• Multiple replicated or diversified IT organizations

Inefficiency

• Tactical consolidation “strategy” focused on server reduction
• Manual and undocumented IT processes
• Technology refreshes performed in silos
• Dev & Test environments manual, insecure, and unreliable
• Production systems running in oversized, yet underutilized servers
Roadmap to IT Transformation

Operational Efficiency, Manageability, Performance, and Improved Agility
Evolution to Private Cloud

Traditional Silos
- Physical silos
- Dedicated, heterogeneous deployments
- Architectural complexity and inefficiency

Standardized Technology
- Standardized hardware and software stack
- Standard deployment configurations
- Architecture simplification, improved manageability

Consolidated Platform
- Shared and secure central data infrastructure
- Dynamic optimizations and resource mgmt
- Automated systems management

Service Delivery Platform
- Catalog of database services and service levels
- On-demand, resilient, and tiered self-service
- Metering, cost allocation and chargeback

Enterprise Cloud Platform
- Fully dynamic and unified resource pools
- Rapid service elasticity and automation
- Secure hybrid cloud integration (vendors, partners, etc.)

Siloed
- Standardized
- Consolidated
- Private DBaaS
- Federated DBaaS

Lower Risk  Lower OpEx  Lower CapEx  Higher Agility  Fully Optimized

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Private Cloud Services

- **Server Consolidation**
- **Application, Database Consolidation**
- **Dev/Test Shared Service**
- **Database-as-a-Service** (includes Security, HA, DR)
- **Middleware-as-a-Service** (includes Integration, Process Flow)
- **BI-as-a-Service** (includes Dashboards, Adhoc Query)
Service Types: iaaS, PaaS, SaaS

Target Users
- IT Professional
- Developer/DBA
- Business End User

Solution Targets
- Consolidation
- App Development
- New Capability
- Cost Savings
- Focus/Agility
- Speed/T2M

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Consolidation at PaaS and IaaS Layers

Consolidate onto **standard**, shared and elastically scalable PaaS

- Standardized PaaS for all applications reduces heterogeneity, cost and complexity
- Accelerated new application development
- Cost savings from less hardware, power and data center space

**vs.**

Consolidate onto shared IaaS **without standardization**

- Software stack heterogeneity, cost and complexity persists
- No administration (O&M) cost savings
- Cost savings from less hardware, power and data center space
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)

PaaS Solution: Database-as-a-Service (DBaaS)

**On Demand Database Services**
- Faster Time to Value
- Business Agility

**Improved Performance**
- Increased productivity
- Continuity of operations
- Advanced monitoring

**Standard Technologies & Best Practices**
- Complete tool set, Standard processes, Simplification
- Higher Reliability, Simplification, better Support

**Resource Pooling**
- Increased Utilization,
- Efficiency
- Lower Costs

**Predefined DB Configuration**
- Quality of Service
- Productivity
- Lower Risks

**Defined Capacity, Metering of Usage**
- Transparency
- Predictability

**Elasticity**
- Agility
- Rapid Respond to Change
- Scalability

**Data Security**
- Protection for data at rest
- Data access isolation and control

**Cost Savings**
- Faster time to value
- Optimized system
- Reduced licensing costs
- Reduced storage costs
- Single vendor accountability

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DBaaS Cloud Architecture

Chargeback and Billing APIs

Chargeback & Capacity Planning

Policy Manager (SLA Mgmt)

Self Service Provisioning

Self Service APIs

Software Library

Assembly Builder

Config. Mgmt.

Monitoring

Provisioning

Zone A

PaaS Resource Pool

DBaaS Resource Pool

Storage Array

Zone B

IaaS Resource Pool

Storage Array

Cloud Infrastructure Layer

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DBaaS Services Lifecycle

Cloud Consumer

Service Request

Provisioning

Chargeback

Cloud Service Provider

Cloud Data Center

- Security and Compliance
- Performance, Availability, & Elasticity
- Incident Response & Event Management
- Provisioning & Virtualization
- System Management
- Metering & Chargeback
- Service Portfolio Management

IT Service Management

- IT Front Office
- IT Back Office

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Database-as-a-Service (DBaaS) Architecture
Architectural Strategies For DBaaS

Deployment Models
- Consolidation
- Isolation
- Capabilities

Operational Model
- Service Catalog
- System Architecture
- Management

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## DBaaS Use Cases

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Typical Deployment</th>
<th>Use Cases</th>
</tr>
</thead>
</table>
| Shared Server         | First Step Consolidation | • Server Consolidation  
• Development and Test environments  
• High isolation or security requirements  
• Multiple operating systems required |
| Shared OS & DB Binaries | Most Common Config       | • Single operating system to manage  
• Development, Test, and Production environments  
• Low security requirements |
| Shared Database       | Large Single Customer    | • Enterprise database platform for business applications (ERP, HR, etc)  
• Shared services for a standardized database platform  
• Simplified provisioning, orchestration, and management |
| Shared Table          | Potential for DW/DM      | • Data consolidation  
• Single source of truth without having to replicate data or databases  
• Data sharing with “need to know” row-level access |
Shared Server - Binaries & Instances Isolated

BENEFITS
• Increases server utilization
• Reduces Cap Ex and environmental costs
• Most flexible O/S and DB configurations

FEATURES
• Single physical server
• Independent O/Ses
• Heterogeneous O/Ses
• Independent databases
Shared OS & DB Binaries - Instances Isolated

**BENEFITS**
- Simplest deployment model
- Simplest system administration effort
- Standardizes operating system

**FEATURES**
- Single operating system
- Common binaries/executables
- Independent databases
- Most flexible DB configurations
Shared Database - Schemas Isolated

**BENEFITS**
- Standardizes database platform
- Simplifies DB management requirements
- Offers the fastest provisioning process
- Common failover and scalability architecture

**FEATURES**
- Single database instance
- Shared SGA
- Independent schemas
- Schema-level security
Shared Table - Rows Isolated

**BENEFITS**
- Eliminates some business requirements to clone databases
- Enables “single source or single version of truth”
- Centralized data security and privacy policy
- Simplifies data consolidation for DW/DM

**FEATURES**
- Single table
- Shared objects
- Row-level isolation

---

<table>
<thead>
<tr>
<th>Dept 1</th>
<th>Dept 4</th>
<th>Dept 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Table 1</td>
<td>Table 1</td>
</tr>
</tbody>
</table>

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## Typical Customer Transformation Approach

<table>
<thead>
<tr>
<th>Database Importance</th>
<th>Infrastructure Deployments</th>
<th>Cloud Deployments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission Critical</td>
<td>May move, but typically does not for performance or security reasons</td>
<td></td>
</tr>
<tr>
<td>Highly Secure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requires Isolation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical</td>
<td>Move designated target with KPIs assigned</td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>Specific services move as requirements change</td>
<td></td>
</tr>
<tr>
<td>Departmental</td>
<td>Move designated target with minimal to no KPIs assigned</td>
<td></td>
</tr>
<tr>
<td>Prototyping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dev/Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Server &amp; DB Separation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binary DB Separation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instance Separation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schema Separation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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DBaaS Strategy Execution
DBaaS Strategy Execution

- Communication Program
- Service Catalog
- Roles and Responsibilities
- Tenant Qualification Process
- Chargeback Model
- Migration Strategy
Communication Program
Communication Plan: Typical Stakeholder Roles

<table>
<thead>
<tr>
<th>Stakeholder Perspective</th>
<th>Technology</th>
<th>Enterprise/Internal</th>
<th>Business/External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic &gt;12 Months</td>
<td>Senior IT staff, External strategic technology partners</td>
<td>Business-unit senior managers, Senior IT staff</td>
<td>Organization leaders, Board of directors, Strategic business partners</td>
</tr>
<tr>
<td>Business Cycle 3 to 12 Months</td>
<td>IT managers and project teams, External account executives, New recruits</td>
<td>Business-unit line managers, IT relationship managers</td>
<td>Business marketing units, Business-unit heads</td>
</tr>
<tr>
<td>Operational &lt;3 Months</td>
<td>Internal and external IT staff</td>
<td>Business-unit staff, IT service delivery &amp; project managers</td>
<td>Customer-facing business staff, Business sales units</td>
</tr>
</tbody>
</table>
Service Catalog
## Business Service Catalog

### Exadata DBaaS Catalog

<table>
<thead>
<tr>
<th>Offering Catalog</th>
<th>Cores</th>
<th>Memory</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>2</td>
<td>20 GB</td>
<td>3.125 TB</td>
</tr>
<tr>
<td>Medium</td>
<td>4</td>
<td>42 GB</td>
<td>6.25 TB</td>
</tr>
<tr>
<td>Large</td>
<td>8</td>
<td>84 GB</td>
<td>12.5 TB</td>
</tr>
</tbody>
</table>

*Sizings can be combined to create custom configurations*

### Service Complexity

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Operational Support</th>
<th>System Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>12 x 5</td>
<td>98.5%</td>
</tr>
<tr>
<td>Medium</td>
<td>&gt; 12x5 &amp; &lt; 24x7</td>
<td>&gt; 98.5 &amp; &lt; 99.9%</td>
</tr>
<tr>
<td>High</td>
<td>24 x 7</td>
<td>99.9%</td>
</tr>
</tbody>
</table>

### Service Level

<table>
<thead>
<tr>
<th>Service Level</th>
<th>DB H/A</th>
<th>Business Continuity</th>
<th>Storage</th>
<th>Backup</th>
<th>Outage RTO</th>
<th>DR</th>
<th>DR RTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronze</td>
<td>Single Node</td>
<td>N/A</td>
<td>Dual Mirror</td>
<td>Tape</td>
<td>Avg &lt; 24 Hrs</td>
<td>Tape</td>
<td>2 Weeks</td>
</tr>
<tr>
<td>Silver</td>
<td>Dual-node RAC</td>
<td>N/A</td>
<td>Multi-cell Mirror</td>
<td>Disk</td>
<td>Avg &lt; 8 Hrs</td>
<td>Tape</td>
<td>5 Business Days</td>
</tr>
<tr>
<td>Gold</td>
<td>Dual-node RAC</td>
<td>50% Capacity (Second Machine)</td>
<td>Multi-cell Mirror on Both Machines</td>
<td>Replicated Storage</td>
<td>Avg &lt; 4 Hrs</td>
<td>Disk</td>
<td>32 Hr Max</td>
</tr>
</tbody>
</table>
Technical Service Catalog Example
Dual Data Center Balanced Model

DBaaS Instance Deployments

- **DB Sizing**
  - Small: 2 Cores
  - Medium: 4 Cores
  - Large: 8 Cores

- **Service Tiers**
  - Bronze
  - Silver
  - Gold
  - Shared Instance
  - Remote Copy

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Roles and Responsibilities
### DB ROLE MODEL

<table>
<thead>
<tr>
<th>Role</th>
<th>DDL on System Objects</th>
<th>DDL on Application Objects</th>
<th>Select, Insert, Update, and Delete on Application Objects</th>
<th>Select on Application Objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational DBA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Account DBA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Account DBA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Application DBA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Application Data Steward</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer Application User</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role</th>
<th>Grant SYSOPER – Startup, Shutdown, Backup, Recover, Create Alter Database Alter System Create SPFILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account DBA</td>
<td>Role Granted – Create / Alter / Drop Users</td>
</tr>
<tr>
<td>Customer Account DBA</td>
<td>Role Granted – Create / Alter / Drop Users</td>
</tr>
<tr>
<td>Customer Application DBA</td>
<td>Role Granted – Select Any, Insert Any, Update Any, Delete Any, Create Any, Alter Any, Drop Any, Execute Any, Audit Any, Restricted Session Applied to Objects – Cluster, Context, Dimension, Index, Index Type, Materialized View, Operator, Outline, Procedure, Sequence, Synonym, Table, Trigger, Type, View</td>
</tr>
<tr>
<td>Customer Application Data Steward</td>
<td>Role Granted – Select, Insert, Update, Delete, Execute (DML Only)</td>
</tr>
<tr>
<td>Customer Application User</td>
<td>Role Granted – Select</td>
</tr>
</tbody>
</table>

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Tenant Qualification Process
Exadata Tenant Preliminary Questionnaire

To be completed internally with input as required from the target agency
This checklist is used to help identify the agencies that are good candidates for migration to the Exadata platform. The higher the agency's score, the better suited the agency is for the Exadata platform. After validation as a good Exadata tenant, a more detailed information gathering exercise will be used to prepare for the migration effort.

Agency/Application Name: __________________________

<table>
<thead>
<tr>
<th>Characteristics of a Good Exadata Tenant</th>
<th>Potential Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency currently owns Oracle Enterprise Edition database licenses</td>
<td>20</td>
</tr>
<tr>
<td>Agency currently owns Oracle DB options licenses (RAC, CCM Packs, etc.)</td>
<td>10</td>
</tr>
<tr>
<td>Agency running Oracle Database 11.2</td>
<td>20</td>
</tr>
<tr>
<td>Running Oracle Database 11.1 and willing to upgrade to 11.2</td>
<td>10</td>
</tr>
<tr>
<td>Running Oracle Database 10.2 and willing to upgrade to 11.2</td>
<td>30</td>
</tr>
<tr>
<td>ISV application certified with Oracle Database 11.2</td>
<td>10</td>
</tr>
<tr>
<td>Agency is running on Unix</td>
<td>10</td>
</tr>
<tr>
<td>Agency is using ASM</td>
<td>10</td>
</tr>
<tr>
<td>Agency is using Oracle RAC</td>
<td>10</td>
</tr>
<tr>
<td>Agency is using other Oracle DB tools (CEM, DataGuard, RMAN, etc.)</td>
<td>10</td>
</tr>
<tr>
<td>Agency needs a hardware refresh or upgrade</td>
<td>10</td>
</tr>
<tr>
<td>Agency is using a virtualization technology</td>
<td>10</td>
</tr>
<tr>
<td>Agency has an existing functional application that they are not planning to make major changes to at the same time as deploying on Exadata platform</td>
<td>10</td>
</tr>
<tr>
<td>Agency is looking at building a new application and has time scheduled for deploying on Exadata platform</td>
<td>10</td>
</tr>
<tr>
<td>Agency is not currently using storage snapshots for testing and backups</td>
<td>10</td>
</tr>
<tr>
<td>Agency is interested in reducing 3rd party solution components (Storage software, custom software, array based replication, etc.)</td>
<td>10</td>
</tr>
<tr>
<td>Agency has a requirement to encrypt and/or remotely replicate database data</td>
<td>10</td>
</tr>
</tbody>
</table>

Total out of 200

Update: Oct 23, 2013
# DBaaS Technical Questionnaire

Fill in information for each server

For each server, fill in database information

For each database, fill in application information

For each application, fill in business considerations

<table>
<thead>
<tr>
<th>Server</th>
<th>Database 1</th>
<th>Database 2</th>
<th>Database 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Now, for each:

For example:

<table>
<thead>
<tr>
<th>Database</th>
<th>Example</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: You can expand if a US Application Hosting Questionnaire has been submitted.

<table>
<thead>
<tr>
<th>Application</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Chargeback Model
DBaaS Chargeback Model

Process Flow

Cost Consideration

DBaaS Costs
- Infrastructure
- HW and SW
- Maintenance
- DBA + Administration
- Facilities
- Power

+ Labor Cost
- Setup
- Architecture
- Tuning
- Migration

+ COOP Cost
- Backup and Restore
- Disaster Recovery

+ DB License Cost
- DB SW License
- DB SW Support

Service Catalog

The consumption of resources (cores, memory, storage) for each service

Calculation

Allocate cost over 5 years to Provisioning Scenario/Model based on Service Catalog

Rate for each Service

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Chargeback Model
DBaaS Chargeback Calculator

The calculator inputs are:

- **Infrastructure Configuration**
- **Costs (TCO) - Example**:  
  - HW License Cost
  - SW License Cost
  - Maintenance Cost
  - Labor Cost
  - COOP Cost
  - Environmentals
- **Technical Service Catalog**:  
  - The consumption of resources (cores, memory, storage) for each service
Chargeback Model
Calculator Outputs

- **Provisioning Model**
  - Allows the customer to build scenarios by which the services from the Service Catalog can be combined to fully provision the Exadata infrastructure (over-provisioning is supported)

- **Infrastructure Sharing Ratio**
  - Calculates how the resources (hence the costs) are divided between each service or per core/TB based on the Provisioning Model

- **Service Cost Estimation**
  - The recurring (annual or monthly) cost for each service based on the provisioning model

- **Deployment Model**
  - Rate of deployment monthly over 5 year cost model

- **Service Catalog Pricing Model**
  - Service and per core/TB pricing models
Migration Strategy
DBaaS Strategy Execution

✓ Communication Program
✓ Service Catalog
✓ Roles and Responsibilities
✓ Tenant Qualification Process
✓ Chargeback Model
✓ Migration Strategy
Example: State of GA - Dept of Revenue Oracle DBaaS
Oracle DBaaS Architecture
Solution Overview - 2 Exadata X4 Half Racks, ZFS and STK Machines

2 Exadata Half Racks
Each Half Rack SW Licensed:
• 72 Cores
• 768 GB RAM
• 12.8 TB Flash
• 192 TB Disk Actual
• 84 TB Disk Mirrored

Backup over InfiniBand

ZFS Storage Appliance
180 TB Storage

Archive to Tape

Oracle Secure Backup

STK Tape Library

4 LTO6 Tape Drives

Oracle ACS Managed Services

Service Desk

DOR

Other

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Example: State of GA - Dept of Transportation DW
Oracle Exadata Environment

- Three X3-2 Exadata racks, 1 Quarter, 2 Eighth
- Active Data Guard for Business Continuity
- Integrated with SharePlex and NetBackup
- Grow into Oracle DBaaS Solution
Thank You
Hardware and Software

Engineered to Work Together