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Deploying a Private Database Cloud using Enterprise Manager 12c Cloud Control Cookbook

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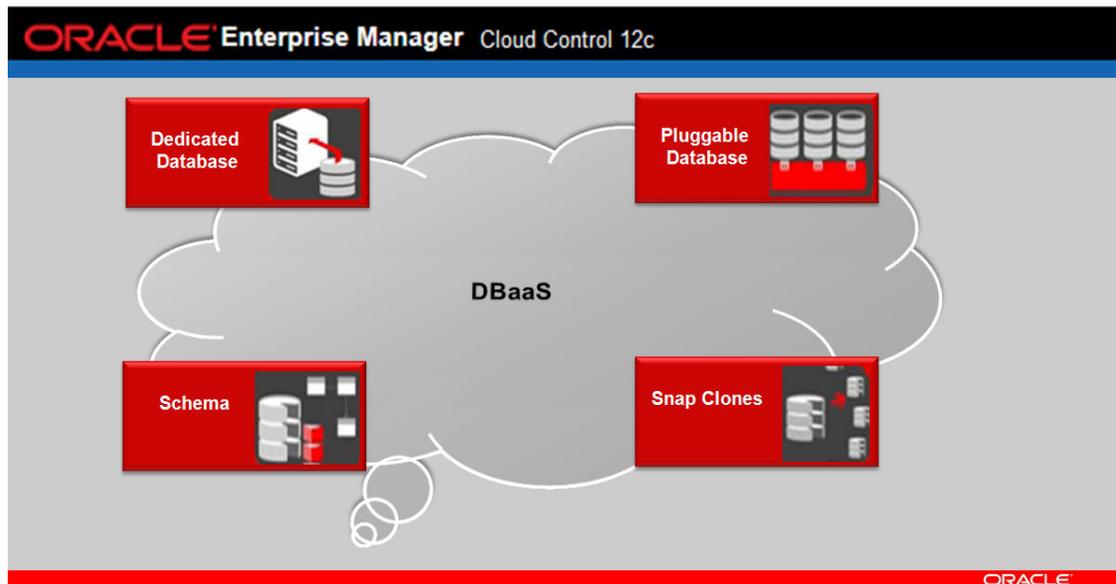
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Product Overview

The ability to deliver database services to a company in a fast, secure, and cost effective manner is an extremely critical part of being successful in today's highly demanding IT environments. Traditionally, the Oracle database administrator provides the database services businesses need to move forward, but resource constraints caused by manual approaches can hinder the ability to provide critical services in a timely manner, increasing business costs and slowing progress. Using Oracle Enterprise Manager 12c, the database cloud administrator can remove the resource and infrastructure barriers and deliver database services dynamically to match supply with demand. This paper provides guidance on how to architect, configure and manage a private database cloud using Oracle Enterprise Manager 12c. Additional guidance regarding high availability and consolidation best practices and the foundation of Database as a Service (DBaaS) can be found at the Maximum Availability Architecture (MAA) white paper below:

[High Availability Best Practices for Database Consolidation: The Foundation for Database as a Service \[Oracle MAA\]](#)

Private Database Cloud Enterprise Manager 12c Capabilities Overview



The Oracle Enterprise Manager 12c Database as a Service solution offers the most comprehensive capabilities to date, providing provisioning, dedicated databases, pluggable databases, schemas and clones all using a self-service model. The cloud capabilities are rapidly growing to satisfy additional business requirements.

Below is a description of the current capabilities of each of the above categories.

Dedicated Database

In the area of dedicated databases, EM currently supports the following capabilities:

- Provisioning of a Single Instance Database
- Provisioning of a Real Application Cluster (RAC) Database
- Provisioning of a RAC One Node Database
- Provisioning of a RAC One Node Database DataGuard configuration
- Provisioning of a Real Application Cluster Database DataGuard configuration
- Provisioning of a Single Instance Database DataGuard configuration

Database 12c Multitenant

In the area of pluggable databases, EM currently supports the following capabilities:

- Provisioning of an empty pluggable database
- Provisioning of a pluggable database from a database gold image

Schemas

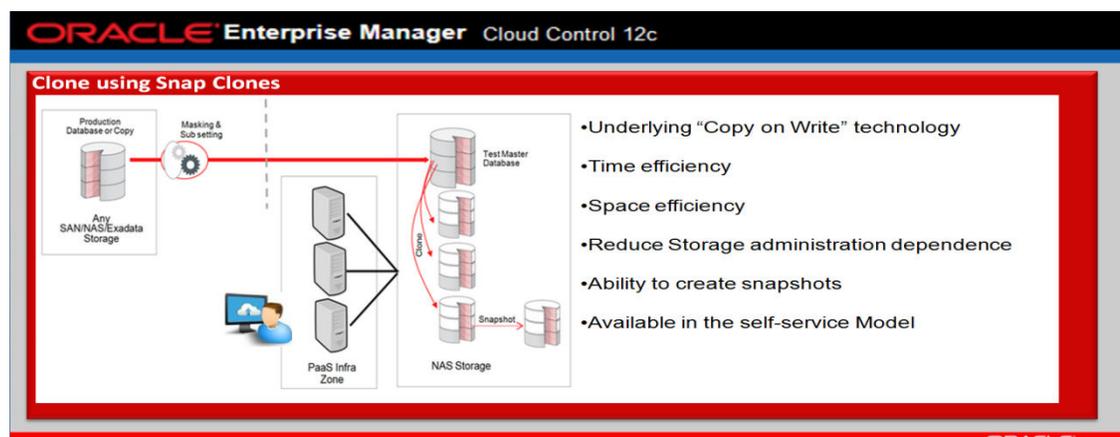
In the area of Schema provisioning, EM currently supports the following capabilities:

- Provisioning of a user defined schema
- Provisioning of imported schema from a database profile

Clone Including Snap Clones

In the area of Snap Clones, EM currently supports the following capabilities:

- Provisioning of a snap clone database
- Creating and restoring snapshots using the self service portal



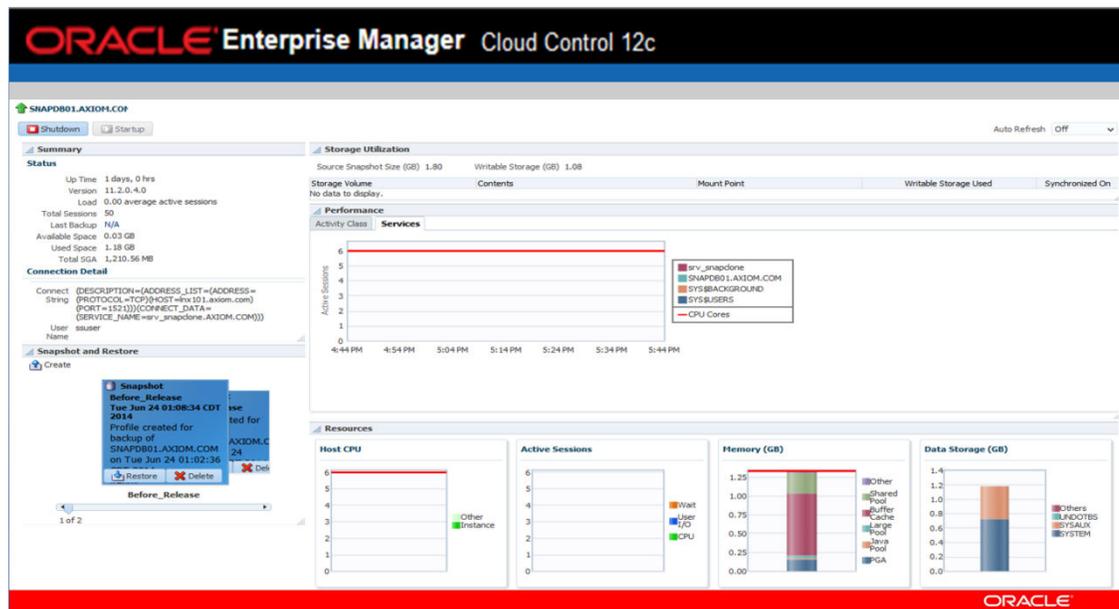
Oracle Enterprise Manager 12c uses the Storage Management Framework plug-in

to utilize storage copy-on-write (or similar) technology to allow the self service user to create database clones.

The Snap Cloning technology offers the following benefits:

- Space efficiency**
 When Using the copy-on-write technology storage blocks are not allocated until the blocks are updated, using this technique can achieve extreme storage savings in the magnitude of 90%.
- Time efficiency**
 The copy-on-write technology uses snapshots to create backups that make the restoration of data as simple as updating the snapshot pointers to their original location. The create of snapshot or restoring the database to the previews version only takes few minutes, even for very large databases.
- Time travel**
 During the application quality assurance testing it is often required to go back to an earlier incarnation of a database. Using Snap Clone and the self-service portal, users can create multiple database copies for testing without consuming significant space.

In the example below, the self service portal user is able to create a snap clone. If necessary, the functionality also allows the self service user to restore the previous version of the database within minutes regardless of the size of the database. This technique provides provisioning agility , storage savings and reduction of administrative overhead.



Private Database Cloud Architecture Design

DBaaS Cloud Definitions

PaaS Infrastructure Zone:

A PaaS infrastructure zone is a group of hosts. Each host in a zone represents a location at which a Service Instance is to be potentially deployed. For instance, in an estate of two datacenters, you may want to define two Zones (Datacenter-A, Datacenter-B). The PaaS Infrastructure Zone allows you to define the placement policy constraints for a specified set of targets and the users to who can access targets within the Zone.

Service Template:

A Service Template is a standardized service definition that is offered to self service users to create dedicated databases, pluggable databases or schemas. The cloud administrators can then map the Service Templates to resource pools and Zones. This feature enables SSA administrators to build a self-service catalog tailored to the specific needs of a company.

Software Pools:

A software pool is a set of homogeneous resources. A Database Pool, which is created in DBaaS, is a collection of database homes, databases, or container databases depending on the type of cloud service model selected.

A software pool has the following constraints:

- A target can belong to only one software pool.
- The name of the software pool and the version cannot be modified after it has been created.
- All targets in a software pool must be homogeneous.
- A Service Template can use multiple zones but only one software pool within each zone.

Oracle Software Library:

The [Software Library](#) is one of the core features offered by Enterprise Manager 12c. The software Library is a repository that stores certified or custom software entities such as Software Patches, Deployment Procedures, Reference Gold Images, components, Application Software and their associated directive scripts. The Software Library enables you to select Oracle-supplied entities and customize them, or create a custom entity of

your own. Once defined, you can reference these reusable entities from a Deployment Procedure to automate the operations such as: patching, provisioning , and so on. The Reference File Location option of the Software Library allows an organization to leverage existing infrastructure for sourcing software and scripts. This is very useful for multi-site implementations to minimize the data transfer between targets and OMS.

The Reference File Location supports the following options:

- **HTTP:** An HTTP storage location represents a base URL
- **NFS :** An NFS storage location represents an exported file system directory on a server
- **Agent:** An Agent storage location can be any host monitored by an Enterprise Manager 12c Agent

In global Enterprise Manager 12c implementations where targets can be distributed across the globe, moving large files over the WAN can be challenging. A Local Reference File Location can be utilized to store a database version 11.2.0.4 gold build image that can be used to provision database homes.

Provisioning Profiles:

A database provisioning profile is an entity that captures source database information for provisioning. It contains software configurations. A profile can represent a complete database or a set of related schemas that form an application. A single profile can be used to create multiple Service Templates.

A cloud administrator can create a database provisioning profile as a one-time activity, which can be used by operators for mass deployments.

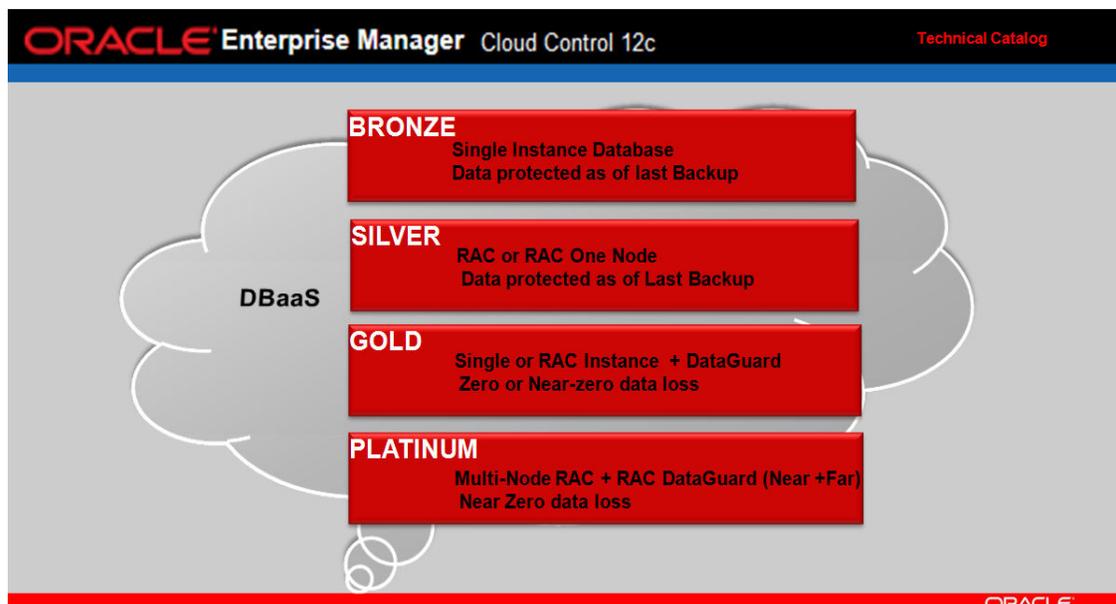
Defining Database Service Tiers and Catalogs

Before engaging in an architecture design, we need to understand the term catalog and the types of catalogs within a Private Cloud architecture. Let's start with the Business Catalog. A business catalog describes the services that will be available to the cloud consumers in terms of availability.

Note: The business catalog named and described below is for illustration purposes only. Depending on the implementation, one customer's Gold tier may be another customer's Platinum etc.



Once the business catalog is defined, the business catalog must be converted to the Technical Catalog. The Technical Catalog describes the underlying technology utilized in order to implement the database services that will be available to the cloud consumers.



The last term to understand and define is the Self-Service Catalog. The Self-Service Catalog describes the database services that will be available to the cloud consumers in an automated self service fashion.

Technical versus Self-Service Catalog

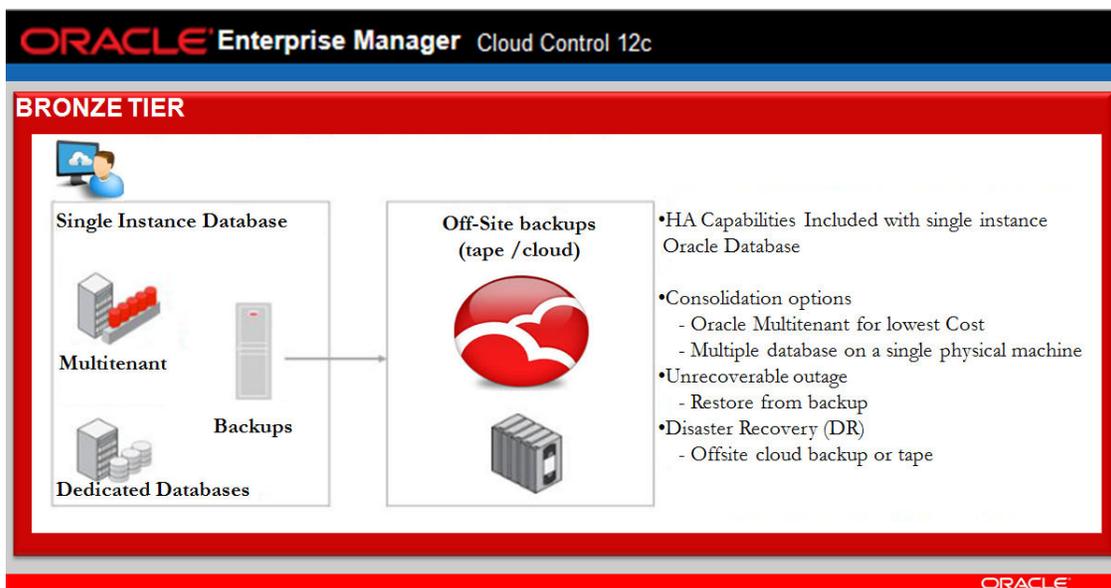
In an effort to improve the speed, agility and automation of the database provisioning, services from the technical catalog can be provided on-demand using the self-service model. Currently, the Oracle Enterprise Manager 12c cloud framework can satisfy all the above technical catalogs in a self-service model.

In very complex implementations, the self-service catalog is usually a subset of the technical catalog. A company can provide the Bronze and Silver tier in the self-service model but choose to deploy the Gold and Platinum tiers using native Oracle Enterprise Manager 12c capabilities.

Bronze Tier Example

The Bronze Tier provides a cost effective database solution where availability and data protection requirements are not as stringent. A database created under this tier can be recovered as of the last backup. In this tier, Oracle recommends the use of a single instance database installed on commodity hardware or Oracle Multitenant configuration. If the reference architecture is an engineered system, a single node RAC database is recommended.

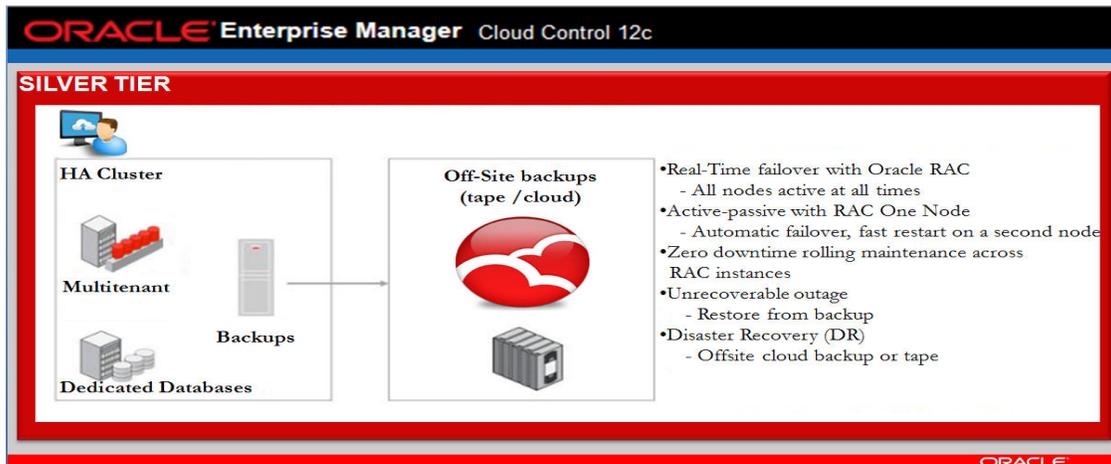
Bronze Reference Architecture



Silver Tier Example

The Silver Tier provides clustering improving and reducing planned and unplanned downtime. Silver can utilize Oracle RAC One Node technology in order to achieve the HA requirements of the tier or a two node RAC. The Silver tier can be recovered as of the last backup. In this tier, Oracle recommends the use of RAC one node, two node RAC or a Multitenant RAC configuration.

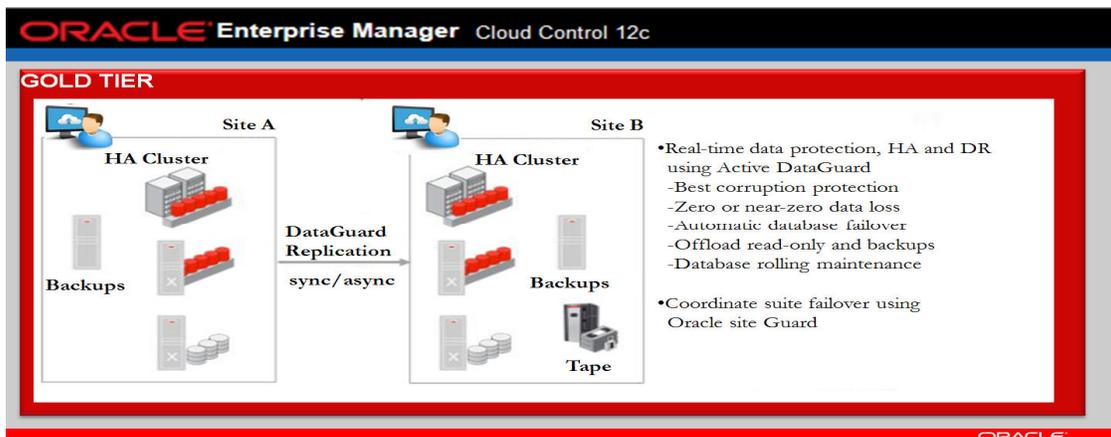
Silver Reference Architecture



Gold Tier Example

The Gold Tier utilizes database replication technology to eliminate single point of failure and provides a higher level of data protection for all types of planned and unplanned outages including database corruption, database failures and site failures. For this tier, Oracle recommends the use of a RAC database with a RAC standby database.

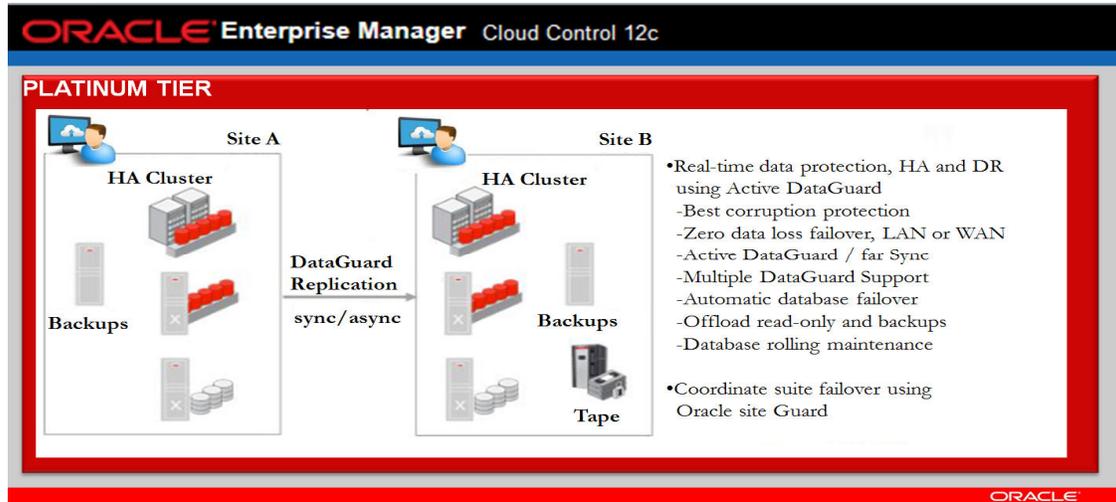
Gold Reference Architecture



Platinum Tier Example

Mission critical tiers such as the Platinum Tier, should be implemented in its own reference architecture. In some cases, companies elect to provision these tiers using Oracle Enterprise Manager 12c native capabilities, as opposed to self-service. For this tier, Oracle recommends the use of a multi-node RAC database with multiple multi-node RAC standby databases.

Platinum Reference Architecture



Service Tier Recovery Point and Time Objectives

The service availability can be defined in terms of Recovery Time Objective and Recovery Point Objective. Oracle technologies, such as Real Application Clusters and DataGuard can significantly improve the RTO and RPO but introduce additional costs and complexities. In order to avoid unnecessary complexities and cost choose the database tiers wisely.

- The **Recovery Time Objective (RTO)** is the goal for how long it may take until a service is recovered from an outage/incident.
- The **Recovery Point Objective (RPO)** defines how much data may be lost as a consequence of an outage/incident, i.e. to which point in time relative to the incident the data needs to be recovered to.

The table below illustrates an RTO and RPO design in relation to the Technical Service Catalog. Please note that the availability of the service is improved or reduced when the database configuration changes.

ORACLE Enterprise Manager Cloud Control 12c		Business Catalog RTO and RPO			
Service Catalog		Bronze	Silver	Gold	Platinum
Availability		Best effort	95%	99.50%	99.90%
Disaster Recovery (Extended Service)	RTO	N/A	5 day	4 hours	2 hours
	RPO	N/A	1 day	1 hour	< 1min
Backup		Weekly Full Daily Incremental Flashback logs			
Service Desk Hours		8x5	8x6	24x7x365	24x7x365
Maintenance Windows		Every 6 months	Every Quarter	Every Quarter sometimes on demand	Every Quarter Plus On Demand
Alert and Response Time		Sev 1 <=4 hours Sev 2 <= 1 day	Sev 1 <=1 hour Sev 2 <= 4 hours	Sev 1 <=15 mins Sev 2 <= 4 hours	Sev 1 <=15 mins Sev 2 <= 2 hours
DB provisioning target time		<= 1 hour	<= 3 hours	<=4 hours	<=8 hours
Database Configuration		Single instance	RAC 1-node	2 Node RAC	2 Node RAC + SI Standby
Storage Mirroring		Dual	Dual	Triple	Triple
Database Version		11g, 12c	11g, 12c	11g, 12c	11g, 12c

The table below illustrates typical incidents and resolutions of this particular Technical Service Catalog.

ORACLE Enterprise Manager Cloud Control 12c		Typical Tier Incidents and resolutions				
Service Tier	DB Instance loss/crash	compute node loss in an frame	storage loss within frame / DB loss	Full Frame Loss	Data Center loss	Data corruption / loss
Platinum	RAC automatically fails over to other instance within same cluster.	RAC automatically fails over to other instance within same cluster.	Fail-/switch-over to 2 nd Data Center, Re-establish DataGuard	Fail-/switch-over to 2 nd Data Center, Re-establish DataGuard	Fail-/switch-over to 2 nd Data Center, Re-establish DataGuard	Recover from flashback if detected within 24h otherwise recover from backup
Gold	RAC automatically fails over to other instance within same cluster.	RAC automatically fails over to other instance within same cluster.	Fail-/switch-over to 2 nd Data Center, Re-establish DataGuard	Fail-/switch-over to 2 nd Data Center, Re-establish DataGuard	Fail-/switch-over to 2 nd Data Center, Re-establish DataGuard	
Silver	Restart DB instance or Activate Passive Database Instance If problem persists recover from backup	Activate Passive Database Instance If problem persists recover from backup	Recover from flashback if not also affected otherwise recover from backup.	Create new Database instance on frame with free capacity and recover from backup	Create new Database instance on frame with free capacity and recover from backup	
Bronze	restart DB instance	Restart DB instance when node is repaired or create new Database Instance for same DB on different node	Recover from flashback if not also affected otherwise recover from backup	Create new Database Instance on frame with free capacity and recover from backup	Create new Database Instance on frame with free capacity and recover from backup	

Private Database Cloud Consolidation Guidelines

In the area of database consolidation planning, Oracle Enterprise Manager 12c provides a number of techniques to ensure that consolidated applications and database workload can exist in harmony, avoiding unnecessary impact on application performance and even outages. When consolidating a database the following steps should be considered:

- Cloud Consolidation Model

During the design of the DBaaS, it is important to consider the placement of the database in terms of consolidation. Please review the table below.

ORACLE Enterprise Manager Cloud Control 12c Consolidation Model			
	Dedicated DB	Dedicated Schemas	12c Multitenant Database
Consolidation Density	High	Highest	Highest
Management	Easy	Easy to Involved (based on required resource isolation)	Easy
Isolation	Good	Least	Good
Implementation & Onboarding	Easy	Difficult	Easy
Application Suitability	All	Home grown Requires application Validation	All but has to be certified for database 12c

As illustrated above, Schema based consolidations offer ease of management and patching, but limited isolation. On the contrary, the 12c Multitenant database option provides the highest consolidation density. The 12c Multitenant database unique architecture provides efficient and flexible database consolidation by improving ease of database expansion and server resource utilization efficiencies, whilst reducing the operation management costs.

If consolidation density and isolation are the driving factors, Oracle recommends the Database 12c Multitenant database. Please also note that not all applications are suitable for all consolidation models. For additional details refer to the Oracle Multitenant [Consolidation study](#) published on the Oracle Technology Network.

- Cloud Consolidation Planning

In the area of database consolidation planning, the Oracle [Consolidation Planner](#), by leveraging metric and configuration data collected from managed target servers, help determine the optimum consolidation scenarios.

To utilize the Oracle Consolidation Planner to determine the optimum database placement, consider the following steps:

1. **Source Server** : Identify the source database server to be discovered by Enterprise Manager 12c. When a source server is discovered and data collection is executed against the server, Enterprise Manager 12c has very accurate data on the resources utilized by the server and the workload of all the databases running on the server.
2. **Destination Server** : Identify the destination database server that the source server will be consolidated to. The destination server could be a pre existing server or event yet-to-be-purchased engineered system such as the Oracle Exadata Database Machine or an Exalogic Elastic Cloud system.
3. **Consolidation Projects and Scenarios** : With the source and destination server identified, the next step is to use the consolidation planner to create consolidation projects and consolidation scenarios. The Oracle Consolidation Planner provides out of the box, a set of pre-configured consolidation scenarios, representing conservative, aggressive, and medium consolidation schemes. Alternatively, custom scenarios can be created that best suit the business requirements. Once created, the various scenarios can be compared to determine which consolidation strategy best meets the business requirements.

- Cloud Consolidation Testing

Once a Cloud Consolidation Model has been selected, the Oracle Consolidation Planner can intelligently place databases into the correct destination server. The next step is to ensure that database production workloads are not impacted by the server configuration changes.

The best tool to meet this need is the Oracle Real Application Testing option, which enables the database administrator to perform real-world testing of Oracle Database workloads. Using Real Application Testing, the database administrator can capture production workloads and assess the impact of system changes on these workloads before production deployment. Using the Oracle Real Application Testing, the database administrator can minimize the risk of instabilities associated with system changes.

Oracle Real Application Testing consists of two key components that can be used for consolidation testing. The SQL Performance Analyzer and Database Replay. Depending on the level of the testing and the business requirements, the database administrator can use either or both components to perform the required testing. Please refer to the Oracle documentation on [Real Application Testing](#) for additional configuration details.

Configuration Pollution and Sprawl

This cloud dimension is concerned with the compute resources that should be selected for a given database instance as well as avoiding database configuration pollution and sprawl.

Note: Although, it is tempting to create custom database configurations and footprints it is not recommended.

ORACLE Enterprise Manager Cloud Control 12c Avoiding Configuration pollution and Sprawl			
DBaaS Databases Size	Initial Database Size	Initial Core Allocation	Initial Memory
Small	50GB	1	6GB
Medium	250GB	2	12GB
Large	1250GB	4	24GB
Extra Large	5TB	8	48GB
Custom	Not Recommended	Not Recommended	Not Recommended

The CPU resources can initially be managed using Instance Caging.

Once the load profile of the estate is better understood, databases can be scaled up/down to the next database size as shown above in order to improve server utilization efficiency, database performance and avoid server pollution and sprawl.

In the Oracle Cloud Framework database sizing can be easily implemented by configuring Service Templates as shown below:

- Single-Instance-11204-**SM**-With DataGuard
- Single-Instance-11204-**MD**-With DataGuard
- Single-Instance-11204-**LG**-With DataGuard
- Single-Instance-11204-**XL**-With DataGuard

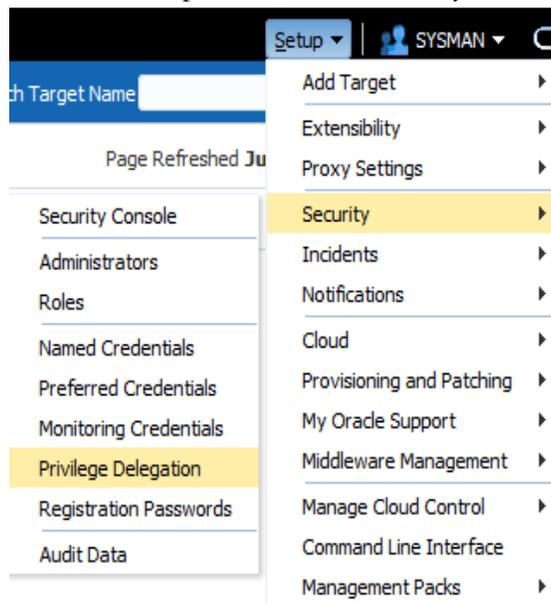
Implementation of a DBaaS using Cloud Management Pack

Oracle Cloud Management Pack utilizes the Oracle Cloud Framework to deliver automation, improve provisioning speed and avoids database pollution by standardizing the database environment. It allows Cloud administrators to define and implement service reference architectures and encapsulate database architecture complexities. One of the key benefits of the Oracle Cloud Framework is faster deployment of typical platforms by moving away from administrator driven provisioning to end user driven provisioning. Enterprise Manager allows administrators to:

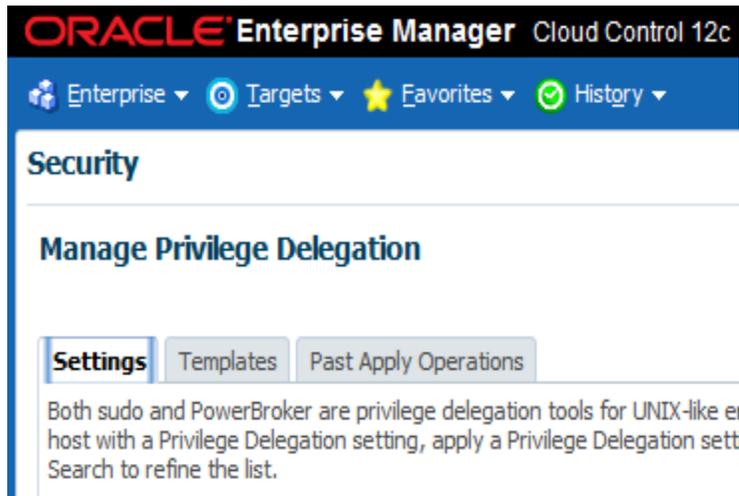
- Create resources pools
- Standardize and automate the deployment processes
- Publish pre-configured service catalog
- Setup access controls
- Manage roles, users and quotas to limit over-consumption
- Enable metering and chargeback on the consumed resources
- Optionally, expose the Service Catalog via RESTFUL APIs

Step 1: Configure Privilege Delegation for Database Servers

The Oracle Enterprise Manager 12c credentials framework allows administrators to configure two types of [privilege delegation](#) tools: Sudo and Powerbroker. From the Setup menu, select Security and then Privilege Delegation.

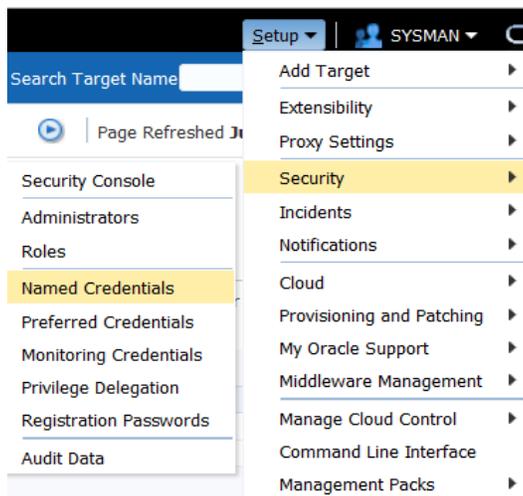


During the configuration of Privilege Delegation a SUDO or Powerbroker template should be created and applied to all the hosts.



- Select Settings to review the existing assignments
- Select Templates to create SUDO or Powerbroker templates

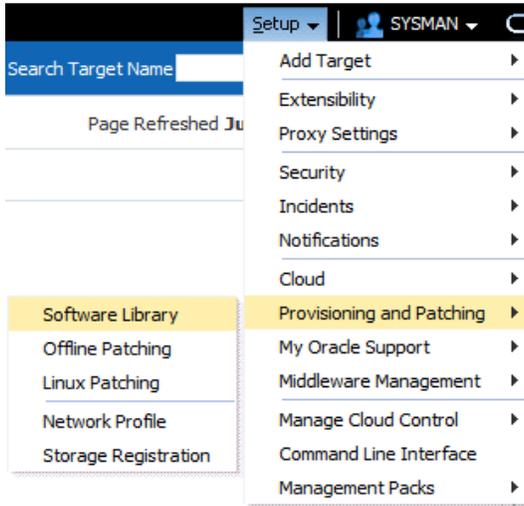
Step 2: Defined Named Credentials



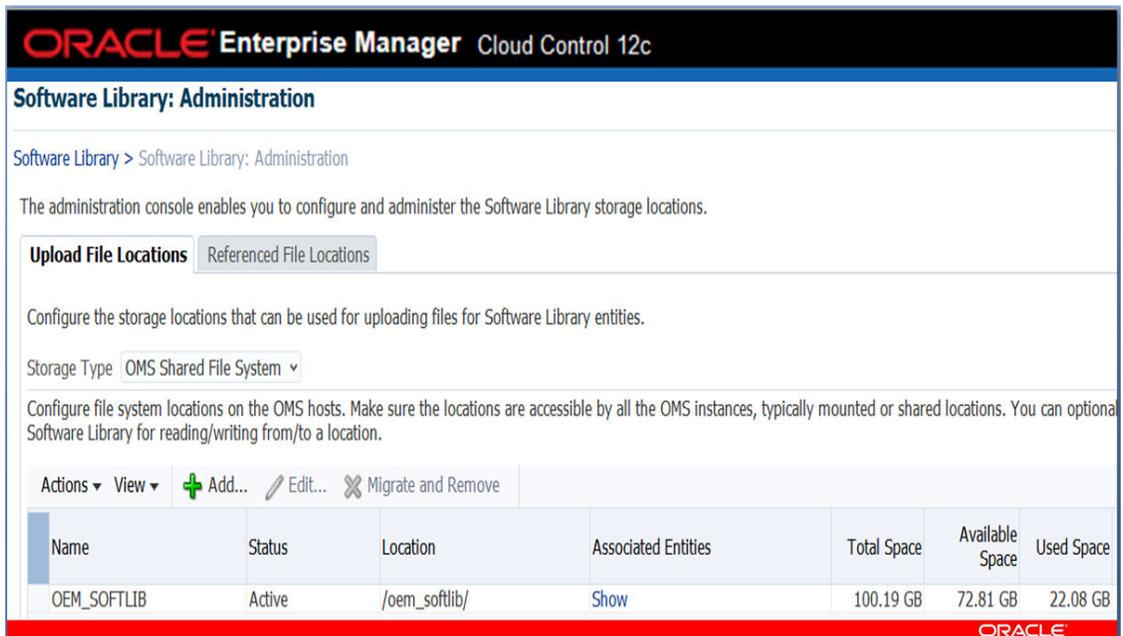
The Enterprise Manager credential subsystem enables cloud administrators to store [Credentials](#), in a secure manner, as preferences or operation credentials. The credentials can then be used to perform different system management activities, such as real-time monitoring, patching, provisioning, and other target administrative operations. In a DBaaS implementation the configuration of the named and preferred credentials is critical. In larger implementations of DBaaS,

the preferred credentials are vital especially when using automation using emcli or when using the cloud framework in conjunction to the lifecycle management pack.

Step 3: Configure Software Library



The Oracle Enterprise Manager 12c Software Library is a required component of any DBaaS implementation. The storage location for the Software Library must be accessible to all OMS's as local directories. In a multi-OMS scenario, you must set up a clustered file system using OCFS2, ACFS or NFS. For single OMS systems, any local directory is sufficient.



Step 4: Creating Cloud Users and Roles

In the Oracle Enterprise Manager 12c, cloud framework users and roles are critical components in defining user quotas. Quotas are assigned at the role level and users should be assigned to the roles based on the desired limits.

Below is an example of a quota definition of the role PAAS_ROLE.

Quota

* Role Name: PAAS_ROLE

* Memory (GB): 100

* Storage (GB): 1000

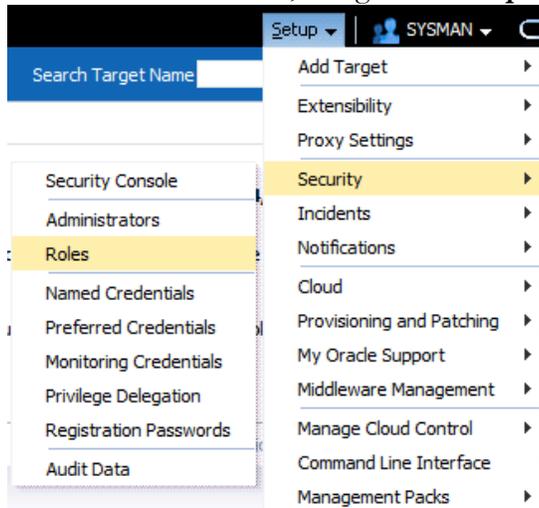
* Number of Database Requests: 100

* Number of Schema Service Requests: 100

* Number of Pluggable database Service Requests: 100

OK Cancel

To create a DBaaS role, navigate to **Setup > Security > Roles**.

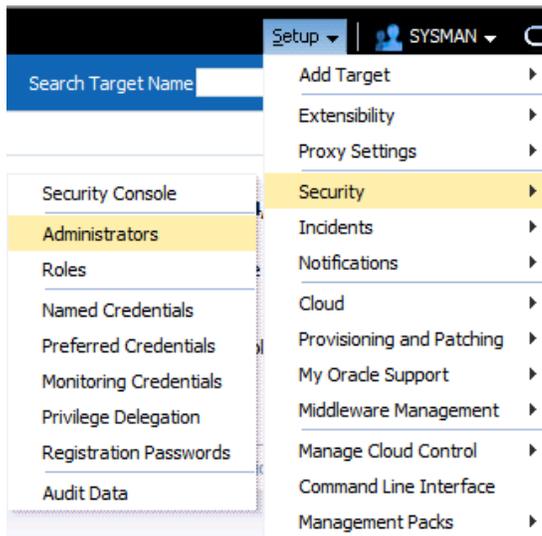


In this example, we created a role named PAAS_ROLE. Please ensure that the EM_SSA_USER is assigned to the PAAS_ROLE. In large implementations, to implement segregation of system resources, it is recommended to create a number of PaaS Roles.

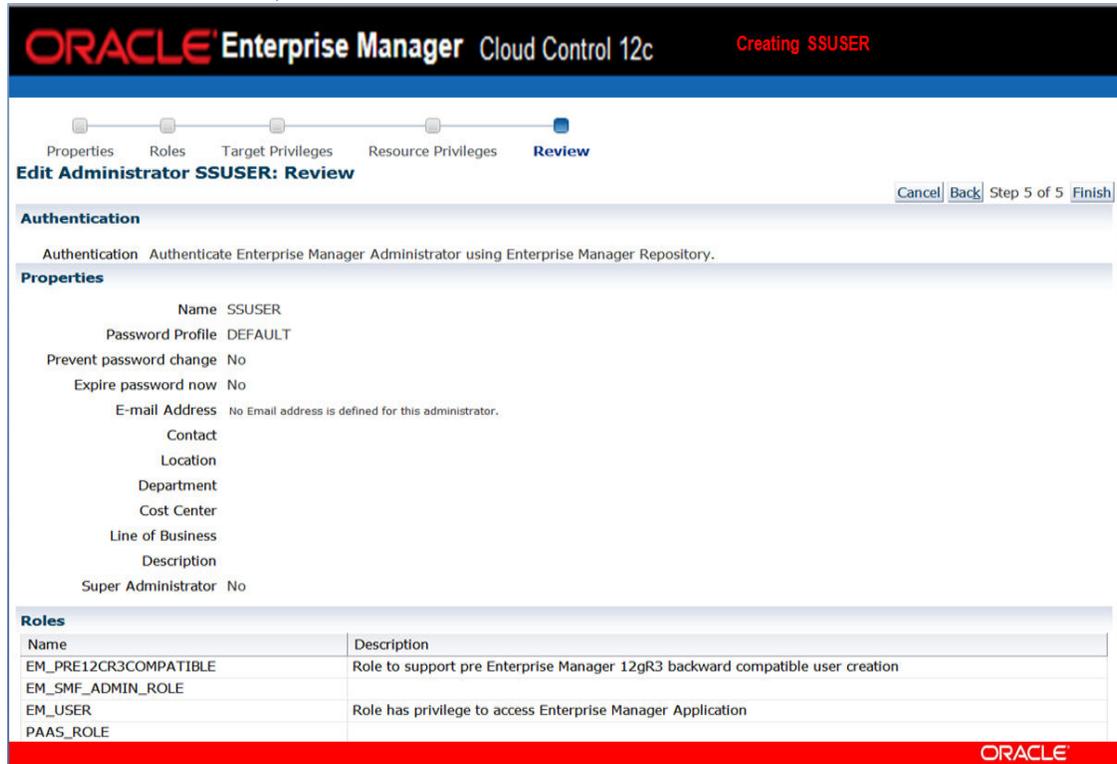


Step 5: Create Self Service Portal Users

To create a DBaaS user, navigate to **Setup > Security > Administrators**.



In this example a user named SSUSER is created. Please ensure that the SSUSER is assigned to the PAAS_ROLE, EM_USER and Public as shown below.



Step 6: Defining Databases Zones

1. Define and create zones to satisfy the Reference Architecture Design.

A zone is a collection of hosts that are used by the cloud framework placement algorithm to intelligently place databases into zones. The placement algorithm will derive database placements based on the user quota and the placement policy that was configured by the cloud administrator.

Depending on the business requirements the cloud administrator will create a number of Database Zones. In this simple example, the requirement is to have multiple datacenters that will satisfy the disaster recovery requirements of the organization. For this reason we have created two PaaS Infrastructure Zones.

1. DataCenter- A - Primary
2. DataCenter -B - Standby

Below are the basic requirements of the DBaaS PaaS Zone:

- a) A zone can be of type Host
- b) The placement policy is defined at the zone level
- c) The credentials provided should be of global credential type and valid across all the members of the zone

A PaaS Infrastructure Zone can consist of different types of database configurations. For example :

- a) Real Application Clusters
- b) Host Configure Snap Clones
- c) Single Instance 11.2.0.4 and 12.1.0.1 database server
- d) Multitenant 12c database configurations

A PaaS Infrastructure Zone can be assigned to one or more Oracle Enterprise Manager 12c roles.

To create a PaaS Infrastructure Zone, navigate to **Setup > Cloud > PaaS Infrastructure Zones** and click on Create.

The screenshot displays the Oracle Enterprise Manager Cloud Control 12c interface. The main heading is "PaaS Infrastructure Zones". Below the heading, there is a search bar and a table listing the zones. The table has columns for "PaaS Infrastructure Zone", "Service Instances", "Members", and "Servers".

PaaS Infrastructure Zone	Service Instances	Members	Servers
DataCenter-A	3 Hosts (6)		Total (6), Unallocated (0)
DataCenter-B	1 Hosts (3)		Total (3), Unallocated (1)

A navigation menu on the right side of the interface is open, showing a list of categories. The "Infrastructure" category is expanded, and "PaaS Infrastructure Zones" is highlighted. Other categories visible include Extensibility, Proxy Settings, Security, Incidents, Notifications, Cloud, Provisioning and Patching, My Oracle Support, Middleware Management, Manage Cloud Control, Command Line Interface, and Management Packs.

Follow the Enterprise Manager wizard and specify the following as shown below:

- PaaS Name:"DataCenter-A"
- Placement Policy
- Target Hosts
- Credentials
- Role

The screenshot displays the Oracle Enterprise Manager Cloud Control 12c interface for configuring a PaaS Infrastructure Zone. At the top, a summary table shows the configuration for two zones:

PaaS Infrastructure Zone	Service Instances	Members
DataCenter-A		3 Hosts (6)
DataCenter-B		1 Hosts (3)

Below the summary table, the configuration details for the 'DataCenter-A' zone are shown:

- Name:** DataCenter-A
- Description:** Primary Data Center A
- PaaS Infrastructure Zone Setting:**
 - Placement Policy Constraints Per Host:**
 - Maximum CPU Utilization (%): 95
 - Maximum Memory Allocation (%): 95
 - Credentials:**
 - Named Credential: NC_HOST_ORACLE
 - Targets:**

Name	Description	Type	Status	VM Guest	Oracle VM Zone
lrx100.axiom.com		Host	🟢	n/a	n/a
lrx101.axiom.com		Host	🟢	n/a	n/a
lrx102.axiom.com		Host	🟢	n/a	n/a
lrx221.axiom.com		Host	🟢	n/a	n/a
lrx222.axiom.com		Host	🟢	n/a	n/a
lrx223.axiom.com		Host	🟢	n/a	n/a
 - Roles:**

Role Name	Role Description
PAAS_ROLE	

Step 6: Defining Database Pools

Navigate to the **Setup > Cloud > Database** and select "Database Pools"

Database Cloud Self Service Portal Setup



- Request Settings
- Quotas
- Profiles and Service Templates

Dedicated Database pool

Click on the **Create** button  and select **For Database**. The create database wizard will guide you to create a dedicated database Service Template.

The example below is an illustration of a singleton database 11.2.0.4 Service Template with an optional DataGuard implementation.

ORACLE Enterprise Manager Cloud Control 12c

Database Pools

Edit Pool: Setup Back Step 1 of 1 Submit Cancel

Pool Details

Name: DataCenter-A-Linux64-11204-SI
 Description:

Credentials

Specify the host credentials that will be used for performing database creation operations. Root credentials are optional. They are needed if you plan to use this pool for snap cloned database requests. Grid Infrastructure credentials are also optional. They are needed if you plan to use this pool for live cloning of a database using ASM.

* Host: NC_HOST_ORACLE (SYSMAN)
 Root: NC_HOST_ROOT (SYSMAN)
 Grid Infrastructure: NC_HOST_GRID (SYSMAN)

Oracle Homes

Add one or more Oracle Homes to the pool. All Oracle Homes must reside in the same PaaS infrastructure zone. Homogeneity is controlled by the target filters that cannot be modified once the pool is created.

PaaS Infrastructure Zone: DataCenter-A Platform: Linux x86-64
 Database Configuration: Database Instance Version: 11.2.0.4.0

Add Remove

Name	Location	Description
Orasidb11g_home1_2014_06...	/u01/app/oracle/product/11.2.0.4/dbhome_1	Orasidb11g_home1_2014_06_17_09_33_15_inx102.axiom.com

TIP A target can only belong to one pool.

Where is my Oracle Home?

Standby Pools

Associate one or more Pools for provisioning the Physical Standby Database(s). The 'Add' list contains a filtered set of Pools based on the Dataguard compatibility matrix.

Add Remove

Name	Member Target Type	Targets	Description
DataCenter-B-Linux64-11204-SI	Oracle Home	2	

ORACLE

The following information should be provided in order to configure the above Service Template:

- a) Database pool name (select a distinct name that describes purpose of the pool in this example: DataCenter-A Linux64-11202-SI,
- b) Provide Global credentials for an Oracle named credential. In this case, the grid and root credentials are optional,
- c) Select the Hosts and database homes that will define the pool,
- d) Select the PaaS Infrastructure Zone, Platform, database configuration and database version to be installed in the pool. If you are planning to support multiple versions, a second pool is needed as shown below:

- e) In this example, a standby database PaaS and pool are also selected.

Pluggable Database Pool

Database Cloud Self Service Portal Setup

- ✓ Database Pools
- ✓ Request Settings
- ✓ Quotas
- ✓ Profiles and Service Templates

Click on the **Create** button  and select **Pluggable Database**. The create database wizard will guide you to create a pluggable database Service Template.

ORACLE Enterprise Manager Cloud Control 12c

Edit Pool... Back Step 1 of 2 Next Cancel

Pool Details

Name: DataCenter-B-Linux64-12101-SI-Pluggable

Description:

Credentials

Specify the database credentials that will be used for performing database operations like Pluggable Database creation. The database credentials require SYSDBA privileges.

- * Host: NC_HOST_ORACLE (SYSMAN) +
- * Grid Infrastructure: NC_HOST_GRID (SYSMAN) +
- * Database: NC_DB_SYS (SYSMAN) +

Container Database Wallet Password:

Container Databases

Add one or more Container Databases to the pool from a single PaaS infrastructure zone. Homogeneity is controlled by the target filters that cannot be modified once the pool is created.

PaaS Infrastructure Zone: DataCenter-B Platform: Linux x86-64

Target Type: Database Instance Version: 12.1.0.1.0

+ Add ✖ Remove

Name	Location	Description
CDB_103.axiom.com	/u01/app/oracle/product/12.1.0.1/dbhome_1	CDB_103.axiom.com

TIP A target can only belong to one pool.

* CPU is not caged.

Where is my Container Database?

ORACLE

The administrator uses the placement policy to set a maximum ceiling for resources. This protects resource consumption for the members of the database pool. The maximum number of pluggable databases that can be created in a container is 252.

ORACLE Enterprise Manager Cloud Control 12c

Database Pools

Edit Pool: Policies Back Step 2 of 2 Submit Cancel

Placement Constraints

Placement policy constraints allow the self service administrator to set maximum ceilings for resource utilization. This provides protection for the members of the database pool in terms of resource consumption. For example, a production database pool might enforce more conservative limits, whereas a development database pool might enforce more liberal limits.

Constrain Placement on Each Container Database by Pluggable Databases

Maximum Number of Pluggable Databases: 252

Workloads associated with the service requests

Maximum CPU allocation never exceeds (%): 99

Maximum memory allocation never exceeds (%): 99

Resource Manager Settings

Enable Resource Manager for CPU i

TIP The service instance will be provisioned on the best member that satisfies the placement constraints.

ORACLE

Step 7: Request Settings

Navigate to the **Setup > Cloud > Database** and select "Request Settings"

The screenshot displays the Oracle Enterprise Manager Cloud Control 12c interface for the Database Cloud Self Service Portal Setup. The page is titled "Request Settings" and features a sidebar with navigation options: Database Pools, Request Settings (highlighted), Quotas, Profiles and Service Templates, and Chargeback. The main content area is divided into three sections:

- Future Request Scheduling Period:** Described as "Amount of time in advance a Self Service user can Schedule a request." It offers two options: "No Restriction" (selected) and "Restricted Period" (set to 1 Days).
- Default Retention Duration:** Described as "The maximum amount of time for which Self Service user can retain a service instance." It offers two options: "No Restriction" (selected) and "Restricted Duration" (set to 1 Days).
- Request Purging Duration:** Described as "Amount of time after which the 'Completed', Self Service Create Requests will be purged from the Repository." It offers two options: "No Restriction" (selected) and "Restricted Duration" (set to 1 Days).

Using the **request setting screen** the cloud administrator is able to specify the following:

- The amount of time in advance the self service user can schedule a request.
- The maximum amount of time for which a self service user can retain the instance.
- The amount of time after the completed self service create requests will be purged from the repository.

All the Request settings are at the self service portal level.

Step 8: Quotas

Navigate to the **Setup > Cloud > Database** and select "Quotas"

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for the Database Cloud Self Service Portal Setup. The page title is "Database Cloud Self Service Portal Setup" and it indicates the page was refreshed on Aug 19, 2014 at 8:51:28 PM CDT. On the left sidebar, there are navigation links: Database Pools, Request Settings, Quotas (highlighted with a green checkmark), Profiles and Service Templates, and Chargeback. The main content area is titled "Quotas" and includes a description: "Quota is calculated for each self service user belonging to a given role and is the aggregate amount of resources one user can occupy at a time. The quota applies only to service instances provisioned through the self service application." Below the description is a table with columns: Role Name, Memory (GB), Storage (GB), Number of Database Requests, Number of Schema Service Requests, and Number of Pluggable database Service Requests. The table contains one row for the role "PAAS_ROLE" with values: 100, 1000, 100, 100, and 100. Above the table are buttons for "View", "Create...", "Edit...", and "Delete".

Role Name	Memory (GB)	Storage (GB)	Number of Database Requests	Number of Schema Service Requests	Number of Pluggable database Service Requests
PAAS_ROLE	100	1000	100	100	100

Using the Quota, the cloud administrator is able to assign to roles the following:

1. The amount of memory all the users assigned to the roles can consume.
2. The amount of storage all the users assigned to the roles can consume.
3. The number of databases all the users assigned to the roles can request.
4. The number of schema requests all the users assigned to the roles can request.
5. The number of Pluggable database requests all the users assigned to the roles can request.

All the Quota settings are at the role level.

Step 9: Defining Service Templates for Self Service Provisioning

Navigate to the **Setup > Cloud > Database** and select "Profiles and Service Templates"

Dedicated Database Service Template Creation

ORACLE Enterprise Manager Cloud Control 12c Creating a Dedicated Service Template

Database Cloud Self Service Portal Setup

General Database Initialization Parameters Scripts Roles Review

Step 1 of 6

Edit Service Template: General

Describe **Source Identification**

* Name: Single-Instance-11204-SM With DataGuard
 * Profile: dbaas_om_tpl_smalldb

Description: 1 Nodes x (2 CPUs, 1024M SGA, 256 Processes) -Sm -SI (11.2.0.4)

Database Definition

Type: Single Instance Real Application Clusters (RAC)

Number of nodes: 1

Database SID: Specify Prefix Specified by user at request time

SID Prefix: SINCDG

Domain Name: axiom.com

Enable Standby Database

Standby Name	Database Type	Number of Nodes	SID Prefix	Protection Mode	Apply Delay (Minutes)	Domain Name	Enabled Read Only Mode
SINCDG	N/A	N/A	SINCDG	Maximum Performance	0	axiom.com	

Pools and Zones

A service template can be configured to provision databases in one or more pools. Select the zone and associated pools that this service template can provision databases into.

Primary Pools		Standby Pools		
Name	Resource Pool	Standby Name	Standby Pool	Zone
DataCenter-A	DataCenter-A-Linux64-11204-SI	SINCDG	DataCenter-A-Linux64-11204-SI	DataCenter-B
DataCenter-B	DataCenter-B-Linux64-11204-SI			

Reference Host: lnx102.axiom.com

During the general section of the Service Template creation wizard, specify the following entries:

Description:

- Service Template name (Single-Instance 11.2.0.4 small database with DataGuard)
- Select the database creation template from the Software Library

Database Definition:

- For Real Application Cluster database Service Templates select the number of nodes
- If the database SID prefix is to be provided by the user during the interview process, select *specify by user at request time*
- Provide the database domain name

- In case the request is for a DataGuard configuration, select *enable standby database* and provide the standby instance name and Protection Mode. The available Protection Modes are listed below:
 - Maximum Performance
 - Maximum Protection
 - Maximum Availability
 -

In the DataGuard use case, the active database option is also available. Please refer to the Oracle DataGuard [documentation](#) for addition details:

Pools and Zones:

- In the Pool and Zone section of the wizard, identify the primary and standby pool if it is desirable.

ORACLE Enterprise Manager Cloud Control 12c Creating a Dedicated Service Template

Database Cloud Self Service Portal Setup

General **Database** Initialization Parameters Scripts Roles Review

Edit Service Template: Database Back Step 2 of 6 Next Cancel

Reference Host
The reference host is used to select the necessary database content values like ASM disk group, data file location, listener port that are available on the reference host.
Zone DataCenter-A Pool DataCenter-A-Linux64-11204-S1 Host lnx102.axiom.com

Storage type
 Automatic Storage Management
* Disk Group +DATA
 File System
Location (ORACLE_BASE)/oradata

Fast Recovery
Specify the location where recovery related files (archived redo logs, RMAN backups and other related files) will be created.
 Enable Fast Recovery Area
 Automatic Storage Management
Disk Group RECO
 File System
Location (ORACLE_BASE)/ffa
Fast Recovery Size(MB) 5000
Enable Archiving

TIP To allow SSA users to schedule backups and perform restore operations, configure a Fast Recovery Area and select the Enable Archiving check box.

Listener Port
* Port Number 1521

RMAN Duplicate Backup Location
Location /NexEntaNAS/TEMP
 TIP This directory need to be present on all the members of the Primary and Standby Pool(s). It should at least have available free space equal to the size of the Database from which the Profile has been created.

Administrator Credentials
Specify passwords for the administrative users (SYS, SYSTEM and DBSNMP) in the new database. These users are used by the SSA Administrator to manage the database. The SSA User has no access to these users.
 Use the same password
* Password ***** * Confirm Password *****
 Use different passwords

User Name	Password	Confirm Password
SYS	*****	*****
SYSTEM	*****	*****
DBSNMP	*****	*****

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During the Database section of the Service Template creation wizard specify the following entries:

Storage Type:

- Depending on the reference architecture, select Automatic Storage Management or File System for the storage type.

Fast Recovery:

- Enabling the Fast Recovery area and the Archiving will allow the Self Service user to schedule backups and restore operations.

RMAN Duplicate Backup Location:

- This directory is required for DataGuard configurations. After the creation of the primary database an RMAN duplicate will be performed in order to create the database DataGuard configuration. The directory **MUST** be present on all the members of the primary and standby pools.

ORACLE Enterprise Manager Cloud Control 12c Creating a Dedicated Service Template

Database Cloud Self Service Portal Setup

General Database Initialization Parameters Scripts Roles Review

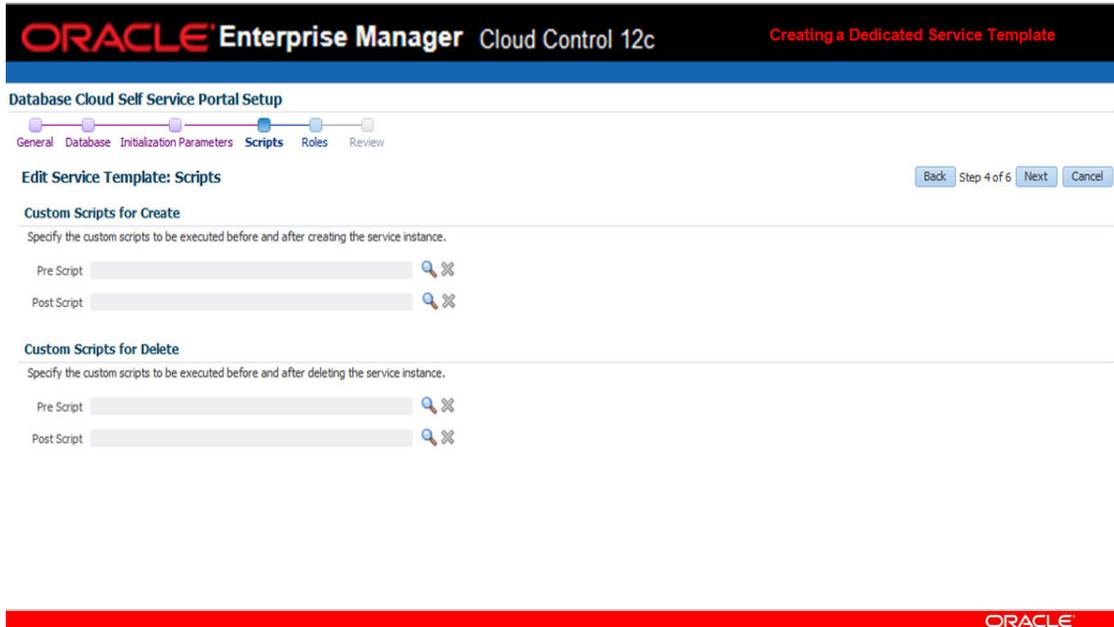
Edit Service Template: Initialization Parameters Back Step 3 of 6 Next Cancel

View ▾ Detach Edit Spt

Name	Value	Editable	Modified	Description
<ul style="list-style-type: none"> ▾ Audit <ul style="list-style-type: none"> audit_trail os No Enable system auditing. Valid Values are none,os,db,(db,extended),xml,(xml,extended). > Common > Memory > Miscellaneous > Recovery 				

ORACLE

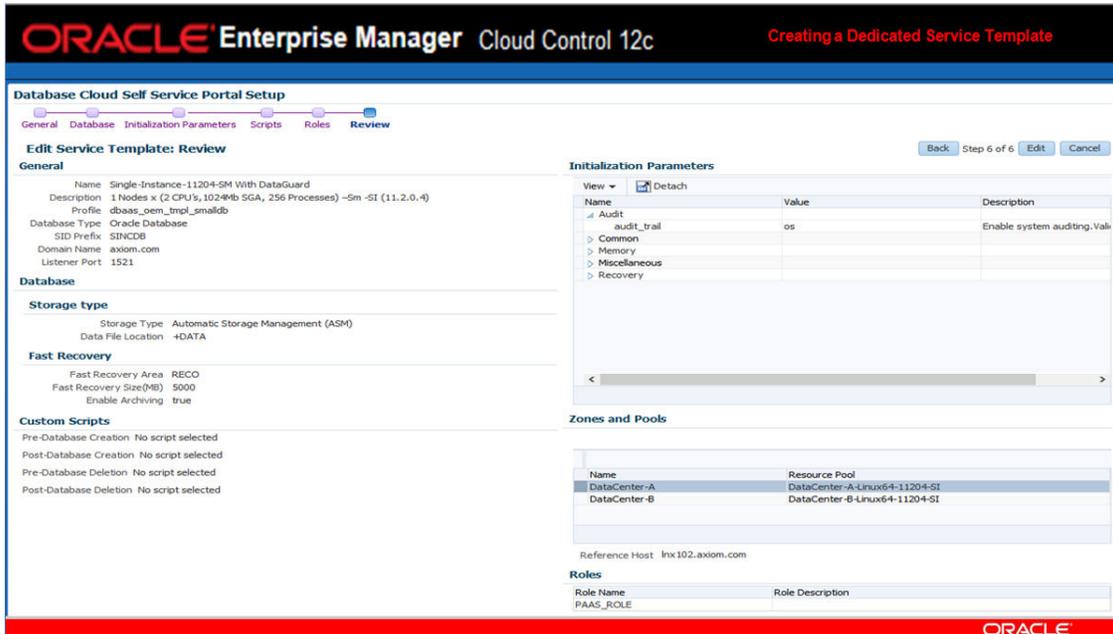
During the Initialization section of the Service Template wizard, provide any optional initialization parameters that are required.



During the Script section of the Service Template wizard, the cloud administrator can provide scripts that need to be executed before and after the database provisioning and de-provisioning. The pre and post scripts are mainly used for the integration of the new provision database with the organizations' eco-system.

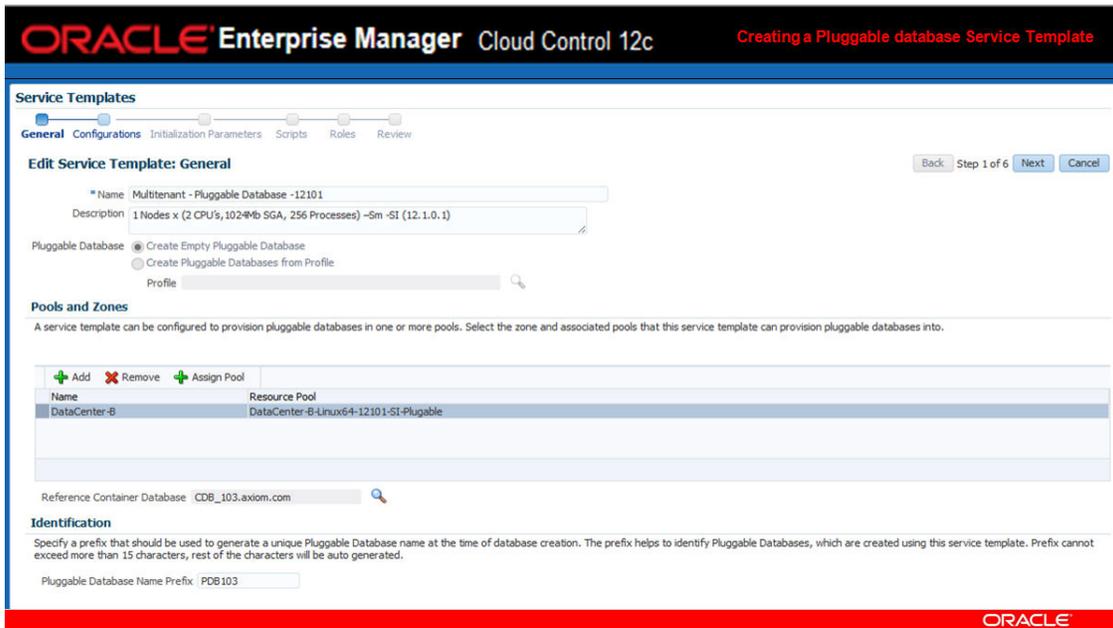


During the Role section of the Service Template wizard, the cloud administrator provides which users are allowed to access the Service Template.



Review the configuration setting and save the Service Templates.

Pluggable Database Service Template



During the General Section of the Service Template creation wizard, specify the following entires:

Pluggable Database:

- Select Empty Pluggable or Pluggable Databases from Profile
- Identify the Zone and Pool where a database will be placed
- Identify the Reference Container Database which the Pluggable Database will be part of

The screenshot shows the 'Edit Service Template: Configurations' step of the wizard. It includes sections for Workloads, Pluggable Database Administrator Privileges, and Pluggable Database Storage.

Workloads

Workload represents the expected CPU, memory and storage requirements for each service.

Name	Description	CPU (cores)	Memory (GB)	Sessions (units)	Storage (GB)
WorkloadA		2	2	10	10
WorkloadB		2	1	10	10

Pluggable Database Administrator Privileges

Select existing roles or create a role which will be assigned to the Pluggable Database Administrator.

Assign Pluggable Database Administrator Privileges: From existing Database Roles By creating a new Database Role

* Role Name: PDBAAS_JUN_18_2014_22_18_PM
 Description: New db role to be assigned to pluggable database administrator.

* Privileges for administrator: CREATE SESSION, ALTER SESSION, CREATE DIMENSION, CREATE INDEXTYPE, CREATE ANY OPERATOR, CREATE ANY PROCEDURE, CREATE ANY SEQUENCE, CREATE ANY INDEX, CREATE JOB, CREATE ANY MATERIALIZED VIEW, CREATE ANY TABLE, CREATE ANY TRIGGER, CREATE ANY TYPE, CREATE ANY VIEW, CREATE ANY SYNONYM, CREATE

Pluggable Database Storage

Specify the Pluggable Database Storage configurations.

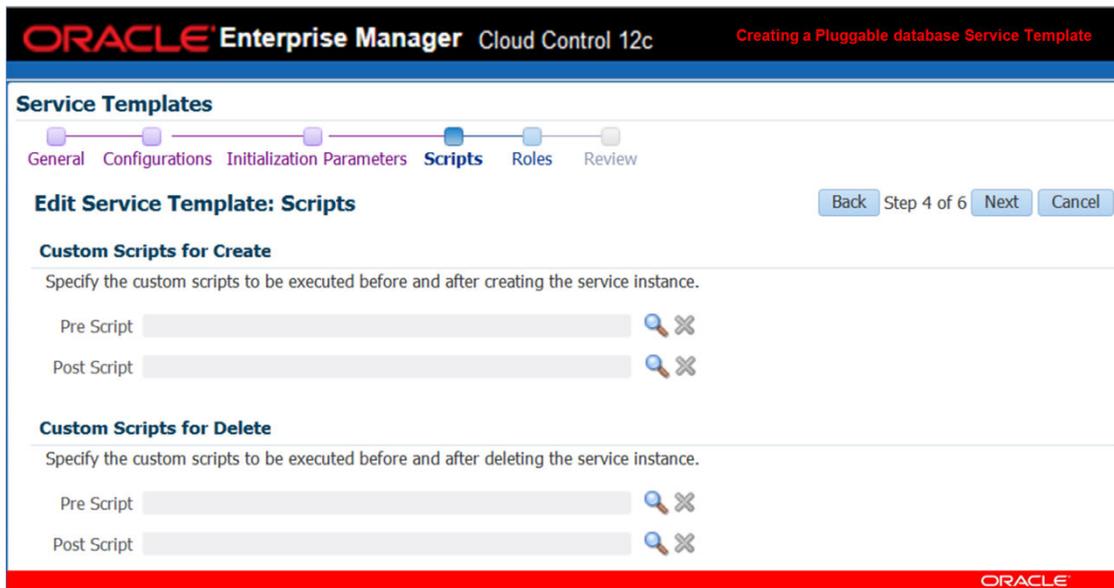
Maximum Size: Unlimited Specified by the workload size selected at request time

Number of Tablespaces: 1

During the Configuration section of the Service Template creation wizard, specify the following entires as shown above:



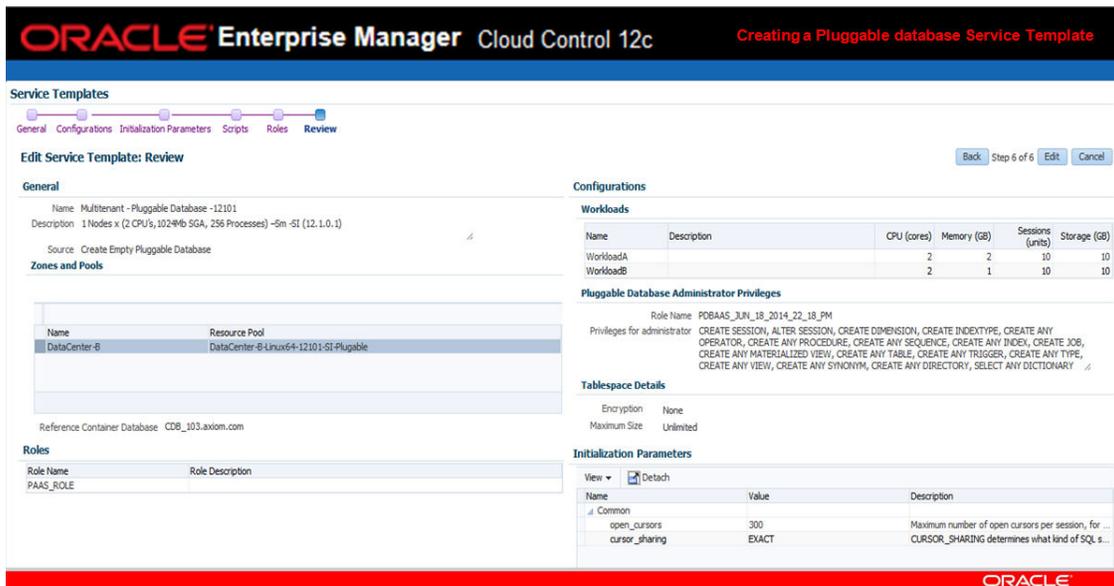
During the Initialization section of the Service Template wizard, provide any optional initialization parameters that required to be set.



During the Script section of the Service Template wizard, the cloud administrator can provide scripts that need to be executed before and after the database provisioning and de-provisioning. The pre and post scripts are mainly used for the integration of the new provision database with the organizations' eco-system.



During the Role section of the Service Template wizard, the cloud administrator provides which users are allowed to access the Service Template.



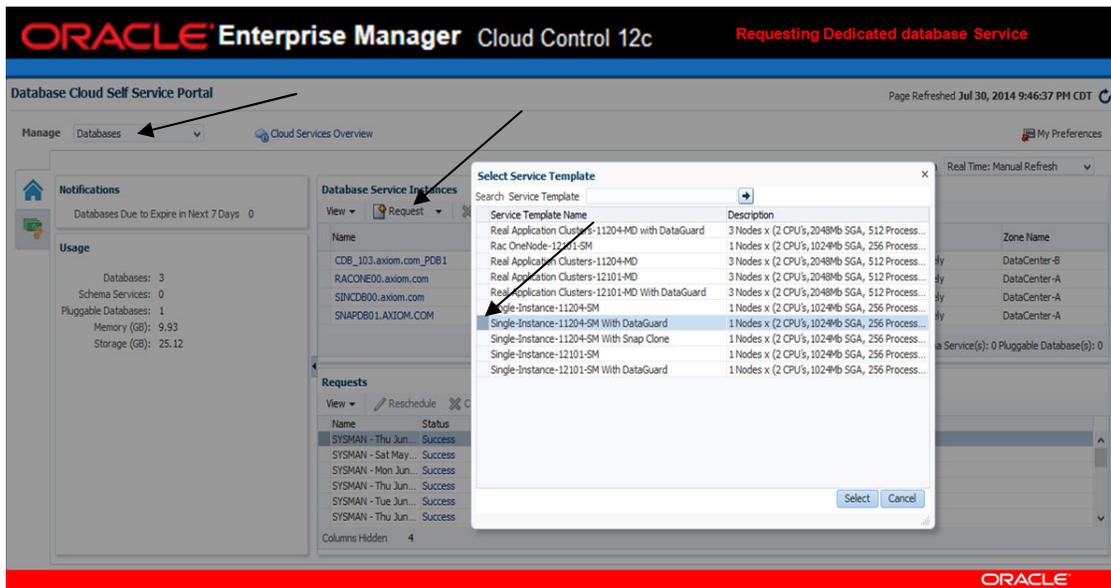
Review the configuration setting and save the Service Templates.

Step 10: Using Self Service Portal

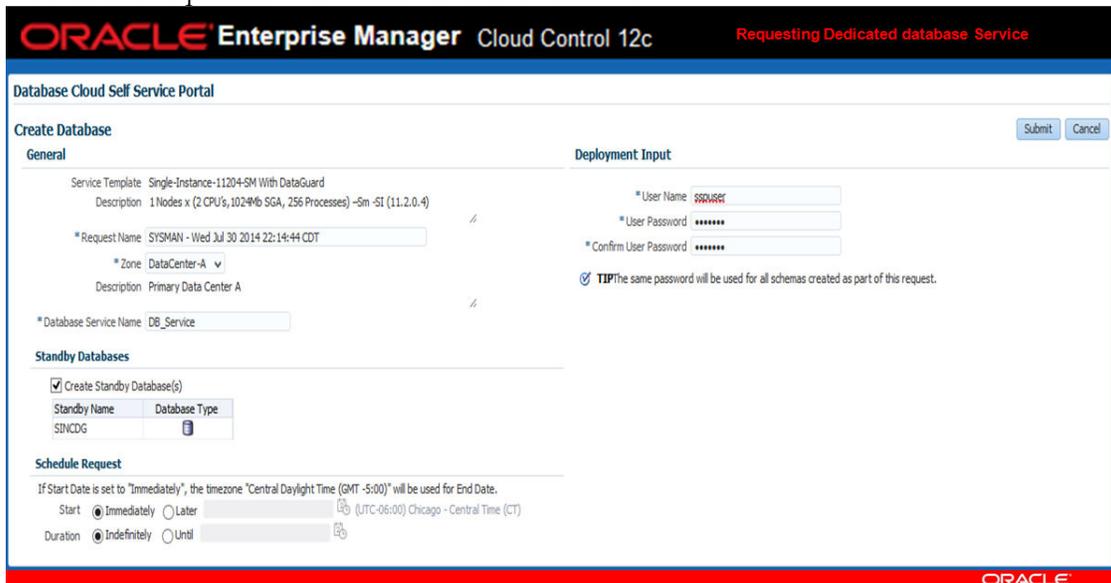
Requesting Dedicated Database

Navigate to **Enterprise > Cloud > Self-Service Portal**

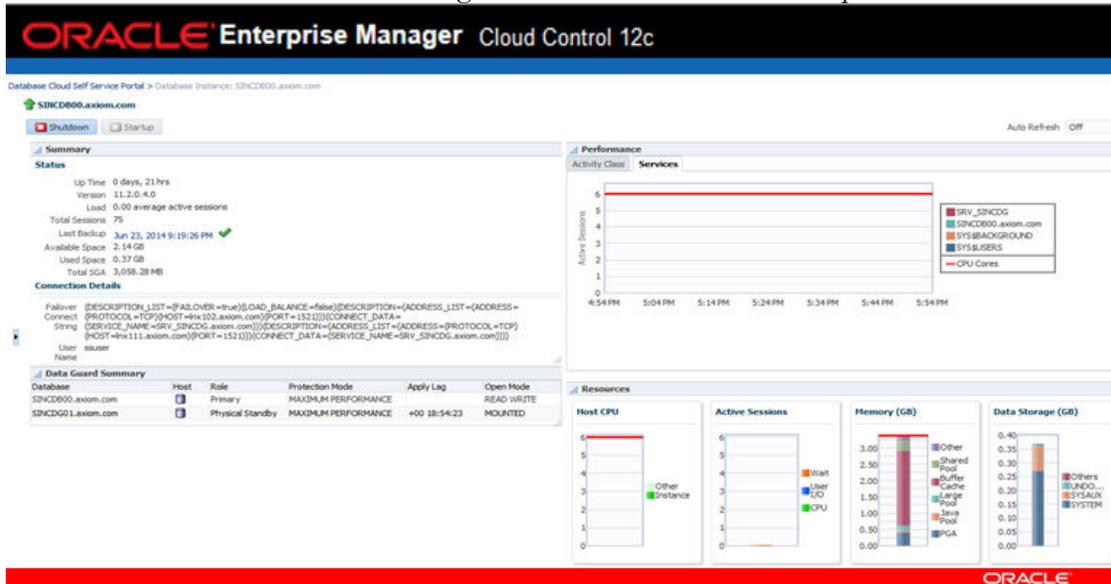
1. Select Databases from the Manage dropdown menu
2. Click the Request button and select Database
3. Select the Service Template



Provide the requested information and click Submit.



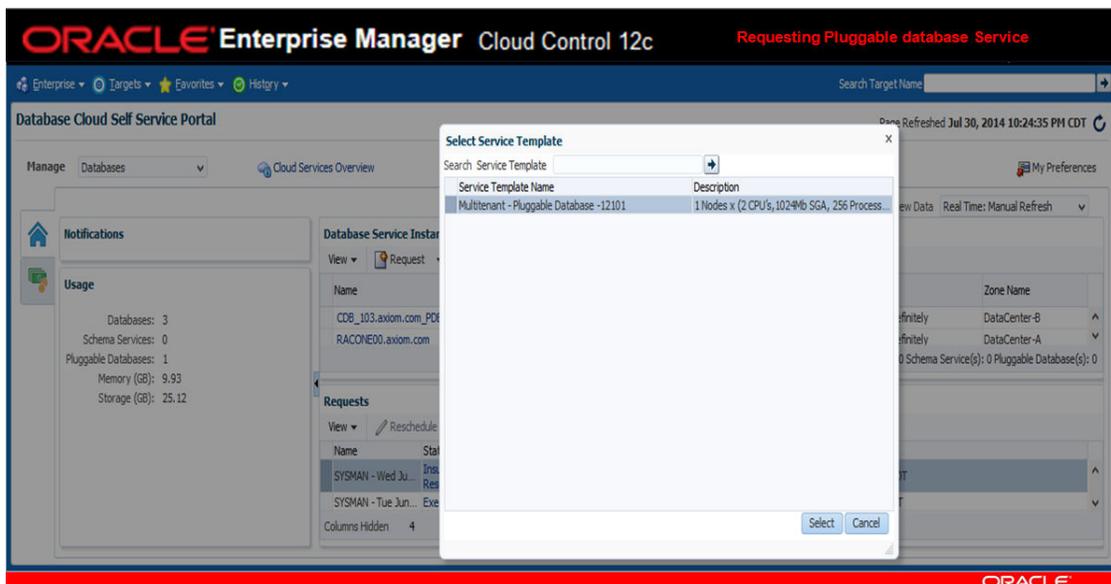
After the database request is created it can be managed again through the Self-Service-Portal. The screen below shows a single instance and DataGuard request.



Requesting Pluggable Database

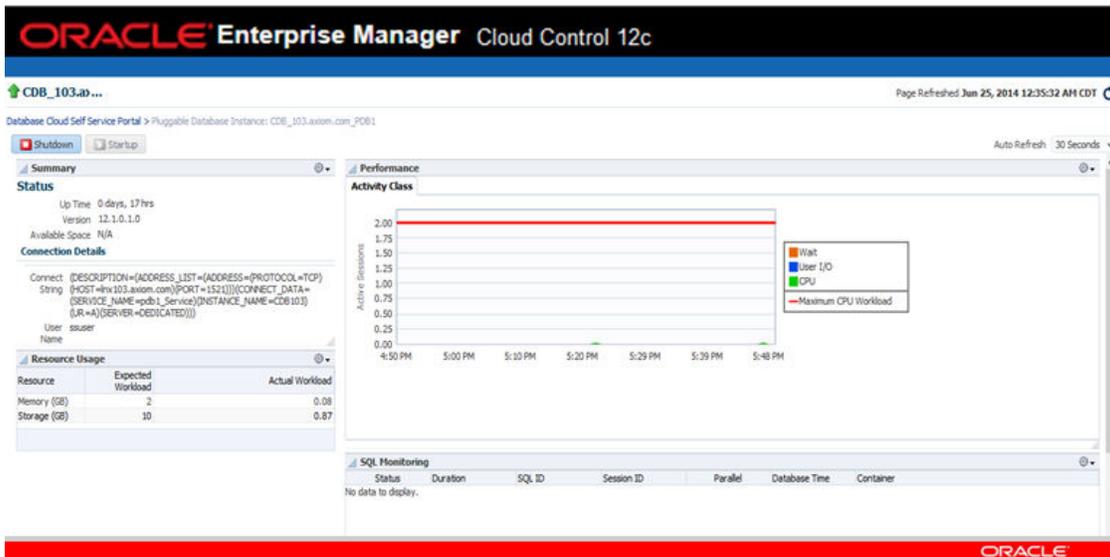
Navigate to **Enterprise > Cloud > Self-Service Portal**

1. Select Databases from the Manage dropdown menu
2. Click the Request button and select Pluggable Database
3. Select the Pluggable Database Service Template



Provide the requested information and click Submit.

After the pluggable database request is completed, the pluggable database can be managed again through the Self-Service-Portal. The screen below shows a pluggable database 12.1.0.1.



Managing Your Private Database Cloud

Defining Monitoring Architecture

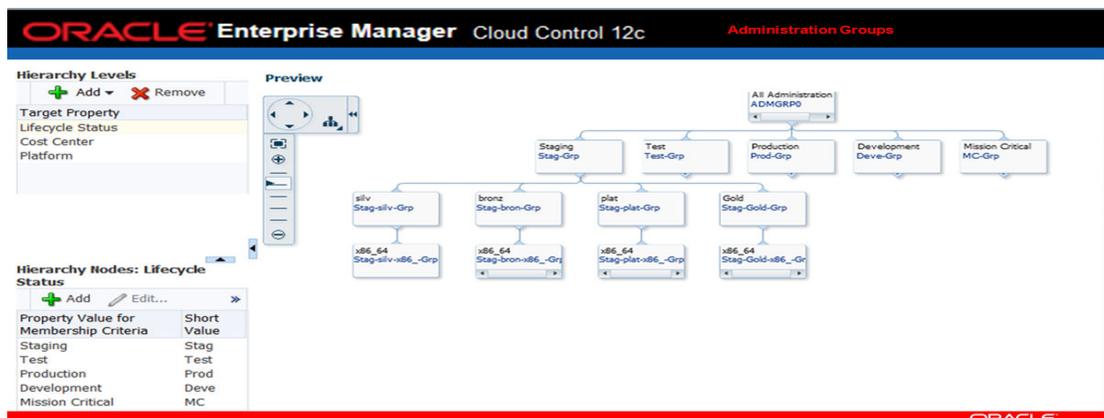
Setting up Oracle Enterprise Manager's monitoring architecture requires the configuration of the following features. The features below should be carefully designed and configured to ensure the Enterprise Manager targets are monitored, are in compliance, alerted and optionally chargeback properly.

Additional guidance on monitoring strategies can be found on the following white paper [Strategies for Scalable, Smarter Monitoring using Oracle](#).

1. The Administrations Groups and Template Collections
2. Incident Management and Incident Rules
3. The Compliance Framework
4. Metering and Chargeback/Showback

Administration Groups

In larger implementations, not all targets have the same criticality. Targets that support critical applications should be treated differently than development targets. Setting up the Enterprise Manager Administration Groups will allow the cloud administrator to segregate the Enterprise Manager Estate based on different usage profiles. A large Estate is likely to have different sets of monitoring settings (i.e. metrics, thresholds, collection schedules, corrective actions) for each usage profile. The details of specific metrics to monitor, the threshold values to use, as well as designing the Administration Groups hierarchy are outside the scope of this paper. The example below illustrates an Estate where the targets have been segregated by lifecycle status, database tier and server platform.



Incident Management and Incident Rules

Incident Management is a functional area in Oracle Enterprise Manager 12c that builds upon the existing monitoring capabilities. The main goal of Incident Management is to enable the cloud administrator to monitor and resolve service disruptions quickly by business priority. Instead of managing numerous discrete events, this feature enables the creation and management of fewer incidents.

Oracle Enterprise Manager 12c also provides features to assign, track, diagnose, notify and resolve the incidents.

Incident Rules enable the cloud administrator to automate operations on events, incidents, and problems. For example, you might want to create a rule that will automatically create an incident for target down events, or you might have another rule that sends notifications for critical incidents. In order to eliminate unnecessary alerts, the Enterprise Manager cloud administrator should implement a number of incident rules to tunnel alerts properly.

ORACLE Enterprise Manager Cloud Control 12c Incident Rules

Incident Rules - All Enterprise Rules Page Refreshed Jul 31, 2014 1:20:04 AM CDT

A rule set is a collection of rules that applies to a common set of objects, for example, targets, jobs, and templates. A rule contains a set of automated actions to be taken on specific events, incidents or problems. For example, individual rules can respond to incoming or updated events, incidents, or problems, and then take actions such as sending e-mails, creating incidents, updating incidents, and creating tickets. Rule sets and rules are evaluated and applied in the order specified. You can change the order using the Reorder Rule Sets action.

Name	Description	Order	Enterprise Rule Set	Owner	Enabled	Email Me	Last Updated
Incident management rule set for all targets	Rule set to create ...	1	✓	System Generated	Yes	No	Jun 6, 2014 2
Event Management Rule set for Self Update	Rule set to manag...	2	✓	System Generated	Yes	No	Jun 6, 2014 2
DBaaS_Metric_Rule_Set		3	✓	SYSMAN	Yes	No	Jun 18, 2014
Production_Critical_Metric_Alerts		3.001			Yes	No	Jun 19, 2014
Production_Warningl_Metric_Alerts		3.002			Yes	No	Jun 19, 2014
Development_Metric_Alerts		3.003			Yes	No	Apr 17, 2014
All_Job_Issues_Alerts		3.004			Yes	No	Apr 17, 2014
OS_Monitoring RealTime Facet		3.005			Yes	No	Jun 12, 2014

The example above illustrates the creation of an Incident Rule that enables the cloud administrator to limit the amount of alerts that are forwarded to operations. The Rule "Production_Critical_Metric_Alerts" will only forward alerts to operations (using Netcool), if the target property *Lifecycle Status* is set to Production or Mission Critical.

Compliance Framework

In a private cloud implementation, it is required to measure the security and overall compliance of DBaaS, as well as provide the high level compliance state of the estate to the business. In addition, the details of every violation should be provided to the compliance administrator in order to further investigate and resolve the violations. This can be easily achieved using the Oracle Enterprise Manager 12c Compliance Framework.

Oracle Enterprise Manager 12c uses a hierarchical approach to compliance monitoring. Starting with Compliance Frameworks, Compliance Standards and Compliance Rules. Oracle Enterprise Manager 12c, out of the box, provides 300 Compliance Rules that can be utilized immediately.

In addition to the Compliance Rules, Oracle Enterprise Manager 12c also provides, out of the box, a number of preconfigured Compliance Frameworks that are shown below:

For instance, the Payment Card Industry Data Security Standard (PCI DSS).

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for DBaaS Compliance. The page title is "ORACLE Enterprise Manager Cloud Control 12c DBaaS Compliance". The main content area is titled "Compliance Library" and includes a search bar and a table of compliance frameworks. The table has columns for "Compliance Framework", "Description", "Compliance Framework State", and "Au Keywords".

Compliance Framework	Description	Compliance Framework State	Au Keywords
Axiom Compliance Framework	A standard set of policies and associated controls for tracking changes and events taking place across your IT infrastructure for determining how well your organization is in compliance with your IT policies	Production	Security
Certification	A set of standards for tracking certifications of Oracle products across your IT infrastructure	Production	Configuration
Fusion Applications Compliance	A set of standards for Oracle Fusion Applications	Production	Configuration
Oracle Engineered Systems Compliance	A standard set of policies and associated controls for tracking changes and events taking place in your Oracle Engineered Systems for determining how well your organization is in compliance with your IT policies.	Production	Security
Oracle Generic Compliance Framework	A standard set of policies and associated controls for tracking changes and events taking place across your IT infrastructure for determining how well your organization is in compliance with your IT policies	Production	Security
Oracle Identity Management Compliance	A set of standards for performance tuning and best practice of Oracle Identity Management components	Production	Configuration
Oracle Support Compliance	Collection of controls that check for expected environment compliance for Oracle Supportability	Production	Configuration
PCI DSS (Version 2.0) - Example Only	Payment Card Industry Data Security Standards (PCI DSS) - Example Only	Production	Security
Security Technical Implementation Guide (STIG)	A set of standards to ensure Security Technical Implementation Guide (STIG) compliance.	Production	Security
Support Policy	A set of standards for tracking supportability of Oracle products across your IT infrastructure	Production	Configuration

Depending on the business requirements it may be necessary to create custom Compliance Frameworks and Standards that satisfy additional business requirements. Additional information on configuring and managing the DBaaS [Compliance](#) can be found in the Oracle documentation.

Showback/Chargeback:

In a private cloud implementation, it is often required to measure resource utilization of the cloud translated into currency and Chargeback the organization that utilizes the resources. Oracle Enterprise Manager's 12c metering and chargeback feature which are part of the *Oracle Consolidation Planning and Chargeback* plug-in uses the collected monitoring and configuration data to derive metric and chargeback data.

Oracle Enterprise Manager's 12c metering and chargeback features provide the cloud administrator the following capabilities:

- Ability to meter Oracle Enterprise Manager 12c targets
- Ability to assign rates to a metered resource
- Ability to manage a Cost Center hierarchy for Chargeback
- Ability to assign resources to a Cost Center

With the integration of Oracle Enterprise Manager 12c and the BI Publisher, the chargeback administrator can create custom reports that fit the needs of the business in addition to the reports that are available out of the box.

Oracle Enterprise Manager 12c enables the chargeback administrator to define external recipients for chargeback reports and choose from a variety of formats such as HTML, PDF, RTF, Excel and PowerPoint. BI Publisher is able to publish these reports to a website/portal or email them directly to the recipients.

The basis for metering and chargeback are metrics collected by Enterprise manager 12c. There are three types of chargeback metrics, configuration-base, availability-base and usage-base.

1. Configuration-based metrics refer to metrics such as number of CPUs or database versions; these metrics are considered static and have a daily aggregation.
2. Availability-based metrics measure the time an entity is available, also known as an entity's uptime. It is the number of minutes in a given hour an entity is considered available. The charge is prorated for downtime.
3. Usage-based metrics refer to metrics such as CPU utilization or memory consumption and have an hourly aggregation.

The table below is an example of Oracle pluggable database chargeable entities and their associated metrics. With the latest version of Oracle Enterprise 12c, version 12.1.0.4, custom target types and metrics can be added to satisfy additional requirements.

Entity Type	Item	Resource Category	Source Type	User-Defined	Item Description
Oracle Pluggable Database	Base Charge	Instance	fixed		Base charge for an Oracle Pluggable Database
Oracle Pluggable Database	CPU Count	CPU	config		Logic CPU core count
Oracle Pluggable Database	CPU Time	CPU	metric		CPU time used by PDB instance (second)
Oracle Pluggable Database	CPU Utilization	CPU	metric		Percentage used of the total CPU time
Oracle Pluggable Database	CPU Utilization (SPECint(R)_rate_base2006)	CPU	metric		
Oracle Pluggable Database	DB Time	Instance	metric		Database time used by PDB instance (seconds)
Oracle Pluggable Database	Disk Read (Physical) Operations	Storage	metric		Count of reads from all physical disks.
Oracle Pluggable Database	Disk Write (Physical) Operations	Storage	metric		Count of writes to all physical disks
Oracle Pluggable Database	Edition	Instance	config		Database edition
Oracle Pluggable Database	Machine Architecture	CPU	config		Host CPU architecture
Oracle Pluggable Database	Option	Instance	config		PDB instance database options or features used
Oracle Pluggable Database	RAC Node Count	Instance	config		Number of the nodes in the rac
Oracle Pluggable Database	Release	Instance	config		Database release
Oracle Pluggable Database	SQL Executes	Activity	metric		Total SQL execution count
Oracle Pluggable Database	Tablespace Size	Storage	config		Total PDB instance disk space allocation (GB)
Oracle Pluggable Database	Uptime	Uptime	metric		Total instance up time (hours)
Oracle Pluggable Database	User Transactions	Activity	metric		Total user transactions
Oracle Pluggable Database	Version	Instance	config		Database version

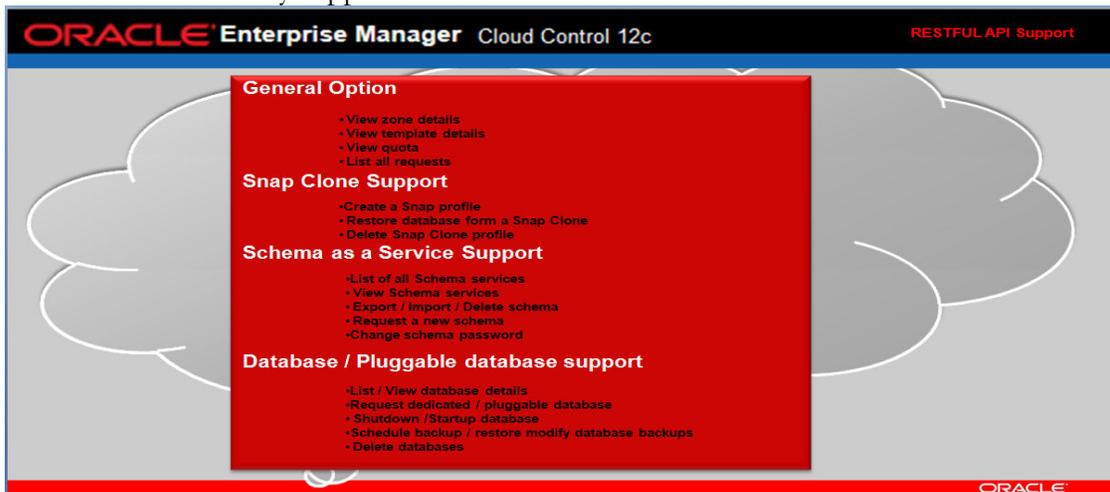
Additional information on metering and chargeback can be found in the [Chargeback whitepaper](#).

Expose Service Catalog via RESTFUL APIs:

The Oracle Enterprise Manager 12c Cloud Management Pack provides the ability for integration with external web services using [RESTFUL API's](#) that use JSON payloads and operate on the Enterprise Manager cloud resource model to drive automation from external systems.

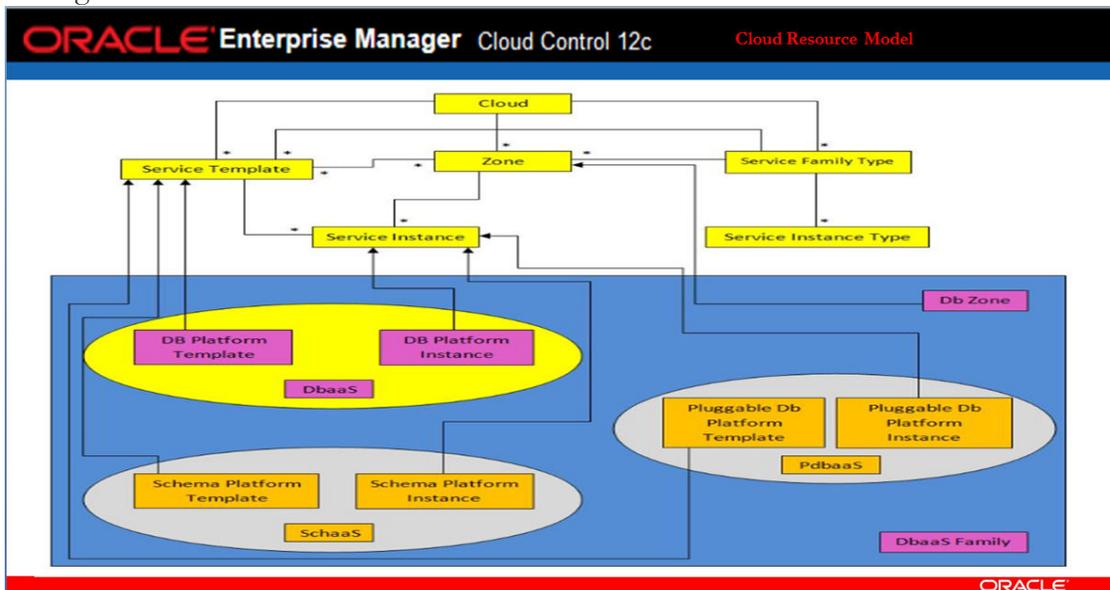
The RESTFUL API's help integrate existing IT infrastructure and resources with cloud workflow, as well as connect different cloud services together and can be utilized to create custom self service portals for cloud workflows.

The list of the currently supported Restful API's are listed below:



Cloud Resource Model

The figure below shows the DBaaS Resource Model:



The following table describes the operations that are supported by the Database as a Service family type.

ORACLE Enterprise Manager Cloud Control 12c		DBaaS REST Operations			
Resource	Description	Operations			
		GET	POST	PUT	DELETE
Cloud	A cloud represents the user's starting view of all accessible resources	✓	✗	✗	✗
Service Family Type	A service family type is a category of services that are offered by the cloud. For example, IaaS, DBaaS, <u>MWaaS</u> , etc. These categories are predefined.	✓	✗	✗	✗
DBaaS Zone	A DBaaS zone represents a logical boundary where the resources may reside to support deployment of database services	✓	✓	✗	✗
DB Platform Template (DB, Schema, pluggable)	A DB platform template represents the definition of the deployable database service	✓	✓	✗	✗
DB Platform Instance (DB, Schema, pluggable)	A DB platform instance describes the metadata about databases deployed using the service templates.	✓	✓	✗	✓

The following table describes the DBaaS Resource Model specifications for all the supported API's.

ORACLE Enterprise Manager Cloud Control 12c		DBaaS REST Operations
Resource	URI Format	Media Type
Cloud	/em/cloud	application/oracle.com.cloud.common.Cloud+json
Service Family Type	/em/cloud/service_family_type/dbaas	application/oracle.com.cloud.common.ServiceFamilyType+json
DBaaS Zone	/em/cloud/dbaas/zone/<zone id>	application/oracle.com.cloud.common.DbZone+json
DB Platform Template	/em/cloud/dbaas/dbplatformtemplate/<template id>	application/oracle.com.cloud.common.DbPlatformTemplate+json
DB Platform Instance	/em/cloud/dbaas/dbplatforminstance/byrequest/<request id>	application/oracle.com.cloud.common.DbPlatformInstance+json
Schema Platform Template	/em/cloud/dbaas/schemaplatformtemplate/<template id>	application/oracle.com.cloud.common.SchemaPlatformTemplate
Schema Platform Instance	/em/cloud/dbaas/schemaplatforminstance/byrequest/<request id>	application/oracle.com.cloud.common.SchemaPlatformInstance
Pluggable Platform Template	/em/cloud/dbaas/pluggabledbplatformtemplate/<template id>	application/oracle.com.cloud.common.PluggableDbPlatformTemplate+json
Pluggable Platform Instance	/em/cloud/dbaas/pluggabledbplatforminstance/byrequest/<request id>	application/oracle.com.cloud.common.PluggableDbPlatformInstance+json

The following example illustrates a RESTFUL API request that retrieves the available service templates. The table above illustrates additional requests which can be composed.

The screenshot shows the Oracle Enterprise Manager RESTclient interface. The title bar reads "ORACLE Enterprise Manager Cloud Control 12c" and "REST API - View Available Service Templates". The interface includes a menu bar with "File", "Authentication", "Headers", and "View". Below the menu bar, there are "Favorite Requests" and "Setting" options, and the "RESTclient" logo.

The "Request" section shows a Method of "GET" and a URL of "https://10.0.0.60:7799/em/cloud/service_family_type/dbaas". A "SEND" button is visible.

The "Headers" section shows an Authorization header: "Authorization: Basic c3lzbWVuOIR..." and a media_type header: "media_type: application/oracle.com.cloud.common.ServiceFamilyType+json".

The "Response" section shows a JSON response. A red box highlights a specific element in the "service_templates" array:

```
{
  "uri": "/em/cloud/service_family_type/dbaas",
  "name": "dbaas",
  "resource_state": {
    "state": "READY"
  },
  "media_type": "application/oracle.com.cloud.common.ServiceFamilyType+json",
  "canonicalLink": "/em/websvcs/restful/extws/cloudservices/service/v0/ssa/em/cloud/service_family_type/dbaas",
  "type": "dbaas",
  "service_templates": {
    "media_type": "application/oracle.com.cloud.common.ServiceTemplate+json",
    "total": "12",
    "elements": [
      {
        "uri": "/em/cloud/dbaas/dbplatformtemplate/FC2B26EE1CB438AEE0433C00000A7EC5",
        "name": "Real Application Clusters-11204-MD with DataGuard",
        "description": "3 Nodes x (2 CPU's,2048Mb SGA, 512 Processes)- Md -RAC (11.2.0.4)",
        "media_type": "application/oracle.com.cloud.common.DbPlatformTemplate+json",
        "service_family_type": "dbaas",
        "type": "dbaas",
        "canonicalLink": "/em/websvcs/restful/extws/cloudservices/service/v0/ssa/em/cloud/dbaas/dbplatformtemplate/FC2B26EE1CB438AEE0433C00000A7EC5"
      }
    ]
  }
}
```

Conclusion

The latest release of Enterprise Manager 12c Cloud Framework provides a abundance of new features and together with the Enterprise Managers' core features makes the Enterprise Manager 12c a critical data center application. Using Enterprise Manager 12c infrastructure, organizations can remove infrastructure barriers and significantly improve delivery of database services, compliance, availability and performance of critical applications.



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