



Accelerate the Journey to Enterprise Cloud with Oracle Database 12c

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Introduction

The promise of cloud computing—greater agility, less risk, and lower costs—is real, but realizing that promise depends on the approach you adopt. Oracle offers choice and flexibility with the most comprehensive, modern, and secure portfolio of cloud products and services to meet all your business needs and deliver the full benefits of cloud computing.

To meet all your business requirements, you need a cloud strategy that leverages leading hardware and software solutions with a range of enterprise and industry applications. You need technology that will complement—and enhance—your existing IT environments. And you need a vendor with experienced professionals who can support you no matter where you are in the cloud lifecycle. With these resources you can design and build a flexible, secure and unified cloud that can host all of your enterprise workloads: an enterprise cloud. An enterprise cloud goes beyond the capabilities of specialized offerings to address all your business needs in a single architecture. Only Oracle offers the full portfolio of services and products required to build an enterprise cloud.

Making the full transformation to an enterprise cloud may take several years, and will affect many aspects of organizations and roles, processes, policies and service delivery. We've seen many enterprises organize their transformation into a phased approach—a journey to enterprise cloud. The journey implements discrete steps that are each achievable and provide significant benefits. So however fast or far each organization chooses to go, they derive immediate value from even their initial steps.

Oracle Database 12c is designed to enable enterprise clouds and delivers new capabilities and benefits at each phase of the journey:

- Efficient and Secure Consolidation for Mixed Workloads
- Resilient, Location-independent Database Services
- Agile, Automated Resource and Data Management
- Centralized, Standardized Management of Software Images

This paper examines the new features in Oracle Database 12c that will accelerate your journey to enterprise cloud.

The Journey to Enterprise Cloud

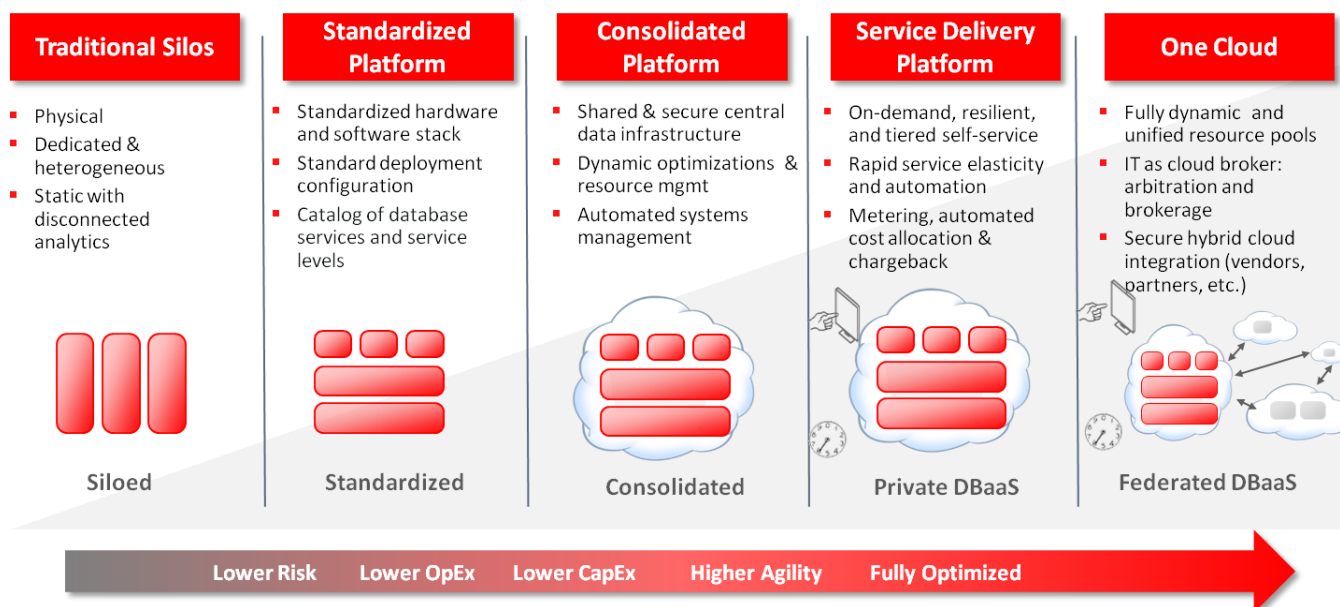


Figure 1: The Journey to Enterprise Cloud


Standardization

The journey begins with simplifying the legacy IT estate and the processes that manage it by standardizing at every level. Deployments are provisioned in a modular, assembly-line model rather than the traditional custom-built, artisan manner. The resulting environments and services are simpler and more uniform, so they can be deployed faster and managed more easily, reducing operating costs and business risk while delivering services more quickly.

To simplify the IT estate, the inventory of vendors, hardware, software, service offerings and processes is rationalized to the smallest set that is needed. Servers, storage and software infrastructure are deployed in standardized “building blocks” that can be quickly and reliably provisioned. Database deployment options are defined in a service catalog from which users choose attributes such as availability level, performance objectives and security options.

There are usually some exceptional cases, such as legacy platforms or special security needs, and planning for these is part of this process. To minimize such cases, IT should collaborate with the database service consumers to define infrastructure building blocks and service catalogs that will address the large majority of an enterprise’s requirements and simplify the estate as much as possible.

One of the marquee options of Oracle Database 12c is Oracle Multitenant. As we will see in more detail, collections of pluggable databases (PDBs) can be easily managed as a single entity, which greatly simplifies and speeds



administration. This also enforces standardization since each PDB is controlled by a single framework. We'll see many more reasons why standardizing on Oracle Database 12c should be a key component of your enterprise cloud journey.

Consolidation

Lowering expenses – both CapEx and OpEx – is the key benefit of consolidating workloads onto shared infrastructure. The same amount of work can be done with a smaller footprint, so capital expenses are reduced. The number of distinct environments is reduced, so operating expenses are also lowered. Finally, provisioning a new service onto a pre-deployed shared environment is faster than provisioning a dedicated environment for the service from scratch. Consolidation therefore enables rapid provisioning of new services.

In all consolidation architectures, the consolidated workloads share the same physical infrastructure. One approach to consolidation is to place each workload in its own virtual machine, and consolidate those VMs onto shared servers. But this approach does not reduce the operating environments to be provisioned and managed, and is therefore the least efficient consolidation model. Instead, consolidation should be as high in the stack as possible to deliver the highest efficiency.


Rather than placing each workload in a dedicated VM, the workloads can be consolidated on a shared operating system. This reduces the environments to maintain, which increases administrative efficiency. Higher densities are possible, enabling greater reduction in hardware footprint and associated costs. For the Oracle Database, this approach can be easily implemented by consolidating multiple databases on a shared collection of servers. Oracle Database has several features which make this approach very effective, such as Database Resource Manager.

Consolidation density and efficiency can be further increased by hosting multiple database workloads in a single database management framework. New in Oracle Database 12c, the multitenant architecture provides exactly this environment, enabling highly efficient consolidation of standardized database services represented by pluggable databases (PDBs). Integrated with key database capabilities, this provides a highly efficient, secure and easy-to-manage consolidation.

Custom workloads may require very strong isolation. Encapsulating these workloads with virtualization may be required to allow consolidation onto a shared server infrastructure. A highly specialized workload may even require a dedicated platform and cannot be consolidated. These non-standard situations must be addressed, but they can be minimized by standardizing on a database that provides isolation capabilities that will handle most consolidation scenarios.

Oracle Database 12c for Efficient Consolidation

- Multitenant architecture: the most efficient consolidation of standardized workloads
- SQL Translation Framework: easier migration from non-Oracle SQL databases into standardized, consolidated Oracle Database 12c environments



To plan, build and operate a consolidation environment it is essential to leverage a full-featured management suite. Oracle Enterprise Manager 12c provides these capabilities and more. This paper will outline EM12c's features for enterprise clouds in a later section.

Service Delivery

The service delivery phase increases speed and agility by leveraging automation and dynamic, online operations. Services are provisioned faster, and operate at higher levels, with less manual attention. A self-service portal allows users to provision and manage database services without IT engagement. End users benefit from faster access to services, and better availability of those services. IT benefits by spending less time on manual operations, and can focus on higher-value initiatives.

Automated, dynamic management of resources is a key characteristic of a service delivery environment. In an environment managed with manual processes, adjusting a database's footprint requires human intervention. By contrast, a service delivery environment uses tools to monitor and dynamically adjust both resource allocations and footprint without impact to running workloads. Adjustments are faster and less error-prone, enabling higher resource utilization and higher service levels.

Because the environment is dynamic, metering and analyzing system operations becomes more important than in a more static environment. The key is choosing what to meter and when to look at the data, both periodically and event-driven. Triggers should be defined which result in audits and adjustments. For example, all system outages should be analyzed to address root causes and improve recovery policies. Missed SLAs or sustained operation at near-capacity are other examples of situations that should cause alerts and be investigated.

Metrics are also critical for measuring each tenant's resource usage. Tenants might be charged for usage, or perhaps only shown their usage. In either case, collecting usage metrics provides hard data that charts usage patterns, enabling better planning and budgeting, and identifying underutilized assets.

Self-service is made available to authorized users, so they can provision database services (from a menu of options defined in a service catalog) on their own. This removes another IT touch point, freeing IT for more valuable tasks, and speeding the provisioning process for end users. Users may also be granted various management capabilities for the entire database lifecycle.

Oracle Database 12c for Service Delivery

- Multitenant architecture: rapid creation, movement and cloning of application backends
- Rapid Home Provisioning for centralized management of standardized software images
- Quality of Service Management: Automated, policy-driven monitoring for an entire system
- Application Continuity: resilient database services

- Automatic Data Optimization: automated Information Lifecycle Management

With Enterprise Manager 12c these capabilities are available in a single management pane that orchestrates every aspect of Service Delivery.

Enterprise Cloud

The goal of the journey is to provide an enterprise cloud – a single architecture that can host all of the workloads of the enterprise and provide the highest possible levels of service availability. To achieve these requirements, the enterprise cloud extends the standard cloud model in several dimensions:

Unified

- Host all workloads in a single architecture, including those which require dedicated resources and environments
- Provide a single management pane for handling the entire estate and its lifecycle
- Single view of every type of deployment (public, private, community and hybrid)

Flexible

- Various service provisioning models to meet required SLAs
- Support for different cloud deployment models as needed to meet business needs

Resilient

- Services stay online during maintenance
- In-flight client work is not impacted by planned or unplanned outages
- Quality of Service-driven dynamic load balancing to ensure SLAs are met

Secure

- Differentiated security policies based on business criticality and data classification
- Enterprise-grade preventive, detective and administrative security
- Logical and physical isolation are applied as needed for sensitive workloads

Users can obtain compute capacity on-demand. Critical workloads are always available and responsive. An enterprise cloud achieves this by decoupling services from the environments that host them, creating service location independence, which allows services to leverage the entire capacity of the cloud.

Workloads are not bound to a specific pool, so if changes in workload patterns indicate that moving a given workload to a different pool is the best choice, the workload will be moved there without service interruption. Some workloads may be distributed across geographically separated pools for load balancing and resiliency.



Oracle Database 12c for Enterprise Clouds

- Flexible provisioning that supports all deployment options
- Active Data Guard Far Sync: Zero data loss at any distance
- Global Data Services: Extend database services across datacenters

An enterprise cloud will host all tiers, from applications to disk. Oracle can provide an enterprise cloud solution that supports all enterprise workloads and use cases. Starting from the foundation of the industry-leading Oracle Database, Oracle's portfolio includes unique capabilities that no competitor can offer.

Oracle Database 12c Accelerates the Journey to Enterprise Cloud

Oracle Database 12c brings key features that deliver benefits at each step of this journey, making the journey faster and easier, with higher value at each step.

Multitenant architecture: the most efficient workload consolidation

Oracle Database 12c introduces a multitenant architecture that simplifies the process of consolidating databases onto a cloud. It delivers all the benefits of managing many databases as one, yet retains the data isolation and resource prioritization of separate databases. The multitenant architecture enables the creation of one or more pluggable databases (PDBs) in a multitenant container database (CDB). Applications use PDBs exactly as they would use a dedicated database, so applications will be able to leverage PDBs with no code changes.

Most management operations are at the CDB level, so administrators can manage many PDBs with a single operation on the CDB. This supports standardization, because a single operation or configuration change is applied consistently to every PDB in the CDB, preventing configuration drift.

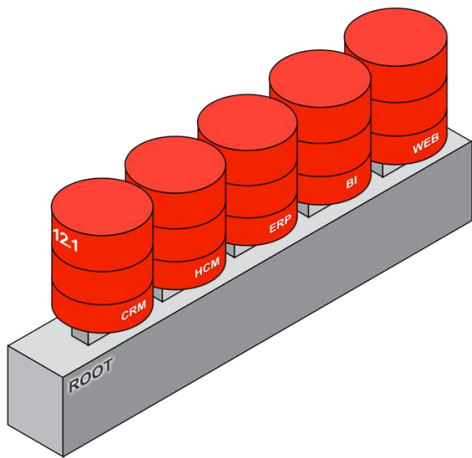


Figure 2: PDBs consolidated in a CDB

The multitenant architecture provides a very efficient consolidation model, since much of the overhead which every database required in the past is now handled just once in the CDB. Strong isolation for PDBs is available in several dimensions:


- Database Resource Manager provides resource isolation
- Each PDB may have its own encryption, providing security isolation
- Restricted administration privileges may be delegated to a PDB for administrative isolation
- Oracle Database Vault and Oracle Audit Vault and Database Firewall are PDB-aware, providing access control and consolidation of audit logs

The consolidated environment can be efficiently managed since many operations are at the CDB level and apply to all the PDBs within that CDB. Administrative and operational time are lowered, and applied with reduced risk. The Oracle database software version, initialization parameters and database properties are all CDB-level. Oracle Data Guard and scheduled RMAN tasks are managed at the CDB level.

PDBs can be provisioned very quickly. In many scenarios, a single command will complete the provisioning in a matter of seconds:

- Create a new PDB from a seed or cloned PDB
- Unplug from one CDB and plug into another CDB (which can be at a different version level)
- Clone on a file system that supports thin provisioning

Migrating an Oracle Database 11g database into a PDB is a straightforward task with a few simple steps.



For workloads that require high availability, the CDB should be deployed with Oracle Real Application Clusters (RAC). Each PDB can be made available on either every instance of the Oracle RAC CDB or on a subset of instances. In any case, access to and management of the PDBs are regulated using Dynamic Database Services, which will also be used by applications to connect to the respective PDB.

Note that while most workloads will be well suited for consolidation into a CDB, some workloads will require higher degrees of isolation. Deployment options supporting stronger isolation are supported with CDBs. At the other end of the spectrum, in environments that support higher levels of sharing, multiple CDBs can be consolidated together on a shared operating environment. In short, Oracle Database 12c supports all of the deployment models that an enterprise cloud may need.

Rapid Home Provisioning: centralized, standardized software management

Patching large software deployments can be time consuming and error-prone. Automation can help, but does not sufficiently reduce the complexity of supporting large software deployments. The existing processes were designed to enable customized deployments, where each home could be tailored to a different level and configuration.

As customers are starting to standardize their environments, new approaches to patching and upgrades become possible. In fact, customers often buy additional software to enforce standardisation in their current environment, to prevent level and configuration drift.

With Rapid Home Provisioning, customers can now create a gold image for each standardized software image they want to support, and easily provision and update homes using these gold images. In this way, they need only apply a new set of patches once, to the gold image, and then make this new binary level available throughout their enterprise for new, as well as existing deployments.

Rapid Home Provisioning supports multiple ways of distributing and updating software homes.

For deployment and test environments, often the most convenient approach is to use NFS-mounted homes. For production environments it is preferable to use local homes. Rapid Home Provisioning supports both deployment models.

Rapid Home Provisioning supports the following capabilities through the use of simple commands:

- Provision a new home, with or without a database
- Switch an existing database to a new gold image level
- Import existing homes into the environment

- Promote local homes to a gold image
- Mass upgrade all instantiations of a gold image to a new gold image level

SQL Translation Framework: easier migration

While migrating non-Oracle database objects and data is non-trivial, migrating the actual database applications is no less critical. Each of the relational database management systems has its own implementation of the SQL standard . The amount of custom SQL present in an application can largely define the amount of time required to fully migrate a database and its applications. This time consuming and error-prone process has been greatly enhanced with the introduction of the SQL Translation Framework in Oracle Database 12c.

The framework allows for the translators in Oracle SQL Developer to be loaded directly into the database as a collection of Java-stored classes and procedures. Once installed from SQL Developer to the database, the translator can be activated at the session or service level. Statements sent to the database will be parsed as non-Oracle SQL, translated, and executed. A collection of these translations are stored in a SQL Translation Profile. The contents of the profile can be reviewed, modified, and approved by the migration team to ensure the translations are accurate. Profiles can be created for each application to be migrated and can then be transferred between databases since the translations are portable.

This new capability eases and speeds the transition to Oracle Database 12c. By migrating data from various vendors to a single standardized platform, the variety and complexity of the IT estate will be lowered. Opportunities to consolidate into multitenant container databases (CDBs) will enable further efficiencies and associated savings.

QoS Management: automated, policy-driven monitoring

With Oracle Database 12c, Oracle Database Quality of Service Management (QoS) is part of the Oracle Real Application Clusters (RAC) license. It is an automated, policy-based mechanism that monitors workloads across an entire system, giving administrators a holistic view of the workloads and the resources handling them.

Oracle Database QoS Management monitors the performance of each work request on a target system. It starts to track a work request from the time it requests a connection to the database using a database service. The amount of time required to complete a work request, or the response time (also known as the end-to-end response time, or round-trip time), is the time from when the request for data was initiated and when the data request is completed. By accurately measuring the two components of response time - the time spent using resources and the time spent waiting to use resources - QoS Management can quickly detect bottlenecks in the system. QoS Management then makes suggestions to reallocate resources to relieve a bottleneck, thus preserving or restoring service levels.



Application Continuity: resilient database services

Clients connect to the database via database services. Maintaining database service availability during planned and unplanned outages enables more work to be completed by clients, since the outages will briefly interrupt work, but do not stop work indefinitely. The Oracle Database enables two increased levels of availability for database services:

High Availability

- In a single instance environment, if the lone instance running the database services is stopped due to an unplanned event, the database instance and its services can be quickly restarted on another node. The client must reconnect and restart the work. Oracle RAC One Node and Data Guard provide this level of availability for single instance deployments.
- For planned outages, Data Guard provides switchover capabilities similar to the failover behavior. Oracle RAC One Node addresses planned outages with Online Database Relocation, providing improved availability.


Continuous Availability

- In an Oracle RAC environment, a uniform database service runs on all nodes of a server pool. If a node is stopped due to a planned or unplanned event, clients can immediately reconnect to an instance of the service running on a surviving node.

Let us examine this last scenario. Although the outage time may be imperceptible, clients connected to the node that is stopped will need to reconnect to the service on a different node. The status of the in-flight work between the client and database is often not known.

For end users, this translates to experiences such as this: while shopping online, the user clicked “purchase” for an airline ticket. The browser began its wait cycle. Seconds passed. The user clicked “purchase” again. The cycle was repeated several times until finally the website responded: sorry, no more tickets available. The user was disappointed (and found a ticket on a different website with a different airline) but the user was even more upset when they learned the flight was sold out because they had accidentally purchased the last dozen empty seats.

Application Continuity addresses this problem and helps meet the requirements of continuous availability for database services by maintaining transaction state under most conditions, even when moved among nodes of an Oracle RAC deployment during planned maintenance or due to a node failure. This is provided by the ability to safely replay many transactions that were interrupted in-flight.



Application Continuity enables replay, in a non-disruptive and rapid manner, of a database request when a recoverable error makes the database session unavailable. The request can contain transactional and non-transactional calls to the database and calls that are executed locally at the client or middle tier. After a successful replay, the application can continue where that database session left off instead of leaving users in doubt not knowing what happened to their funds transfers, flight bookings, and so on, and for administrators' avoiding the need to reboot mid-tier machines to recover from logon storms. With Application Continuity, the end user experience is improved by masking many outages, planned and unplanned, without requiring the application developer to attempt to recover the request.

Automatic Data Optimization: automated ILM

Information Lifecycle Management (ILM) is the practice of applying policies for the effective management of information throughout its useful life. ILM includes every phase of a “row” from its beginning to its end, and consists of the policies, processes, practices, and tools used to align the business value of information with the most appropriate and cost effective IT infrastructure from the time information is conceived through its final disposition.

Automatic Data Optimization (ADO), new in Oracle Database 12c, can be used to create policies, and automate actions based on those policies, to implement your ILM strategy with techniques such as automated compression, movement of least-accessed data to lower cost infrastructure, and in-database archiving. This relieves administrators of the burdens of manually tracking and implementing your ILM strategy. This is increasingly business-critical as the volume and importance of data and the laws that govern its management grow. ADO leverages the new Heat Map feature. Heat Map automatically tracks data modification times at the row and segment level, and access times at the segment level, providing unprecedented insights into how data is being accessed. ADO and Heat Map are part of Oracle Advanced Compression and enable a more automated, services-driven deployment.

Active Data Guard Far Sync: zero data loss at any distance

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

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

Consider an asynchronous Data Guard configuration with a primary in New York, and a standby in London. Upgrade to zero data loss simply by using Active Data Guard to deploy a far sync instance within synchronous replication distance of New York (less than 150 miles). There is no disruption to the existing environment nor is there any requirement for proprietary storage, specialized networking, more database licenses, or complex management. With this enhancement, database services are more resilient, enabling higher service levels to database users.




Figure 3: Active Data Guard Far Sync – Zero Data Loss Protection at any Distance

Global Data Services: extend services across data centers

Global Data Services (GDS) extends database services to span multiple database instances (which can belong to different, synchronized databases) in near and far locations. GDS extends Oracle RAC-like failover, service management, and service load balancing to database configurations using Active Data Guard and GoldenGate for replication. GDS benefits include:

- Higher Availability with service failover across local and global databases.
- Better Scalability by providing load balancing across multiple databases.
- Better Manageability via centralized administration of global resources.

GDS provides inter- and intra-region load balancing across replicated databases. For example, it can distribute load across a reader farm composed of standby instances, and even direct some read traffic to the primary if conditions



warrant it. This enables true location independence for database services, which is a key characteristic of the enterprise cloud.

Navigate the Journey with Oracle Enterprise Manager 12c

Oracle Enterprise Manager is Oracle's integrated enterprise IT management product line, which provides the industry's only complete, integrated and business-driven enterprise cloud management solution. Oracle Enterprise Manager creates business value for IT by leveraging the built-in management capabilities of the Oracle stack for traditional and cloud environments, allowing customers to achieve unprecedented efficiency gains while dramatically increasing service levels.

- A complete cloud lifecycle solution allowing you to quickly set up, manage and support both enterprise clouds and traditional Oracle IT environments from applications to disk
- Maximum return on IT management investment through the best solutions for intelligent management of the Oracle stack with real-time integration of Oracle's knowledge base with each customer environment
- Best service levels through business-driven application management

Enterprise Manager supports every phase of the journey to enterprise cloud:

Standardization and Consolidation

- Database Lifecycle Pack - discovery, initial provisioning, patching, configuration management and ongoing change management; compliance frameworks for reporting and management of industry and regulatory compliance standards.
- Diagnostics Pack – real-time and automatic performance diagnostics and monitoring functionality built into the core database engine and EM 12c
- Tuning Pack (requires Diagnostics Pack) - add-on pack for management of Oracle Database, offers an extremely cost effective and easy-to-use solution that automates the entire application tuning process
- Real Application Testing - assess the effect of system changes on real-world applications in test environments before deploying the change in production.
- Consolidation Planner - part of EM Cloud Control; determines the optimum consolidation scenarios that also reflect business and technical constraints in the consolidation process
- Data Masking Pack - replace sensitive data with fictitious data so that production data can be shared safely with IT developers or offshore business partners.
- Test Data Management Pack - creates reduced size copies of production data for application development, training and testing while maintaining the referential integrity of the data set



Service Delivery and Enterprise Cloud

- Oracle Cloud Management Pack for Oracle Database delivers capabilities spanning the entire database cloud lifecycle. It lets cloud administrators identify pooled resources, configure role-based access, define the service catalog, and the related chargeback plans. Users can request database services, and consume them on-demand. Users can scale-up and down to adapt to changes in workload. Finally, it lets both providers and consumers understand the costs of the services delivered, and establish accountability for consumption of resources.

With deep support for Oracle Database 12c, Oracle Enterprise Manager 12c gives you a complete, out-of-the-box management solution for your enterprise cloud.

Conclusion

Oracle Database 12c delivers significant innovations to Oracle's industry-leading database technologies. The depth and breadth of the feature set is unique in the industry and enables a wide range of deployments. Customers designing and building enterprise clouds with Oracle Database 12c have a powerful and comprehensive portfolio to leverage: Oracle Multitenant, Oracle Database Quality of Service Management, Application Continuity, Automatic Data Optimization, Global Data Services and Active Data Guard Far Sync deliver key benefits of cloud computing.

With the powerful combination of Oracle Database 12c and Oracle Enterprise Manager 12c's out-of-the-box cloud management solution, customers can immediately realize significant benefits, including higher standardization, more efficient consolidation, better speed and agility, and resiliency and location independence for database services. Orchestrated by Oracle Enterprise Manager 12c, Oracle Database 12c delivers the promise of the enterprise cloud.

Further Reading

WHITE PAPER TOPICS	LOCATION
Plug in to the Cloud with Oracle Database 12c	http://www.oracle.com/technetwork/database/plug-into-cloud-wp-12c-1896100.pdf
Oracle Multitenant	http://www.oracle.com/technetwork/database/multitenant/overview/multitenant-wp-12c-2078248.pdf
Database Consolidation onto Private Clouds	http://www.oracle.com/us/products/database/database-private-cloud-wp-360048.pdf
Service Catalog for Private Database as a Service	http://www.oracle.com/technetwork/database/database-cloud/private/service-catalogs-for-dbaas-2041214.pdf
Rapid Home Provisioning	http://www.oracle.com/technetwork/database/database-cloud/private/rapid-home-provisioning-2405191.pdf
Migration to Oracle Database 12c	http://www.oracle.com/technetwork/database/migration/migrating-to-oracle-database-wp-12c-1896125.pdf
Oracle Database 12c - Oracle Real Application Clusters	http://www.oracle.com/technetwork/database/clustering/rac-wp-12c-1896129.pdf
Oracle Quality of Service Management	http://www.oracle.com/technetwork/products/clusterware/qos-management-12c-wp-1965512.pdf
Application Continuity	http://www.oracle.com/technetwork/database/database-cloud/private/application-continuity-wp-12c-1966213.pdf
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Hardware and Software, Engineered to Work Together

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