ORACLE 12c DATABASE

Oracle White Paper
November 2016

Service Catalogs: Defining Standardized Database Services

ORACLE

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Service Catalogs enable the evolution to enterprise cloud

The promises of cloud computing—greater agility, less risk, and lower costs—are real, but their realization depends on the approach you adopt. 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. Many enterprises have successfully organized their transformation into a phased approach—an evolution to enterprise cloud.

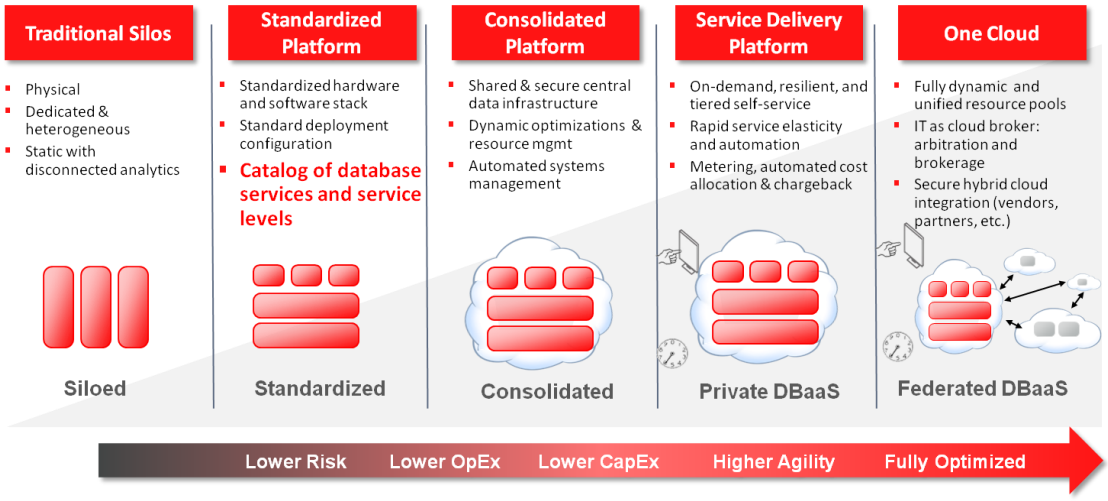


Figure 1: Evolution to enterprise cloud

The first step of this transformation is standardization, and one of the key deliverables that supports standardization is a service catalog. A service catalog is a collection of documents and artifacts which describe the services an IT organization provides, and specifies how those services are delivered and managed.

Standardized services can be deployed more quickly and repeatably than custom services. This benefits consumers directly since they have faster access to more reliable services, while the provider spends less time with the nuts and bolts of provisioning, and can focus on higher-value initiatives.

During its lifecycle, a standardized service will behave predictably during maintenance, unplanned outages, and under system load. Consumers and providers will have common, documented expectations for these scenarios.

Moving to a standardized environment is a significant change with important benefits. If done properly, standardization also paves the way for further steps. For example, if most deployments use the same operating system and database version, it is easier to consolidate those deployments together into a shared operating environment.

The service delivery phase of the evolution focuses on dynamic, policy-driven resource management. If the standardized components support those capabilities, then enabling a service delivery model is a simple matter of activating the supporting features and options of the environment – no upgrades or rearchitecting are needed.

Effective standardization

The effectiveness of standardization depends on several factors. One might assume that the more rigidly standardized an enterprise's services are, the better. But it is rarely possible to meet all of a large enterprise's IT requirements with a single deployment option. At the other end of the spectrum, each department or functional team cannot create individual "standards" that simply describe what each group happens to be doing.

For standardization to be effective, it must

- Apply across the entire enterprise
- Satisfy the majority of current and future use cases
- Allow for but minimize exceptions

When properly implemented and maintained, a service catalog enables effective standardization:

Enterprise-wide, end-to-end view of the IT estate

Each enterprise needs a single source which defines what IT provides, and specifies the components and processes that support those offerings. As the single source of information, the service catalog can be audited for consistency and uniformity — standardization (or its absence) can be readily seen. This facilitates the creation and enforcement of standardization.

Clear and consistent terminology defines all service offerings – this enables consumers to understand what each service provides (and does not provide), and the cost of each service. Services can be compared to other services both within the enterprise and to external (public cloud) services where appropriate.

Fulfill the majority of current and future use cases

Services should be designed that meet current and future consumer needs. To make this happen, the service offerings should be developed and evolved collaboratively between IT (hereafter referred to as the "provider") and end users (hereafter known as "consumers").

When the provider and consumers meet to define and evaluate the offerings, consumers have a forum to provide feedback and to understand new offerings and collections of services. The provider has a framework for refining the service offerings and an opportunity to guide consumers to appropriate services and beneficial behaviors.

Allow for but minimize exceptions

Some degree of flexibility must be available to accommodate non-standard cases, such as legacy applications or exceptional resource requirements. Defining a methodology for identifying and handling such exceptions is a necessary aspect of standardization and should be documented in the service catalog.

The exception process must not be too cumbersome, or administering it will be time consuming and contentious. Consumers who need an exception could choose to take their workload elsewhere (e.g., into a public cloud, creating a "shadow IT" scenario).

And, it must not be too generous, or consumers will not be compelled to adopt the new standards, but will be content to keep doing business as usual.

Finding the right balance between per-consumer flexibility (low standardization) and business agility (high standardization) is possible only when consumers and providers collaborate to develop and evolve a framework that is consistent for all stakeholders and can be adapted over time. The service catalog and its proper management meet those goals.

Service catalog overview

The catalog is divided into different components for different audiences. Collectively, the service catalog provides an end-to-end view of the entire IT estate and its management.

- The business catalog provides consumers with a succinct description of the salient features and costs of available services
- Selected services are exposed in a self-service catalog, allowing consumers to independently provision those services on demand
- The technical catalog is the provider's detailed guide to deploying and managing services

- Criteria for identifying and handling exceptions are specified

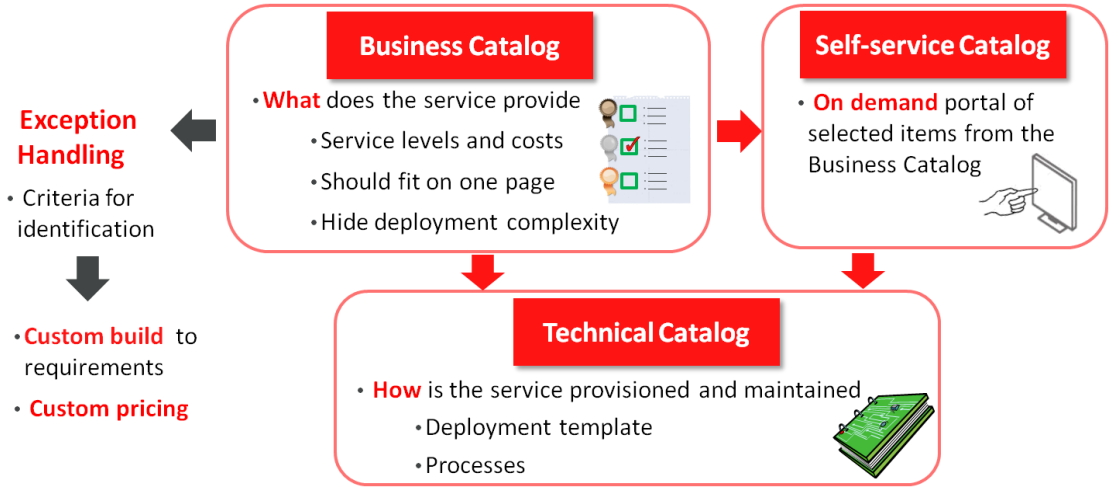


Figure 2: Service Catalog Components

Business catalog

The business catalog is the consumers' view of the services available. Typically, three or more service offerings will be defined. Often they are labeled with a scheme such as Bronze/Silver/Gold to provide a high-level differentiation. For each service, the capabilities, policies and procedures of the service are documented in formal terms that are relevant to the consumer.

The definition for each service offering should include:

- Description of the service offering, in business terms
- For each service category which defines the service, an explanation of the level of service provided
- How to order, change, learn more about the service offering

We will examine the different service categories that comprise a service offering in a following section.

Self-service catalog

An enterprise may wish to offer some of the services from the business catalog in an on-demand, self-service model. This will usually be a subset of the business catalog, i.e., those services well-suited for full automation, and services that are provisioned and deprovisioned frequently. Database services for test and development are a common example. More complex configurations, such as those with unique compliance or performance requirements, are not usually offered in a self-service catalog.

The self-service catalog will be an interactive portal through which consumers can deploy, monitor and manage services on-demand.

Technical service catalog

The technical service catalog is the provider's detailed guide for how to deploy and manage each service offering. For each service, there will be a standardized deployment template. The template includes every detail needed for provisioning the service: database edition, version, patch level; number of database instances; configuration parameters; options to be enabled (such as encryption to support a security requirement), and so on.

Ideally, the template should be fully portable so that the service can be deployed in a private or a public cloud. The template would specify any variations required to address the differences between the two provisioning models. There will also be variants to describe instantiations of the service for the different consolidation models in which services can be deployed.

Exceptions

It is unrealistic to expect that a service catalog can provide standardized offerings that address every possible service that a business may need. In fact, trying to enumerate every possible service variant will lead to a complex and confusing catalog. Instead, service attributes that trigger an exception should be spelled out, along with the response to non-standard requests. Unique sizing or isolation requirements are typical examples of such triggers.

However to encourage customers to adopt the standard services, the exception process should be less agile and more expensive than for standard services. By designing services which address most current and future needs, and encouraging their adoption, exceptions can be minimized to perhaps fewer than ten percent over time.

Case Studies

Our discussion so far may suggest that designing an effective service catalog is a simple process that will produce very similar results from one case to the next. To the contrary, we will see a wide variety in the customer examples that follow. For each case, we will highlight one or two items which illustrate the range of choices available to a catalog designer.

1. Extreme standardization at a large commercial bank

A large bank began an extensive transformation of its IT estate in 2008. One of their guiding principles for their transformation has been to enforce strong standardization. This is reflected in the bank's highly standardized service catalog for their Oracle Database offerings:

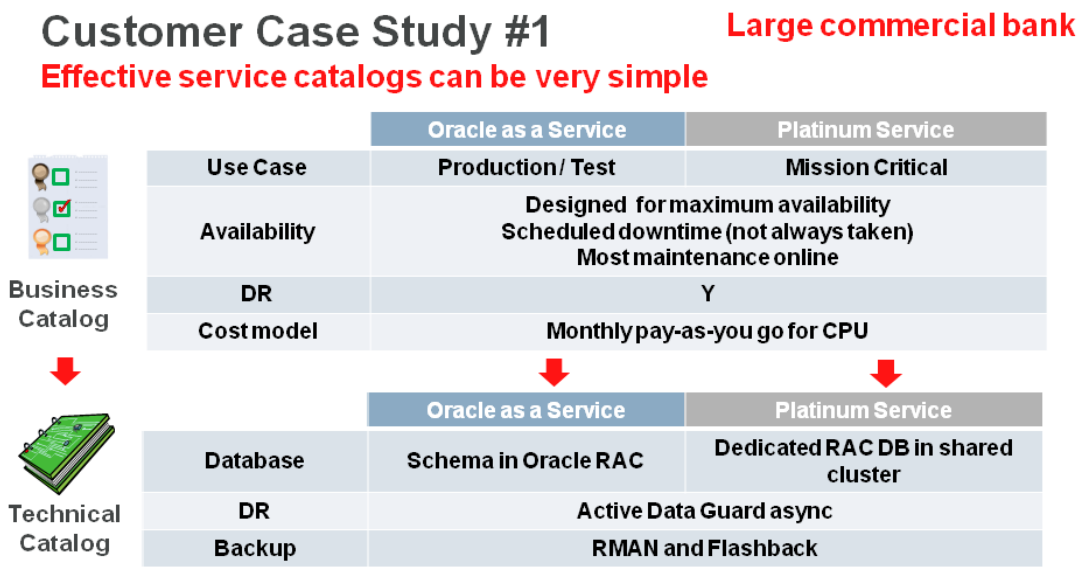


Figure 3: Service Catalog for a large commercial bank

Obviously, it is very easy for consumers to choose a service. And it is very straightforward to provide the selected service. The cost model is also very simple, and reflects the bank's decision to leverage the economics of standardization and consolidation by providing every consumer with the same high degree of availability and disaster recovery protection.

If a database service cannot be provided by the two choices above, then the bank creates a custom deployment. This process (intentionally) takes longer than deploying a service through the service catalog, thereby allowing but discouraging exceptions.

2. Security options for database services at a northern European bank

A worldwide bank based in northern Europe has developed five service levels which address about 80% of their Oracle Database deployments. Their business catalog reflects a common way to address security – it is handled orthogonally to other service categories:

Customer Case Study #2 Global financial services company

Security is usually handled as an orthogonal service level

		A	B	C	D	E
Use Case		Statistical, background	HRM, dev/test	Accounting, intranet	Mail, customer facing	Internet, banking
Availability	Uptime	98%	99%	99.5%	99.99%	99.99%
	RTO	12 hrs	4 hrs	2 hrs	1 hr	0
	RPO	24 hrs	0	0	0	0
Disaster Recovery	RTO	14 days	84 hrs	12 hrs	2 hrs	0.5 hr
	RPO	5 days	0	0	0	0
Security		Security class 1, 2 or 3				
Support hrs X days		9 x 5	9 x 5	10 x 5	16 x 6	24 x 7

Figure 4: Business Catalog for a global financial services company

The security classes are constructed to comply with relevant mandates from the national banking system. All three security options are applicable to and available for all of the service levels. When a particular service is provisioned, the selection of the security class is made by an oversight group.

Also, note that the service use cases give consumers helpful guidance for their selection. Recovery objectives and support hours are detailed so consumers know what to expect in the event of a localized failure ("Availability") or a large-scale incident ("Disaster Recovery").

Although 9's are used to describe availability, in practice this measurement is not emphasized at the bank. Several caveats (e.g., not applicable outside of support hours) make the 9's yardstick less relevant than the RPO / RTO targets and the support hours.

The technical catalog informs the provider (IT) of the database configuration and supporting options:

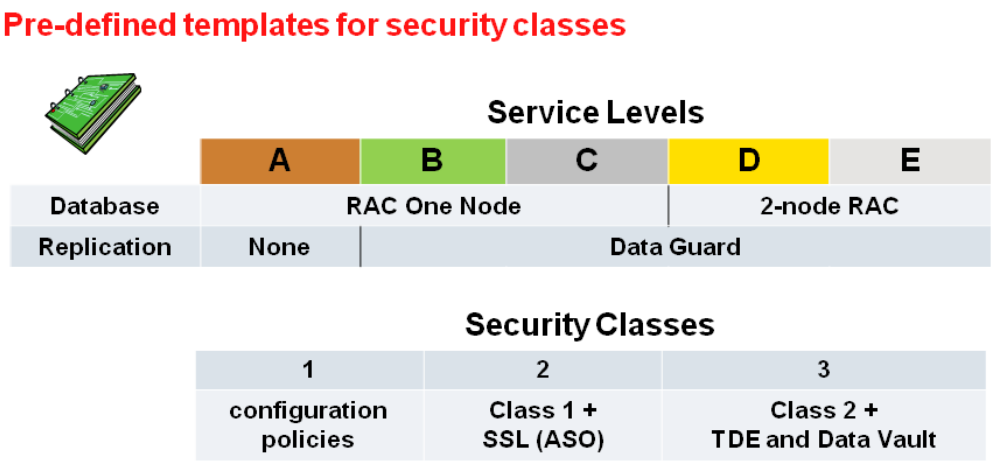


Figure 5: Technical Catalog for a global financial services company

The security classes are implemented with pre-defined templates; these details are not exposed in the business catalog.

Note that service levels A, B and C are all implemented with RAC One Node. While the bank determined that a Single Instance deployment could meet the availability requirements of level A, the bank sought to reduce the variety of supported deployments. Therefore RAC One Node is used for all three service levels.

3. Pre-defined templates and a "custom" option at a global insurance company

This customer offers three levels of DBaaS. For the first two tiers, the consumer chooses a database size from a set of pre-defined templates. This is a common approach and helps ensure that resources are appropriately balanced for each service. If a consumer needs a database service at the highest tier, then by definition there is a custom sizing exercise to define the resource allocation.

Customer Case Study #3 Global insurance company

Pre-defined, balanced sizings with allowance for customization

	Entry level	Business level	Advanced
Use case	non-critical system	Critical System	
Availability levels	One	One / Two / Three	One / Two / Three
Disaster Recovery	No	Yes	Yes
Performance Guarantees	No	Yes	Yes

Service Resources	Entry level				Business level				Advanced
	Cores	RAM GB	Disk GB	IOPs	Cores	RAM GB	Disk GB	IOPs Disk	
Small	No KPI	2	256	No KPI	1	4	256	512	Each deployment is a custom sizing
Medium		4	512		2	8	512	1024	
Large		8	1024		4	16	1024	2048	

Figure 6: Business Catalog for a global insurance company

Not reflected in the business catalog – the consumer does not need to know this – is the fact that Advanced services are deployed in a dedicated platform.

Some high-end services may require a dedicated flex-silo

	Entry level	Business level	Advanced
Hardware Infr	Shared cluster	Shared cluster	Dedicated cluster
Software Infr	OL 5.5, Grid Infr 11.2.0.3 (CRS and ASM), Database EE 11.2.0.3, RMAN, EM 12c Cloud Control		
	No DR software	Data Guard	

	Availability Level		
	One	Two	Three
Database Implementation	Single Instance in a one-server pool	RAC One Node in two-server pool	Two-node RAC in two-server pool

Figure 7: Technical Catalog for a global insurance company

4. Some database services may be deployed in Virtual Machines

While all of the other examples we have and will see follow the best practice of deploying Oracle Database services on bare metal, some enterprises have identified use cases which they wish to support by provisioning in a VM.

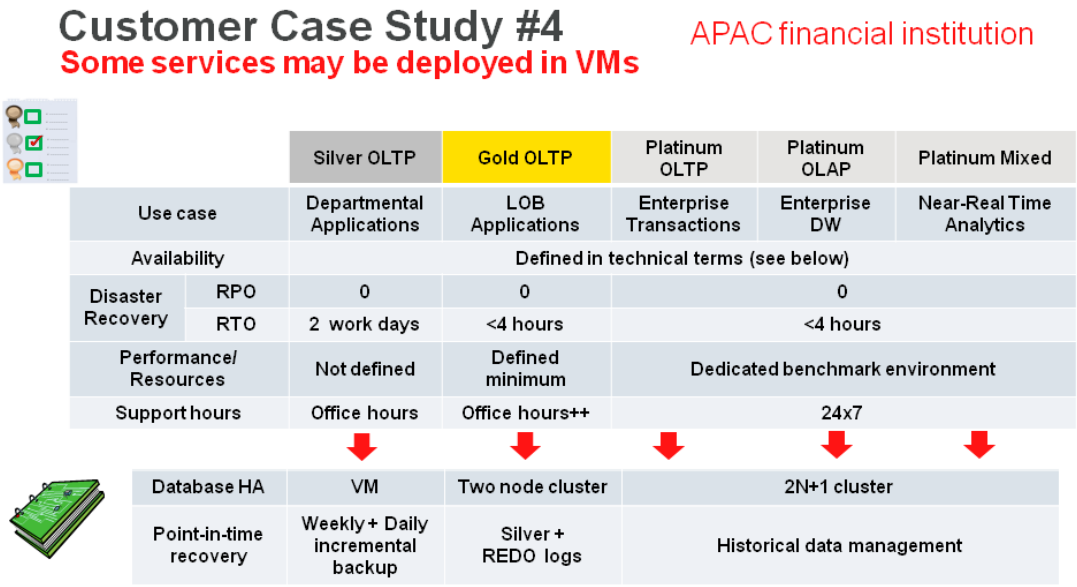


Figure 8: Service Catalog for a financial institution

Note that the provisioning detail of deploying in VM is not exposed in the business catalog.

5. Planned downtime is important to consumers

Planned maintenance of hardware and software is typically more frequent than unplanned events that can disrupt services. Maintenance may require service downtime, depending on the activity. To prepare consumers for maintenance events, several enterprises spell out pre-defined maintenance windows, so consumers can plan ahead for downtime.

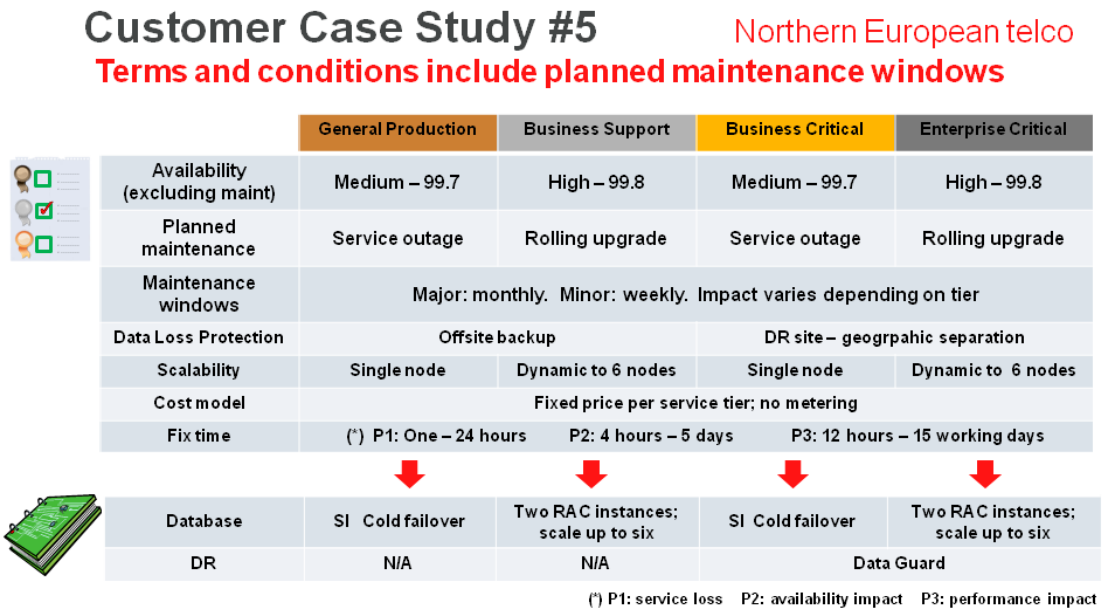


Figure 9: Service Catalog for a Telco

Providers report that although consumers may be reluctant at first to sign up for a service with planned downtime, they usually adapt quickly to the predictable schedule. For consumers that require customized maintenance terms, the provider has an opportunity to "upsell" that as a special service.

6. SLA specification can be general, or more precise

Defining RTO and RPO for overall availability – i.e., with any possible planned or unplanned event in mind – can produce misleading metrics, since they must account for the worst-case scenario. A worst-case scenario (such as site destruction) is very unlikely, so unless the architecture is designed to handle the worst-case quickly, then giving a single metric will not reflect the service's performance in the face of localized events.

This customer has divided availability into two categories – local and disaster – and provided separate metrics for the classes of events:

Customer Case Study #6 U.S. government agency

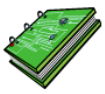
Differentiated SLAs defined with RTO / RPO

		Bronze	Silver	Gold	Platinum
Local Outage	RTO	Best effort	24 hours	8 hours	1 hour
	RPO	0	0	0	0
DR	RTO	Best effort	2 weeks	1 week	3 days
	RPO	80 hours	40 hours	24 hours	1 hour
Reserved capacity for DR		N/A	N/A	50%	100%

DB Size	CPU	RAM GB	Storage GB (min)	Adders
S	2	12	200	RAM Storage
M	4	24	400	
L	8	36	800	

Figure 10: Business Catalog for a U.S. government agency

This condensed representation of the customer's technical catalog provides a feel for the level of detail that the technical catalog should cover:



Technical catalog should be detailed

	Bronze	Silver	Gold	Platinum
Database 11gR2 (only)	EE	RAC One	RAC	
Database files mirror	Dual		Triple	
Remote Replication	No			Data Guard Async
Network isolation, no SPOF	Yes			
Exadata FRA	No		Optional	Yes
Exadata Smart Scan + Index	Yes			
Exadata Smart Flash Cache	No	Read		
On-line backup	No		Yes	
Backup and recovery	Tape	Disk		
Database Vault	No	Optional	Yes	
Standard features	-	Advanced Security, Internal Data Encryption, Advanced Compression		
Options	-	App to DB Server encryption, RAT		

Figure 11: Technical Catalog for U.S. government agency

Of course, the above is only a summary of the actual technical catalog. The actual document will cover more details such as how often to take backups, access controls for different users and administrators, and so on.

7. Provisioning services on different platforms

Most datacenters host more than one type of server platform. This European Telco deploys Bronze services on Oracle Exadata when those services support a Silver or Gold service (i.e., support a service that is by definition deployed on Exadata). Otherwise, the service is deployed on a non-engineered system.

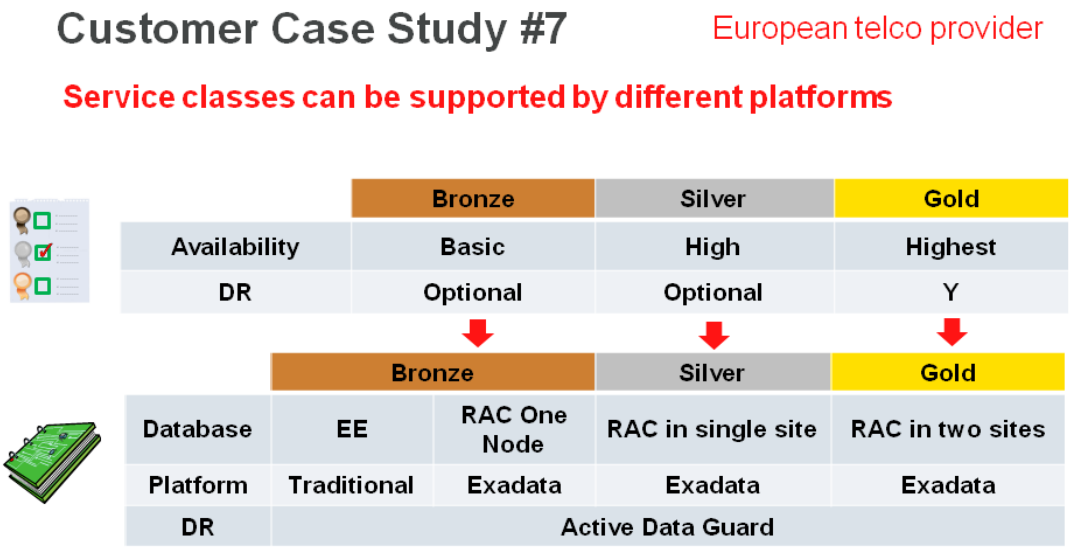


Figure 12: Business Catalog for Telco provider

This implementation detail is not exposed in the business catalog, since there is no choice or decision for the consumer to make, beyond the selection of a Bronze service.

8. Variability and options provide flexibility

This large financial institution specifies two levels of performance for services. Bronze and Silver services can be given more resources, but the activity must be scheduled ahead of time. Gold and Platinum services, on the other hand, can rapidly scale up as workloads demand.

Also note that availability is defined as a metric for Bronze and Silver services, and qualitatively for Gold and Platinum.

Customer Case Study #8 Large financial services company

Variable agility; qualifiers to tailor services

		Bronze	Silver	Gold	Platinum
Availability RTO		< 15 min (best effort)	< 15 min	Minimal business impact	
DR	RTO	> 24 hr	< 6 hr	< 30 min	
	RPO	<= 24 hr	<= 24 hr	< 30 min	0
Restore from b/u		< 72 hr	< 24 hr	< 8 hr	< 30 min
Performance		Scheduled scale-up		Rapid scale-up	

Additional Service Qualifiers								
Workload Type	Dev	Test	UAT	Prod	BCP	OLTP	DSS	Mixed
Adders	Security			Replication			Compression	
Resource Allocation	CPU			Memory			Storage	

Figure 13: Business Catalog for large financial services company

The technical catalog is very succinct, and provides a limited number of architectures. The backup and recovery approaches build up in a logical, stepped manner. Note that in the business catalog, technologies for backup and restore are not shown – only the metrics which the consumer is concerned about.

Stepped approach for providing backup/recovery levels

		Bronze	Silver	Gold	Platinum
Database HA		Single Instance MAA		RAC + DR	
Data Replication	Local	None		None	Data Guard (Sync)
	Remote			Data Guard (Async)	
Backup / Recovery		Weekly full Daily logs	Weekly full Daily incremental	Silver + Flashback logs	Gold + Intraday logs + RMAN merge

Figure 14: Technical Catalog for large financial services company

Note that this customer chose to meet the DR business goals for Platinum services with tiered Oracle Data Guard targets. The local Data Guard secondary is also useful for maintenance activities such as database upgrades.

Exception handling

Customer case study number three showed one example of exception identification and resolution. Additional examples illustrate other criteria that customers have selected for triggering custom deployments:

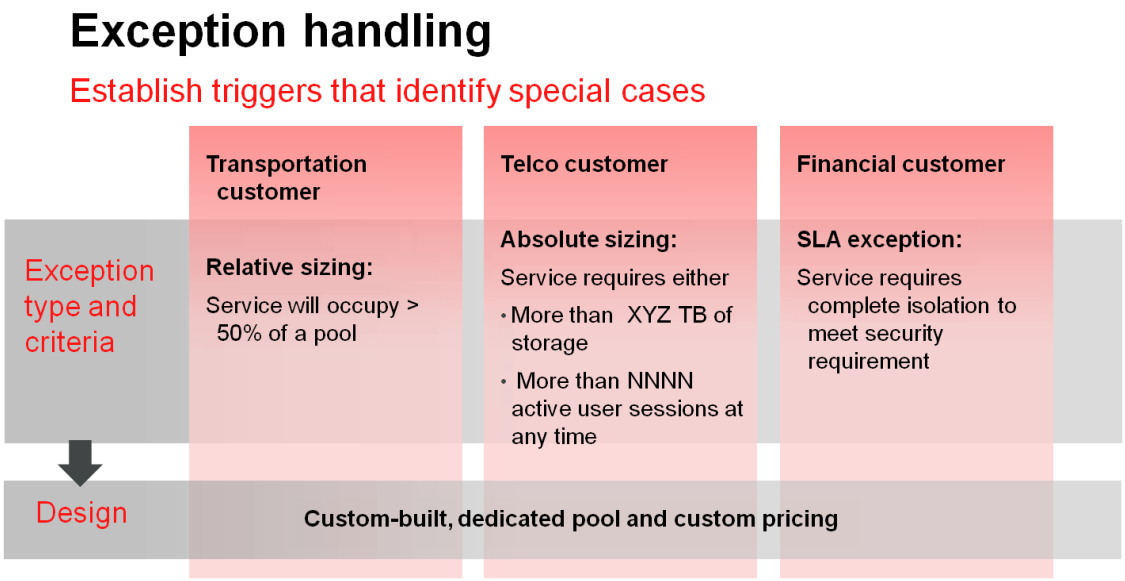


Figure 15: Exception Triggers and Responses

Note that in each case, the exceptions are handled with a dedicated pool: non-standard services are not consolidated with standard services, nor with other non-standard services.

Standardized service offerings for Oracle Database services

Now that we have looked at several customer case studies, we will summarize with our recommendation for the service categories that should be used to define database services:

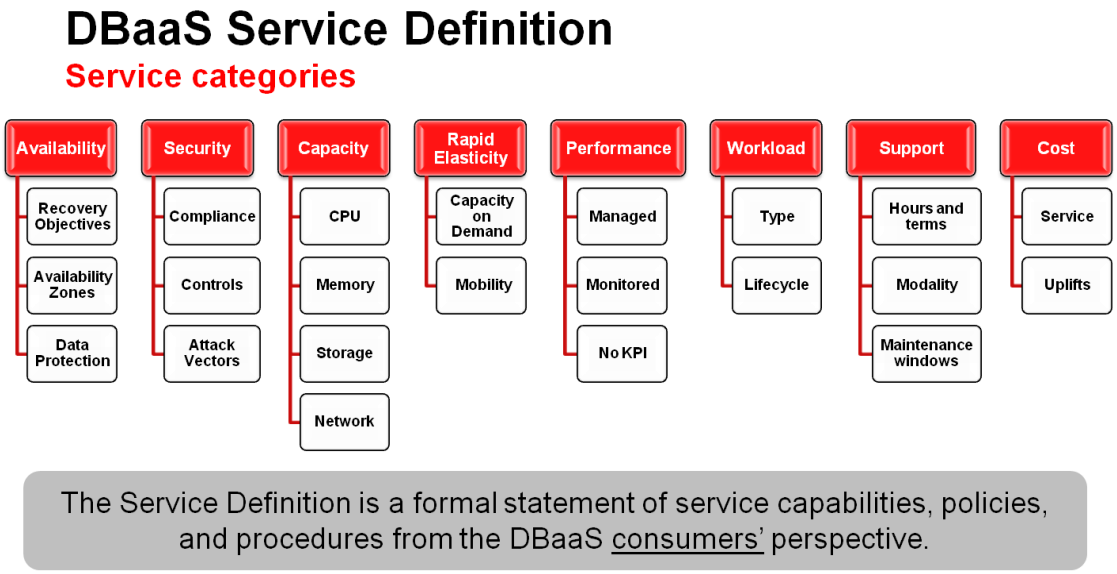


Figure 16: DBaaS Service Categories

When defining database services, most if not all of the above should be specified for describing services.

We will now apply these concepts as we define standardized service offerings for Oracle Database services in private clouds. Customers are encouraged to adopt these definitions, or adapt them to their particular needs. At the highest level, our standardized service offerings are as follows:

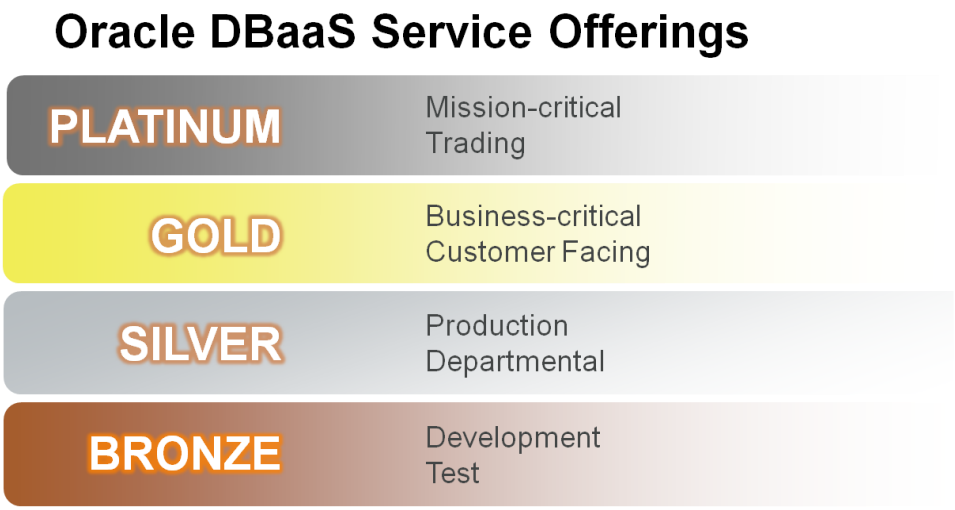


Figure 17: Standardized service offerings for Oracle Database services

Within each service offering, the service level for each service category is as follows:

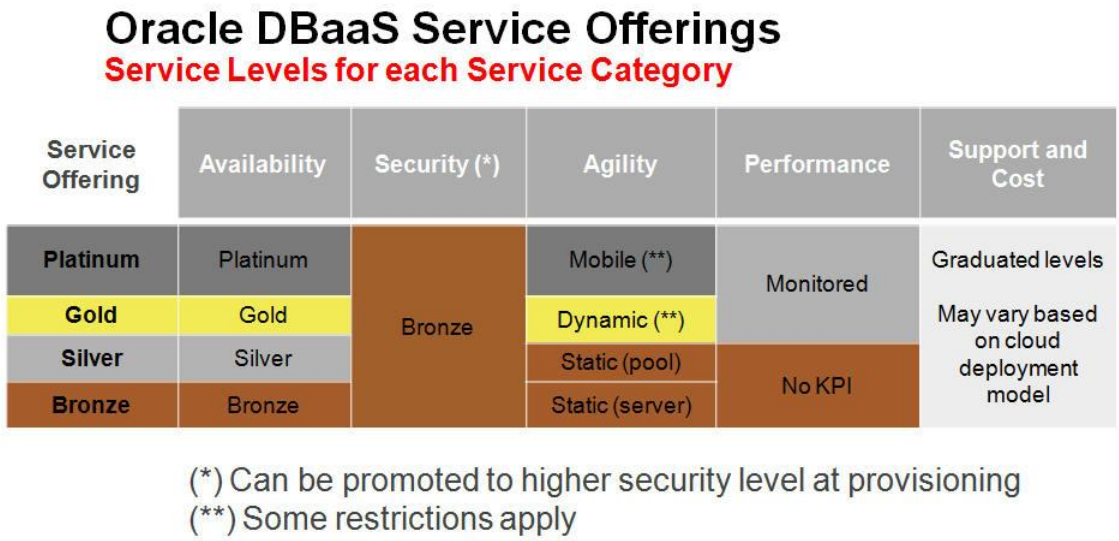


Figure 18: Service levels for each service category

We will now examine each service category, and the definitions of the service levels listed in the above figure.

Describing availability

The business catalog could enumerate every possible event that can impact services, and describe service availability in the face of each, but this introduces much more complexity than a business catalog should expose. Instead, either an expression of global availability or a more fine-grained description that defines the service availability for different outage classes is recommended.

A global definition can be quantitative or qualitative. Recovery Time Objective (RTO) and Recovery Point Objective (RPO) are more useful as a quantitative measure than nines, because for a nines measurement to be useful it must account for the probability of every possible disruptive event, and the mean-time-to-fix for each. Alternatively, a qualitative description for availability levels (e.g., basic, high) can provide useful expectations for service consumers.

Defining availability in terms of outage classes is often employed. We define those classes as follows:

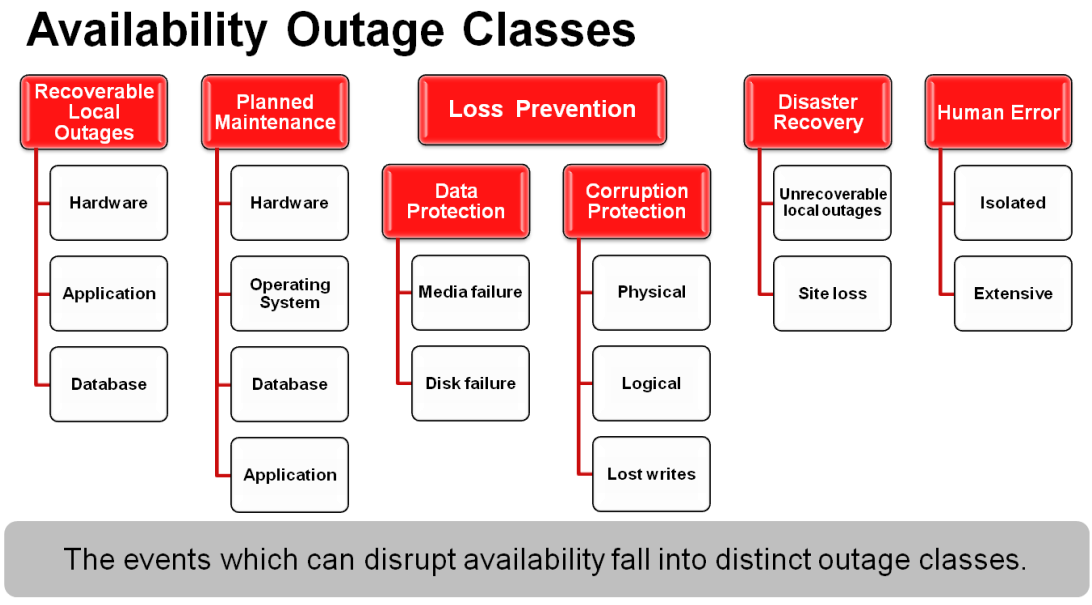


Figure 19: Availability Outage Classes

- Recoverable local outages covers component failures that can be addressed within the service's local environment.
- Planned maintenance includes hardware and software patching and upgrades
- Data protection – data loss due to failure of storage media
- Corruption protection – from physical and logical corruptions, and lost writes, is handled with data protection technologies and processes
- Disaster Recovery handles events which cannot be addressed at the primary site, or render the entire site unavailable
- Human errors are often limited and quickly reparable, but errors with large impact may take a significant amount of time to correct

Oracle Database availability levels

With a broad range of features and options, virtually any level of availability can be delivered with the Oracle Database. Oracle has defined four availability levels with distinct characteristics and bounded implementation choices[1]. Enterprises offering database services may wish to adopt the definitions and implementations of these availability levels to align with established terminology and proven best practices:

[1] Complete details in MAA Best Practices for Database Consolidation: the Foundation for Database-as-a-Service

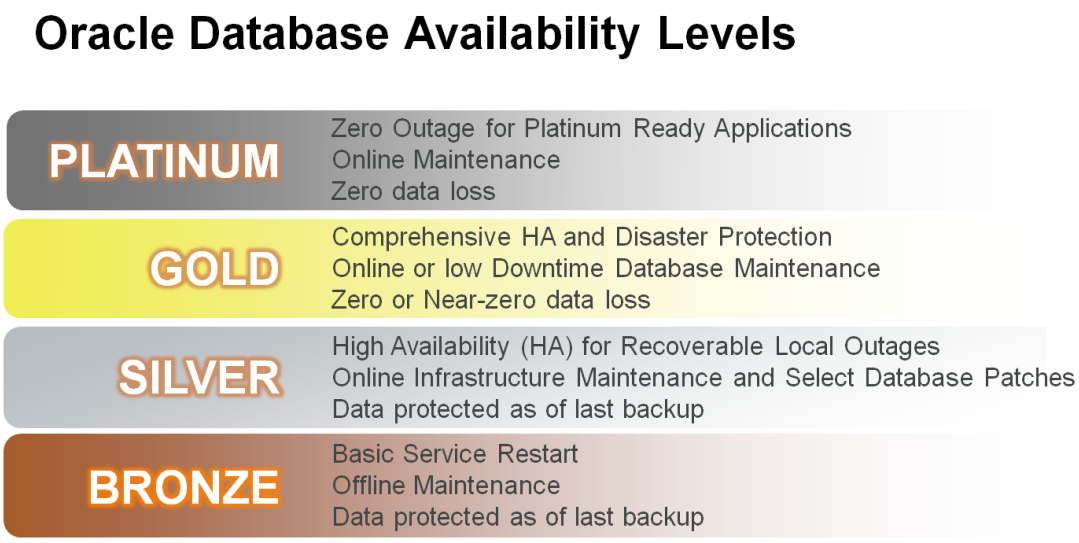


Figure 20: Oracle DBaaS Availability Levels

Bronze Availability

The entry level, which provides basic availability, is for database services that are not highly critical. The service is hosted on a single standalone machine with no failover target. If that machine fails or is taken offline for maintenance the service is not available until the machine is restored or replaced. Data loss and disaster recovery are addressed by restoring from backup.

Silver Availability

These services provide high availability with clustering. This improves service levels in the face of recoverable local outages and planned maintenance. As with Bronze, data loss and disaster recovery are addressed by restoring from backup.

Gold Availability

The availability requirements of business-critical services are met with Gold availability. As with Silver, the service has clustering for local HA. The difference in this architecture is that a secondary site is maintained, which provides fast recovery for DR and unrecoverable local outages, and also improves protection from data corruptions.

Platinum Availability

Platinum leverages new capabilities of Oracle Database 12*c* to enable the deployment of database services which can provide zero outage to Platinum-ready applications. (More details are provided in the MAA white paper cited above.) Platinum addresses the requirements of the most mission-critical workloads.

The following figures offer side-by-side comparisons of the four availability levels in more detail. A provider may choose to expose some of this information in the business catalog, depending on the needs of the consumers.

Oracle Database Availability
Service Levels for each Outage Class

Availability Service Level	Recoverable Local Outages	Planned Maintenance	Corruption Protection	Data Protection media, disk failure	Disaster Recovery & Unrecoverable Local Outages
Platinum	Zero Application Outage	Zero Application Outage	Comprehensive	Zero Data Loss	Zero Application Outage
Gold	Fast Failover	Premium		Near Zero to Zero Data Loss	Fast Failover
Silver	Failover	Advanced	Basic	Since last backup	Provision and restore
Bronze	Restart	Basic			

Figure 21: Availability service levels within each outage class

Oracle Database Availability
Impact to application and data for each Outage Class

Recoverable Local Outages	Planned Maintenance	Corruption Protection	Data Protection Media, disk failures	Disaster Recovery & Unrecoverable Local Outages
Outage is Masked from Application	Maintenance is transparent to user	More runtime checks, auto-repair using isolated remote copy, detect silent corruption	Zero data loss using synchronous replica	Outage is Masked from Application
Impact limited to sessions on failed server Fast failover	Additional rolling database maintenance for patch sets and full releases		Zero or near-zero data loss using replica of production	All sessions impacted Automatic failover to standby database
All sessions impacted, automatic restart on second node	Additional online infrastructure (H/W, OS) maintenance and database patches	Runtime checks for physical and logical intra-block corruption	Data loss exposure dependent upon backup interval	Provision and Restore
All sessions impacted, automatic restart on same node	Basic online database maintenance, all other maintenance is offline			

Figure 22: Impact of outage classes for each availability level

Oracle Database Availability
Recovery Objectives provided in each Outage Class

Recoverable Local Outages	Planned Maintenance	Corruption Protection	Data Protection media, disk failures	Disaster Recovery & Unrecoverable Local Outages
RTO	RTO	RPO	RPO	RTO / RPO
Zero Application Outage	Zero Application Outage	Zero for physical corruption, near-zero for lost write corruption, variable for other types of logical corruption	Zero	Zero Application Outage Zero data loss
Seconds for component or instance failure, variable for other outages	Silver plus rolling maintenance that reduces downtime for database patchsets and new releases to minutes		Zero or Near Zero	Automatic failover completes in seconds Zero or Near-zero data loss
Minutes for component or instance failure, variable for other outages	Bronze plus zero for hardware maintenance and select database patching	Since last backup if unrecoverable	Since last backup	Hours to days of downtime Data loss since last backup
Minutes if successful auto restart on same server, variable for other outages	Zero for online database maintenance, variable for most other tasks			

Figure 23: RTO and RPO within each availability level

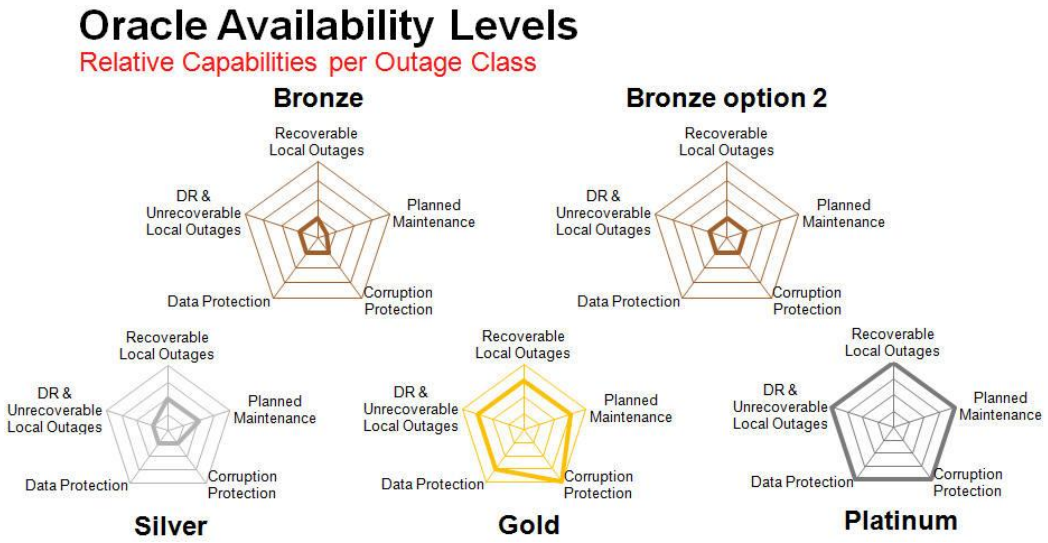


Figure 24: Relative Capabilities per outage class

Providing availability for Oracle Database Services

To deliver the availability levels described above, simply follow these implementation templates endorsed by Oracle's Maximum Availability Architecture (MAA) team:

Bronze availability

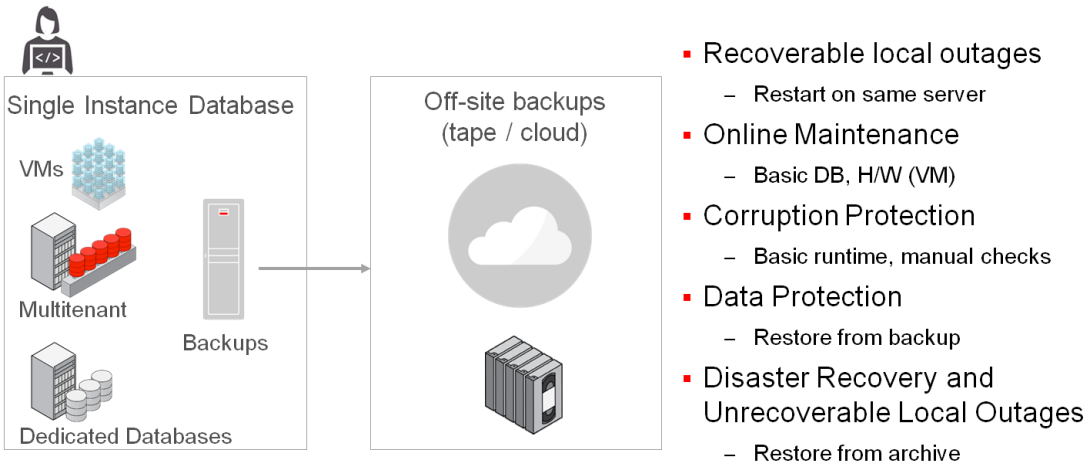


Figure 25: Bronze Availability

Bronze services are based on Oracle Database Enterprise Edition and Oracle ASM. The capabilities of the database and ASM, together with manual checks during RMAN backup and restore, provide good protection against data corruption. Because there is no secondary site with a replica of the database, the overall RTO for all outages and planned maintenance activities will range from minutes to possibly days for full restore and recovery operation. Some planned maintenance activities will be less disruptive when the database is deployed in a virtual machine.

The second part of the architecture is a well defined backup/restore solution. We recommend using RMAN backups to disk, to tape and offsite for DR purposes.

Silver availability

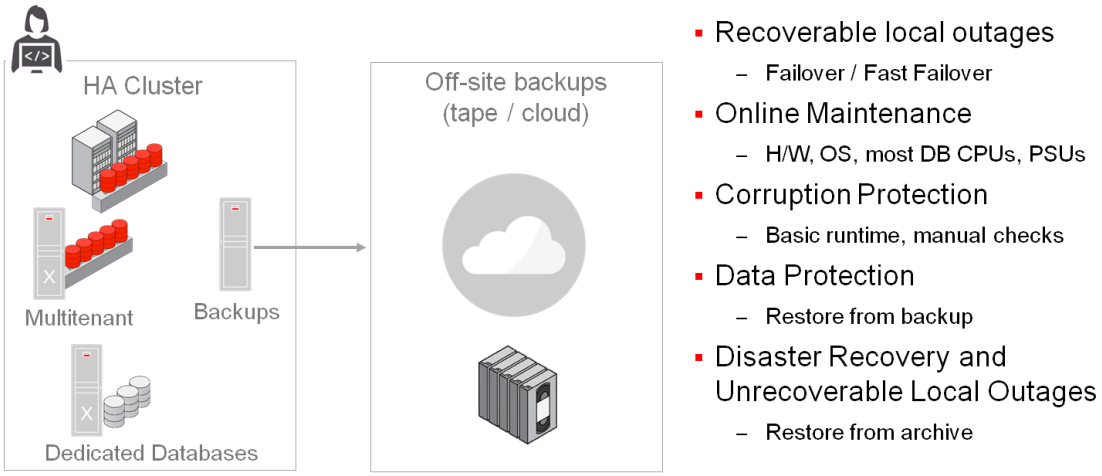


Figure 26: Silver Availability

Silver services extend the capabilities of Bronze services with clustering, using either Oracle RAC or Oracle RAC One Node. Oracle RAC is required if the service is too large for a single server, or if the fastest possible local failover is required. Otherwise, the lower-cost alternative of Oracle RAC One Node can be deployed.

With Oracle RAC / Oracle RAC One Node, RTO and RPO for recoverable local outages, and RTO for planned maintenance are significantly reduced when compared to Bronze.

Gold availability

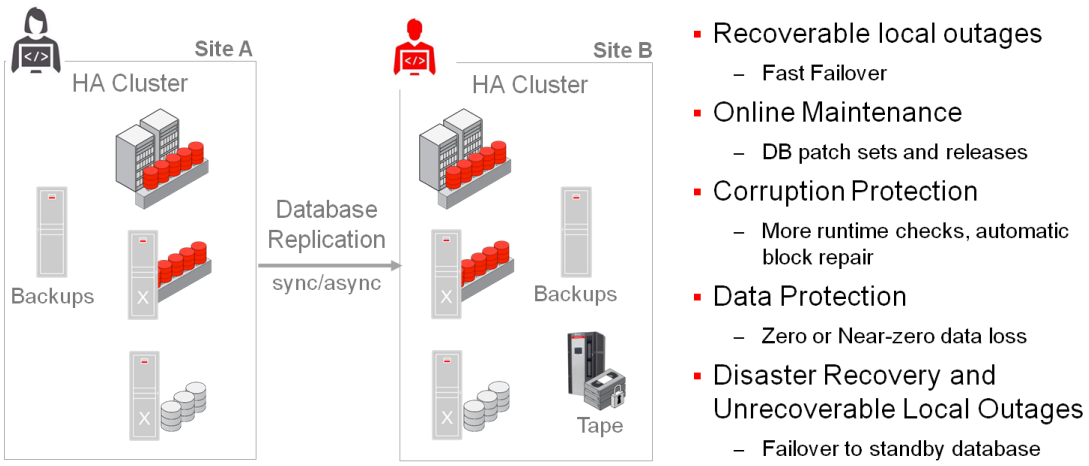


Figure 27: Gold Availability

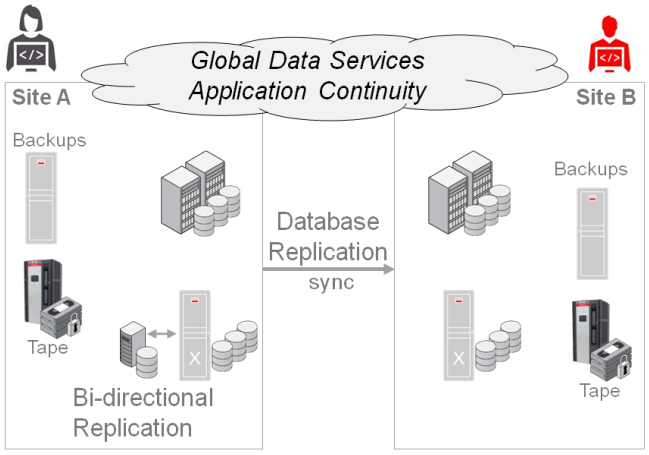
Gold is designed for business-critical workloads which must be resilient to unrecoverable local outages and disaster events. Therefore a secondary site is deployed, and kept current with the primary using Oracle Active Data Guard. Active Data Guard provides the management, monitoring, and automation software to create and maintain one or more standby databases to protect from a variety of events, including site-wide outages.

Active Data Guard can replicate data in either synchronous (enabling zero data loss) or asynchronous mode (near-zero data loss). For synchronous replication, the network capability between the sites will limit the practical distance separation.

With Active Data Guard added to the capabilities of RMAN and ASM, comprehensive protection against data corruption is delivered with continuous checks on both the primary and the replica for corruptions and lost writes, and automatic block repair on corrupted data blocks.

GoldenGate may also be used for replication, however, note that it does not provide the corruption protection of Active Data Guard. Also, Golden Gate provides asynchronous replication only.

Platinum Availability



- Recoverable local outages
  - Masked from Platinum-ready applications, in-flight transactions preserved
- Online Maintenance
  - All activities
- Corruption Protection
  - More runtime checks, automatic block repair
- Data Protection
  - Zero data loss
- Disaster Recovery and Unrecoverable Local Outages
  - Failover to standby database

Figure 28: Platinum Availability

Platinum takes Silver to the next level, enabling configurations in which applications experience no outage during any failure or maintenance activity, and zero data loss is possible with no regards to the distance between the sites. While Bronze, Silver and Gold services can be provided with Oracle Database 11g or Oracle Database 12*c*, Oracle Database 12*c* is required to deliver Platinum availability by leveraging Application Continuity, Global Data Services, and Active Data Guard Far Sync.

Application Continuity

Application Continuity is invoked for outages that result in recoverable errors, typically related to underlying software, hardware, communications, network, or storage layers outages. Application Continuity is used to improve the user experience when handling both unplanned outages and planned outages.

Introduced in Oracle Database 12*c*, Application Continuity strengthens the fault tolerance of systems and applications that use an Oracle database.

Active Data Guard Far Sync

Prior to the release of Oracle Active Data Guard Far Sync with Oracle Database 12*c*, disaster recovery architectures faced a difficult choice:

- Target an RPO of zero with a nearby site (usually closer than 100 km, and thus vulnerable to large scale events that would impact both sites)

OR

- separate the secondary site by a large (safe) distance but accept a higher RPO

Oracle Active Data Guard Far Sync resolves this dilemma by offering the best of both options: unlimited site separation and potentially zero RPO. Active Data Guard Far Sync enables 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.

Platinum availability leverages Active Data Guard Far Sync to enable unlimited site separation and an RPO target of zero.

Global Data Services

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.

Oracle Database security levels

An enterprise will typically define a minimum security level that all data must comply with. The implementation details and supporting processes will be part of the technical service catalog. Data that must comply with further internal policies or industry or government regulations such as PCI-DSS should be flagged as such in the business catalog, because responsibility for proper data security extends to the highest level in the enterprise. Of course, the implementation details for each security level remain in the technical service catalog.

This will often be prescriptive. For example, the service for a database containing credit card information cannot propose PCI-DSS compliance as an option. Instead, PCI-DSS compliance must be an integral part of the service definition.

Also note that the security and compliance requirements are often orthogonal to other key service attributes such as availability level: there can be databases containing sensitive information, but with low HA requirements. Conversely, a database with high HA requirements may or may not contain data with special compliance needs. Therefore, compliance is usually shown as a menu of options available to appropriate service offerings.

The Oracle DBaaS business catalog makes this easy for consumers: for each service offering, the default security level is Bronze. Service offerings that may need higher security can be upgraded as an option. The four standard levels are:

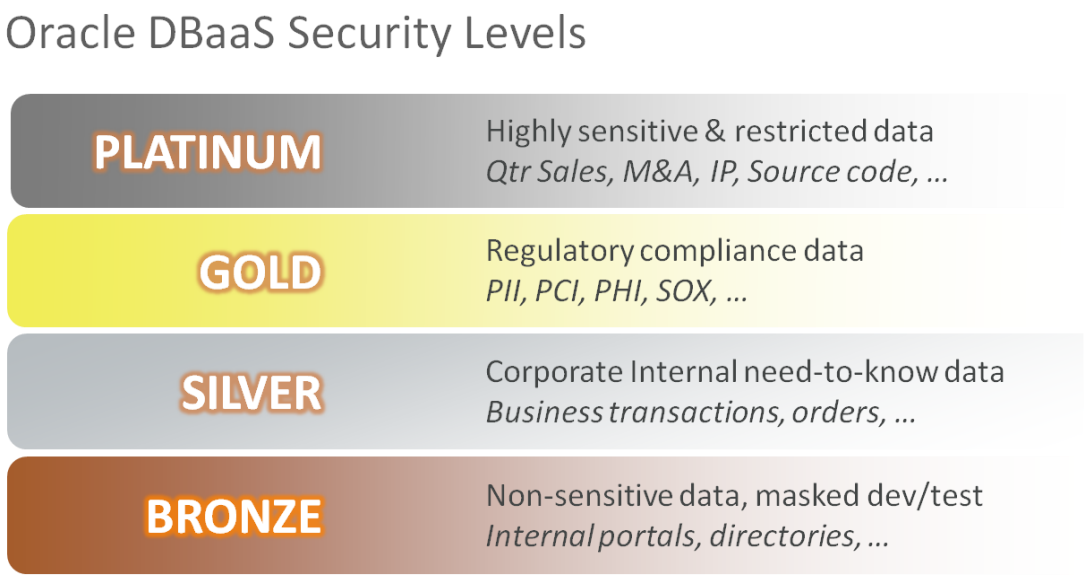


Figure 29: Security levels

The technical catalog then spells out the components and processes that the provider must implement. The implementations for each level outlined above are as follows:

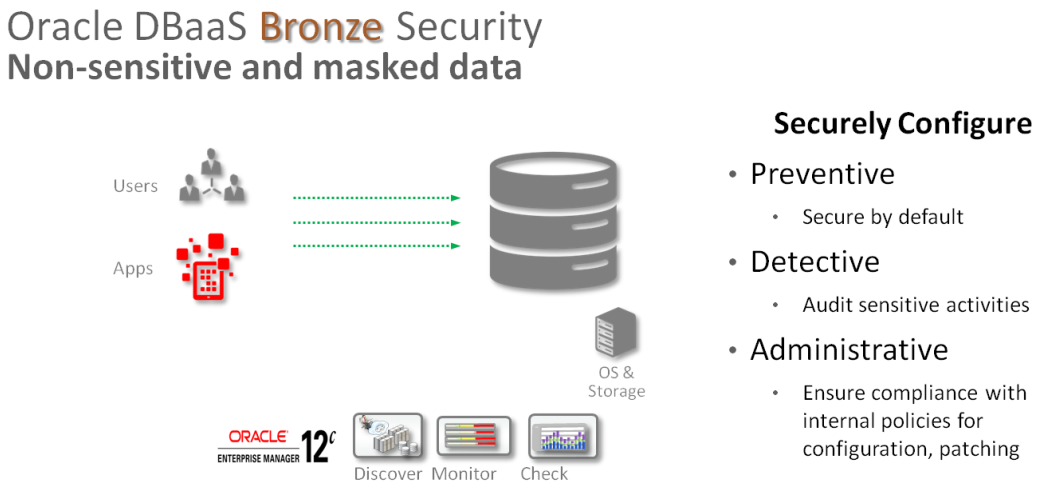


Figure 30: Bronze security

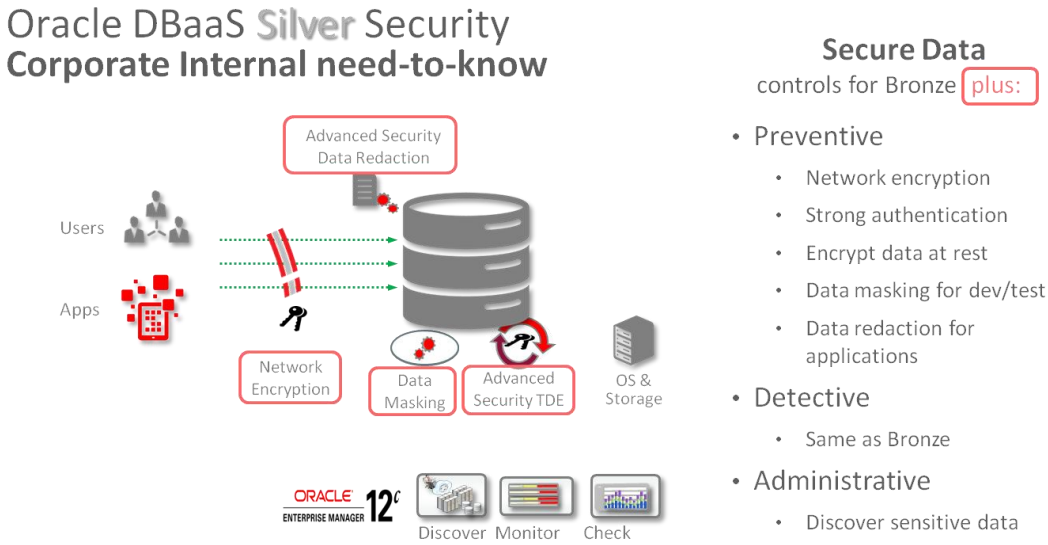


Figure 31: Silver security

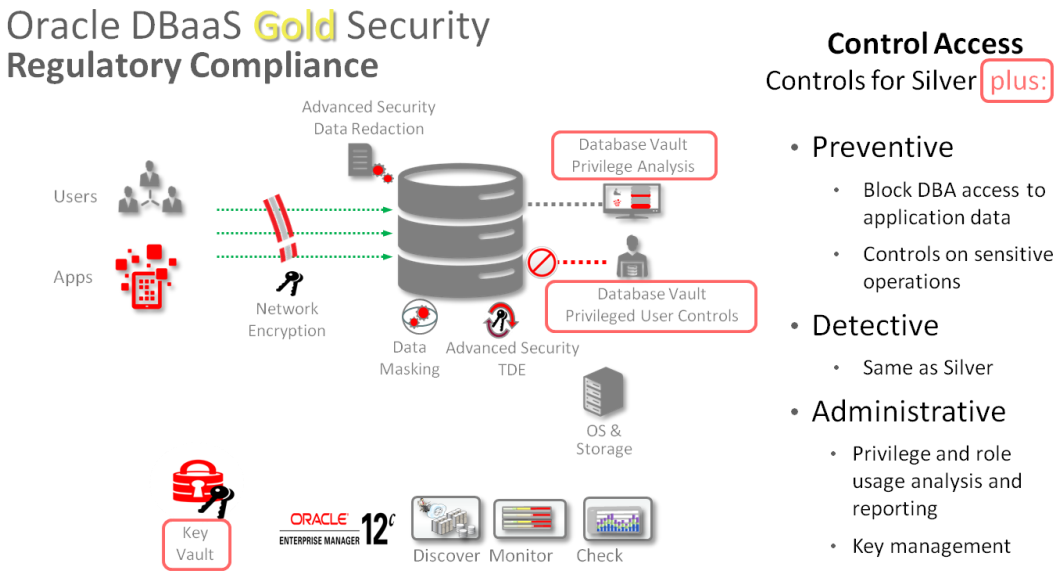


Figure 32: Gold security

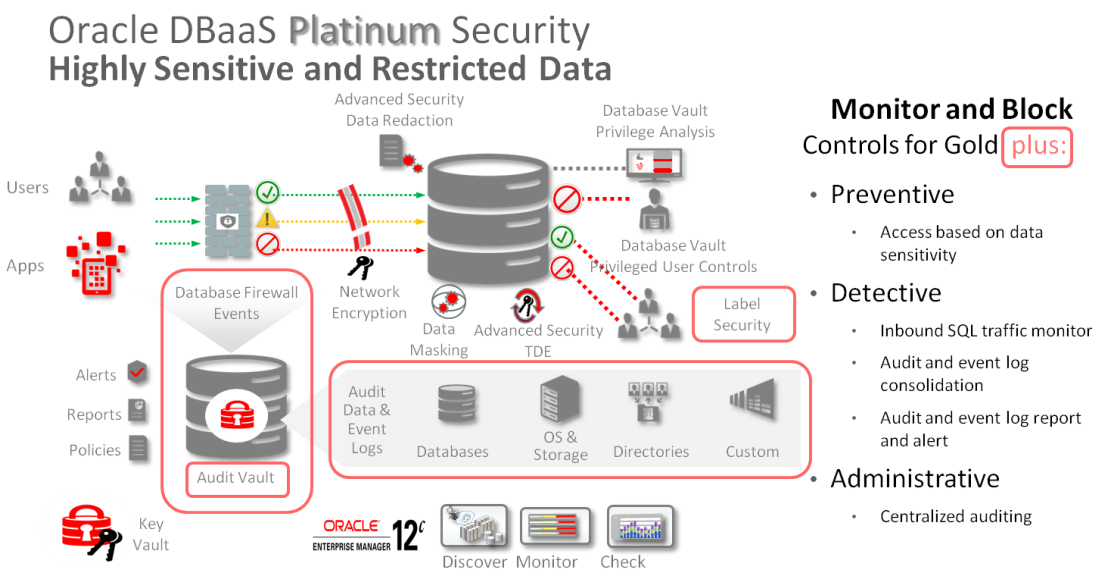


Figure 33: Platinum security

While the outlines above establish a baseline of essential components for meeting different security and compliance requirements, providing full compliance with regulations such as PCI-DSS or HIPAA HITECH entails more than simply deploying the products and options mentioned above. For full details of meeting government and industry regulations, please refer to the reference material listed in this paper's reference section.

Capacity

Providers may determine service footprint based on characterstics of the service request such as workload type, but they often specify "T-shirt sizes" for consumers to choose from. A menu would specify balanced configurations such as the following:

Table 1: Example service footprint sizings

		XS	S	M	L	XL	XXL	XXXL
CPU_COUNT		2	4	8	12	24	32	48
SGA	GB	4	8	16	24	48	64	96
PGA		2	4	8	12	24	32	48

However the provider chooses to expose (or not expose) CPU and RAM for services, storage is typically exposed in the business catalog in fixed increments, which consumers may be allowed to increase post-deployment:

Table 2: Example storage sizings and tiers

Storage	XS	S	M	L	XL	XXL	XXXL
Capacity (TB)	0.5	1	2	4	8	16	32
Tier	Slow | Medium | Fast						

Furthermore, the provider may offer the consumer to select from different storage tiers, which could be priced appropriately.

Oracle Database agility levels

Agility describes the capabilities of the service in terms of provisioning speed and modality; whether the service can receive capacity-on-demand as workloads require; and the service mobility, which includes changing the service level (for example of availability), and physically relocating the service.

Relocating a service could be desirable for several reasons. For example, the consumer might move their service to a datacenter with lower costs or more desirable service levels.

The agility levels are defined as follows:

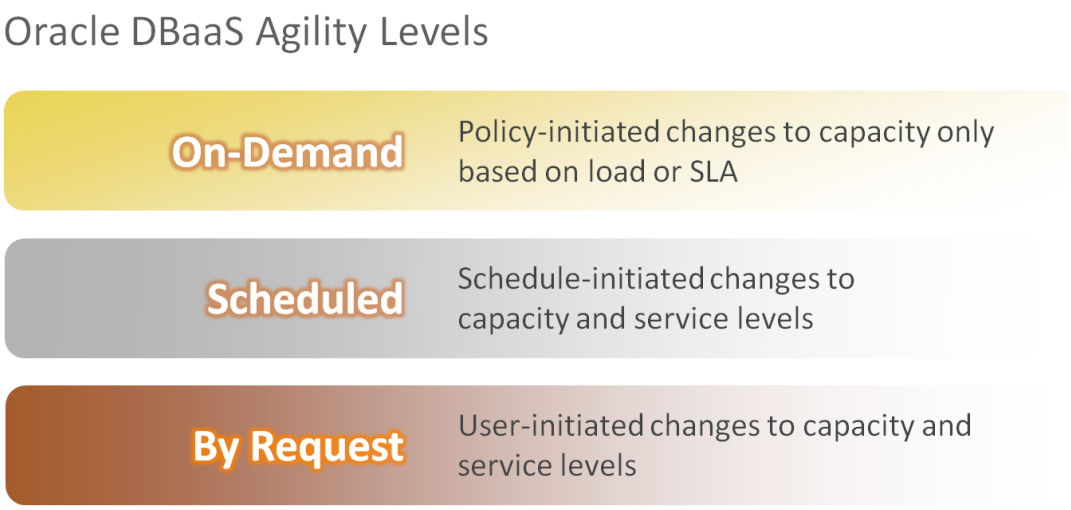


Figure 34: Agility levels

Static agility is the default for the Bronze and Silver service offerings. Resources such as CPU and IOPs can be shared by multiple services, and dynamically allocated to address changing workloads. Features such as Instance Caging and Database Resource Manager enable this agility level.

The Gold service offering provides capabilities for dynamic pools and services, including the ability to change a service's service tier. Oracle Real Application Cluster and Quality of Service Management are the key technologies for delivering agility to Gold services.

Platinum services provide service mobility within and across data centers. Features in Oracle Database 12*c* including Global Data Services and Application Continuity broaden the scope of mobility.

Oracle Database performance management

The Performance service category describes IT's involvement (manually or via automation and polices) with a service's performance:

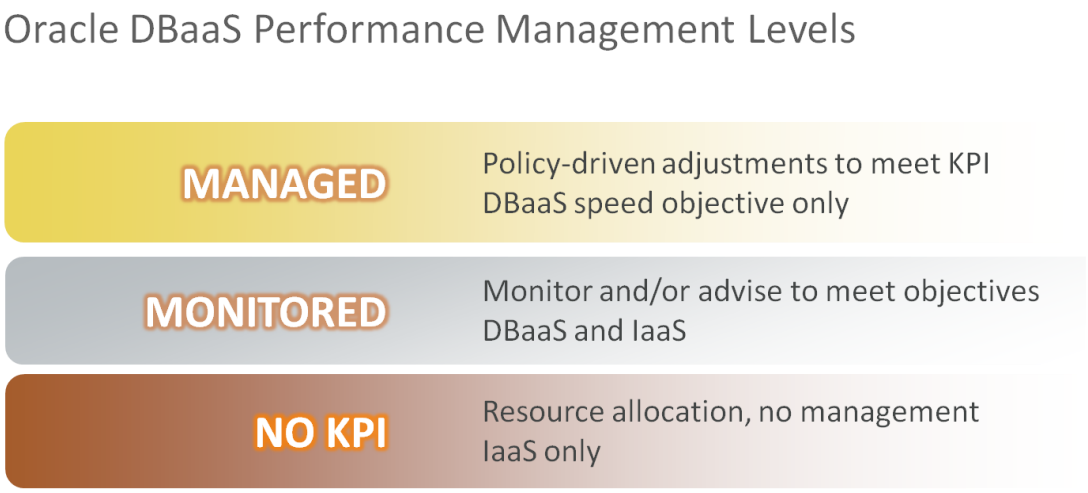


Figure 35: Oracle Database performance management levels

By default, Bronze and Silver service offerings are provided with no Key Performance Indicators – the assumption is that the resource allocation and management rules provided at provisioning time will deliver acceptable performance.

Gold and Platinum service offerings are monitored and potentially tuned with Enterprise Manager packs to ensure that performance goals are met. A provider may consider the option to apply this same performance level to Silver services.

To enable dynamic resource adjustments to meet KPIs, Quality of Service Management will be applied. Using a policy-based architecture, QoS Management correlates accurate run-time performance and resource metrics, analyzes this data with its expert system to identify bottlenecks, and produces recommended resource adjustments to meet and maintain performance objectives under dynamic load conditions. Should sufficient resources not be available, QoS will preserve the more business critical objectives at the expense of the less critical ones.

Support terms

This category defines the time windows that support is available for the service, and the form of the support. A mission-critical service will usually receive 24x7 live support. A non-critical service such as a development environment could have ticket-driven support during business hours, with self-helps forums (e.g. a wiki/FAQ) as the primary support mechanism. This category also specifies the response and resolution times for support incidents.

Also, maintenance windows are often specified: their frequency, duration, and impact to the service. Even though the provider might not need to perform maintenance during each scheduled window, having a defined schedule avoids surprises for the service consumers.

Cost model

Enterprises often associate a cost with each service. Funds may be recovered from consumers, or the cost metrics may be used only for "showback" purposes. When chargeback or showback are implemented, there are several options, including:

- Fixed cost for service tier
- Fixed cost for service footprint (whether resources are used or not)
- Variable cost based on resources consumed
- A formula that factors in service tier and footprint
- Possible charges for special capabilities, service tier upgrades or downgrades, resizing, etc.

Service uplifts available to consumers could include things such as on-demand or more-frequent backups, or preferential / consumer-scheduled maintenance windows.

Several customers we work with have examined all the options carefully and concluded that simpler is better. Keep in mind that for an enterprise cloud, the provider is not attempting to make money from the consumers. Ultimately, the provider is there to add value to the business.

However the provider chooses to handle costs, Enterprise Manager 12c offers a full range of options. Enterprise Manager Chargeback provides the administrator with:

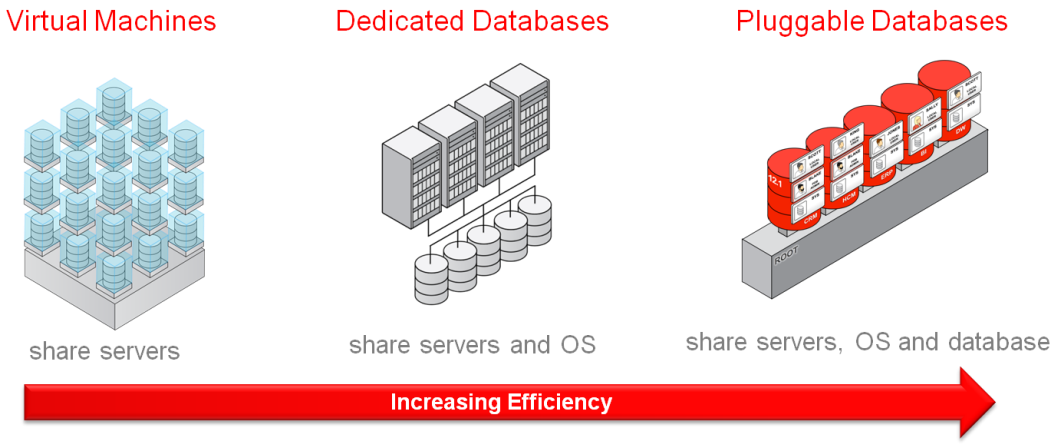
- Metering for Enterprise Manager targets and resources
- Assignment of rates to metered resources
- Management of a cost center hierarchy
- Assignment of costs to cost centers

- Usage and charge reports
- Integration with billing applications

This set of features can be used to implement chargeback in a private cloud. API's that export metering and charge data to billing solutions such as Oracle Billing and Revenue Management (BRM) provide a solution for the creation of chargeback and billing solutions.

Consolidating Oracle Database Services

Oracle Database services can be consolidated onto a shared platform in several ways:



An Oracle Database Service can be provisioned into any of these consolidation architectures. We recommend deploying standardized Oracle Database 12*c* services as PDBs. For non-standard Oracle Database 12*c* services, and standard Oracle 10g and 11g services, we recommend provisioning a dedicated database. Except for selected Bronze services, provisioning into a virtual machine environment is recommended only for non-standard cases that require a high level of isolation.

For complete details of consolidating Oracle Database Services and considerations for isolation, security, networking etc., please visit the Private Database Cloud page on the Oracle Technology Network[2].

[2] http://www.oracle.com/technetwork/database/database-cloud/private/index.html

Engineered Systems for Oracle Database Services

The concepts in this paper are platform-agnostic. In other words, the benefits of a service catalog approach can be realized for Oracle Databases deployed on any supported platform. In fact, as noted earlier, the deployment templates for database services should be portable, to facilitate provisioning in private clouds, public clouds, and hybrid clouds, on whatever platform is appropriate.

Of course, the capabilities of each specific hardware platform will influence several characteristics of the overall services solution. For example, a small configuration can host only a small overall workload, limiting the consolidation possibilities. From another perspective, hosting services in an environment with a variety of third-party components will be more time-consuming and error-prone than hosting services on a pre-built platform. For those and other considerations, Oracle's engineered systems offer several advantages for hosting Oracle Database services:

- Oracle's engineered systems are optimized to achieve enterprise performance levels that are unmatched in the industry
- Faster time to production is achieved by implementing pre-engineered and pre-assembled hardware and software bundles
- Single-vendor stack simplifies and reduces the costs associated with purchasing, deploying, and supporting IT environments

The Oracle Exadata Database Machine provides extreme performance for both data warehousing and online transaction processing (OLTP) applications.

Oracle SuperCluster is Oracle's fastest and most scalable engineered system, ideal for consolidating databases and applications, private cloud deployments, and Oracle software.

Oracle Virtual Compute Appliance is an integrated, wire-once, software-defined infrastructure system designed for the quick deployment of hardware and virtualized applications.

The Oracle Database Appliance is an engineered system of software, servers, storage and networking that offers a simple, reliable, low-cost package for mid-range database workloads.

Conclusion

Creating and maintaining effective standardization is the essential foundation for realizing the benefits of cloud computing. In fact, many enterprises have achieved significant results simply by effectively standardizing their environments and processes.

The tool to achieve effective standardization is the service catalog. The service catalog provides an end-to-end view of the IT estate, and establishes a provider/consumer relationship between IT and end-users. Evolving the catalog in a collaborative manner enables an ongoing, mutually beneficial relationship.

Several key points summarize our suggestions for implementing and managing a service catalog:

- Keep it simple – the Business Catalog should fit on one page
- Clear terms and conditions
- You'll probably need three ~ five Service Offerings
- Develop jointly with consumers
- Define a process to identify and handle exceptions
- Minimize the number of distinct environments
- Add services incrementally as needed
- Stay with the plan but be willing to adjust
- Make sure the entire model supports your business goals
- Become a service provider

The Oracle Database includes features and options that enable the full range of enterprise deployments—from basic development environments to the most demanding mission-critical. The full spectrum is possible, which can make it challenging to create a succinct business catalog with a small set of standardized database services.

To address this, we have leveraged Oracle's best practices and key lessons learned to define four service offerings for Oracle Database services. Providers can adopt or adapt these to quickly create the foundation for delivering Database as a Service with the service catalog model.

Glossary of 'service' terms

Database as a Service (DBaaS)

Database as a Service (DBaaS) is an architectural and operational approach enabling IT providers to deliver database functionality as a service to one or more consumers. Database as a Service architectures support the following capabilities:

- Consumer-based provisioning and management of database instances using on-demand, self-service mechanisms;
- Automated monitoring of and compliance with provider-defined service definitions, attributes and quality of service levels;
- Fine-grained metering of database usage enabling show-back reporting or charge-back functionality for each individual consumer

In addition to these characteristics, it is expected that DBaaS architectures will naturally support granular service elasticity, secure multi-tenancy, access using a broad range of non-proprietary devices and mechanisms, automated resource management, and integrated capacity planning.

Database Service

Database services represent groups of applications with common attributes, service level thresholds, and priorities. Database services provide a single system image to manage competing applications, and allow each workload to be managed as a unit. A database service can span one or more instances of an Oracle database, multiple databases in a global cluster, and a single instance can support multiple database services.

Self-Service

Consumer-based provisioning and management of services, available through a web portal interface. The process could be fully automated, i.e., the service can be provisioned through the portal; or, it could start a workflow with gating approvals and so on.

Service Catalog

The collection of documents and artifacts that describe the services provided by IT, and the details of how those services are provisioned and managed.

Service Delivery

In the evolution to enterprise cloud, 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 trigger alerts and be investigated.

Metrics are also critical for measuring each consumer's resource usage. Consumers 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.

References

TOPIC	FORMAT	LOCATION
Private Database Cloud	Website	http://www.oracle.com/technetwork/database/database-cloud/private/index.html
MAA for On-Premises, Public, and Hybrid Cloud	Website	http://www.oracle.com/technetwork/database/features/availability/oracle-cloud-maa-3046100.html
Oracle Database 12*c* documentation	Website	http://docs.oracle.com/cd/E16655_01/server.121/e17906/toc.htm
Engineered Systems	Website	http://www.oracle.com/us/products/engineered-systems/index.html
Evolution to Cloud	Doc	http://www.oracle.com/technetwork/database/database-cloud/journey-to-enterprise-cloud-wp-1959164.pdf
Security and Compliance with Oracle Database 12*c*	Doc	http://www.oracle.com/technetwork/database/security/security-compliance-wp-12c-1896112.pdf

Service Catalogs:Defining Standardized Database Services
November 2016, Revision 1.6
Author: Burt Clouse Contributing authors: Joe Meeks, Paul Needham, Michael Timpanaro-Perrotta, Lawrence To, Rex Wang

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

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