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Cloud-based Spatial Data Infrastructures for Smart Cities

Geospatial World Forum 2015

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Smart Cities require Geospatial Data

Providing services to citizens, enterprises, visitors ...

- Conventionally using location data on a map
- Two-dimensional data usually not sufficient, need 3D
 - Location within buildings - shopping malls, airports, ...
 - Lots of use cases for city modelling
- Value-add through integration with other data
 - spatial or non-spatial information combined in open platform
- SDI is well-established approach for this purpose
 - Exchanging geospatial data and associated metadata
 - Based on open standards (ISO, OGC)



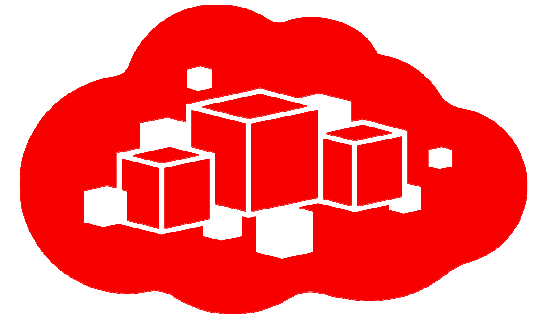


Spatial Data Infrastructure (SDI)

- Distributed responsibility for data provisioning and maintenance
 - Lead to rapid deployment
- Downside: Proliferation of countless services
 - Thousands of view and download services under INSPIRE directive
 - All with different content, but identical technical interfaces
 - All highly standardized
 - All requiring operational effort (systems management, capacity management, ...)
 - All causing software and hardware cost
- Ideal candidates for cloud computing
 - High degree of reuse and usually only loose coupling with data source

Cloud Computing for SDIs

- more efficient management of data and services by using centrally hosted platforms
 - Economy of scale
- reduce CapEx by using hosted services
- achieve elasticity to address variable load
- reduce time-to-market through self-service and higher degree of automation
- Simplify service level compliance



SDIs are ideal for a Cloud Infrastructure

Agility ↑



Self-Service

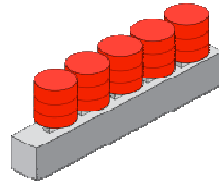


Service Catalog



Elasticity

Cost ↓



Shared Resources



Metering



Automation

Risk ↓



Higher Availability

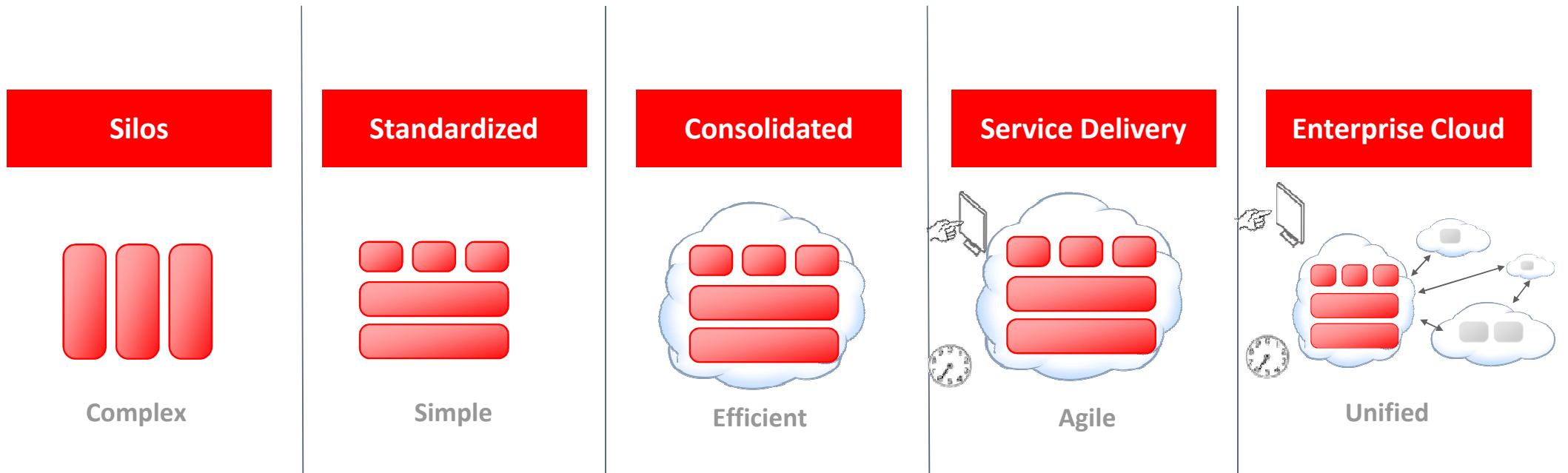


Tighter Security



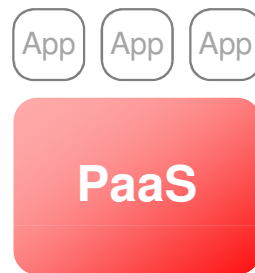
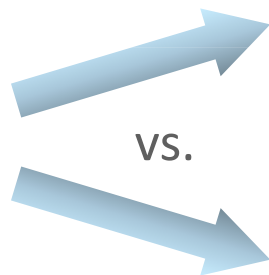
Greater Control

Flexible Adoption – Roadmap to Cloud



Consolidation at Platform or Infrastructure Layer

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



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

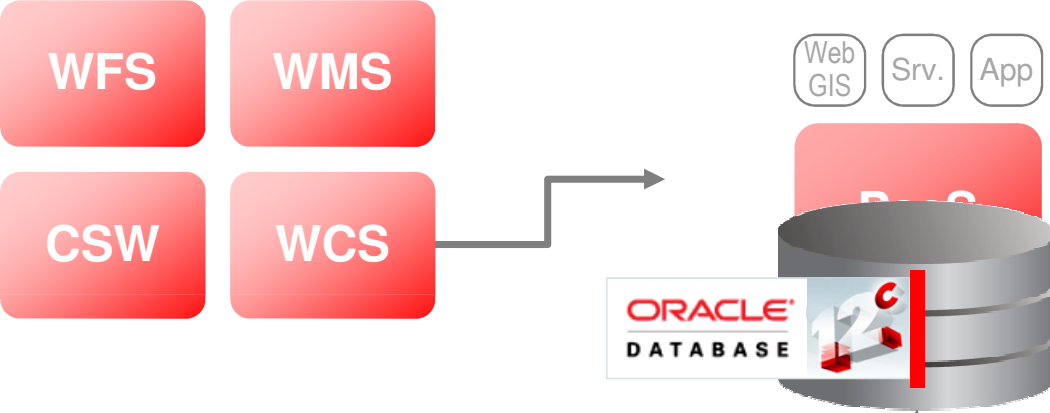
Consolidate onto shared IaaS **without standardization**



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

PaaS for a Spatial Data Infrastructure

Requirements

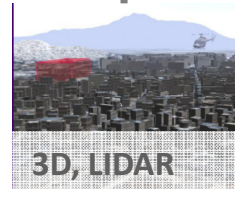
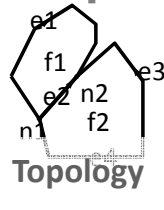
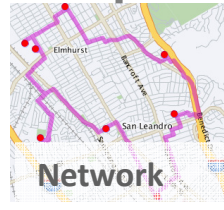
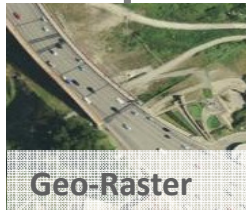
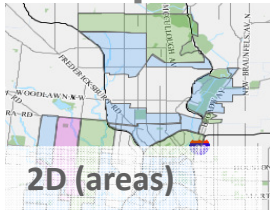
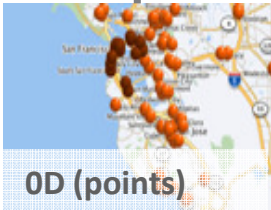


Database functionality such as

- Spatial queries
- RDF support
- Versioning/Long Transactions

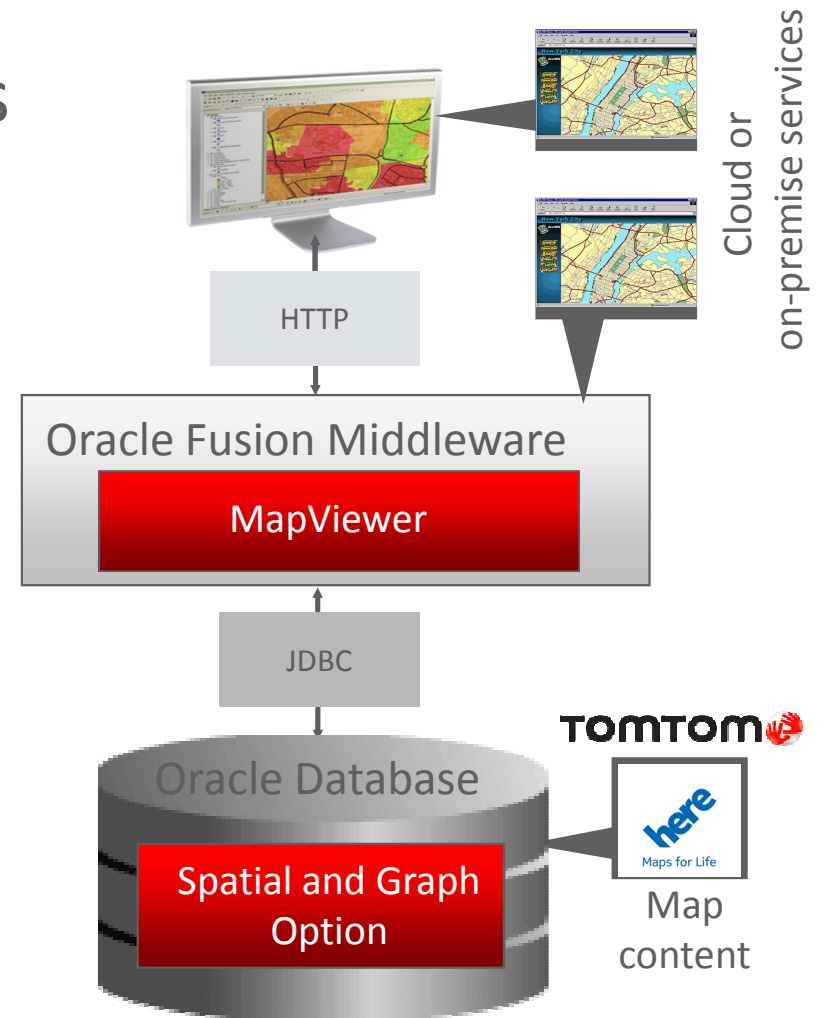
Use existing open standards

- Interoperability
- Protect the Investment



Core Spatial and Graph Technologies

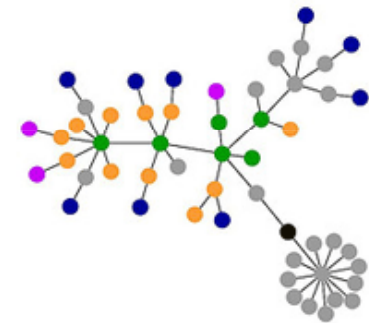
- **Oracle Database**
 - Basic capabilities for spatial data management
 - Supports versioning/long transactions
- **Oracle Spatial and Graph**
 - Additional option for Geocoding, Routing, High-Performance Query and Analytics, and more
 - Includes WFS and WFS-T Services
 - RDF Graph implementation for Linked Data
- **Oracle Fusion Middleware MapViewer**
 - Java-based map rendering engine
 - Can consume cloud services out-of-the-box
 - Supports WMS, WFS, WMTS
- Partnerships with SIs, ISVs, data providers, ...



Linked Data support – on-premise or in the Cloud

Included in Oracle Database-as-a-Service Cloud Offering

- Highly scalable, secure triple store based on RDF
 - 1 trillion triple benchmark, leading Large Triple Store on W3.org
 - 1.13 million triples per second query performance
- SPARQL and SPARQL in SQL support
 - Apache Jena and OpenRDF Sesame pre-integrated
 - SPARQL endpoint enhanced with query control
 - GeoSPARQL support (classes, properties, datatypes, query functions)
- Forward-chaining based inferencing engine in the database
 - Various native rulebases (RDFS, OWL2 RL, SKOS, ...), integration with OWL2 reasoners (TrOWL, Pellet)
- RDB to RDF mapping on relational data aligned with RDB2RDF standard



Istat, Italy – Publishing Census Data as Linked Open Data

Recently gone live on Oracle Spatial and Graph on Oracle Exadata Database Machine

- Domain analysis and ontology definition
 - Territorial ontology
 - Census data ontology
- Triple generation
 - Mapping CSV files using R2RML
 - Using OWLSIF (OWL with IF Semantic)
- Publishing
 - SPARQL endpoint (Joseki)
 - Faceted search, graph browser

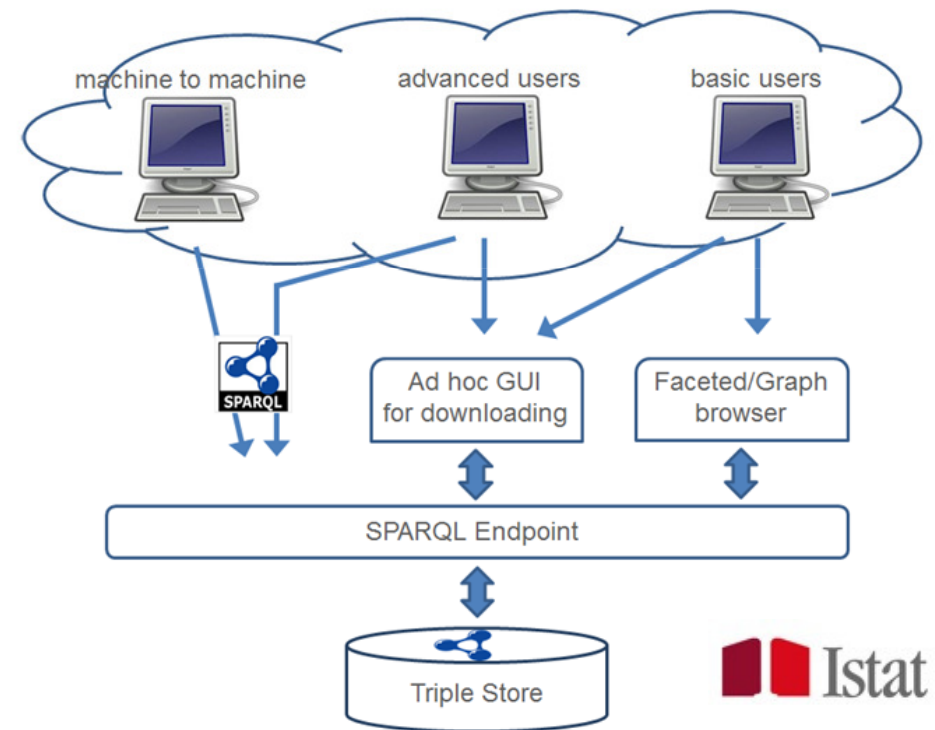


Image courtesy of: Monica Scannapico, Istat

Big Data Analytics

Infrastructure for Innovative Services in Smart Cities

- Analytic services and data models supporting Big Data workloads on Apache Hadoop or NoSQL databases
 - eg. Social media analysis, eg. Twitter monitoring in disaster management or tourism
 - eg. Traffic monitoring and optimization
- Spatial services providing geo-enrichment, 2D and 3D vector analysis, raster data processing
- Property Graph database with built-in analytic functions to model and analyze relationships (communities, influencers, behavioural patterns, ...)
- Currently available on-premise, cloud-based service coming soon

The Big Picture – Smart City Platform

Collaboration



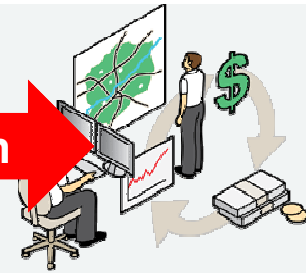
**City
Service**

**Citizen
Empowerment**



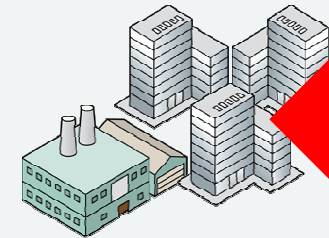
Social Media

Harmonization



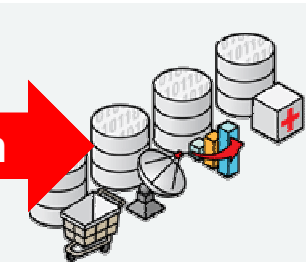
**City
Operation**

**Business
Productivity**



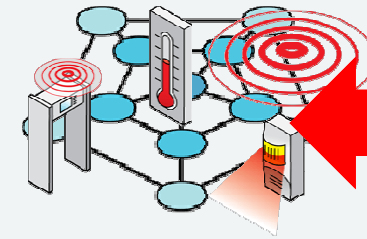
Entrepreneurs

Modernization



**City
Infrastructure**

**Sustainable
City**



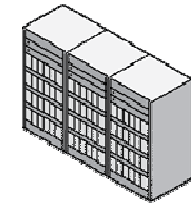
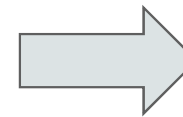
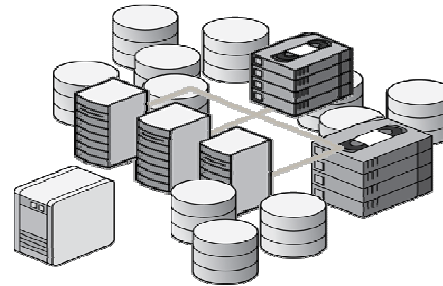
Sensors

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Trending Topics addressed by City Infrastructure building block

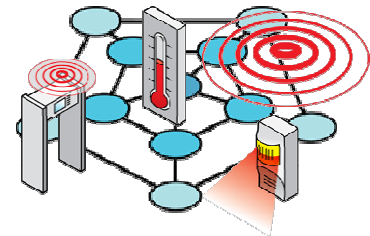
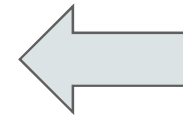
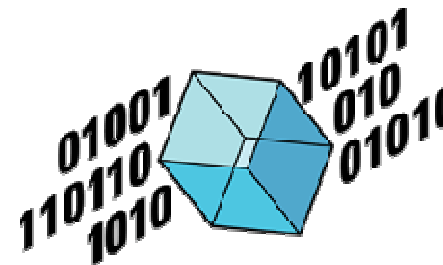
#Consolidation

Datacenter consolidation and complexity reduction reduces costs and speed deployment



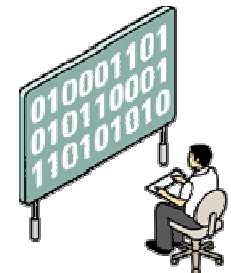
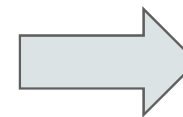
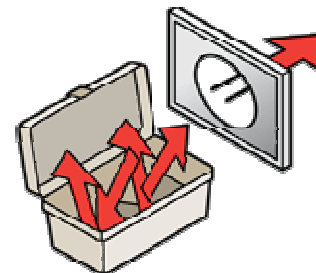
#BigData

Need to ingest, filter, analyze and respond to immense influx of high volume raw data



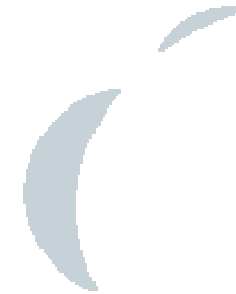
#OpenData

Governments are requested to publish information in a reusable format to 3rd parties



Recommendations

- Develop a **vision** to move to cloud computing
 - save operational cost, improve time-to-market
- Start with file and database **consolidation**
 - reduce complexity, improve security & availability
- Integrate geospatial data in **all layers** of the stack
 - simplify SW development, improve security & availability
- Use **standards** wherever possible
 - protect investments, improve interoperability
- Consider **Oracle Cloud (PaaS) Services** for consolidation
 - save operational cost, reduce deployment time, improve scalability
 - drive innovation by making use of leading edge technologies



Hardware and Software Engineered to Work Together



Provisioning Demo

Initial provisioning wizard screens

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18

My Service – Service Creation

jaasacct | weblogic ▾

ORACLE Database Cloud Service Instances

Cancel Assign Service Details Activate Services Review Summary Next >

Assign Service Details

Account

Name

* Language ?
Default language for administrators of services in the account. This language will be as in the Welcome email.

Time Zone ?
Default time zone for administrators of services in the account. This time zone will be as in the Welcome email.

Account Administrator


* User Name ?

First Name

Last Name

Identity Domain

* Name ?

 **Exadata Cloud Service**
Service URL Preview: https:// -usmeteringtes19192.Exadata.us1.oraclecloud.com/...

* Service Name ?

Description

Service Administrator

* Email ?

* User Name

First Name

Last Name

Additional Details

* Exadata Rack Name ?

* Do you want Database backups on Exadata Storage? ?



Oracle Database Cloud Service

Identity Domain: idm1063





As of Apr 20, 2015 5:15:06 PM UTC

Services	OCPUs	Memory	Storage	Public IPs
5	34	511 GB	147,636 GB	4

Services

Create Service

	DB11gService2 Status: In Progress Version: 11.2.0.4 Edition: Enterprise Edition	Submitted On: Apr 20, 2015 1:41:35 PM UTC	OCPUs: 1 Memory: 7.5 GB Storage: 90 GB
	DB11gService1 Status: In Progress	Submitted On: Apr 20, 2015 1:38:53 PM UTC	OCPUs: 1 Memory: 7.5 GB

	DB11gService1 Status: In Progress Version: 11.2.0.4 Edition: Enterprise Edition	Submitted On: Apr 20, 2015 1:38:53 PM UTC	OCPUs: 1 Memory: 7.5 GB Storage: 90 GB	
	ExaStarter-temp Version: 12.1.0.2 Edition: Enterprise Edition - Extreme Performance	Created On: Apr 16, 2015 6:43:20 PM UTC Exadata Unit: exadsvc1063	OCPUs: 32.0 Memory: 496 GB Storage: 144 TB	[menu]
	Exa-Temp Version: 12.1.0.2 Edition: Enterprise Edition - Extreme Performance	Created On: Apr 16, 2015 12:12:45 AM UTC Exadata Unit: exadsvc1063	OCPUs: 32.0 Memory: 496 GB Storage: 144 TB	[menu]
	Exa-2 Version: 12.1.0.2 Edition: Enterprise Edition - Extreme Performance	Created On: Apr 13, 2015 5:50:05 PM UTC Exadata Unit: exadsvc1063	OCPUs: 32.0 Memory: 496 GB Storage: 144 TB	[menu]

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* CPU, Memory and Storage values shown are shared between Database Cloud Services running on the same Exadata Unit

► Service create and delete history

Create Database Cloud Service Instance

Cancel



Next >

Subscription Type

Select the service level and billing frequency for this Oracle Database Cloud Service instance.

Service Level

- Oracle Exadata Cloud Service**
 - Oracle Database software pre-installed on Oracle Exadata Machine.
 - Database Service instances are created on available Exadata infrastructure
 - Additional cloud tooling is available for backup, recovery and patching.

- Oracle Database Cloud Service**
 - Oracle Database software pre-installed on Oracle Cloud Virtual Machine.
 - Database instances are created for you using configuration options provided in this wizard.
 - Additional cloud tooling is available for backup, recovery and patching.

- Oracle Database Cloud Service - Virtual Image**
 - Oracle Database software pre-installed on an Oracle Cloud Virtual Machine.

Oracle Exadata Cloud Service

- Oracle Database software pre-installed on Oracle Exadata Machine.
Database Service instances are created on available Exadata infrastructure
Additional cloud tooling is available for backup, recovery and patching.

Oracle Database Cloud Service

- Oracle Database software pre-installed on Oracle Cloud Virtual Machine.
Database instances are created for you using configuration options provided in this wizard.
Additional cloud tooling is available for backup, recovery and patching.

Oracle Database Cloud Service - Virtual Image

- Oracle Database software pre-installed on an Oracle Cloud Virtual Machine.
Database instances are created by you manually or using DBCA.
No additional cloud tooling is available.

Billing Frequency

- Monthly**
Pay one low price for the entire month irrespective of the number of hours used

Create Database Cloud Service Instance

[Previous](#) [Cancel](#)



[Next](#)

Software Release

Select the database release version for this Oracle Database Cloud Service instance.

- Oracle Database 11g Release 2**
 - Oracle Database Version 11.2.0.4
Installed on Oracle Grid Infrastructure 12.1.0.2
- Oracle Database 12c Release 1**
 - Oracle Database Version 12.1.0.2
Installed on Oracle Grid Infrastructure 12.1.0.2

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Create Database Cloud Service Instance

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Software Edition

Select the database edition for this Oracle Database Cloud Service instance.

Enterprise Edition - Extreme Performance [\(Details\)](#)

- Oracle Database 12c Release 1
Installed on Oracle Grid Infrastructure 12.1.0.2

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Create Database Cloud Service Instance

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Service Details

Provide details for this Oracle Database Cloud Service instance.

Service Configuration

* Service Name ?

Description ?

* Exadata v

Backup and Recovery Configuration

* Backup Destination v

* Cloud Storage Container ?

* Cloud Storage User Name

* Cloud Storage Password

Database Configuration

* Administration Password ?

* Confirm Password ?

* DB Name (SID) ?

* PDB Name ?

Create Database Cloud Service Instance

[← Previous](#) [Cancel](#)



[Create >](#)

Confirmation

Confirm your responses and create this Oracle Database Cloud Service instance.



Service Level: Oracle Exadata Cloud Service
Billing Frequency: Monthly
Software Release: Oracle Database 12c Release 1
Software Edition: Enterprise Edition - Extreme Performance
Service Name: TELETRAAN1
Description: My 1st Exadata
Exadata: exadsvc1063 - Quarter Rack (2 nodes available)
Key:
DB Name (SID): ORCL
PDB Name: PDB1
Failover Database: no



Backup Destination: DISK



Oracle Database Cloud Service

Identity Domain: idm1063

As of Apr 20, 2015 5:32:07 PM UTC

Services	OCPUs	Memory	Storage	Public IPs
6	34	511 GB	147,636 GB	4

Services

Create Service

i Oracle Database Cloud Service instance creation request was Accepted

	TELETRAAN1	Submitted On: Apr 20, 2015 5:32:06 PM UTC	OCPUs: 32.0
	Status: In Progress	Exadata Unit: exadsvc1063	Memory: 496 GB
	Version: 12.1.0.2		Storage: 144 TB
	Edition: Enterprise Edition - Extreme Performance		

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