Autonomous Database

Level 100

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Oracle Cloud Infrastructure
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Safe harbor statement

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Objectives

After completing this lesson, you should be able to:

- Compare Autonomous Database (ADB) with DB System Cloud offerings in OCI
- Describe the features of Autonomous Data Warehouse Cloud - Serverless and Autonomous Data Warehouse Cloud - Dedicated, Autonomous Transaction Processing - Serverless and Autonomous Transaction Processing – Dedicated
- Describe how to deploy, use and manage ADB
Serverless
- Ultra-Simple & Elastic

Dedicated
- Customizable Private Cloud

ExaCS
- Scale, Performance, Availability

DBCS
- VM or bare metal, single server or RAC

Autonomous Database
- All database operations fully automated
- User runs SQL, no access to OS or CDB
- Exadata Performance and Availability
- Customizable for DW or TP Workload

Automated DB Services
- Database lifecycle automation provided
- User operates, has DBA and OS root access
- Runs older database versions
- ALL database features (e.g. Java, etc.)

ORACLE CLOUD
**Oracle Database**
World’s Best Database
Oracle Builds and Operates Databases and Infrastructure
User Builds and Operates Databases and Infrastructure

**Exadata**
World’s Best Database Platform
Oracle Builds, Optimizes, and Automates Infrastructure
All In-Database Automation Features Included

**Oracle Database Cloud Services**
World’s Best Automated Database Cloud
Oracle Builds and Operates Infrastructure
User Operates Databases Using Provided Lifecycle Automation
User Has Full Control, including DBA and Root Access

**Autonomous Database**
World’s Best Fully Self-Driving Database
Oracle Builds and Operates Exadata Infrastructure and Databases
User runs SQL, no Access to OS or Container DB

**Use Cases**
Cloud elasticity, Machine Learning, Self driving
Instant Provisioning, Always online operation
All workloads, JSON Documents, Graphs, and more

**Use cases**
Availability, Flexible Version and Features,
Small to Large DB deployment,
Single Instance or RAC, Automated Backup,
Patching, Customer controls

**Use Cases**
Private/Public Cloud on-premise, Consolidation,
Highest Performance, Scalability for Mission
Critical Workload

**Use Cases**
Small to Big Database transactional need
as well DWH needs, Customer Data Center,
DIY model
## Autonomous Optimizations - Specialized by Workload

<table>
<thead>
<tr>
<th>Autonomous Data Warehouse</th>
<th>Autonomous Transaction Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columnar Format</td>
<td>Row Format</td>
</tr>
<tr>
<td>Creates Data Summaries</td>
<td>Creates Indexes</td>
</tr>
<tr>
<td>Memory Speeds Joins, Aggs</td>
<td>Memory for Caching to Avoid IO</td>
</tr>
<tr>
<td>Statistics updated in real-time while preventing plan regressions</td>
<td></td>
</tr>
</tbody>
</table>
# Autonomous Database - Choice of Cloud Deployment

<table>
<thead>
<tr>
<th></th>
<th>DBaaS VM or Bare Metal</th>
<th>Exadata Cloud Service or Cloud @ Customer</th>
<th>Autonomous Serverless</th>
<th>Autonomous Dedicated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management</strong></td>
<td>Customer</td>
<td>Customer</td>
<td>Oracle</td>
<td>Oracle</td>
</tr>
<tr>
<td><strong>Private Network</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Single/Multi Tenant</strong></td>
<td>Single/Multi</td>
<td>Single/Multi</td>
<td>Single</td>
<td>Single/Multi</td>
</tr>
<tr>
<td><strong>Software Updates</strong></td>
<td>Customer Initiated</td>
<td>Customer Initiated</td>
<td>Automatic</td>
<td>Customer Policy Control</td>
</tr>
<tr>
<td><strong>Private Cloud</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Offers Availability SLA</strong></td>
<td>No</td>
<td>99.95%</td>
<td>SLO</td>
<td>SLO</td>
</tr>
<tr>
<td><strong>Database Versions</strong></td>
<td>11g,12c,18c,19c</td>
<td>11g,12c,18c,19c</td>
<td>18c</td>
<td>19c</td>
</tr>
<tr>
<td><strong>Disaster Recovery</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Hybrid DR</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Consolidation</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Autonomous Database Cloud Service – Deployment Options

Oracle Autonomous Database can be deployed in 2 ways – dedicated and serverless.

Dedicated deployment is a deployment choice that enables you to provision autonomous databases into their own dedicated Exadata cloud infrastructure, instead of a shared infrastructure with other tenants.

With serverless deployment, the simplest configuration, you share the resources of an Exadata cloud infrastructure. You can quickly get started with no minimum commitment, enjoying quick database provisioning and independent scalability of compute and storage.

Both deployment options are available for Autonomous Transaction Processing and Autonomous Data Warehouse.
Autonomous Database - Serverless

Autonomous Data Warehouse & Autonomous Transaction Processing
Autonomous Database - Fully-managed

Oracle automates end-to-end management of the autonomous database

- Provisioning new databases
- Growing/shrinking storage and/or compute
- Patching and upgrades
- Backup and recovery

Full lifecycle managed using the service console

- Alternatively, can be managed via command-line interface or REST API
Automated Tuning in Autonomous Database

“Load and go”

- Define tables, load data, run queries
  - No tuning required
  - No special database expertise required
  - No need to worry about tablespaces, partitioning, compression, in-memory, indexes, parallel execution

- Fast performance out of the box with zero tuning
- Simple web-based monitoring console
- Built-in resource-management plans
Autonomous Database – Fully-elastic

Size the database to the exact compute and storage required
• Not constrained by fixed building blocks, no predefined shapes

Scale the database on demand
• Independently scale compute or storage
• Resizing occurs instantly, fully online

Shut off idle compute to save money
• Restart instantly

Auto scaling:
• Enable auto scaling to allow Autonomous Database to use more CPU and IO resources automatically when the workload requires it.
Full Support of Database Ecosystem

Autonomous Database service supports:

• Existing tools, running on-premises or in the cloud
  – Third-party BI tools
  – Third-party data-integration tools
  – Oracle BI and data-integration tools: BIEE, ODI, etc.

• Oracle cloud services: Analytics Cloud Service, GoldenGate Cloud Service, Integration Cloud Service, and others

• Connectivity via SQL*Net, JDBC, ODBC
Autonomous Data Warehouse: Architecture

Developer Tools
- SQL Developer

Autonomous Data Warehouse
- Service Management
- Built-in Query and Application Development Tools
  - Machine Learning
  - SQL Developer Web
- REST Data Services
- Application Express

Autonomous Database

Data Integration Services
- Oracle DI Platform Cloud
- 3rd Party DI on Oracle Cloud Infrastructure
- 3rd Party DI On-premises

Oracle Object Storage Cloud
- Data Files for Loading and External Access

Business Intelligence Services
- Oracle Analytics Cloud
- Oracle Data Visualization Desktop
- 3rd Party BI on Oracle Cloud Infrastructure
- 3rd Party BI On-premises
Autonomous Transaction Processing: Architecture

**Developer Services**
- Oracle Java Cloud Service
- Developer Cloud Service
- Container Clusters (OKE)
- Registry

**Developer Tools**
- SQL Developer

**Autonomous Transaction Processing**
- Service Management
- Built-in Query and Application Development Tools
  - Machine Learning
  - SQL Developer Web
  - REST Data Services
  - Application Express

**Applications**
- 3rd Party applications on Oracle Cloud Infrastructure
- 3rd Party applications On-premises

**Business Intelligence Services**
- Oracle Analytics Cloud
- 3rd Party BI on Oracle Cloud Infrastructure
- 3rd Party BI On-premises

**Oracle Object Storage Cloud**
- Data Files for Loading and External Access

**TP Database**
Getting Started with Autonomous Database

Provisioning an ADB database requires only answers to 7 simple questions:

- Database name?
- Which data center (region)?
- How many CPU cores?
- How much storage capacity (in TBs)?
- Admin password?
- License Type?
- Enable Auto scaling?

New service created in a few minutes (regardless of size)

Database is open and ready for connections
Auto Scaling Autonomous Database

- Auto scaling allows Autonomous Database to automatically increase the number of CPU cores by up to three times the assigned CPU core count value, depending on demand for processing.
- The auto scaling feature reduces the number of CPU cores when additional cores are not needed.
- You can enable or disable auto scaling at any time.
- For billing purposes, the database service determines the average number of CPUs used per hour.

This picture shows how ADW service automatically scales OCPUs up when there is a demand for more computing power and then scales it down once the demand goes down.
Securing Autonomous Database (ADB)

- Stores all data in encrypted format in the Oracle Database. Only authenticated users and applications can access the data when they connect to the database.

- Database clients use SSL/TLS 1.2 encrypted and mutually authenticated connections. This ensures that there is no unauthorized access to the ADB Cloud and that communications between the client and server are fully encrypted and cannot be intercepted or altered.

- Certificate based authentication uses an encrypted key stored in a wallet on both the client (where the application is running) and the server (where your database service on the ADB Cloud is running). The key on the client must match the key on the server to make a connection. A wallet contains a collection of files, including the key and other information needed to connect to your database service in the ADB Cloud.

- You can specify IP addresses (or CIDR block) allowed to access the ADB using the access control list. This access control list will block all IP addresses that are not in the list from accessing the database.
Connecting to the Autonomous Database

1. Connecting to Autonomous Database Warehouse (ADW) or Autonomous Transaction Processing (ATP) from Public Internet
2. Connecting to ADW or ATP (via NAT or Service Gateway) from a server running on a private subnet in OCI (in the same tenancy)
3. Connecting to ADW or ATP from a server running on a public subnet in OCI (in the same tenancy)
Troubleshooting connectivity issues

• Ensure that the Access Control List for the Autonomous Database (ADB) has the necessary entries for CIDR Block ranges and IP addresses, as your use case dictates.

• When connecting to ADB from a client computer behind a firewall, the firewall must permit the use of the port specified in the database connection when connecting to the servers in the connection. The default port number for Autonomous Data Warehouse is 1522 (find the port number in the connection string from the tnsnames.ora file in your credentials ZIP file). Your firewall must allow access to servers within the .oraclecloud.com domain using (TCP) port 1522.

• When connecting to ADB from a server running on a private subnet (on the same OCI tenancy as the ADB), ensure that you have a service gateway or NAT gateway attached to the VCN. The route table for the subnet needs to have the appropriate routing rules for the service gateway or NAT gateway. The security lists for the subnet will need to have the right egress rules.

• For connections originating from a server running on a public subnet (on the same OCI tenancy as the ADB), ensure that route table and security lists are appropriately configured.
Scaling Your Database

Scale your database on demand without tedious manual steps

• Independently scale compute or storage
• Resizing occurs instantly, fully online
• Memory, IO bandwidth, concurrency scales linearly with CPU
• Close your database to save money when not used
• Restart instantly
Monitoring

- **Service Console based monitoring**
  - Simplified monitoring using the web-based service console.
  - Historical and real-time database and CPU utilization monitoring.
  - Real Time SQL Monitoring to monitor running and past SQL statements.
  - CPU allocation chart to view number of CPUs utilized by the service.

- **Performance Hub based monitoring**
  - Natively integrated in the OCI console and available via a single click from the ADB detail page
  - Active Session History (ASH) analytics
  - Real Time SQL monitoring
Autonomous Database (ADB) Cloud – Backup and recovery

• Autonomous Database Cloud automatically backs up your database for you. The retention period for backups is 60 days. You can restore and recover your database to any point-in-time in this retention period.

• Autonomous Database Cloud automatic backups provide weekly full backups and daily incremental backups.

• Manual backups for your ADB database is not needed.

• But, you can do manual backups using the cloud console if you want to take backups before any major changes, for example before ETL processing, to make restore and recovery faster. The manual backups are put in your Cloud Object Storage bucket. When you initiate a point-in-time recovery Autonomous Database Cloud decides which backup to use for faster recovery.

• You can initiate recovery for your Autonomous Database using the cloud console. Autonomous Database Cloud automatically restores and recovers your database to the point-in-time you specify.

• Network Access Control Lists (ACL)s are stored in the database with other database metadata. If the database is restored to a point in time the network ACLs are reverted back to the list as of that point in time.
Autonomous Database Cloud – Cloning

- Autonomous Database provides cloning where you can choose to clone either the full database or only the database metadata.
- **Full Clone**: creates a new database with the source database’s data and metadata.
- **Metadata Clone**: creates a new database with the source database’s metadata without the data.
- When creating a **Full Clone** database, the minimum storage that you can specify is the source database’s actual used space rounded to the next TB.
- You can only clone an Autonomous Database instance to the same tenancy and the same region as the source database.
- During the provisioning for either a Full Clone or a Metadata Clone, the optimizer statistics are copied from the source database to the cloned database.
- The following applies for optimizer statistics for tables in a cloned database:
  - Full Clone: loads into tables behave the same as loading into a table with statistics already in place.
  - Metadata Clone: the first load into a table after the clone clears the statistics for that table and updates the statistics with the new load.
Create Autonomous Database Clone

Choose Clone Type

- **Full Clone**: Creates a new database with same database and restrictions.
- **Mirrored clone**: Creates a new database that replicates an existing database schema. You can also choose to mirror source database costs.

Provide basic information for the Autonomous Database

- **Compartment**: [Specify Compartment]
- **Database Name**: [Specify Database Name]
- **Display Name**: [Specify Display Name]
- **Database User**: [Specify Database User]
- **License Type**: [Specify License Type]

Configure the Database

- **CPU core count**: [Specify CPU core count]
- **Storage GB**: [Specify Storage GB]

Add tags

- **Tag Name**: [Specify Tag Name]
- **Value**: [Specify Value]

Additional Information

- **License Information**: [Specify License Information]
- **Cloning Options**: [Specify Cloning Options]
Pre-defined Services for Autonomous Data Warehouse

3 pre-defined database services identifiable as high, medium and low

- Choice of performance and concurrency for ADW

HIGH
- Highest resources, lowest concurrency
- Queries run in parallel

MEDIUM
- Less resources, higher concurrency
- Queries run in parallel

LOW
- Least resources, highest concurrency
- Queries run serially

Example for a database with 16 OCPUs

<table>
<thead>
<tr>
<th></th>
<th>No of concurrent queries</th>
<th>Max idle time</th>
<th>CPU shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>3</td>
<td>5 mins</td>
<td>4</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>20</td>
<td>5 mins</td>
<td>2</td>
</tr>
<tr>
<td>LOW</td>
<td>32</td>
<td>1 hour</td>
<td>1</td>
</tr>
</tbody>
</table>

*When connecting for replication purposes, use the LOW database service name. For example, use this service with Oracle GoldenGate connections.*
Pre-defined Services for Autonomous Transaction Processing

- Five pre-defined database services controlling priority and parallelism
- Different services defined for Transactions and Reporting/Batch

<table>
<thead>
<tr>
<th>SERVICES NAME</th>
<th>RESOURCE MANAGEMENT PLAN SHARES</th>
<th>PARALELLISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>4</td>
<td>Operations run in parallel and are subject to queuing</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>2</td>
<td>Operations run in parallel and are subject to queuing</td>
</tr>
<tr>
<td>LOW</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>TPURGENT</td>
<td>12</td>
<td>Manual</td>
</tr>
<tr>
<td>TP</td>
<td>8</td>
<td>None</td>
</tr>
</tbody>
</table>

- For Transaction Processing
- For Reporting or batch processing
Autonomous Database Demo
Autonomous Database - Dedicated

Autonomous Data Warehouse & Autonomous Transaction Processing
Autonomous Database - Dedicated

• The Autonomous Dedicated database service provides a private database cloud running on dedicated Exadata Infrastructure in the Public Cloud.
• It has multiple levels of isolation protects you from noisy or hostile neighbors.
• Customizable operational policies give you control of provisioning, software updates, availability and density.
Autonomous Database - Dedicated

Physical Characteristics and constraints

- Quarter rack X7 Exadata Infrastructure
  - 2 servers (92 OCPU, 1.44TB RAM)
  - 3 Storage Servers (76.8TB Flash, 107TB Disk)
- Cluster / Virtual Cloud Network
  - 1 Cluster per quarter rack
- Autonomous Container Database
  - Maximum of 4 per Cluster
- Autonomous Database
  - High Availability SLA – Maximum 100 DBs
  - Extreme Availability SLA – Maximum 25 DBs
Autonomous Database - Dedicated
High Level Deployment Flow

1. Create VCN
2. Provision Autonomous Exadata Infrastructure
3. Create Autonomous Container Database
4. Create Autonomous Database
Autonomous Database - Dedicated

Security

- Databases always encrypted
- Reduced attack surface
- Automatic protection of customer data from Oracle operations staff
- Database Vault’s new Operations Control feature
- Oracle automatically applies security updates for the entire stack
- Quarterly, or off-cycle for high-impact security vulnerability
- Customer can separately use Database Vault for their own user data isolation
Summary

You should now be able to

• Compare Autonomous Database (ADB) with DB System Cloud offerings in OCI
• Describe the features of Autonomous Data Warehouse Cloud - Serverless and Autonomous Data Warehouse Cloud - Dedicated, Autonomous Transaction Processing - Serverless and Autonomous Transaction Processing – Dedicated
• Describe how to deploy, use and manage ADB
Additional resources

- Autonomous Data Warehouse Service Documentation

- Autonomous Transaction Processing Documentation

- Autonomous Data Warehouse Cloud for Experienced Oracle Database Users

- Migrating Amazon Redshift to Autonomous Data Warehouse Cloud
Oracle Cloud always free tier:  
oracle.com/cloud/free/

OCI training and certification:  
https://www.oracle.com/cloud/iaas/training/  
https://www.oracle.com/cloud/iaas/training/certification.html

OCI hands-on labs:  
ocitraining.qloudable.com/provider/oracle

Oracle learning library videos on YouTube:  
youtube.com/user/OracleLearning