Migrating Application Data to Oracle Cloud Infrastructure

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Revision History

The following revisions have been made to this white paper since its initial publication:

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
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<tbody>
<tr>
<td>April 17, 2019</td>
<td>Initial publication</td>
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You can find the most recent versions of the Oracle Cloud Infrastructure white papers at https://cloud.oracle.com/iaas/technical-resources.
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Overview

You've decided to move a key application to the cloud, and you've chosen Oracle Cloud Infrastructure as your cloud. So what does it take to successfully move a business application to Oracle Cloud Infrastructure? It's a big move, and any migration plan should include the following steps:

- Determine the application specifics and data that need to move
- Determine the types of storage that are available
- Determine a simple strategy for moving the data and users
- Determine additional services that might help in moving large data sets

This white paper discusses best practices for moving application data to the Oracle Cloud Infrastructure, and it is intended for the business application owner. It covers defining the data that needs to move and how to move it, when to use the disk and appliance transfer services and when to copy your data directly, and using Oracle Cloud Infrastructure Object Storage and file services.

This paper doesn't cover establishing network connections or security lists. Because the focus is the migration of data, all of the references to application functions are assumed and aren't discussed in detail.

Application Components

When you move an application, it's important to identify all of its components, especially if you plan to update how the data is structured. Applications have four basic components: clients, software, connectivity, and data.

Clients

Before you move the application, answer the following key questions:

- Who are all the clients that use this application?
- What kind of access does each client need for this application?
- Do the power users have different access requirements than normal or report-only users?

Building a matrix of the users and their requirements helps to architect the application move.
Software

What software is required for the system to work? Identify whether the application has any middleware or database requirements. Be sure to list all the basic requirements for the application. This move might also be an opportunity to either scale up or scale back the application.

Connectivity

Identify the connectivity requirements, and understand what the access requirements will be.

- Is latency currently an issue for this application? If so, what is the latency threshold?
- Identify the connection to Oracle Cloud Infrastructure: FastConnect, traffic over the internet, or an IPSec tunnel over the internet?
- How much bandwidth does the application require?
- Will the clients be making round trips with the data or is it all going to be used and stored in Oracle Cloud Infrastructure?
- Are there special VPN or VCN security lists?
- Are subnets required to separate the clients, SQL Server, and the data?

Data

Access to the application data is critical in any computing environment, including a cloud environment. One of the core issues in cloud computing is architecting the data storage around the compute systems, whether that storage is an object store, a block volume, or a file system. Large sets of data pose a different set of problems for migration. Calculate the amount of data that must move, whether that's a few gigabytes or a few petabytes.

Moving an application also gives you the opportunity to archive or reorganize the data to better suit the needs of the organization. Answer the following questions about the organization, management, and retention of the data:

- How much of the data needs to move for the application to function properly?
- Does the data need to be accessed across geographies or across availability domains?
- If a major outage occurs, how much data can be lost? Is there a scale for acceptable data loss?
- What kind of backup policies are needed to ensure compliance with organizational policies?
- Are clones of the data required?
• Does the application have any features that can help facilitate the migration between systems?

This list of questions isn't exhaustive, but it's the bare minimum that you should consider in the move to Oracle Cloud Infrastructure.

**Example Migration Scenario**

To illustrate the challenges of moving an application to Oracle Cloud Infrastructure, this white paper describes the migration of a legacy application that relies on Microsoft SQL Server. This instance of SQL Server employs Always On availability groups and is hosted between two hosts, with locally attached disks. Daily backups are stored on a file system and retained for two weeks; weekly backups are stored in the local object store for long-term retention.

To help architect the migration of this application to Oracle Cloud Infrastructure, let's consider the previous questions. The following diagram describes the application as it resides within the current on-premises environment.

A successful move of the application to Oracle Cloud Infrastructure must move both the structured database files and the archive backup data. This is an opportunity to trim the amount of data and purge your archive to meet the data requirements of your business.
Now consider what part of the data must be accessed across geographies or availability domains. The current state of the application structure shows the need to ensure high availability but not a need for the structure to be duplicated in multiple regions. Focusing on the migration of the data, availability domains create the redundancy necessary for the application to fail over in a reasonable timeframe.

To reduce latency and ensure performance, keep the block volume within the same fault domain as the SQL Server host. The data must be highly available, but how much data can actually be lost before the loss starts to significantly impact business operations? SQL Server availability groups manage data loss between the individual databases. This consideration also affects the backup policies for the application. In this example, the backups are occurring on the secondary server, so they don't impact the performance of the primary server.
How many copies of the data are needed to ensure both high availability and business continuance with the application? The organization of the Always On availability groups within fault domains and availability zones is key when building the new home for the application in Oracle Cloud Infrastructure. Because the object store is redundant across the region, the decision to replicate the backup data to another region must be part of the business operations model. Using the Oracle Cloud Infrastructure Object Storage service to replace an offsite tape solution can be accomplished with cross-region replication. Cross-region replication for the backup data and object storage ensures that the data is protected from region-wide outages that might affect the business.

**Storage Options**

To understand the Oracle Cloud Infrastructure storage options, it's important to define the following storage characteristics: performance, durability, availability, scalability, elasticity, security, and access method.

- Performance describes the combination of throughput, bandwidth, and latency.
- Durability ensures that the data is saved and not susceptible to loss or erasure during a crash.
- Availability of the service describes how the storage service is built within the availability domains to ensure access to the data.
- Scalability and elasticity describe how easy it is to grow or shrink data while being able to move the data between compute systems.
- Security describes how data is secured from unauthorized access.
- Access method describes how customers can access data across the different storage offerings.

Use the following matrix to help you determine which data storage option to use to ensure a successful application migration to Oracle Cloud Infrastructure. More information about each option is provided in sections following the matrix.

<table>
<thead>
<tr>
<th>Storage Characteristics</th>
<th>NVMe</th>
<th>Block</th>
<th>File</th>
<th>Object</th>
<th>Archive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>Best</td>
<td>Better</td>
<td>Good</td>
<td>Good</td>
<td>Cold line</td>
</tr>
<tr>
<td>Durability</td>
<td>Locally Managed</td>
<td>Across availability domains</td>
<td>Across availability domains</td>
<td>Regional</td>
<td>Across regions</td>
</tr>
</tbody>
</table>
### File Storage

File Storage is an enterprise-grade file system that is secure, scalable, and durable, and it provides the following functions for your application needs:

- **General purpose file storage**: Access an unlimited pool of file systems to manage the growth of structured and unstructured data.
- **Big data and analytics**: Run analytic workloads and use shared file systems to store persistent data.
- **Migration of enterprise applications**: Migrate existing Oracle applications that need NFS storage, such as Oracle E-Business Suite and PeopleSoft.
- **Databases and transactional applications**: Run, test, and development workloads with Oracle, MySQL, and other databases.
- **Backups, business continuity, and disaster recovery**: Host a secondary copy of relevant file systems from on premises to the cloud for backup and disaster recovery.
- **Microservices and Docker**: Deliver stateful persistence for containers. Easily scale as your container-based environments grow.

If NFS files are used in the on-premises data center, then moving to File Storage can be simple and direct. If there is a reliance on Microsoft Windows Server, use the NFS client to attach the NFS shares to the Windows Server hosts.

For more information about File Storage, see [Overview of File Storage](#).
Block Volume

The Block Volume service lets you expand your current storage footprint. It provides persistent storage that can move between instances within Oracle Cloud Infrastructure. Volumes work with both bare metal and virtual machine (VM) instances, and they are attached via iSCSI for data volumes or paravirtualized. For more information, see Overview of Block Volume.

Block Volume lets an Oracle Cloud Infrastructure user create, attach, connect, and move volumes as needed to meet application storage requirements. After you attach a volume to an instance, the volume behaves like a standard hard drive. Volumes can also be disconnected and attached to another instance without the loss of data, thus allowing for easy moment of data between instances as requirements change.

The following components are required to create a volume and attach it to an instance:

- **Instance**: A bare metal or VM host running in the cloud.
- **Volume attachment**: One of the following types:
  - **iSCSI**: A TCP/IP-based standard used for communication between a volume and attached instance.
  - **Paravirtualized**: A virtualized attachment available for VMs.
- **Volume**: One of the following types:
  - **Block volume**: A detachable block storage device that lets you dynamically expand the storage capacity of an instance.
  - **Boot volume**: A detachable boot volume device that contains the image used to boot a Compute instance.

Block Volume supports policy-based backups, with predefined policies of Bronze (monthly), Silver (weekly), and Gold (daily). These policies let you customize full and incremental backups, and give you a five-year backup retention for full backups.

NVMe

Oracle Cloud Infrastructure provides locally attached NVMe devices in some specific compute shapes. These devices provide extremely low-latency, high-performance block storage that is ideal for big data, OLTP, and any other workload that can benefit from high-performance block storage. These devices are not automatically protected and require the proper RAID configuration to protect the data on them.
Object Storage and Archive Storage

Oracle Cloud Infrastructure offers two storage class tiers to address the need for both performant, frequently accessed "hot" storage, and less frequently accessed "cold" storage.

- Object Storage has support for big data/Hadoop through the HDFS connector. This is an excellent solution, combined with the Oracle Cloud Infrastructure command line interface (CLI), for storing your backups and large log data. Object Storage is made up of namespaces that manage buckets, which contain objects that reside within a region. For more information, see Overview of Object Storage.

- Archive Storage is designed for items that don't need frequent access and need to held for longer periods. An example use case for Archive Storage is the placement of archive backups for a database. These archive backups need longer retention to meet business data retention and archive responsibilities. Data retrieval of Archive Storage is slower and not immediate. For more information, see Overview of Archive Storage.

Data Migration Guidelines

After you decide what data needs to move and how it will be structured in Oracle Cloud Infrastructure, determine the method to use to move the data from its current location to Oracle Cloud Infrastructure. A critical component of this process is the connection to Oracle Cloud Infrastructure. The throughput depends on the size of the connection.

Oracle Cloud Infrastructure supports many levels of connectivity. Connections can range anywhere from 10 Mbps to 10 Gbps. Taking into account the size of the data set and the connection throughput, the migration of the data might be as simple as a direct copy, or you might need specialized appliances (such as the Data Transfer service) to move the data.

The following table presents a reasonable expectation of how long it will take to move the data to Oracle Cloud Infrastructure, based on the connection and data set size. For more information about the Data Transfer service, see the FAQ.

<table>
<thead>
<tr>
<th>Approximate Data Upload Time</th>
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<tbody>
<tr>
<td><strong>Data Set Size</strong></td>
</tr>
<tr>
<td>10 TB</td>
</tr>
<tr>
<td>100 TB</td>
</tr>
<tr>
<td>500 TB</td>
</tr>
<tr>
<td>1 PB</td>
</tr>
</tbody>
</table>
Example Migration Exercise

The SQL Server migration example shows the key components for migrating the data between systems. SQL Server Always On availability groups can employ the failover strategy to move the users from the on-premises instances to the Oracle Cloud Infrastructure tenancy. This strategy extends the Always On availability groups into Oracle Cloud Infrastructure. After extending SQL Server into Oracle Cloud Infrastructure, and after the Oracle Cloud Infrastructure versions of SQL Server are in sync with the on-premises databases, then you can issue the failover of the Always On availability groups within SQL Server to Oracle Cloud Infrastructure.

The following high-level steps illustrate this example migration:

1. Create the new SQL Server environment in Oracle Cloud Infrastructure and attach block volumes to the SQL Server VM or bare metal instance. Ensure that the block volumes are in the same fault domain as the instance.

2. Create the new backup data file system in the same availability domain by using File Storage, and ensure that the NFS utilities within the SQL Server are turned on.

3. Create the new archive backup data within Object Storage.
4. Copy the latest full backup of the SQL Server instance to Oracle Cloud Infrastructure by using rsync (on Linux) or robocopy (on Windows Server).
   - rsync: `-avz sqlbackups/ root@newOCIserver:/sqlbackups/`
   - robocopy: `\currenthost\sqlbackups \newOCIserver\sqlbackups /MIR /Z /s`

5. Use the Oracle Cloud Infrastructure CLI to bulk upload the archived backups to the new object store. Use the following commands:
   ```
   oci os object bulk-upload -ns namespace -bn sqlbackups --src-dir /sqlbackups
   ```
   You can also perform the bulk upload by using Cyberduck. For more information about establishing a connection with Oracle Cloud Infrastructure, see the Cyberduck pages.

6. For instructions on establishing an Always On availability group, see the Always On availability group documentation.

7. After the Always On availability group is established and the data is synchronized between sites, the failover can be made when it is convenient for users.

This simple strategy is one that employs the features of the application with the power of Oracle Cloud Infrastructure services to provide a resilient environment for your application. For larger data sets, consider using similar concepts with the Data Transfer service.

Data Transfer Service and Appliance

The Data Transfer service lets you move larger sets of data by copying the data onto your own disks or to an appliance supplied by Oracle. The service has some caveats:

- The disks must be SATA II/III 2.5" or 3.5" HDDs or external USB 2.0/3.0 HDDs.
- The Data Transfer utility must be used to copy the data to the disks.
- The utility works only on Debian, Ubuntu, Oracle Linux, and Red Hat Linux.
- The transfer appliance is limited to 150 TB of usable space.

Conclusion

Building a migration plan is critical to a successful application move. This paper discusses the necessary components for moving application data and the customers to Oracle Cloud Infrastructure, using an example of moving a Microsoft SQL Server application. It presents key questions to consider before migrating any application, such as identifying the application customers, the amount of data to move, any software that is necessary for the application to run, and connectivity requirements for the application. It also examines the backup policies and storage
capabilities within Oracle Cloud Infrastructure, and possible migration methods, even for large data sets.

Oracle Cloud Infrastructure provides the infrastructure to successfully migrate an application such as SQL Server. If you have not tried Oracle Cloud Infrastructure, sign up for a free trial at https://cloud.oracle.com/tryit.

Resources

- Cyberduck
- Microsoft SQL Server Always On availability groups
- Oracle Cloud Infrastructure resources:
  - Overview of Block Volumes
  - Protecting Data on NVMe Devices
  - Overview of File Storage
  - Overview of Object Storage
  - Overview of Archive Storage
  - Data Transfer service
  - Data Transfer appliance
  - Data Transfer FAQ
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Integrated Cloud Applications & Platform Services

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