

Introduction to Oracle Storage Cloud Service

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Objectives

After completing this lesson, you should be able to:

- Discuss object storage on Oracle Cloud
- Explain the basic concepts of object storage
- Explain how object storage on cloud compares with other storage solutions
- Describe how to access object storage on cloud by using the REST API

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Oracle Cloud: Overview

- Includes a broad set of industry standards–based, integrated services
- Provides subscription-based access
 - Data storage
- Includes application services
- Provides the following:
 - Service management
 - Hosting
 - Support

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- Oracle Cloud includes a broad set of industry standards–based, integrated services that provide customers with subscription-based access to Oracle Platform Services, Application Services, and Social Services, all completely managed, hosted, and supported by Oracle.
- With predictable subscription pricing, Oracle Cloud delivers instant value and productivity for business users, developers, and administrators.
- Oracle Storage Cloud Service is the main focus in this lesson.

So What Exactly Is Object Storage on Oracle Cloud?

- Definition of object storage
 - Components
 - Advantages over traditional storage (block storage)
- Popularity in cloud storage
 - Scalability
 - Customizable attributes and metadata
 - Flexibility
 - Data manipulation
 - Nearly any file type
 - Multiple user accessibility from anywhere

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- Object storage is where data is handled as an object, also known as unstructured data. The main differences between object storage and traditional storage (also known as *block storage*), are listed as follows:
 - Stored data contains customized metadata.
 - Data is indexed, allowing for much faster search results.
 - Data can be located by using pointers instead of finding its location based on tracks and sectors on the hard disk (that is, the standard *file system* that we have used for many years).
- This type of storage is used as an essential part of cloud services, in data centers, and it is normally integrated with virtual machines.
- Because object storage allows for additional attributes as part of the “bundle,” applications, programs and storage devices are able to better manipulate data.
- Nearly any file type can be stored in the form of object storage. Some popular files include media files (images, videos, music, and photos), documents, PDFs, backups, archives, and so on.
- Multiple users can access the data.

Storage is a fundamental requirement for any enterprise application workload. Traditional storage solutions pose certain scalability, performance, and management challenges that Oracle Storage Cloud Service helps to overcome. Oracle Storage Cloud Service provides a low cost, reliable, secure, and scalable object-storage solution for storing unstructured data and accessing it anytime from anywhere. It is ideal for data backup, archival, and file sharing, and for storing large amounts of unstructured data such as logs, sensor-generated data, and VM images.

How Does Object Storage Work?

- Data stored alongside one another (flat structure)
 - Unique identifiers to locate and retrieve data
 - Infinite storage capacity
- Beneficial when handling large amounts of data
 - Advantages over traditional storage (file system hierarchy)
 - Benefits of searchable metadata
- Storage disks and storage devices

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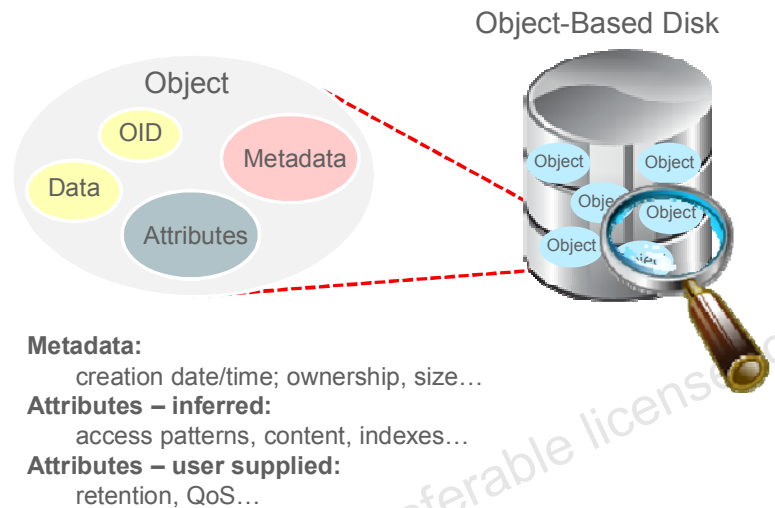
To better understand how object storage works, make a note of the following factors:

- Object storage data is stored alongside one another. That is, all data is stored in the form of a single layer.
- Unlike traditional file systems, with object storage, data is pulled by servers by using unique identifiers to retrieve the desired data. This is particularly helpful for enterprises that interact with large amounts of data because the “large” file is not retrieved until it is found based on its searchable metadata and location.

Object storage is an intelligent evolution of disk drives that can store and serve objects rather than simply place data on tracks and sectors. This task is accomplished by moving low-level storage functions into the storage device and accessing the device through an object interface.

Object Storage Elements

- Object Storage Platform
 - Containers
- Objects
- Disk Volumes
 - Traditional: Block Storage
 - New: Object Storage



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- A container is a user-created resource, which can hold an unlimited number of objects, unless you specify a quota for the container. Note that containers cannot be nested.
- When using this form of storage, data is treated as an object. Think of an object as a document file. Users can add additional attributes to each object such as: notes about the file, location where the file was created, compatibility options, and so on.
- Traditional data storage (block storage) does not support additional metadata and attributes. Additionally, the file location must be specified by the user; this way, the operating system calls up that file from the hard drive directly.
- Object storage allows for searchable metadata, automatic indexing, multiple copies/backups of stored data, and the ability to access storage nodes found in different parts of the world.
 - If the storage container is about to reach its capacity limit, a new storage node is created to allow the user to continue adding data.
- A common analogy to better understand object storage is valet parking:
 - Even though you do not know where the car is parked—or if it has been relocated multiple times while you were away—when you are ready to leave, your ticket number is used to trace your car and return it to you. The car is the object; the ticket number is the object's unique identifying number that provides the location of the car; and the valet's parking lot is the container where the vehicles are parked in a flat area.

Other Storage Solutions

- Object storage has advantages over:
 - Direct-attached storage
 - Network-attached storage (NAS)
 - Block storage

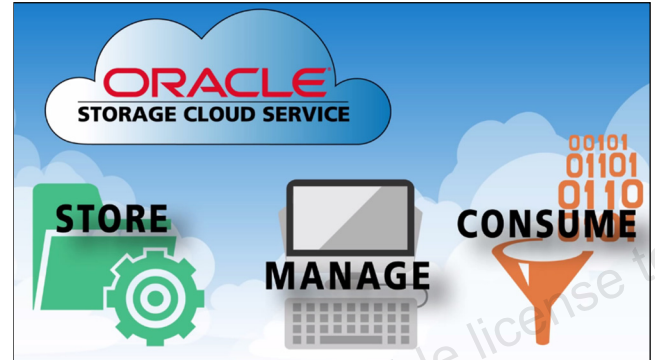
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- Other storage solutions include direct-attached storage, network-attached storage, and block storage.
 - With *direct-attached storage*, such as the hard disk drive in a laptop, the operating system that underlies the applications manages data storage, retrieval, and organization through a file system, which is a schema that the operating system uses to organize data on locally attached disks. Direct-attached storage provides convenient, low latency, durable storage. However, because storage capacity is spread between isolated devices, direct-attached storage does not scale well.
 - In *network-attached storage (NAS)*, the storage device is physically separate from the servers that host the applications. To the application hosts, the storage device is available as a network drive. A network file system on the storage device manages data storage, retrieval, and organization. NAS enables applications running on multiple hosts to share storage. It enables centralized management of storage resources and high performance over a local network. But this architecture is feasible only within a limited geographical area, and it offers limited room for scaling. As with direct-attached storage, in NAS as well, applications rely on the underlying operating system and on the network file system of the storage device.
 - *Block storage* enables applications such as online transaction processing (OLTP) databases that have high IOPS (input/output operations per second) requirements to store and retrieve data efficiently, by bypassing the host operating system and interacting directly with the virtual block devices. Chunks of data are stored in blocks, each with an address, but with no other metadata. Applications decide where data is stored, and they retrieve data by calling the appropriate block addresses directly. Block storage optimizes storage for IOPS and block-based access, and provides POSIX-compliant file systems for Oracle Compute Cloud Service instances. It is limited in terms of scalability and does not support the definition of granular metadata for stored data.

What Are the Benefits of Oracle Storage Cloud Service?

- Enterprise solution
 - Cost effective
 - Reliable
 - Scalable
- Public cloud storage solution
 - Secure
 - Elastic
 - Reliable
- Data
 - Enterprise-grade storage capacity
 - Purchase storage now, and buy more later.



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- Oracle Storage Cloud Service is a secure, elastic, and on-demand public cloud storage solution.
- It is accessible from anywhere, 24/7, and from any device.
- It provides an easy way to store, manage, and consume large amounts of data.
- It enables users to manage data at a granular level with role-based access control.
- User data is never moved out of the data center without the customer's permission.

What Features Does Oracle Storage Cloud Service Provide?

- Object-based storage
- Replication within the data center
- Automatic error detection and healing
- Fine-grained read/write access control to containers
- REST API and Java library interfaces
- Global namespace URL to access the service
- Low-cost data archival

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- All objects or containers created in Oracle Storage Cloud Service are replicated to three separate storage nodes in the data center. If one of the three nodes fails, at least two copies of the object or container will continue to be available.
 - Note that by default, data is eventually consistent across the nodes in the data center. When an object or a container is created or modified, the change is not replicated instantaneously to the other two nodes. Until the replication is completed, a container or an object's data may not be consistent across the three nodes. Over time, all changes to all objects or containers are replicated, and the data becomes consistent across the three nodes.
- Object copies are actively scanned for data corruption. If a bad copy is found, it is replaced, automatically, with a new copy.
- Read and write access to an object is controlled via access control lists for its container. Each container can be assigned its own read and write access control lists. By default, access to a container and its objects is private (that is, only the user who created the container can access it), but read access can be made public if required.
- The primary method for accessing Oracle Storage Cloud Service is through a REST web service, which is based on OpenStack Swift. The service can be accessed from anywhere over the Internet, at any time, and from any device.
- A Java library that wraps the REST web service is also available. No special hardware is required to start using the service.

- Regardless of the data center where your service instance is provisioned, you can access Oracle Storage Cloud Service by using a global namespace. Requests sent to the global namespace URL are routed to the data center where your service instance is provisioned.
- In metered accounts, you can create containers of two storage classes, Standard (default) and Archive. You can use Archive containers to store large data sets that you do not need to access frequently, at a fraction of the cost of storing data in Standard containers. Note that to download data stored in Archive containers, you must first restore the objects. The restoration process can take up to four hours depending on the size of the object. A few features, such as dynamic large objects, bulk upload and deletion, and server-side COPY, are not supported for Archive containers. Other specific differences are highlighted in the sections that describe the affected features. Archive containers are ideal for storing data such as email archives, data backups, and digital video masters.

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- The diagram in the slide presents an architectural overview of the Oracle Storage Cloud Service architecture.
- The Oracle Storage Cloud Service architecture is highly available and supports support for external access methods, including customer applications and clients.
- When objects are stored in Oracle Storage Cloud Service, they are replicated across multiple storage nodes in the data center. This replication strategy ensures data availability and can survive hardware failure. Note that there can be only one master copy of an object at any given time.

Oracle Storage Cloud Service - Replication Policy

- The service administrator **MUST** select a replication policy
 - This allows for stored data to be replicated at another data center
- This is required for Oracle Storage Cloud Service for the following subscription types:
 - Commercial IaaS metered
 - Commercial IaaS nonmetered
 - Public sector IaaS nonmetered
- Any user who is assigned the `Storage_Administrator` role can do this task
 - Role name for metered members:
`Storage.Storage_Administrator`
 - Role name for nonmetered members: `service-instance-name.Storage_Administrator`

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- To be able to use Oracle Storage Cloud Services, a user, with the storage administrator role, must select a replication policy for the service instance.
- Data is written to the primary data center and replicated asynchronously to the secondary data center. The primary and secondary data centers are eventually consistent.
 - If the primary data center is unavailable, read requests to the global namespace URL are routed to the secondary data center. This is known as *failover*. While the primary data center is unavailable, write requests will fail with the 403 – Forbidden error. When the primary data center is available again, all requests to the global namespace URL are routed to the primary data center. This is known as *failback*.
- See Practice 7.1, titled “How To Select a Replication Policy,” for instructions on how to select a replication policy.
- **IMPORTANT:** Users will not have access to Oracle Cloud Services if this Replication Policy is not selected.

Interface to Oracle Storage Cloud Service

- REST web service API additions:
 - Centralized identity management across Oracle Cloud
 - Centralized reporting of usage metrics
- No support for some OpenStack Swift features
- REST web service API
 - Over HTTPS only

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- Oracle Storage Cloud Service provides REST APIs based on OpenStack Swift. The following major additions have been made:
 - Centralized identity management across Oracle Cloud
 - Centralized reporting of usage metrics
- Oracle Storage Cloud Service does not support the following OpenStack Swift features:
 - Object versioning
 - Static website support
 - Container synchronization
 - Form post
 - Account ACLs
 - Rate limits
- The REST web service API is available only over HTTPS.

How Do I Access Object Storage on Cloud?

- The application or platform must:
 - Completely understand the Hypertext Transfer Protocol (HTTP)
 - Have internet connectivity
- Applications include:
 - cURL
 - Web browsers
- If using a Linux machine, ensure that cURL is installed.
- The following slides describe how to install Cygwin with cURL on a Windows machine

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- The REST API can be accessed from any application or programming platform that correctly and completely understands HTTP and has Internet connectivity. The REST API uses advanced facets of HTTP such as secure communication over HTTPS, HTTP headers, and specialized HTTP verbs (PUT, DELETE).
- Some applications that meet these requirements are:
 - cURL: cURL is a command-line tool that you can use to invoke REST API calls by sending HTTP requests.
 - Web browsers: Support varies across vendors. Some browser plugins may be needed for full support.
- Many programming platforms (Java, Ruby, Perl, PHP, .NET, and so on) also meet these requirements, although some may require the use of third party libraries for full support. See your programming platform's documentation for guidance.

Installing Cygwin with cURL (1/3)

- The installation tutorial is available at:
https://apexapps.oracle.com/pls/apex/f?p=44785:112:::::P112_CONTENT_ID:11571

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The next three slides will guide you through the installation process.

- For more details on the installation process, you may also follow the tutorial online.

Installing Cygwin with cURL (2/3)

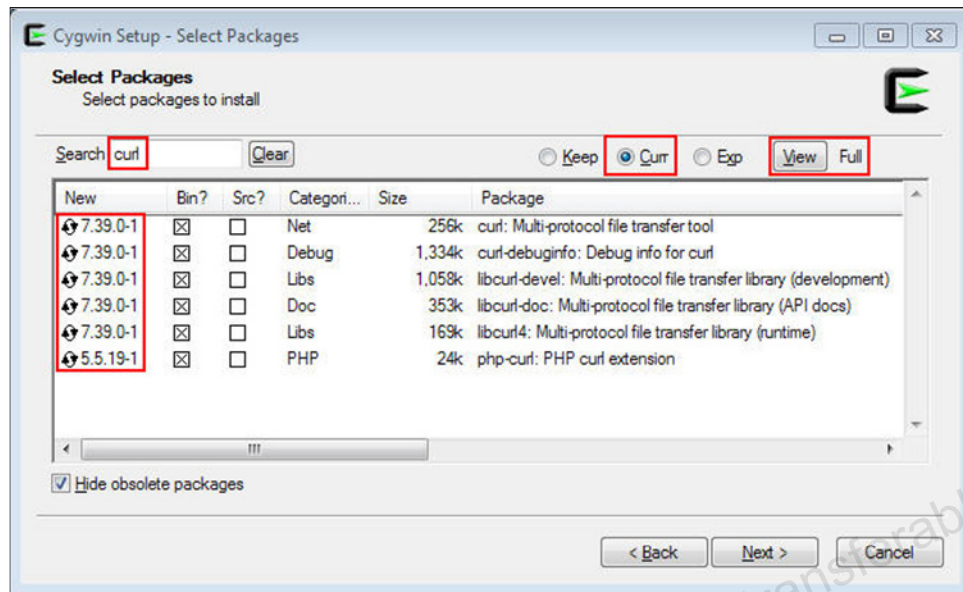
1. Download and run the Cygwin installer.
 1. 64-bit: https://cygwin.com/setup-x86_64.exe
 2. 32-bit: <http://cygwin.com/setup-x86.exe>
2. Follow the prompts by the Cygwin Setup wizard.

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- On the Windows system where you want to install Cygwin with cURL, download and run the Cygwin installer:
 - 64-bit: https://cygwin.com/setup-x86_64.exe
 - 32-bit: <http://cygwin.com/setup-x86.exe>
- Follow the prompts by the Cygwin Setup wizard.
- You can leave most settings at their default values. Pay specific attention to the following:
 - On the **Choose A Download Source** screen, select “Install from Internet.”
 - On the **Select Your Internet Connection** screen, select the appropriate type depending on the Internet connection that you are currently using. For example, if you connect via your company's proxy server, either select the IE5 method or specify the proxy.
 - On the **Choose a download site** screen, select a site from the list, or add your own sites to the list.
 - The **Select Packages** screen displays a list of all available packages and lets you select those that you want to install. By default, only packages in the “Base” category are marked for installation. The Base category does not include tools such as cURL. You should select those explicitly.
 - By default, the packages are grouped by category. Click the View button to toggle to the Full view.
 - Make sure that the Curr radio button remains selected. This ensures that only the most stable version (rather than an experimental version) is selected for each package.
 - In the Search field, enter “curl.” The curl-related packages are displayed.

Installing Cygwin with cURL (3/3)



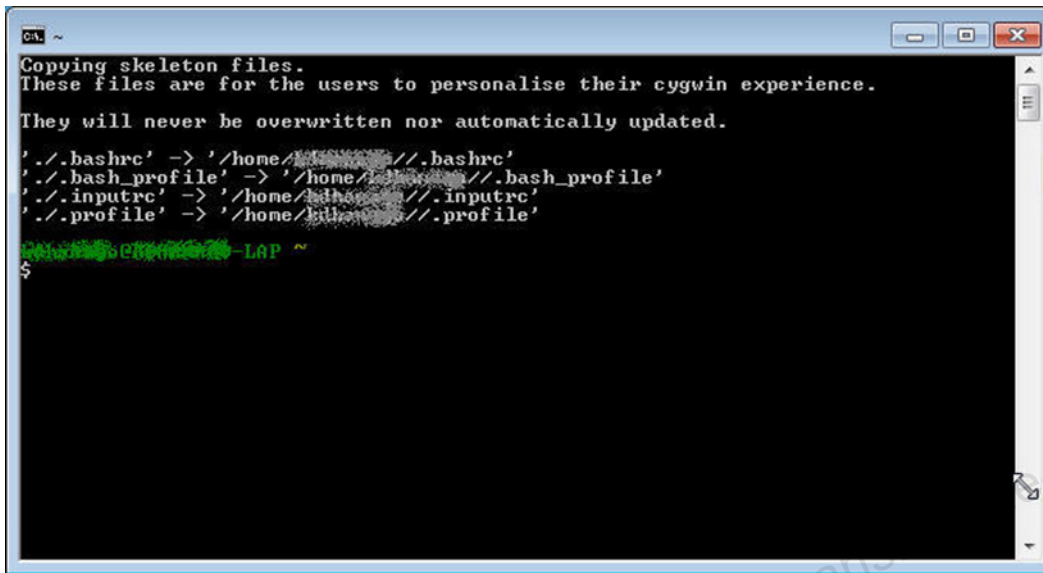
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The screenshot in the slide shows the cURL packages that are available for installation.

- Select all the curl packages by clicking the Skip button for each package once. Note how the Skip label changes to show the version number of the selected package. At this point, the Select Packages screen should look like the example in the slide.
- Click Next on the remaining screens of the wizard. The selected packages are downloaded and installed. This may take a while if you have a slow Internet connection.
- On the Installation Status and Create Icons screen, click Finish.

Starting Cygwin



```
CA. ~
Copying skeleton files.
These files are for the users to personalise their cygwin experience.
They will never be overwritten nor automatically updated.
'./bashrc' -> '/home/.../bashrc'
'./bash_profile' -> '/home/.../bash_profile'
'./inputrc' -> '/home/.../inputrc'
'./profile' -> '/home/.../profile'
C:\cygwin64\bin\cygwin.exe -LAP ~
$
```

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The screenshot in the slide shows the Cygwin command prompt with cURL.

- Go to the directory in which you installed Cygwin (default: C:\cygwin64).
- Double-click Cygwin.bat. A terminal window opens, as shown in the example in the slide.
 - Verify that cURL was installed by running the command, "curl".
 - You should see the following output:

```
curl: Try 'curl --help' or 'curl --manual' for more information
```
- You can now start by using cURL to send HTTP requests.

Tip: Do not delete the setup*-exe file. Move it to the C:\cygwin64 folder. You can use it at any time in the future to update your Cygwin installation, with new or updated packages, for example.

REST URLs: URL for the Account

- REST API endpoint of the service instance
- One of the following formats for the REST API endpoint:
 - Global namespace URL for all customers
 - Data center–specific URL for all customers
- URL in the early releases of Oracle Storage Cloud Service:
 - Metered subscription
 - Nonmetered subscription
- URL formats
- Examples

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- The URL for the Oracle Storage Cloud Service REST API endpoint is in one of the following formats:
 - Global namespace URL for all customers: This is the URL that you see in My Services.
 - Data center–specific URL for all customers:
<https://dataCenterCode.storage.oraclecloud.com/v1/Storage-identityDomainID>
- URL in the early releases of Oracle Storage Cloud Service:
 - Metered subscription: <https://storage.dataCenterCode.oraclecloud.com/v1/Storage-identityDomainID>
 - Nonmetered subscription:
<https://storage.dataCenterCode.oraclecloud.com/v1/serviceInstanceName-identityDomainID>

Note:

- If your client applications use a URL from an early release of Oracle Storage Cloud Service, you can update the applications to use the global namespace URL.
- In these URL formats:
 - `identityDomainID` is the identity domain in which the service instance is provisioned
 - `dataCenterCode` is the identifier of the data center in which the service instance is provisioned. For example, `dataCenterCode` is `us2` for the data center in Chicago, Illinois, U.S.A. and `us6` for Ashburn, Virginia, U.S.A.
 - `serviceInstanceName` is the customer-specified name of the service instance

Examples

For example, for a service instance named `myStorage2` that is provisioned in the `myIdentity3` domain ID in the `us2` data center, the REST API endpoint URLs would be:

- Global namespace URL for all customers: <https://foo.storage.oraclecloud.com/v1/Storage-myIdentity3>
 - The foo part in this example would be different for each account.
- Data center–specific URLs for all customers: <https://us2.storage.oraclecloud.com/v1/Storage-myIdentity3>
- URL in the early releases of Oracle Storage Cloud Service:
 - Metered subscription: <https://storage.us2.oraclecloud.com/v1/Storage-myIdentity3>
 - Nonmetered subscription: <https://storage.us2.oraclecloud.com/v1/myStorage2-myIdentity3>

REST URLs: URL for Containers and Objects

- URLs for Containers
 - Resources within an account
- URLs for Objects
 - Resources within containers
 - Data center–specific URL for all customers

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- URLs for Containers
 - Containers are resources within an account.
 - Given the sample global namespace REST API endpoint URL in the slide, the URL for a container named *myContainer4* would be
<https://foo.storage.oraclecloud.com/v1/Storage-myIdentity3/myContainer4>.
- URLs for Objects
 - Objects are resources within containers.
 - Given the sample global namespace REST API endpoint URL in the slide, the URL for an object named *myObject5* in the *myContainer4* container would be
<https://foo.storage.oraclecloud.com/v1/Storage-myIdentity3/myContainer4/myObject5>.

Note

- These URLs are valid for any object in a *Standard* or *Archive* container. To restore an object in an *Archive* container and to track the progress of the restoration, the URL for an object named *myObject5* in the *myArchiveContainer5* container would be
<https://foo.storage.oraclecloud.com/v0/Storage-myIdentity3/myArchiveContainer5/myObject5>. Note the v0 API version in the URL.

Quiz



We already know that object storage is used in cloud computing. Beside this exception, object storage is essentially the same as the *file system* storage (what we have used in PCs for decades now).

- a. True
- b. False

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Quiz

How is object storage stored?

- a. Same as the file system architecture
- b. File-path form, where the user must specify where on the disk the item is located
- c. Alongside one another, in the form of a single layer
- d. All of the above
- e. None of the above

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Quiz

A container is _____.

- a. The primary disk on the server
- b. What holds an unlimited number of objects
- c. The same as a node
- d. All of the above
- e. None of the above

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Quiz



When using object storage, data is treated as objects, giving us the advantage of:

- a. Customizing metadata
- b. Getting faster results because the metadata is already indexed
- c. Filtering search results based on metadata, regardless of where this data is stored
- d. All of the above
- e. None of the above

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Summary

In this lesson, you should have learned how to:

- Discuss object storage on Oracle Cloud
- Explain the basic concepts of object storage
- Explain how object storage on the cloud compares with other storage solutions
- Describe how to access object storage on the cloud by using the REST API

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