

ĐIỆN TOÁN ĐÁM MÂY (Cloud Computing)

PRACTICES Practice 4 – Data Storage Design

Presenter: **Dr. Nguyen Dinh Long**

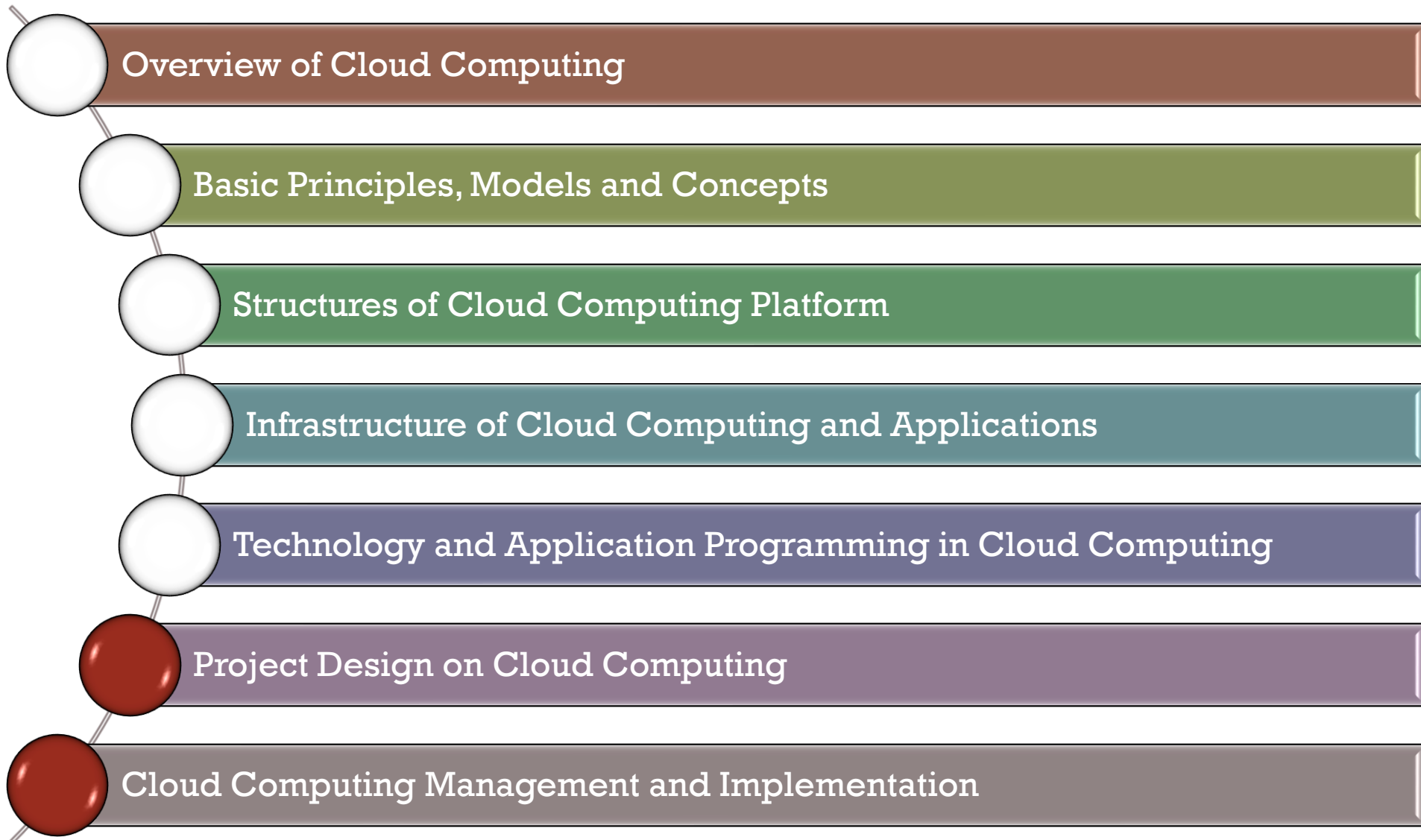
Email: dinhlonghcmut@gmail.com

Phone: +84 947 229 599

Google-site: <https://sites.google.com/view/long-dinh-nguyen>

Nov. 2022

Outline



References

Main:

- Thomas Erl, Zaigham Mahmood, and Ricardo Puttini. 2013. *Cloud Computing Concepts, Technology & Architecture*. Prentice Hall.
- Michael J. Kavis. 2014. *Architecting the Cloud: Design Decisions for Cloud Computing Service Models*. Wiley
- Arshdeep Bahga, and Vijay Madisetti. 2013. *Cloud Computing: A Hands-On Approach*. CreateSpace Independent Publishing Platform

More:

- Rajkuma Buyya, Jame Broberg and Andrzej Goscinski. 2011. *Cloud Computing –Principles and paradigms*, Wiley
- Nick Antonopoulos, and Lee Gillam. 2010. *Cloud Computing - Principles, Systems and Applications*, Springer-Verlag London Limited.
- Slides here are modified from several sources in Universities and Internet.

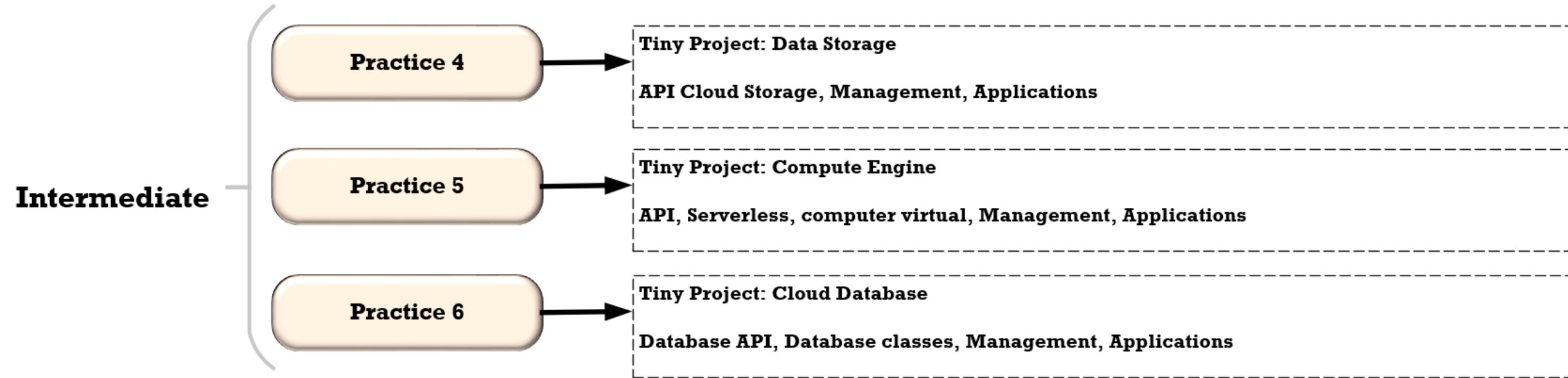
Cloud Computing: Practices

Levels: Beginning (3 weeks) – **Intermediate (3 weeks)** – Advanced (3 weeks)

Groups: 9 with 5 person/group

Practice: submit a report for each group, submit to our Google Classroom

Cloud Computing: Practices



Content of Practice 4

1. Overview of Data Storage on Cloud
2. Enable API with Cloud Storage
3. Cloud storage services and Management
4. Cloud storage with Database on Cloud
5. Applications of Cloud storage

Overview of Cloud Storage

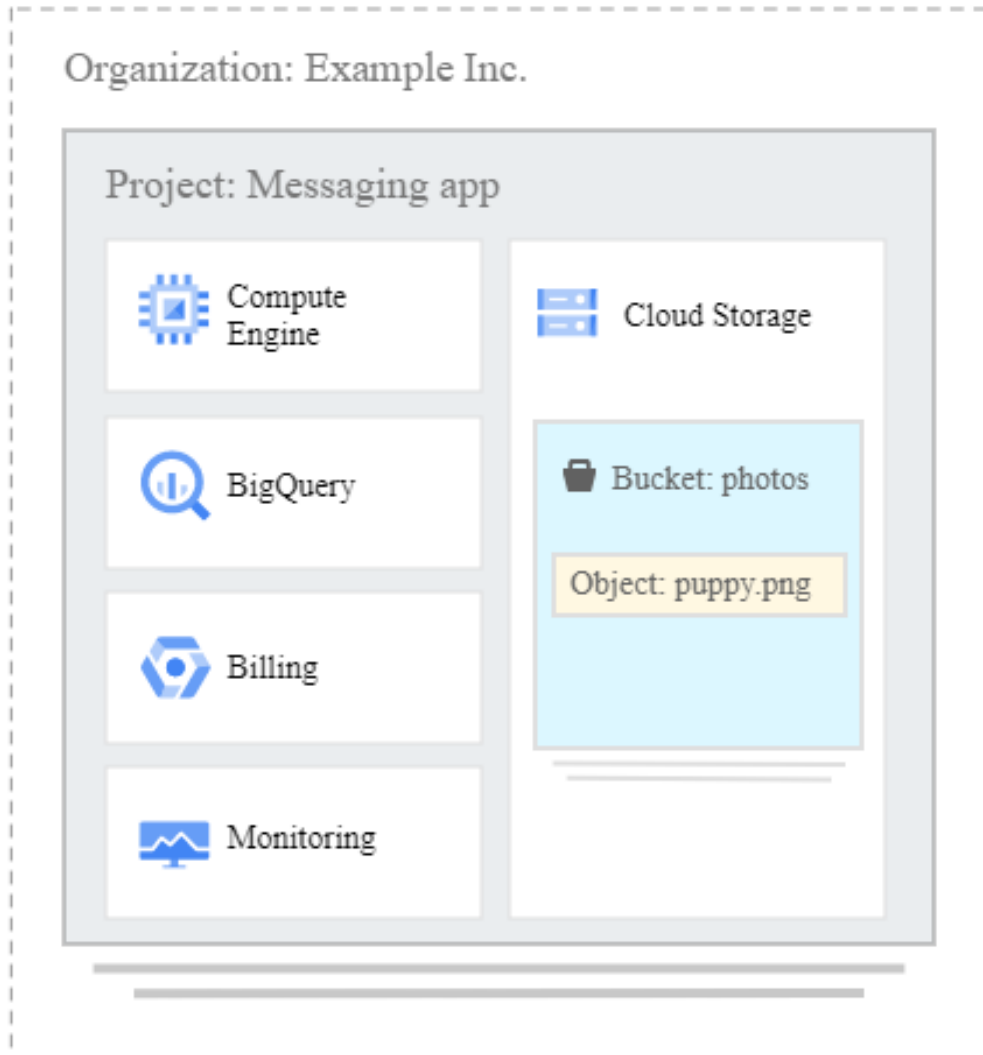
❑ What is Cloud Storage:

- Cloud Storage is a service for storing your [objects](#) in Google Cloud. An object is an immutable piece of data consisting of a file of any format. You store objects in containers called [buckets](#). All buckets are associated with a [project](#), and you can group your projects under an [organization](#). Each project, bucket, and object in Google Cloud is a resource in Google Cloud, as are things such as [Compute Engine instances](#).
- After you create a project, you can [create Cloud Storage buckets](#), [upload objects](#) to your buckets, and [download objects](#) from your buckets. You can also grant permissions to make your data accessible to principals you specify, or - for certain use cases such as hosting a website - [accessible to everyone on the public internet](#).

Overview of Cloud Storage

❑ What is Cloud Storage:

The Cloud Storage structure looks like this:



Here's how the Cloud Storage structure can apply to a real-world case:

Organization: Your company, called Example Inc., creates a Google Cloud organization called exampleinc.org.

Project: Example Inc. is building several applications, and each one is associated with a project. Each project has its own set of [Cloud Storage APIs](#), as well as other resources.

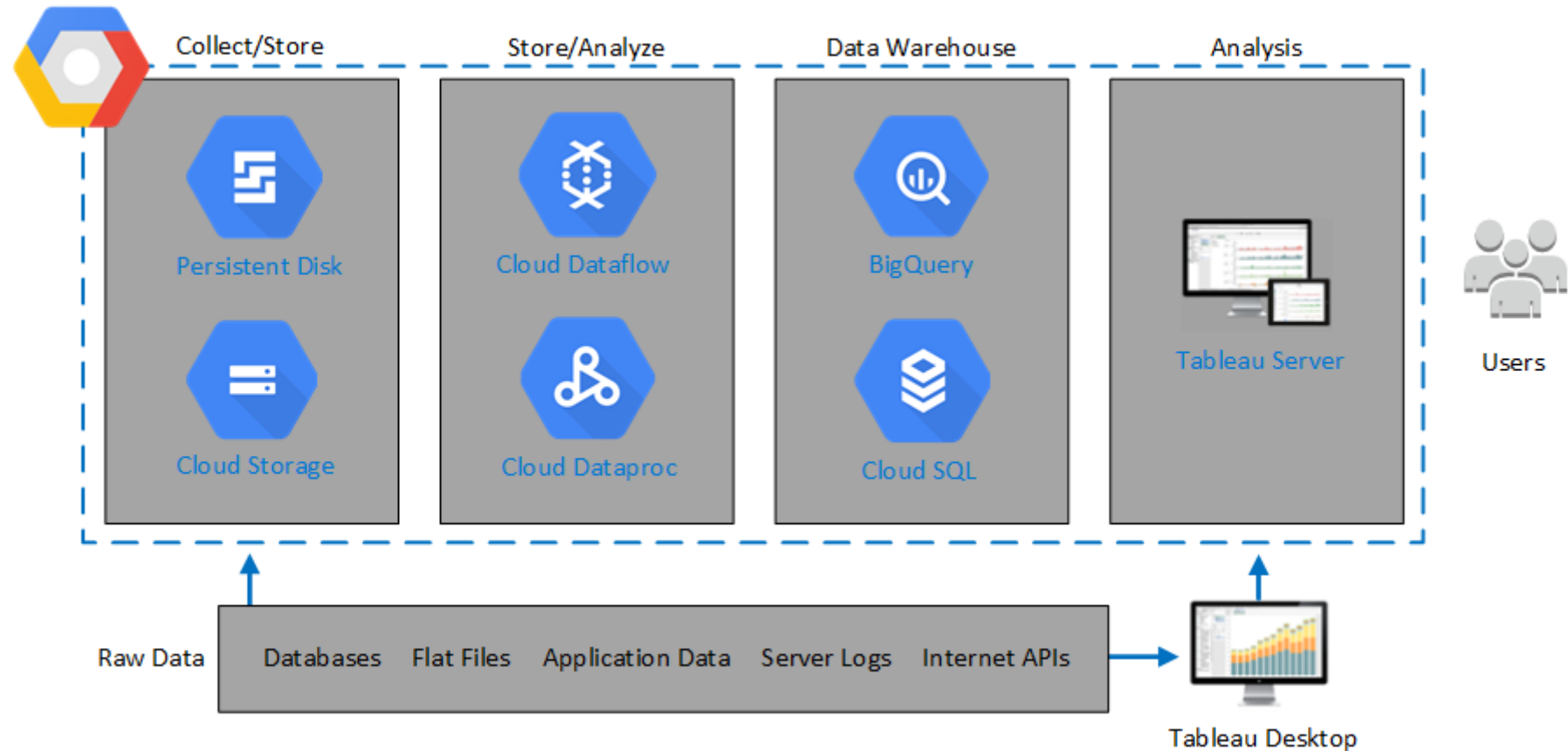
Bucket: Each project can contain multiple [buckets](#), which are containers to store your objects. For example, you might create a photos bucket for all the image files your app generates and a separate videos bucket.

Object: An individual file, such as an image called [puppy.png](#).

Overview of Cloud Storage

What is Cloud Storage:

Google Cloud Platform Hosting Type:



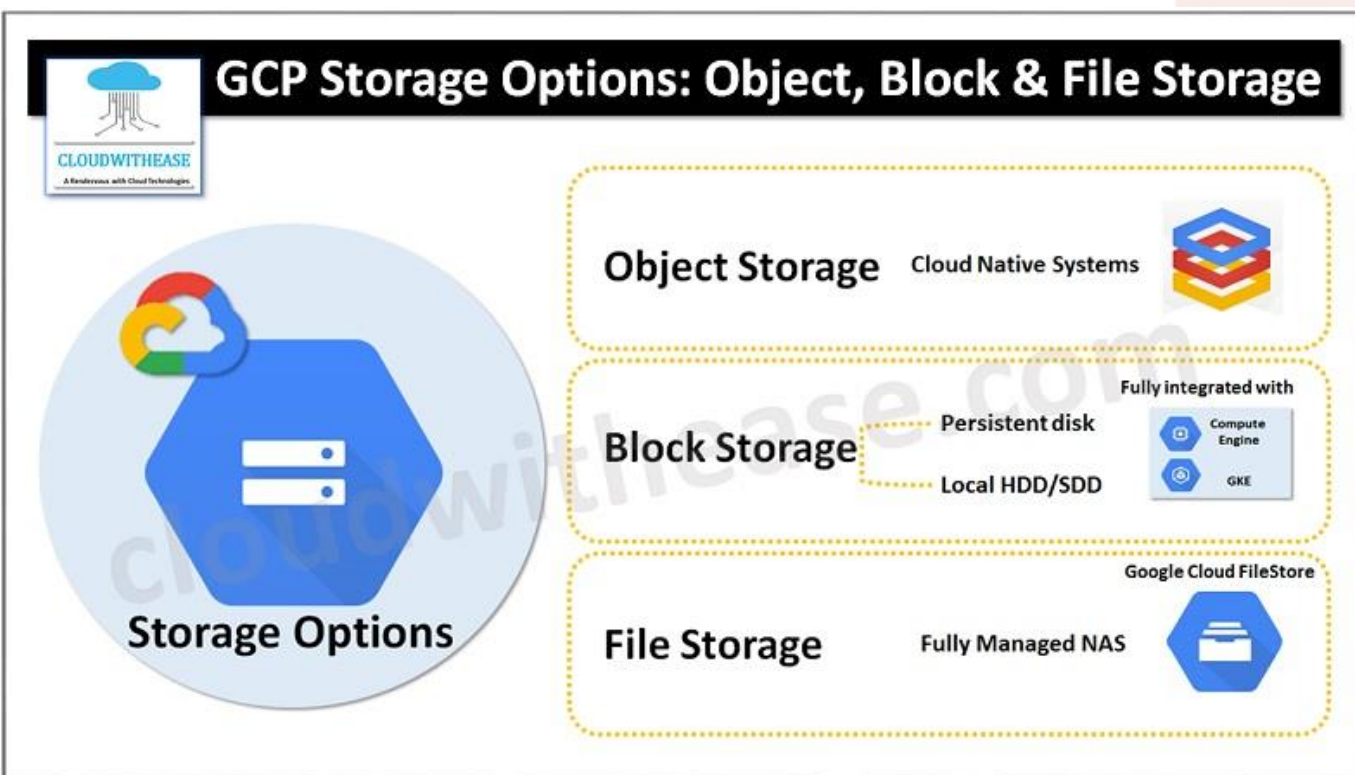
Overview of Cloud Storage

What is Cloud Storage:

Google Cloud Platform Hosting Type:

File Storage	Block Storage	Object Storage
 <p>Files are located to logical folders to store data.</p> <p>Example: ../images/site-logo.jpeg ../AppLog/log-error.txt</p>	 <p>Block storage - Fixed size (non- scalable) memory</p> <p>Example: Hard Disk Pen Drive</p>	 <p>Object storage- Highly scalable object based storage.</p> <p>Example: Dropbox Amazon S3</p>

Different Types of Storage Example





Which Storage Should I Use?

OBJECT



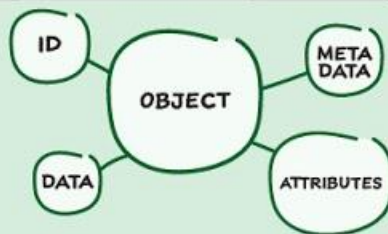
Cloud Storage

For any app. Store any type & any amount of data for any duration, & retrieve it as often as needed

GOOD FOR:
Binary or object data,
blobs, unstructured data

Object Storage

DATA ↓ ↑ METADATA/
OBJECTID



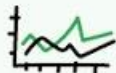
USE CASE:



Streaming videos



Images



Data analytics



Backups



Documents



Regulatory archives



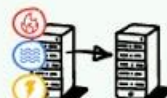
Tape replacement



Websites



Genomics



Disaster recovery

BLOCK



Persistent Disk

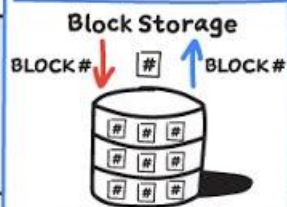


Fully integrated with
Compute Engine & GKE



Local SSD

GOOD FOR:
✓ Block store for VMs
✓ Range of latency & performance options



GOOD FOR:
✓ Ephemeral block store for VMs
✓ Lowest latency
✓ Stateless workloads

USE CASE:



Disks for VMs



Share read-only data
across VMs



Rapid, durable backups
of running VMs



Storage for databases

USE CASE:



Flash-optimized databases



Hot caching layer for analytics



Application scratch disk



Scale out analytics



Media rendering

FILESTORE



Filestore

Fully managed, cloud-based
Network Attached Storage



GOOD FOR:
Shared file storage
(unstructured) data

USE CASE:



Media processing



Life sciences/
Genomics processing



Electronic Design Automation
(EDA)



Data Analytics



Application migrations



Machine Learning



Web content management



Financial Modeling

Overview of Cloud Storage

❑ Basic tools for Cloud Storage:

Here are some basic ways you can interact with Cloud Storage:

- **Console:** The Google Cloud console provides a visual interface for you to manage your data in a browser.
- **Google Cloud CLI:** The gcloud CLI allows you to interact with Cloud Storage through a terminal using gcloud storage commands.
- **Client libraries:** The Cloud Storage client libraries allow you to manage your data using one of your preferred languages, including C++, C#, Go, Java, Node.js, PHP, Python, and Ruby.
- **REST APIs:** Manage your data using the JSON or XML API.

Overview of Cloud Storage

❑ Key Features of Google Cloud Storage:

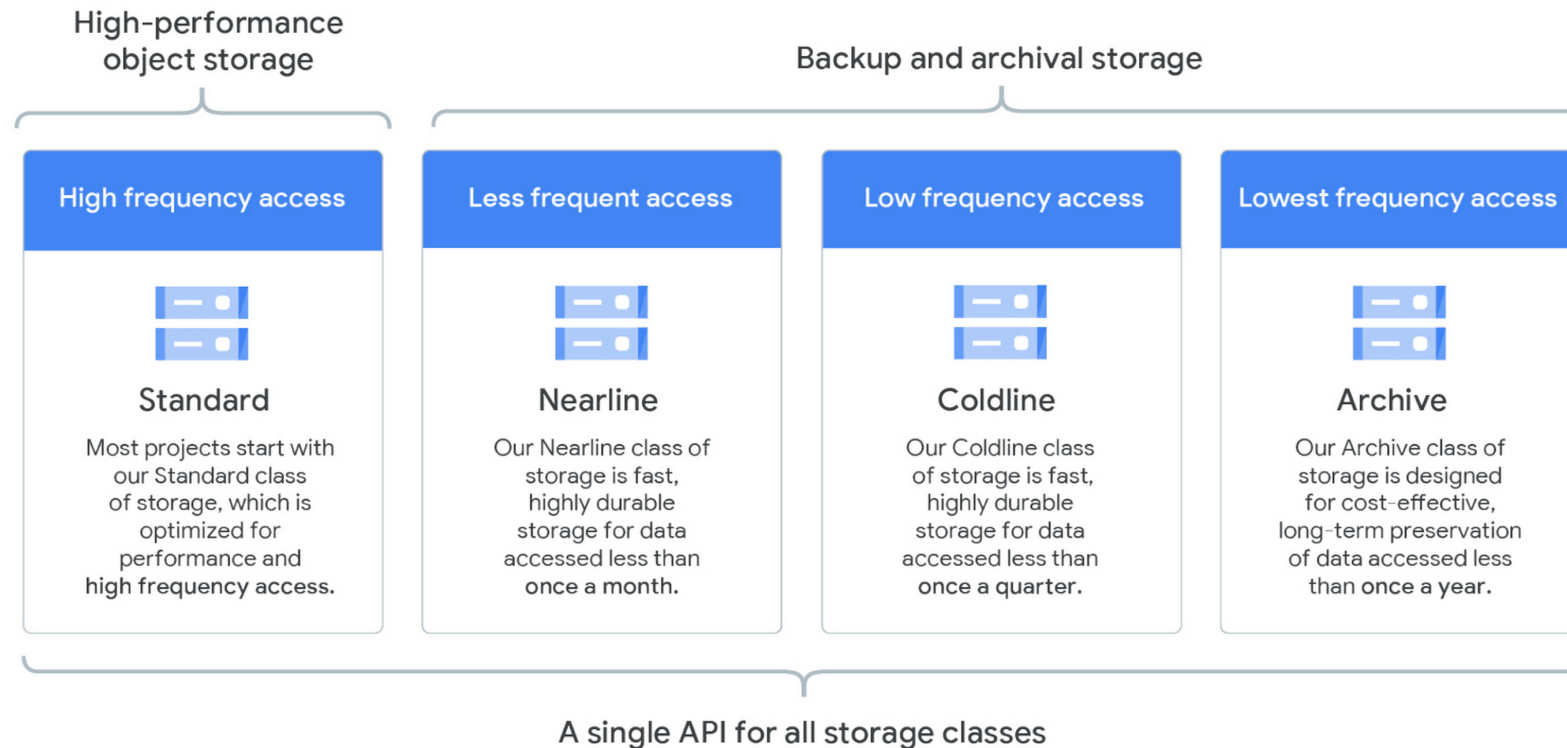
- It offers **low latency** and high durability (up to 99.9999%)
- It provides **unlimited storage** with no minimum object size
- It is a **reliable and secure** object storage option for the users.
- **Object Lifecycle Management**: Cloud Storage allows users to define and assign conditions to a bucket that could trigger a data deletion or move to a less costly storage class.
- **Object Versioning**: It allows users to keep track of the objects they have stored and have access to them if they are deleted or overwritten. It does increase storage costs, but Object Lifecycle Management can be used to remove older versions of the objects.
- Users can **easily transfer data** to Google Cloud Storage
- **Multiple redundancy options**: Cloud Storage has an ever-growing list of storage bucket locations where users can store their data with multiple automatic redundancy options.

Overview of Cloud Storage

Storage Classes:

Google Cloud Storage offers 4 types of storage classes for any workloads which can be used as per the requirement:

- **Standard Storage:** “hot” data that is accessed frequently, including websites, streaming videos, and mobile apps.
- **Nearline Storage:** low-cost option suited for data that can be stored for at least 30 days, including data backup and long-tail multimedia content.
- **Coldline Storage:** Very low cost suited for data that can be stored for at least 90 days, including disaster recovery.
- **Archive Storage:** It offers the lowest cost and suited for data that can be stored for at least 365 days, including regulatory archives.



Overview of Cloud Storage

❑ Use Cases For Google Cloud Storage:

1. **Backups and archives:** It provides fast, low-cost, highly durable storage for data accessed less than once a month. It is perfect for reducing the cost of backups and archives while still retaining immediate access. Backup data in Cloud Storage can be used for more than just recovery because all storage classes have ms latency and are accessed through a single API.
2. **Integrated repository for analytics and ML:** The highest level of availability and performance within a single region is ideal for compute, analytics, and machine learning workloads in a particular region. Cloud Storage is also strongly consistent, giving you confidence and accuracy in analytics workloads.
3. **Media content storage and delivery:** Geo-redundant storage with the highest level of availability and performance is ideal for low-latency, high-QPS content serving to users distributed across geographic regions. Google Cloud Storage service provides the availability and throughput needed to stream audio or video directly to apps or websites.

Overview of Cloud Storage

❑ Securing your data:

Once you upload your objects to Cloud Storage, you have fine-grained control over how you secure and share your data. Here are some ways to secure the data you upload to Cloud Storage:

- **Identity and Access Management:** Use IAM to control who has access to the resources in your Google Cloud project. Resources include Cloud Storage buckets and objects, as well as other Google Cloud entities such as Compute Engine instances. You can grant principals certain types of access to buckets and objects, such as update, create, or delete.
- **Data encryption:** Cloud Storage uses server-side encryption to encrypt your data by default. You can also use supplemental data encryption options such as customer-managed encryption keys and customer-supplied encryption keys.
- **Authentication:** Ensure that anyone who accesses your data has proper credentials.
- **Bucket Lock:** Govern how long objects in buckets must be retained by specifying a retention policy.
- **Object Versioning:** When a live version of an object is replaced or deleted, it can be retained as a noncurrent version if you enable Object Versioning.

Overview of Cloud Storage

❑ Looking for other products?

If Cloud Storage is not the right storage solution for you, see more information about the following storage services:

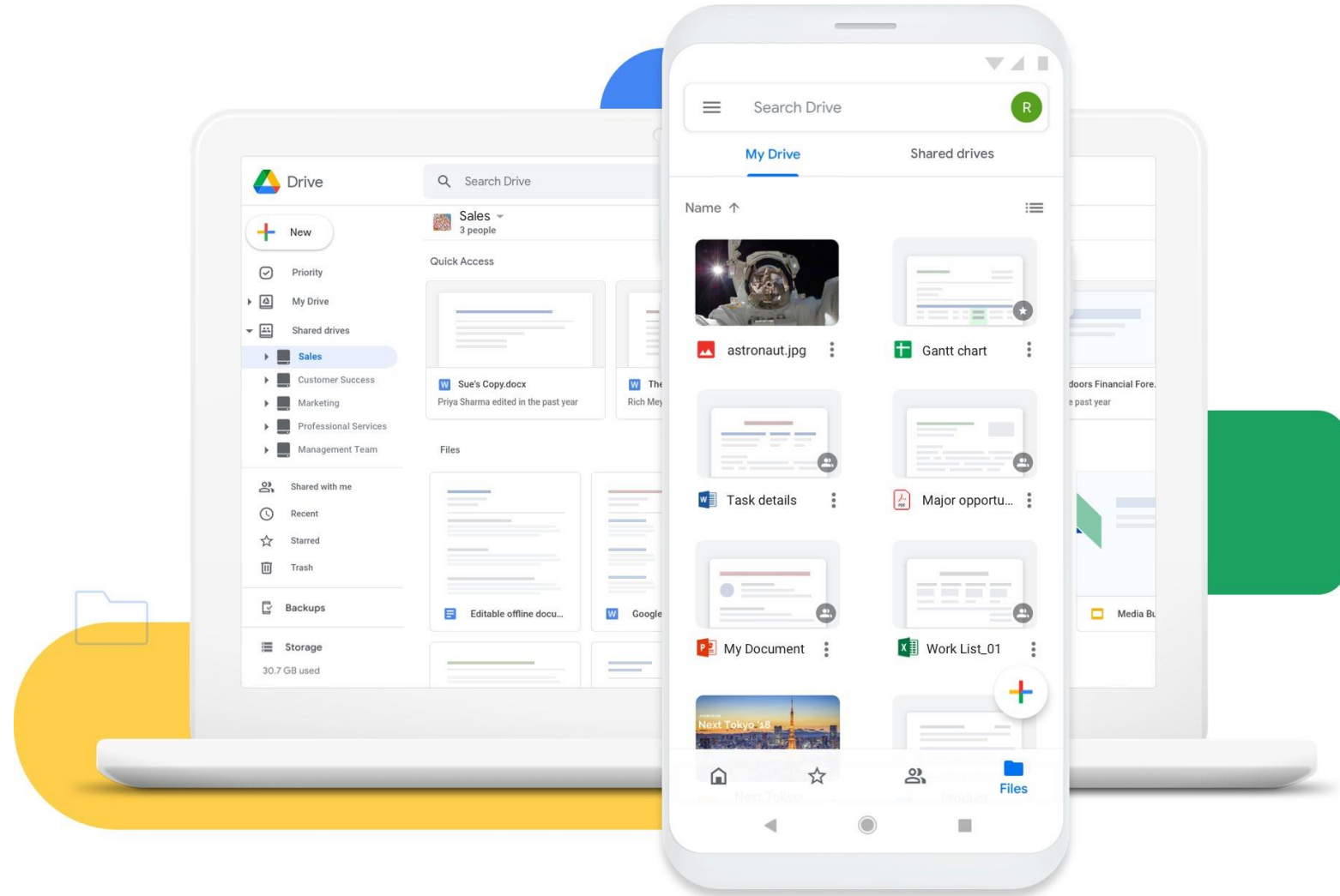
- [Google Drive](#): Store, manage, and share your personal files.
- [Cloud Storage for Firebase](#): Manage data for your mobile applications.
- [Persistent Disk](#): Add block storage to your Compute Engine virtual machine.
- [Storage Transfer Service](#): Quickly import online data into Cloud Storage or between Cloud Storage buckets.
- [Filestore](#): Create a file-based workload.

Overview of Cloud Storage

❑ Looking for other products?



Google Drive



<https://www.google.com/intl/en/drive/>

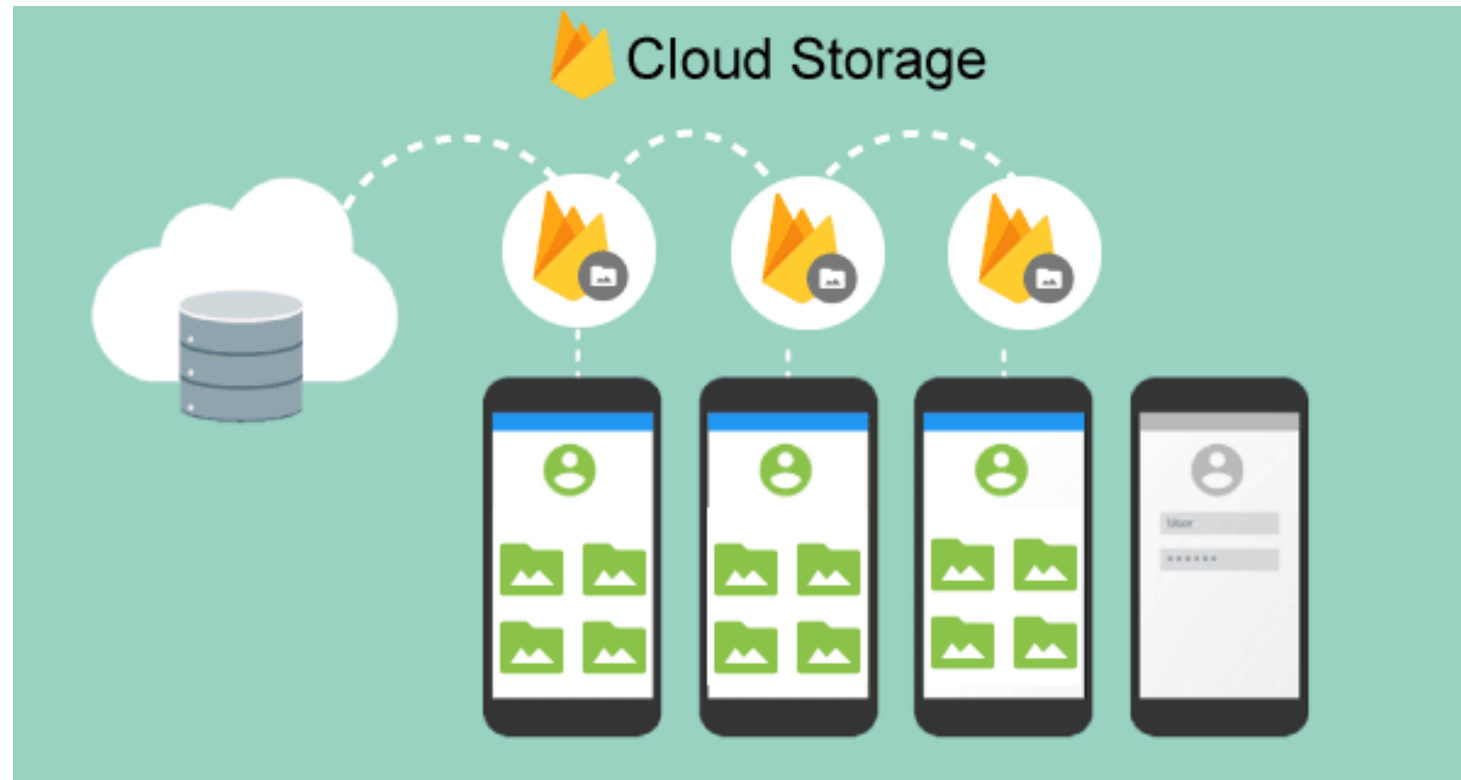
Overview of Cloud Storage

❑ Looking for other products?



Cloud Storage
for Firebase

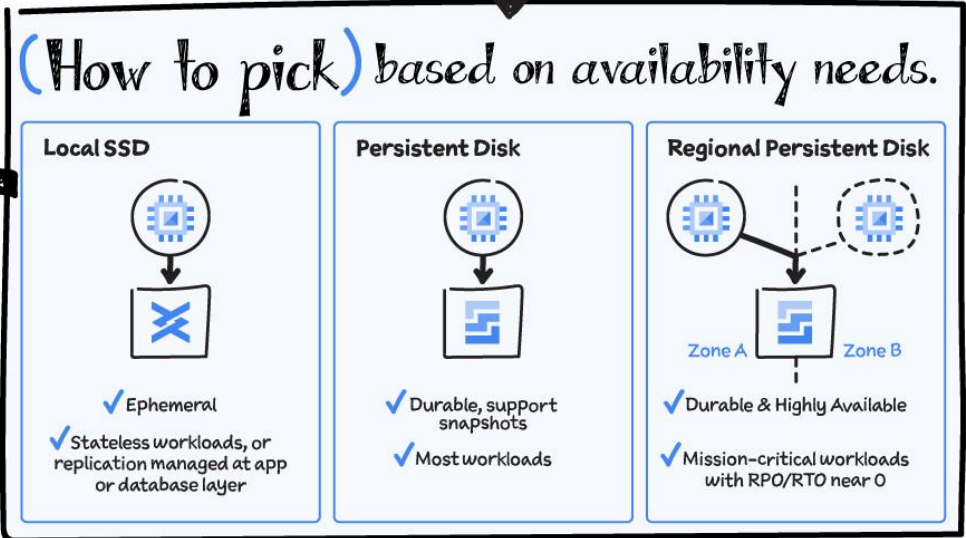
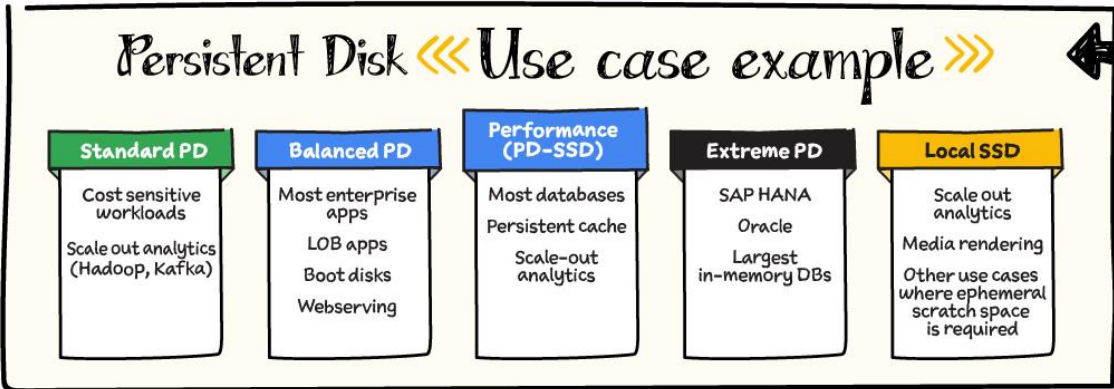
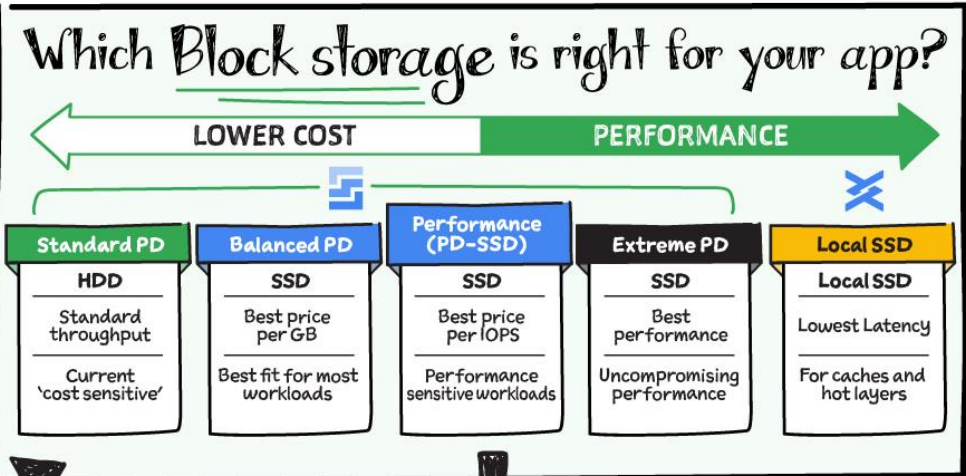
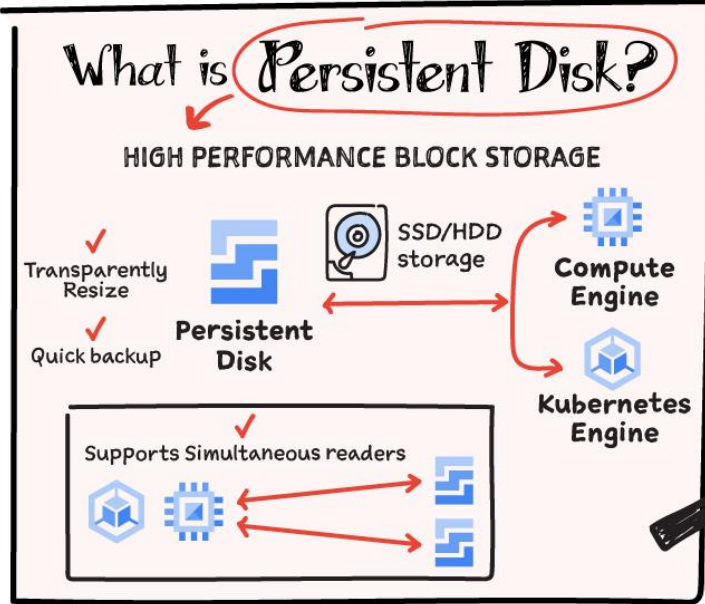
<https://firebase.google.com/docs/storage/>



Overview of Cloud Storage

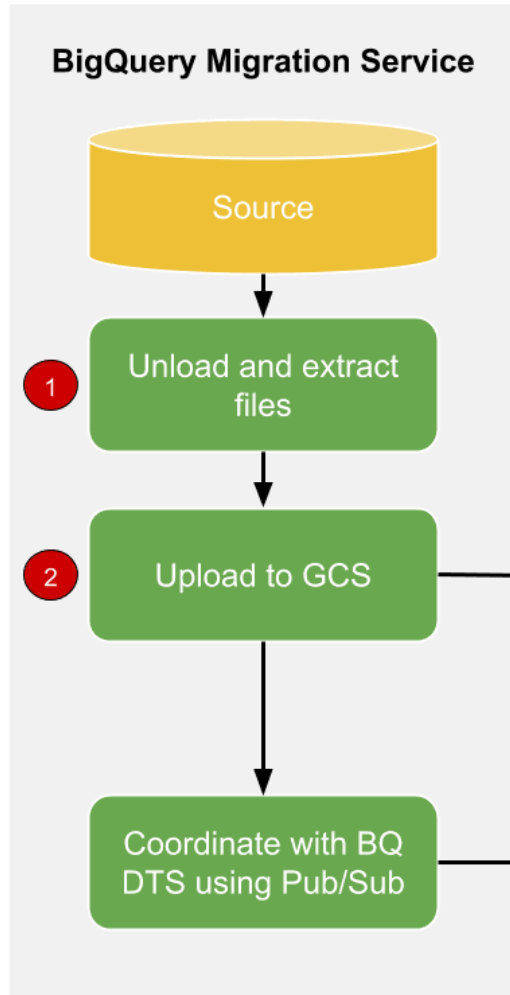
Looking for other products?

<https://cloud.google.com/compute/docs/disks>

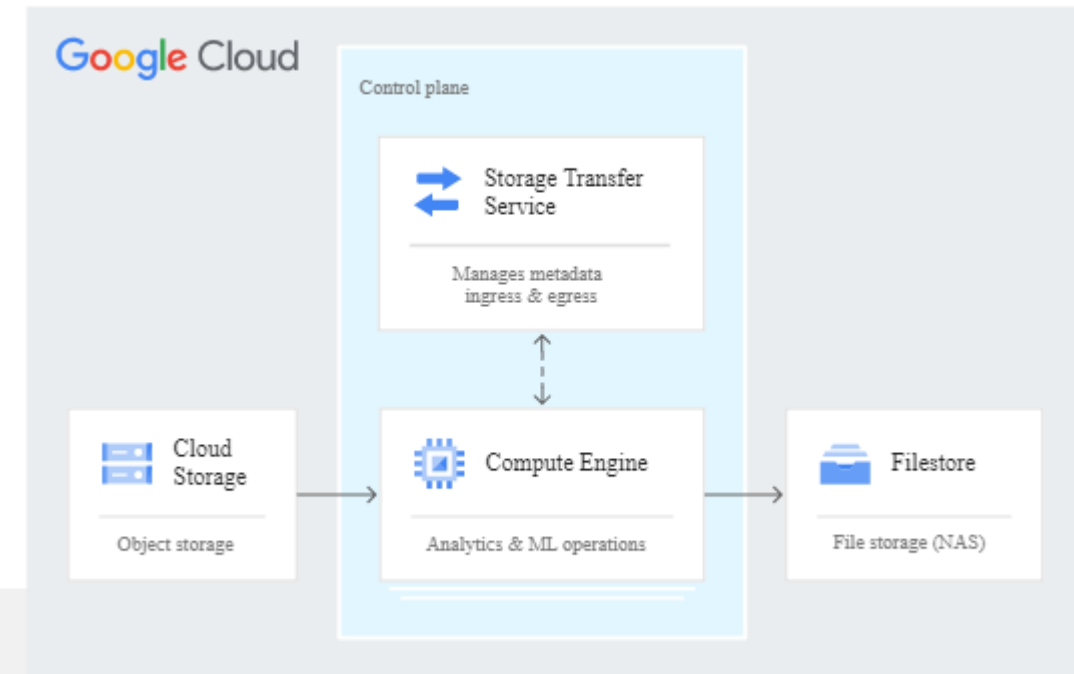
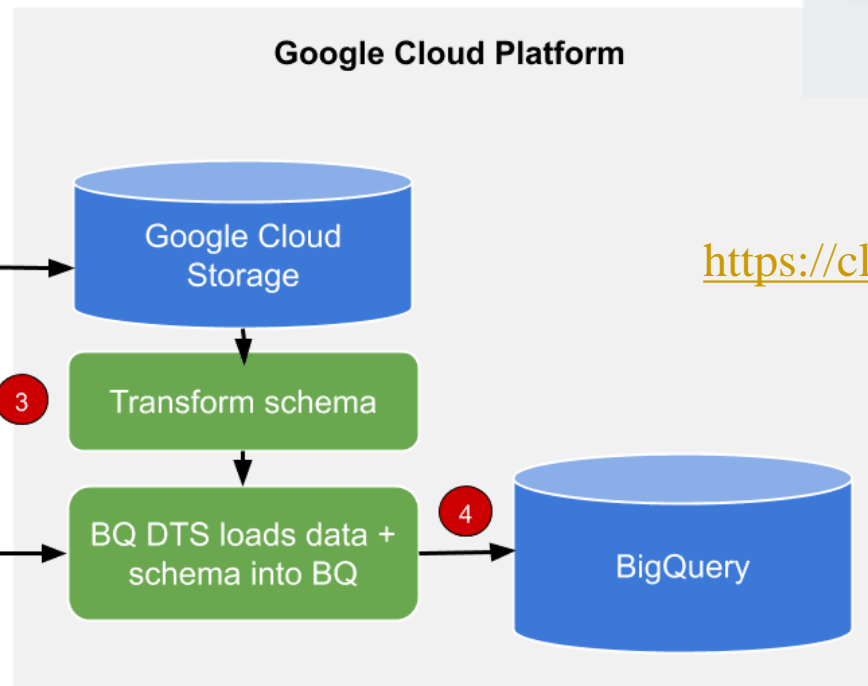


Overview of Cloud Storage

Looking for other products?



Storage Transfer Service



<https://cloud.google.com/storage-transfer/docs/overview>

1. On-premises agent extracts tables from data warehouse. Extraction speed is bounded by your JDBC connection.
2. Extracted table data is uploaded to Cloud Storage.

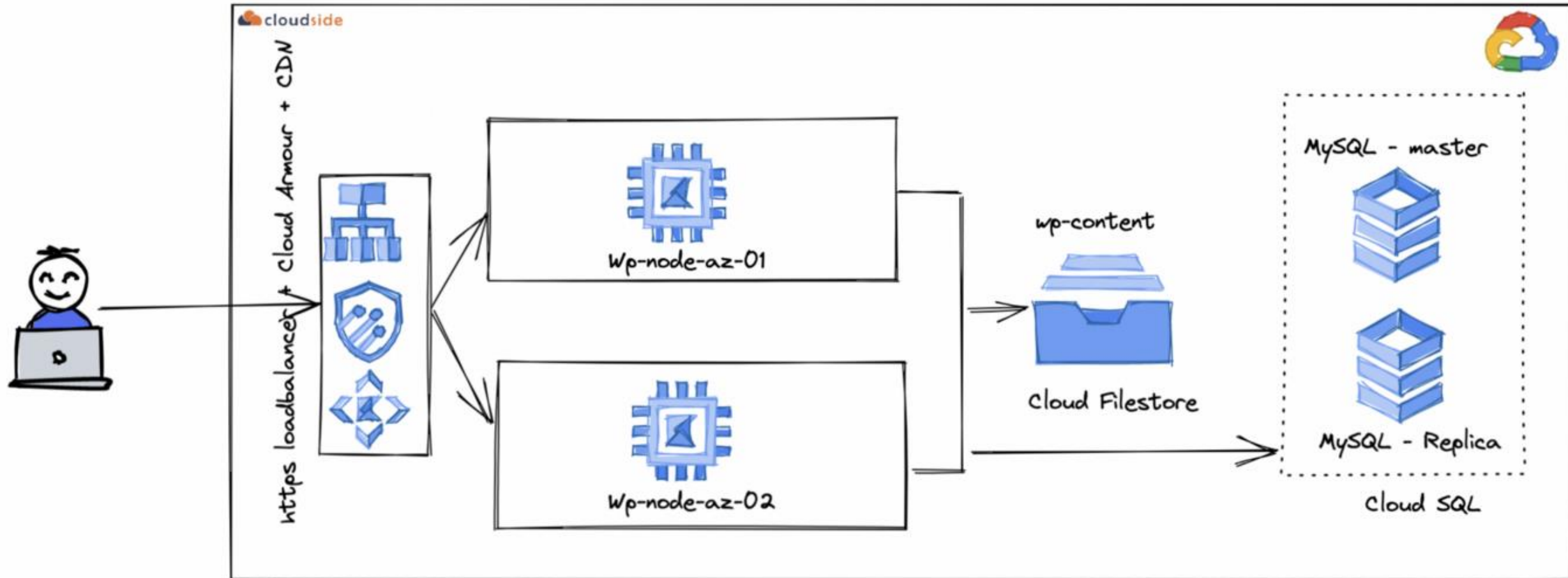
3. Optional transformation schema can be applied to data, or let BigQuery apply a default schema.
4. BigQuery Data Transfer Service loads data into BigQuery.

Overview of Cloud Storage

Looking for other products?



Google
Cloud Filestore



APIs and IAM for Cloud Storage

❏ XML API:

The Cloud Storage XML API is a RESTful interface that lets you manage Cloud Storage data in a programmatic way. As a RESTful API, it relies on method information and scoping information to define the operations to perform:

- ***Method information***

You specify the method information with standard HTTP methods, such as DELETE, GET, HEAD, and PUT.

- ***Scoping information***

You specify the scoping information with a publicly-accessible endpoint (URI) and various scoping parameters. For the XML API, the primary scoping parameters are the bucket and object names. You can further scope your operations by using HTTP headers and query string parameters.

You use HTTP methods to perform operations on the resource you specify in the scope. For a list of operations available in the XML API, see XML API Request Methods.

Access to Cloud Storage through the XML API is useful when you are using tools and libraries that must work across different storage providers, or when you are migrating from another storage provider to Cloud Storage. For more information about migrating to Cloud Storage, see Simple migration from Amazon S3 to Cloud Storage.

APIs and IAM for Cloud Storage

❑ JSON API:

The Cloud Storage JSON API is a simple, JSON-backed interface for accessing and manipulating Cloud Storage projects in a programmatic way. It is fully compatible with the Cloud Storage Client Libraries.

The JSON API is intended for software developers. To use it you should be familiar with web programming and be comfortable creating applications that consume web services through HTTP requests. If this does not describe you, consider one of the following alternatives:

- If you are just starting out with Cloud Storage, you should first try either the Google Cloud console Quickstart or the gsutil Quickstart. These tutorials demonstrate the basics of using Cloud Storage without the need to use the API directly.
- If you are a mobile or web app developer, you can use the Firebase SDKs for Cloud Storage.
- If you are not a software developer and want to store your personal data in the cloud and share it with others, you can use Google Drive.

APIs and IAM for Cloud Storage

❑ IAM roles for Cloud Storage:

The following table describes Identity and Access Management (IAM) roles that are associated with Cloud Storage and lists the permissions that are contained in each role.

- Storage Object Creator (roles/storage.objectCreator)
- Storage Object Viewer (roles/storage.objectViewer)
- Storage Object Admin (roles/storage.objectAdmin)
- Storage HMAC Key Admin (roles/storage.hmacKeyAdmin)
- Storage Admin (roles/storage.admin)
- Storage Insights Admin (roles/storageinsights.admin)
- Storage Insights Viewer (roles/storageinsights.viewer)

<https://cloud.google.com/storage/docs/access-control/iam-roles>

Getting Started with Google Cloud Storage

Getting started with Google Cloud Storage requires very simple steps:

❑ **Activating Google Cloud Storage**

For instructions about activating Google Cloud Storage see: [Activate Google Cloud Storage](#) .

❑ **Creating a bucket**

The bucket is the container for your data (objects). You can select the region where your bucket resides to reduce costs and speed-up access or satisfy local requirements.

❑ **Uploading data**

Google Cloud Storage stores and replicates your data (objects) allowing a high level of persistence. For more information on the service, see [Terms of Service](#) .

❑ **Controlling access**

You can control access to your data from anywhere on the Internet.

Cloud storage services and Management

❏ Activate Google Cloud Storage for a project:

To activate Google Cloud Storage:

1. Go to the [Google Developers Console](#) .

If you don't have a Google account, you will be prompted to create one.

2. Select or create a project.

If you have multiple projects, make sure that you are in the project for which you want to activate Google Cloud Storage. If you do not have a project, you will be prompted to create one.

3. Enable the Google Cloud Storage service if it isn't already.

- a. In the left sidebar, expand the **APIs & AUTH** section and then click **APIs** . You must select a project first to see the **APIs & AUTH** section.

- b. In the **APIs** list, if the button next to **Google Cloud Storage** service is **OFF** , click it to activate the service. When the service is activated, the button displays **ON** and the Google Cloud Storage service is activated for the project.

Note: If you plan to access Google Cloud Storage using the [JSON API](#) , then you must also activate the **Google Cloud Storage JSON API** service as well.

4. Enable billing for the project.

Before you can use Google Cloud Storage, you need to enable billing for your project if you haven't already done so. To enable billing, select **Settings** in the left sidebar of the project, click **Enable billing** , and the Google Developers Console will guide you through the process. Enabling billing does not necessarily mean you will be charged. See [Pricing and Terms](#) for more information.

Cloud storage services and Management

❏ Create storage buckets:

1. In the Google Cloud console, go to the Cloud Storage **Buckets** page.

Go to Buckets

2. Click **Create bucket**.

3. On the **Create a bucket** page, enter your bucket information. To go to the next step, click **Continue**.

- For **Name your bucket**, enter a name that meets the [bucket name requirements](#).
- For **Choose where to store your data**, select a **Location type** and **Location** where the bucket data will be permanently stored.
- For **Choose a default storage class for your data**, select a [storage class](#) for the bucket. The default storage class is assigned by default to all objects uploaded to the bucket.

★ **Note:** The **Monthly cost estimate** panel in the right pane estimates the bucket's monthly costs based on your selected storage class and location, as well as your expected data size and operations.

- For **Choose how to control access to objects**, select whether or not your bucket enforces [public access prevention](#), and select an [Access control model](#) for your bucket's objects.

★ **Note:** If public access prevention is already enforced by your project's [organization policy](#), the **Prevent public access** toggle is locked.

- For **Choose how to protect object data**, configure **Protection tools** if desired, and select a [Data encryption method](#).

4. Click **Create**.

Cloud storage services and Management

❏ Upload into the bucket:

1. In the Google Cloud console, go to the Cloud Storage **Buckets** page.

[Go to Buckets](#)

2. In the list of buckets, click on the name of the bucket that you want to upload an object to.

3. In the **Objects tab** for the bucket, either:

- Drag and drop the desired files from your desktop or file manager to the main pane in the Google Cloud console.
- Click the **Upload Files** button, select the files you want to upload in the dialog that appears, and click **Open**.



★ **Note:** If you are using the Chrome browser, folder uploads are also supported.

Cloud storage services and Management

❏ Download the object:

1. In the Google Cloud console, go to the Cloud Storage **Buckets** page.

Go to Buckets

2. In the list of buckets, click on the name of the bucket that contains the object you want to download.

The *Bucket details* page opens, with the *Objects* tab selected.

3. Navigate to the object, which may be located in a folder.

4. Click the **Download** icon associated with the object.

Your browser settings control the download location for the object.

★ **Note:** For some object types, selecting **Download** opens the object in the browser. To download these objects to your local computer, right-click on **Download** and select **Save Link As....**

Cloud storage services and Management

❑ Share the object:

To allow public access to the bucket and create a publicly accessible URL for the image:

1. Click the **Permissions** tab above the list of files.
2. Ensure the view is set to **Principals**. Click **Add**.

The **Add principals** pane appears.

3. In the **New principals** box, enter `allUsers`.
4. In the **Select a role** drop-down, select **Cloud Storage > Storage Object Viewer**.
5. Click **Save**.
6. In the **Are you sure you want to make this resource public?** window, click **Allow public access**.

To verify, click the **Objects** tab to return to the list of objects. Your object's **Public access** column should read **Public to internet**. The **Copy URL** button provides a shareable URL similar to the following:

```
https://storage.googleapis.com/YOUR_BUCKET_NAME/kitten.png
```

To remove public access from the bucket and stop sharing the image publicly:

1. Click the **Permissions** tab above the list of objects.
2. Find the entry that has **allUsers** listed in the **Principals** column. Select the checkbox for that entry.
3. Click **Remove**.
4. In the **Delete allUsers** window, click **Confirm**.

In the **Objects** tab, you should see that the image no longer has a **Copy URL** button associated with it.

Cloud storage services and Management

❏ Create object folders:

1. In the **Objects** tab, click **Create folder**.
2. Enter **folder1** for **Name** and click **Create**.

You should see the folder in the bucket with an image of a folder icon to distinguish it from objects.

Create a subfolder and upload a file to it:

1. Click **folder1**.
2. Click **Create folder**.
3. Enter **folder2** for **Name** and click **Create**.
4. Click **folder2**.
5. Click **Upload files**.
6. In the file dialog, navigate to the screenshot that you downloaded and select it.

After the upload completes, you should see the file name and information about the file, such as its size and type.

Cloud storage services and Management

❏ Delete the objects and Clean up:

1. Click the arrow next to **Bucket details** to return to the buckets level.
2. Select the bucket.
3. Select the checkbox next to **folder1**.
4. Click on the **Delete** button.
5. In the window that opens, enter the folder name you want to delete.
6. Click **Delete** to permanently delete the folder and all objects and subfolders in it.

To avoid incurring charges to your Google Cloud account for the resources used on this page, follow these steps.

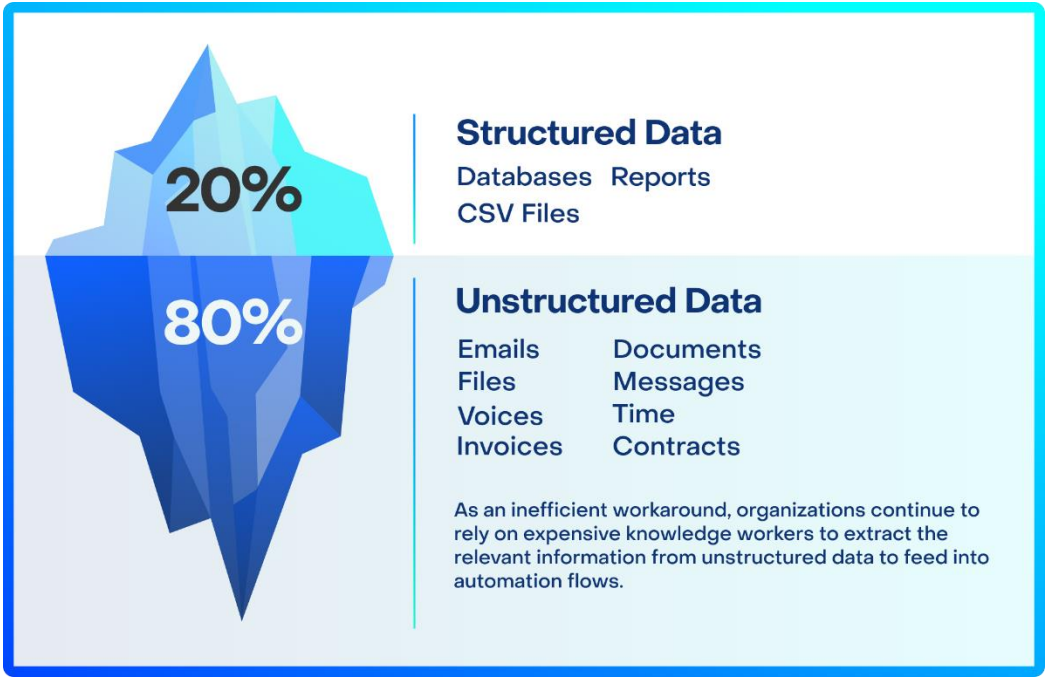
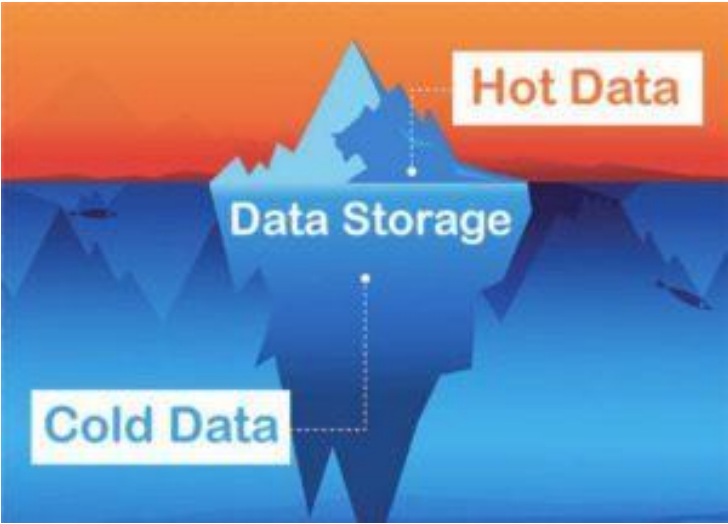
1. Open the Cloud Storage buckets page in the Google Cloud console.

[Open the Buckets page](#)

2. Select the checkbox next to the bucket that you created.
3. Click **Delete**.
4. In the window that opens, confirm you want to delete the bucket.
5. Click **Delete**.

Cloud storage with Database on Cloud

Cloud Storage and Cloud Database:



Cloud storage with Database on Cloud

Cloud Storage and Cloud Database:

Where do I store my stuff?



Cloud storage with Database on Cloud

❑ Cloud Storage and Cloud Database:

K21Academy
Learn Cloud from Experts

ORACLE Gold Partner | **Microsoft** Silver Partner | **DevOps Institute** REGISTERED PARTNER 2020

Cloud Storage	Cloud SQL	Cloud Spanner
Cloud Datastore	Cloud Bigtable	Persistent Disk
Cloud Firestore	Cloud Filestore	Cloud BigQuery

Storage & Database Services
In
Google Cloud

Cloud Storage

Work Tasks

Cloud Monitoring - Report

TASK I: Basic Storage in Cloud

😊 Phân tích và so sánh 3 loại hình DATA của Google cloud storage:

- File store
- Block store
- Object store

→ (bằng tiếng Việt)



Cloud Resources - Report

TASK II: API and IAM roles for Cloud storage

Understand API and IAM roles for deploying Cloud Storage

😊 Phân tích ý nghĩa của các Roles for Cloud storage:

Storage Object Creator, Storage Object Viewer, Storage Object Admin, Storage HMAC Key Admin, Storage Admin, Storage Insights Admin, Storage Insights Viewer
(bằng tiếng Việt)

😊 Enable two APIs for Cloud storage

Trình tự các bước thực hiện, ảnh chụp minh chứng

Cloud Resources - Report

TASK III: Storage Bucket Builder

(Create, Upload, Download a cloud storage service: Bucket)

<https://cloud.google.com/storage/docs/discover-object-storage-console>

☺ Create a bucket, tên bucket: cloud-dh20hm-group<num>

Trình tự các bước thực hiện, ảnh chụp minh chứng

☺ Upload an “image” to your bucket đã tạo:

Trình tự các bước thực hiện, ảnh chụp minh chứng

☺ Upload 3 “pdf files” to your bucket, là report của practice 01, 02, 03

Trình tự các bước thực hiện, ảnh chụp minh chứng

Cloud Resources - Report

TASK VI: Storage Bucket Viewer

<https://cloud.google.com/storage/docs/getting-bucket-information>

😊 Determine a bucket's size

Trình tự các bước thực hiện, ảnh chụp minh chứng

😊 Display a bucket's metadata

Trình tự các bước thực hiện, ảnh chụp minh chứng

Cloud Resources - Report

TASK V: Bucket storage sharing or changing

https://cloud.google.com/storage/docs/discover-object-storage-console#share_the_object

<https://cloud.google.com/storage/docs/changing-default-storage-class>

☺ Thực hiện share the “image” and “3 pdf files” to “allow public”

Trình tự các bước thực hiện, ảnh chụp minh chứng

☺ Thực hiện thay đổi loại hình lưu trữ Data bucket của nhóm:

Step 1: Kiểm tra loại Data (default) của bucket hiện tại

Step 2: Thay đổi loại hình Data khác với loại default, chọn trong (*Cloud storage class*)

Trình tự các bước thực hiện, ảnh chụp minh chứng