

Storage services in GCP can be grouped into

> **Block Storage**

> **File Storage**

> **Object Storage**

Persistent Disk (PD):

What

Persistent Disks are durable, high-performance **network block storage** that can be attached to VM instances.

Why (Use Cases)

- Primary storage for Compute Engine VMs.
- Databases that need durability.
- Balanced cost and performance workloads.

Key Features

- Zonal PDs (replicated within one zone).
- Regional PDs (replicated across two zones for HA).
- Types: Standard (HDD), Balanced (pd-balanced SSD), and SSD (pd-ssd).
- Snapshots for backup and disaster recovery.
- Resize dynamically without downtime.

Pricing Model

- Charged per provisioned capacity (GB/month) and IOPS throughput.
- Regional PDs cost ~2× Zonal PDs.

Limitations

- Tied to VM's zone (Zonal PD) or region (Regional PD).
- Slower than Local SSD for IOPS.

Integration

- Compute Engine (boot or data disks).
- GKE persistent volumes.

Best Practices

- Use Regional PDs for HA.
 - Separate OS and data disks.
 - Use snapshots for backup automation.
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Local SSD:

What

Local SSDs are **physically attached block storage** to a VM host, offering very high throughput and low latency.

Why (Use Cases)

- Workloads needing high IOPS with temporary data (e.g., caches, scratch space).

Key Features

- Extremely high IOPS (~10–100× PD).
- Data encrypted by default.
- NVMe and SCSI interface support.

Pricing Model

- Billed per GB capacity.

Limitations

- Ephemeral: data lost if VM stops or migrates.
- Limited VM families support it.

Integration

- Compute Engine and GKE nodes.

Best Practices

- Use for temporary, high-speed workloads.
 - Don't rely on it for durable data.
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Filestore:

What

Filestore is Google's managed **NFS-based file storage service**, providing shared file systems for applications.

Why (Use Cases)

- Media workflows, content management.
- Enterprise applications needing file shares.
- GKE apps requiring POSIX file system.

Key Features

- NFSv3 protocol support.
- Scales up to 320 TB.
- Throughput: up to 16 GB/s and 480K IOPS.
- HDD (general) and SSD (performance).

Pricing Model

- Billed per provisioned capacity.

Limitations

- Regional availability.
- Must pre-provision capacity.

Integration

- Compute Engine VMs.
- GKE Pods.

Best Practices

- Use SSD tier for performance-critical apps.
 - Use for multi-VM workloads needing file share.
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Cloud Storage:

What

Cloud Storage is Google's **object storage service** for storing unstructured data at scale.

Why (Use Cases)

- Media content, backups, and archives.
- Data lake for analytics.
- Web assets and static website hosting.

Key Features

- Buckets hold unlimited objects (max 5 TB per object).
- Storage classes: Standard, Nearline, Coldline, Archive.
- Lifecycle rules to move/delete objects automatically.
- Strong global consistency.
- Encryption: Google-managed, CMEK, or CSEK.

Pricing Model

- Billed per GB/month + network egress + operations.
- Lower cost for colder classes (Archive < Coldline < Nearline < Standard).

Limitations

- Objects immutable (no partial updates).
- Access latency higher than block storage.

Integration

- BigQuery (external tables).
- Dataflow / Dataproc ETL pipelines.
- GKE/VMs for logs, backups, datasets.

Best Practices

- Use storage classes + lifecycle rules to optimize cost.
- Use Signed URLs for temporary access.
- Use versioning to protect against accidental deletions.

✓ These four (Persistent Disk, Local SSD, Filestore, Cloud Storage) cover **Block, File, and Object storage** in GCP.

In addition, Google recently added **Hyperdisk** (next-gen PD for specialized workloads) — but it's an extension of Persistent Disk.

Hyperdisk:

What

Hyperdisk is the next-generation block storage for Compute Engine and GKE. It provides highly configurable performance that can be scaled independently of storage size.

Why (Use Cases)

- High-performance transactional databases (e.g., Oracle, SQL Server).
- Analytics workloads requiring extreme throughput.
- Applications that need predictable performance at scale.

Key Features

- Three types:
 - **Hyperdisk Balanced** → General-purpose workloads.
 - **Hyperdisk Throughput** → Analytics, data warehouses, big data.
 - **Hyperdisk Extreme** → High IOPS transactional DBs.
- Performance (IOPS, throughput) can be tuned without resizing capacity.
- Fully integrated with Compute Engine and GKE.
- Supports snapshots, encryption, and regional replication.

Pricing Model

- Billed separately for provisioned **capacity (GB)** and **performance (IOPS / MBps)**.
- Regional Hyperdisks cost more due to replication.

Limitations

- Currently available in limited regions.
- Not all VM types support all Hyperdisk SKUs.

Integration

- Compute Engine VMs (boot/data disks).
- GKE persistent volumes.
- Works with snapshots and machine images.

Best Practices

- Choose the right type (Balanced, Throughput, Extreme) for workload profile.
- Use regional Hyperdisk for HA.
- Right-size performance to workload demand to optimize cost.