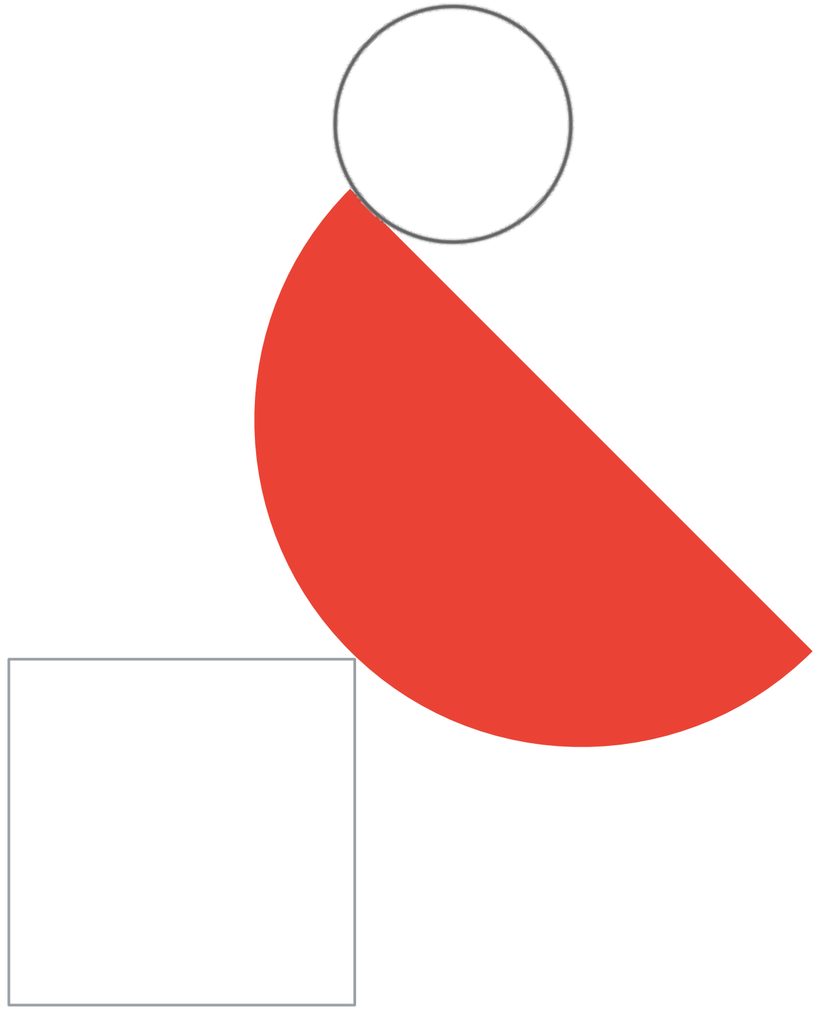
Filestore

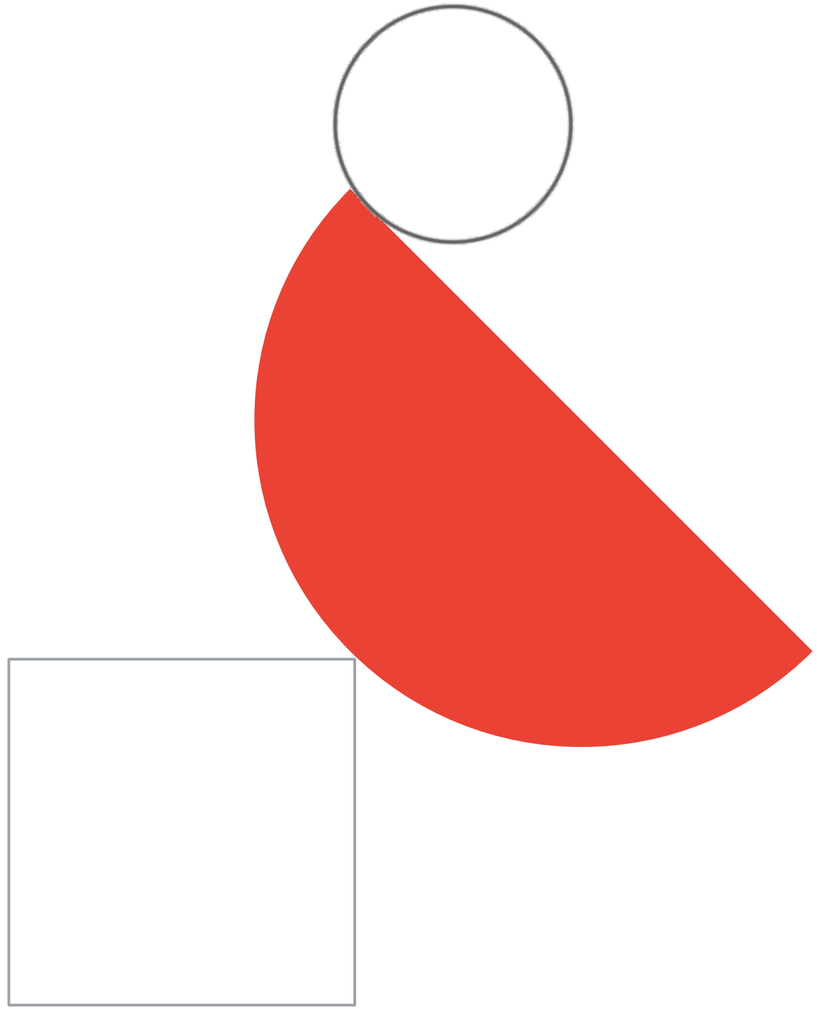


Filestore

Managed NFS, NOT a database

	Filestore Basic (GA)	Filestore High Scale (Public Preview)	Filestore Enterprise (GA)
Workloads	File sharing, Software Dev, and Web Hosting	HPC, Financial Modeling, Pharma, and Analytics	SAP, GKE, and ‘Lift & Shift Apps”
Capacity	1 - 64 TiB	10 - 100 TiB	1 - 10 TiB
Scale	Scale-up	Scale-out	Scale-out
Capacity Management	Grow	**Grow & Shrink**	**Grow & Shrink**
Max Performance (Throughput | IOPS)	1.2GiB/s | 60k	26GiB/s | 920k	1.2GiB/s | 120k
Data Protection	**Backups**	None	**Snapshots**
Availability SLA	99.9%	99.9%	**99.99%**

Firestore



Firestore: When to use?

Datastore is ideal for applications that rely on **highly available structured data** at scale.

Ideal Use Cases:

- Product catalogs that provide real-time inventory and product details for a retailer.
- User profiles that deliver a customized experience based on the user's past activities and preferences.
- Transactions based on ACID properties

Non-Ideal Use Cases:

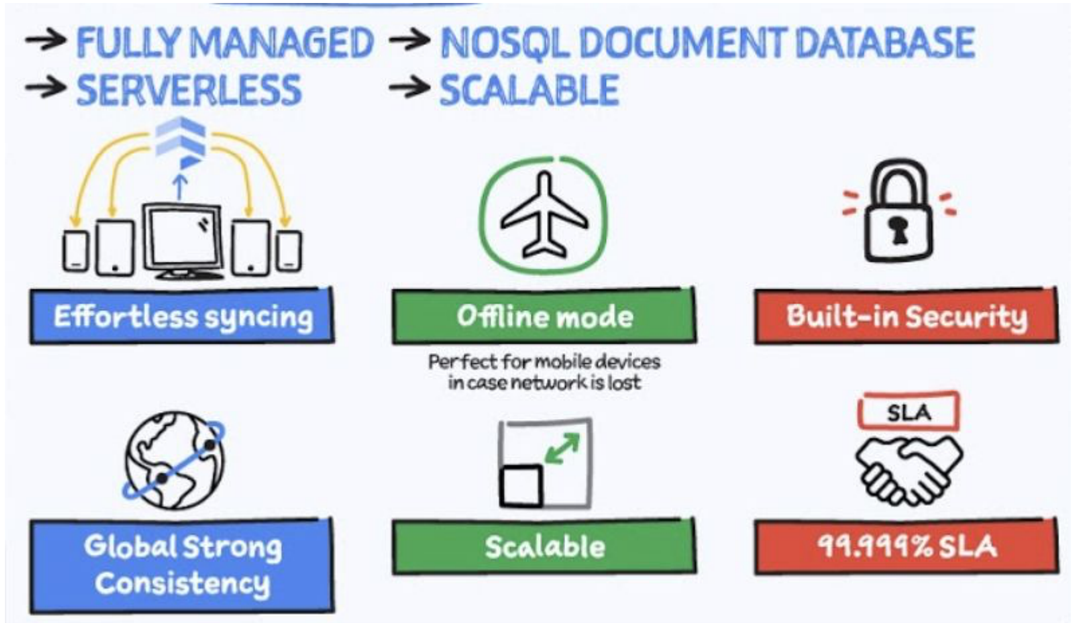
- OLTP relational database with full SQL support. *Consider:* Cloud SQL
- Data isn't highly structured or no need for ACID transactions. *Consider:* Cloud Bigtable
- Interactive querying in an online analytical processing (OLAP) system. *Consider:* BigQuery
- Unstructured data such as images or movies, *Consider:* Cloud Storage

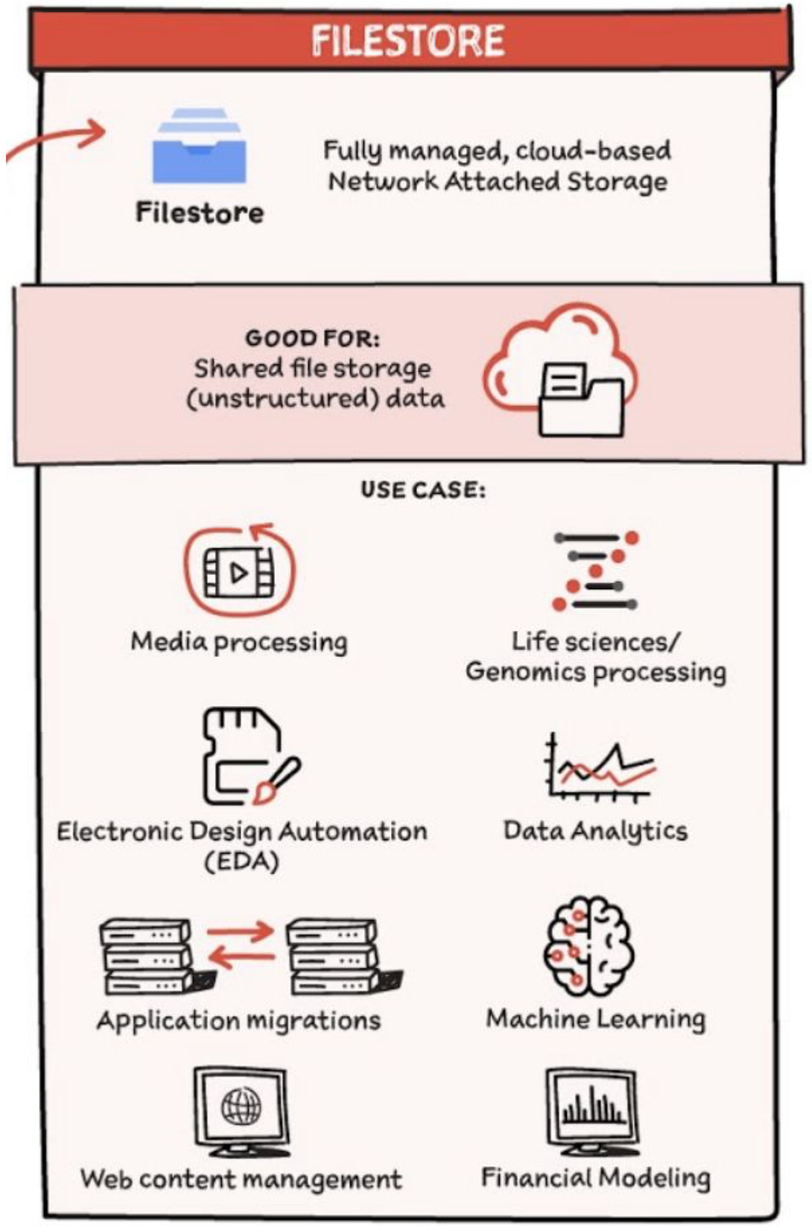
Firestore: Datastore mode vs Firestore (native) mode

	Both	Native Mode (only)	Datastore Mode (only)
Data model	Strong consistency	Documents and collections	Entities, kinds, ancestor queries/results
Performance limits	No read limits	10K writes/sec 500 documents/txn	
API		Firestore (Documents)	Datastore (Entities)
Security	IAM	Firebase Rules	
Offline data persistence		**Yes**	
Real-time updates		Yes	

Firestore or Datastore - comparison

Firestore vs Filestore





… vs Firebase

Exam Tip: *Firestore is a NoSQL Database, but Firebase is a development platform with a ton of additional features that uses Firestore. Make sure to differentiate between them!*

Firestore #GCPSketchnote

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06.22.2021

What's the secret large companies use to build data-driven apps quickly?

Yes! Build robust apps in half the time with...

Firestore!

What is Firestore?

→ FULLY MANAGED → NOSQL DOCUMENT DATABASE
→ SERVERLESS → SCALABLE

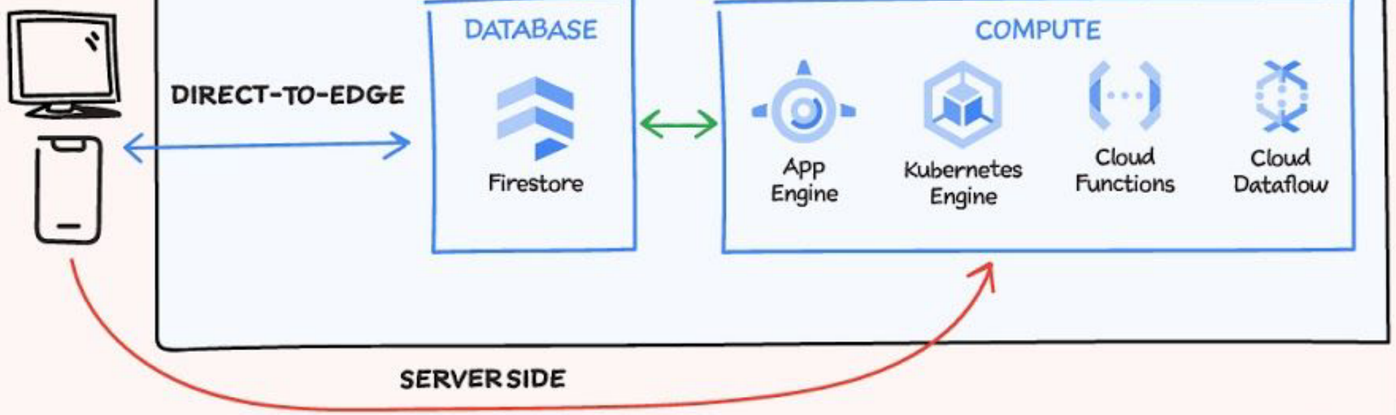
- Effortless syncing
- Offline mode — Perfect for mobile devices in case network is lost
- Built-in Security
- Global Strong Consistency
- Scalable
- SLA 99.999% SLA

→ BACKEND-AS-A-SERVICE

Allows apps to directly connect to the database

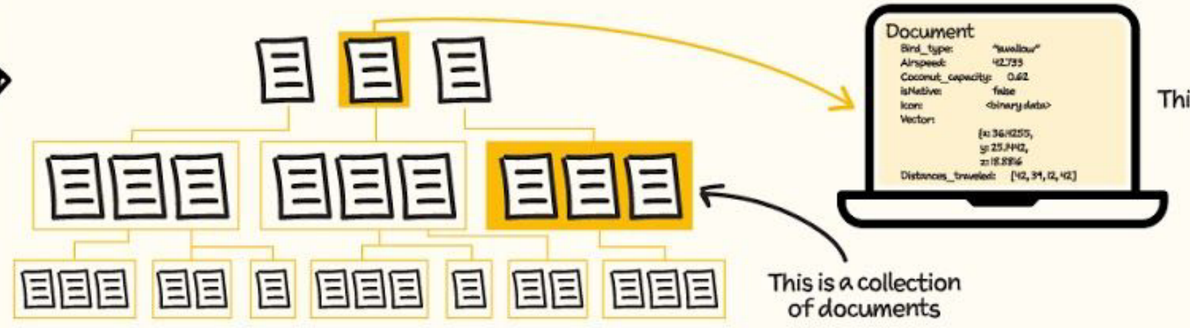
How do you use it?

→ 2 MODES - DIRECT-TO-EDGE & SERVER-SIDE



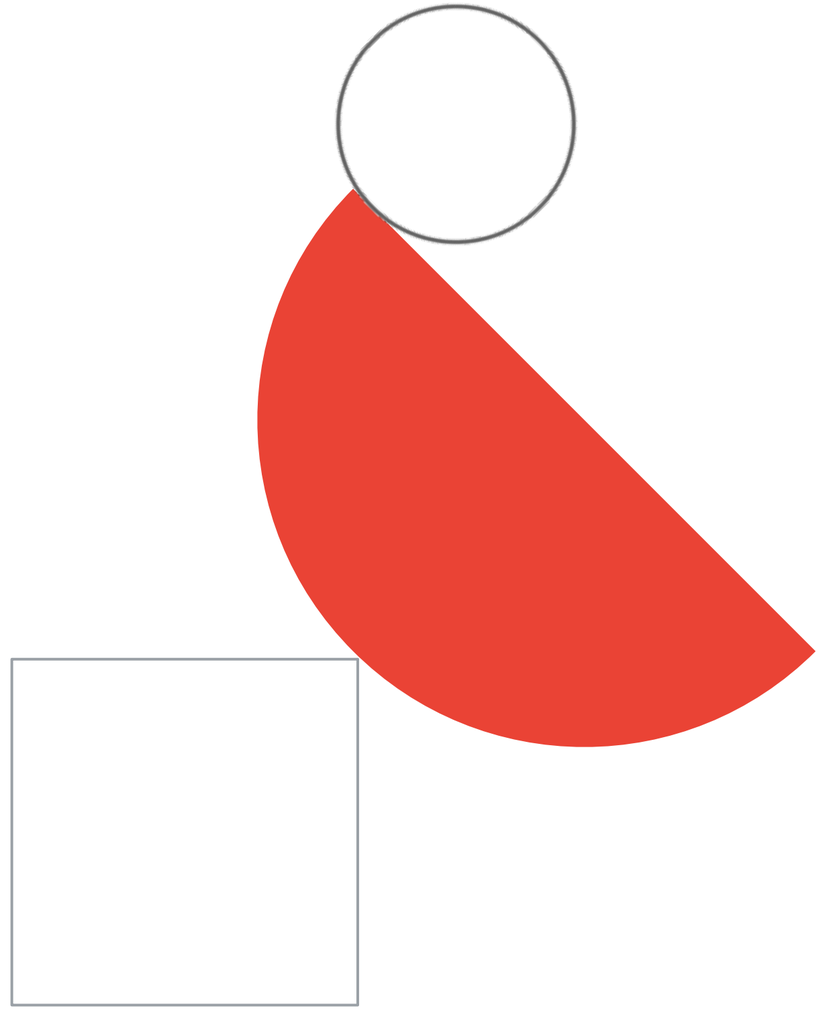
How is data stored?

→ DOCUMENTS ARE STORED IN COLLECTIONS



Firebase

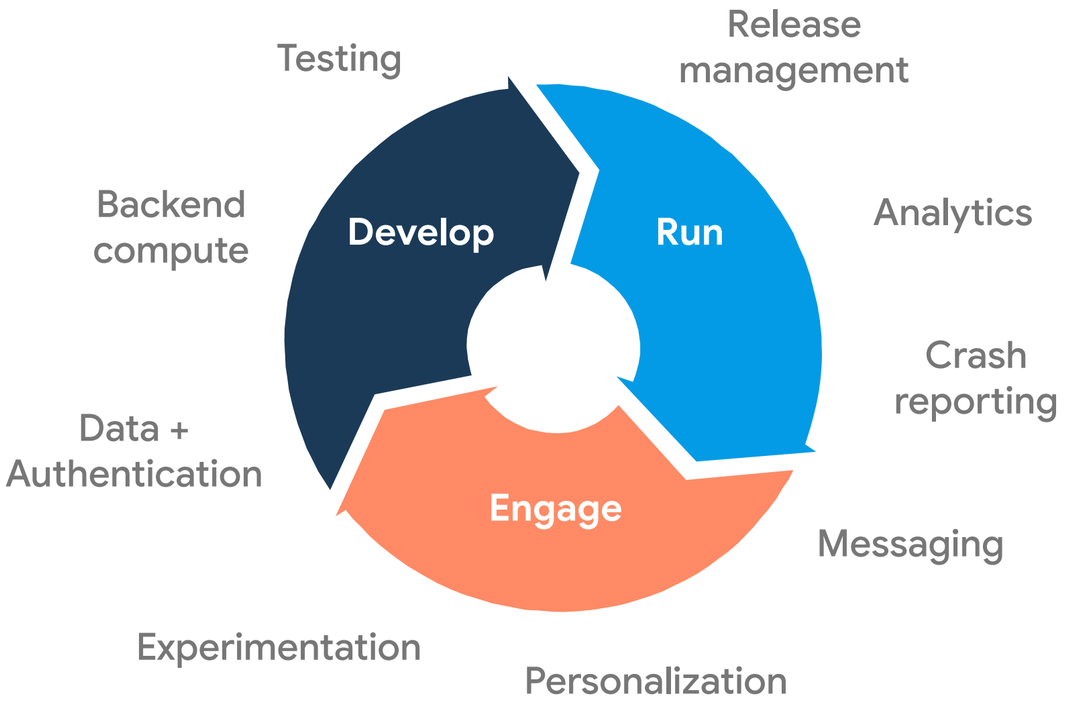
* Platform, NOT a database *



Firebase is Google's complete app development platform

Complete = it provides different products to:

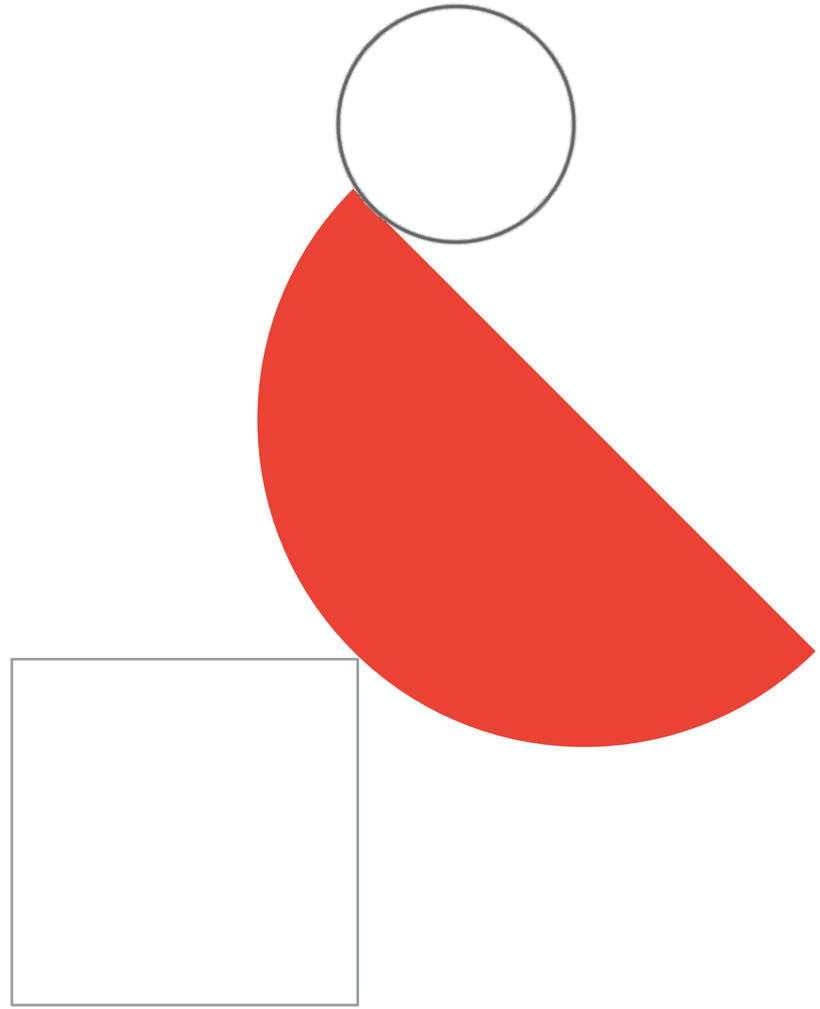
- Build apps
- Test apps
- Implement authentication (Firebase Authentication can be a part of PCA exam on very high-level!)
- Run apps
- Run analytics
- Personalize apps
- And more...



iOS Android Web C++ Unity

Exam Tip: *Firestore is usually a part of Firebase-based app (for storing and syncing data)*

Memorystore



Memorystore #GCPSketchnote

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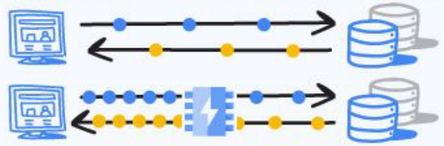
6.29.2021

What is Memorystore?

- APPLICATION
  - Web browser
- MEMORYSTORE
  - Fully managed in-memory data store for Redis & Memcached
  - Scalable, more secure, & highly available
- DATABASES

	Redis	Memcached
Storage	100s of GB	TBs
Throughput (in QPS)	100s of thousands	Millions

In memory caching layer - high-speed storage layer that stores a subset of data & reduces latency



What is your applications' availability need?

MEMORYSTORE FOR REDIS

BASIC TIER

Single Redis instance, ideal for caching use cases

- Instance health monitoring & automatic recovery from failures
- No SLA

STANDARD TIER

Replicated Redis instance, increased availability

- One secondary replica deployed across zones, protection from zone failures
- Seamless scale up down
- 99.9% availability SLA

FEATURES & CAPABILITIES

SECURE BY DEFAULT

Data is protected from the internet using VPC networks, private IP & IAM integration

Instance Auth, Data encrypted in-transit

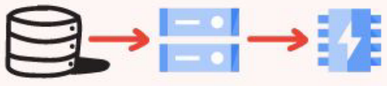
SEAMLESS SCALE & HA

Standard high availability instances are replicated across zones

DEEP INSIGHTS

Monitor instances using cloud operations

BACKUP DATA



Easily backup instance data or import data into Memorystore from GCS buckets using RDB files

NO CODE CHANGES

OSS compliance allows using Memorystore without any code changes

CLOUD MEMORYSTORE USE CASES

GAMING

- Session Store
- Distributed Lock

SOCIAL MEDIA

- Content Caching
- Fast Data Ingestion
- Jobs and Queues
- Stream Processing

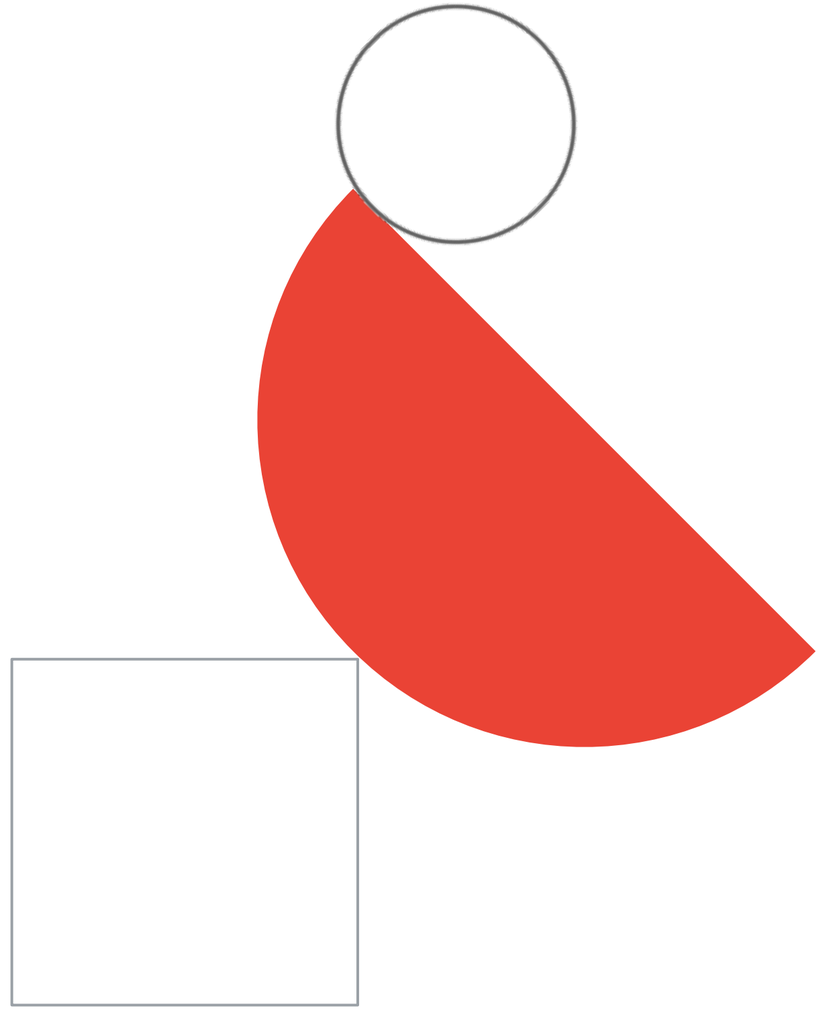
IoT

- Real-time Analytics
- Counters
- Leaderboard
- Page Ranking

ANALYTICS

- Recommendation Engine

Spanner



Cloud Spanner

Relational semantics

Schemas, ACID transactions, SQL

+

Horizontal scale

99.999% SLA, fully managed, and scalable

Google Cloud

What workloads fit Cloud Spanner best?

01

Sharded RDBMS

Manually sharding is difficult. People do it to achieve scale. Cloud Spanner gives you relational data and scale.

02

Scalable relational data

Scalable relational database. Instead of moving to NoSQL, move from one relational database to a more scalable relational database.

03

Manageability/HA

Highly automated. Online Schema changes and patching. No planned downtime and comes with up to a 99.999% availability SLA.

04

Multi-region

Write once and automatically replicate your data to multiple regions.

Most customers use regional instances, but multi-region is there if you need it.

When Cloud Spanner fits less well

TIP

It's NOT a straightforward thing to migrate a different RDBMS to Cloud Spanner. Be familiar with challenges on high level.

1. Lift and shift
2. Lots of in-database business logic (triggers, stored procedures)
3. Compatibility needed
4. App is very sensitive to very low latency (micro/nano/low single digit ms)

   Lots of analytics / OLAP type of queries / workloads

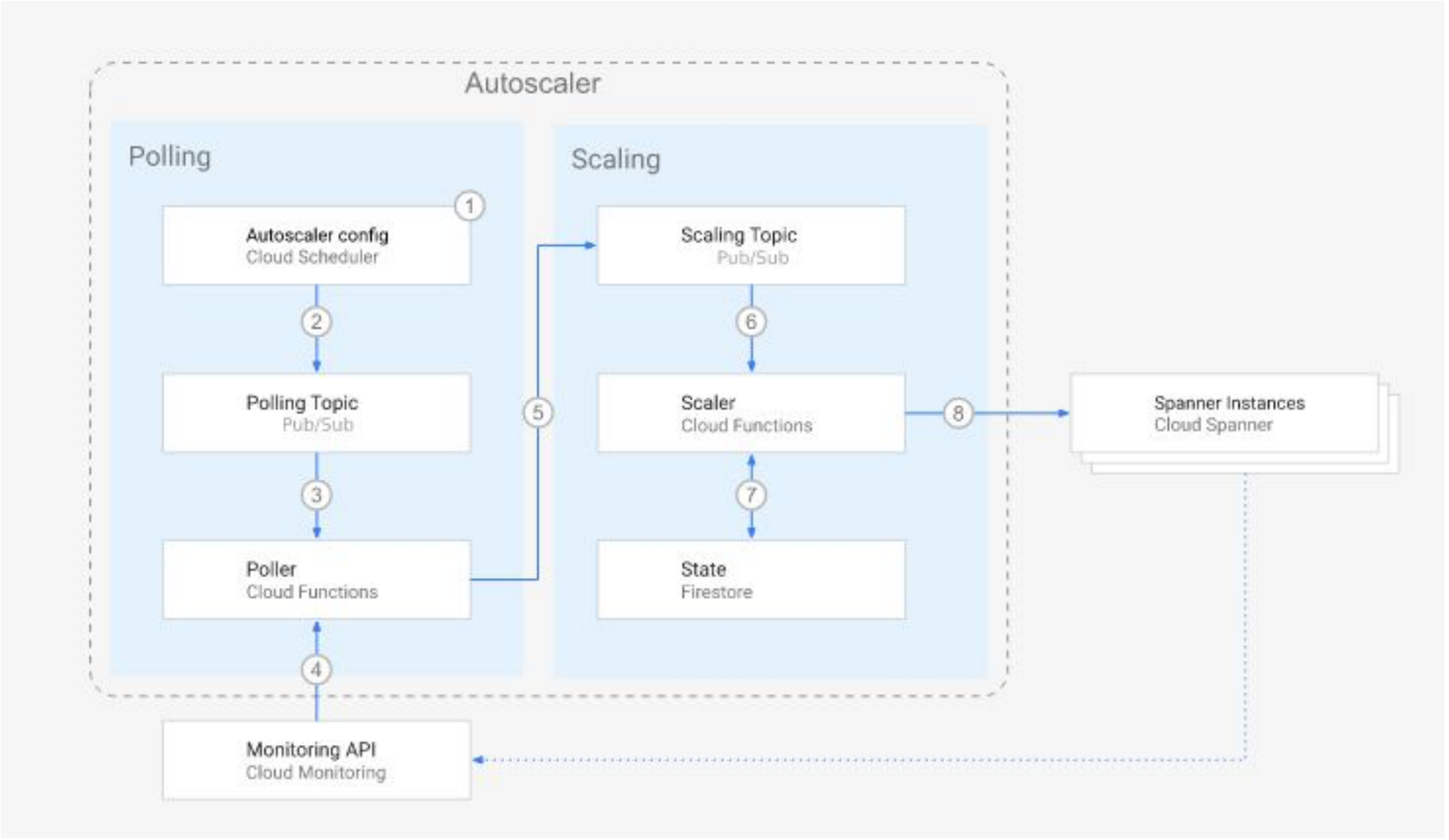
Cloud Spaner - (auto)scaling

Some DIY (still) required...

- The Autoscaler architecture consists of Cloud Scheduler, two Pub/Sub topics, two Cloud Functions, and Firestore. The Cloud Monitoring API is used to obtain CPU utilization and storage metrics for Spanner instances.

Exam Tips:

- *Do-It-Yourself still needed to automatically scale Spanner*
- *Scale Spanner nodes mostly based on CPU utilization metrics.*



Google Cloud

Cloud Spanner

#GCPSketchnote

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5.7.2021

What is Cloud Spanner?

- ✓ FULLY MANAGED
- ✓ HORIZONTALLY SCALABLE
- ✓ GLOBALLY CONSISTENT
- ✓ RELATIONAL DATABASE
- ✓ MULTI-VERSION DATABASE

Relational Semantics

Schemas, ACID transactions, SQL

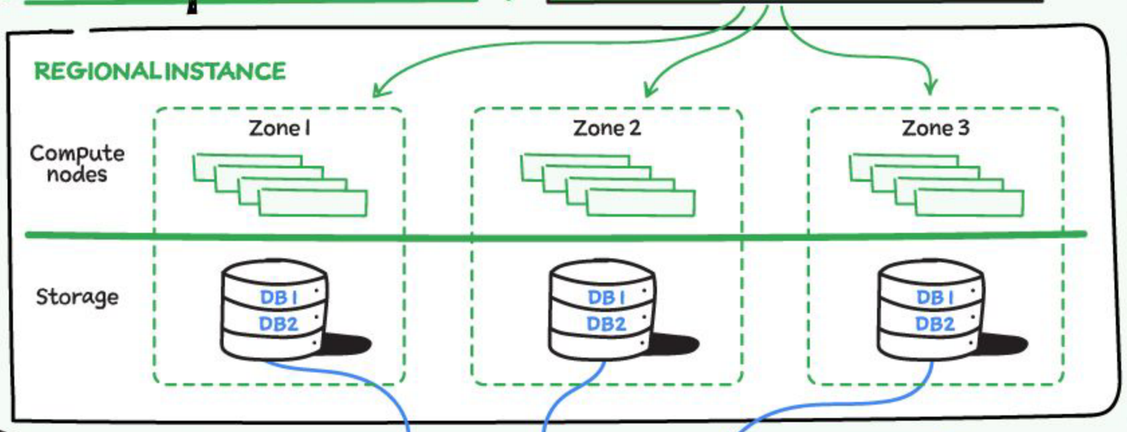
Horizontal Scale

99.999% SLA, fully managed, and scalable

Relational | Non-Relational

How does Cloud Spanner work?

This Spanner instance contains 4-nodes



This Spanner instance is hosting 2 databases across 3 zones

How does Spanner provide «global consistency?»

SPANNER GLOBAL CONSISTENCY

TrueTime

Synchronizes clocks in all machines across datacenters

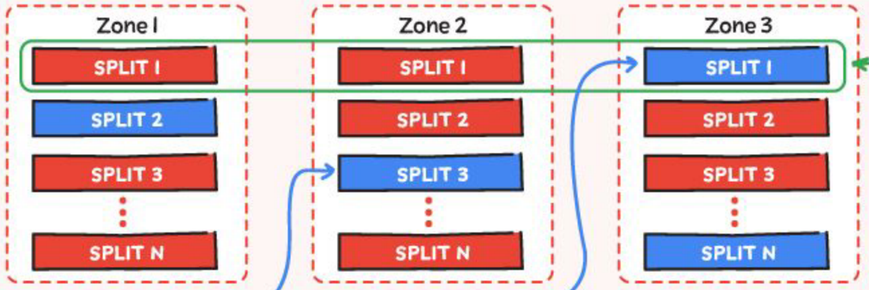
+

Google's Global Network

Fast & redundant

How does Spanner provide high availability* & scalability*?

Zero downtime for planned maintenance or schema changes



1. **WHAT IS A SPLIT?**
   Each table in the database is broken down into several splits using ranges of the primary key

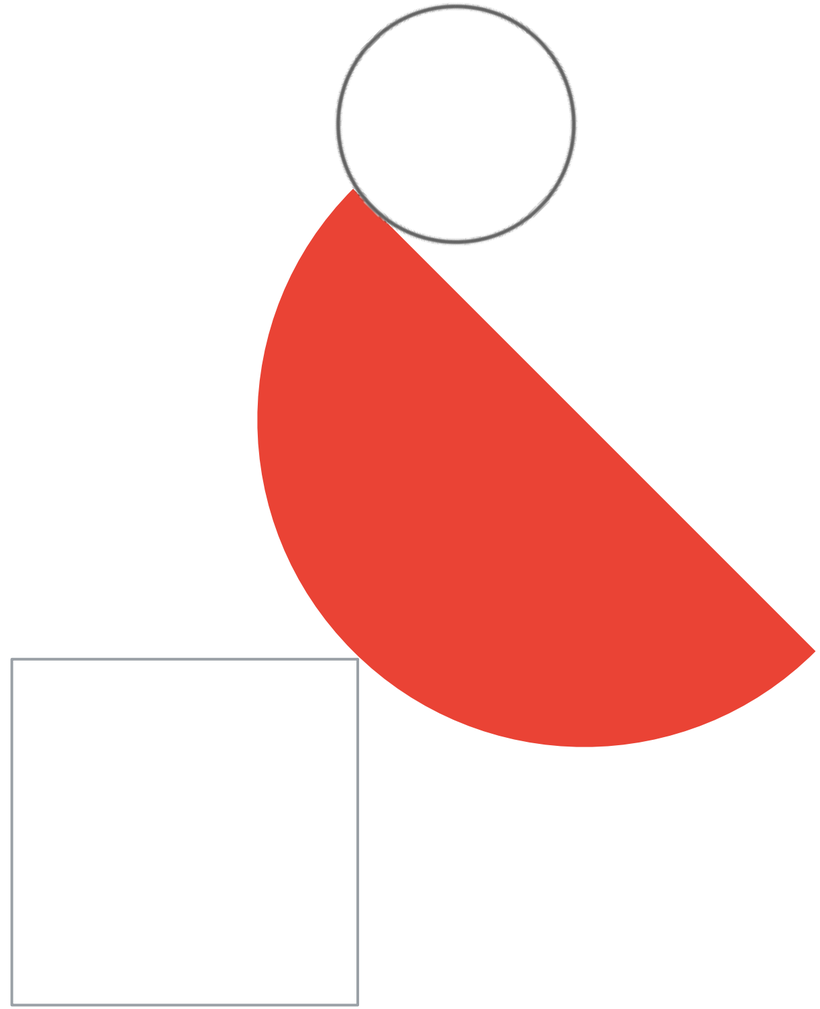
SPLIT ID	0	1	...	n
KEY RANGE	[-∞,3]	[4,224]	...	[2457,∞]

2. Splits are re-balanced dynamically based on amount of data + load
3. Paxos group for split 1
4. Replicas participate in voting for writes to achieve a majority quorum (2 out of 3) and serve reads
5. Different splits can have leaders in different zones

Leader manages writes for that split

All replicas serve reads

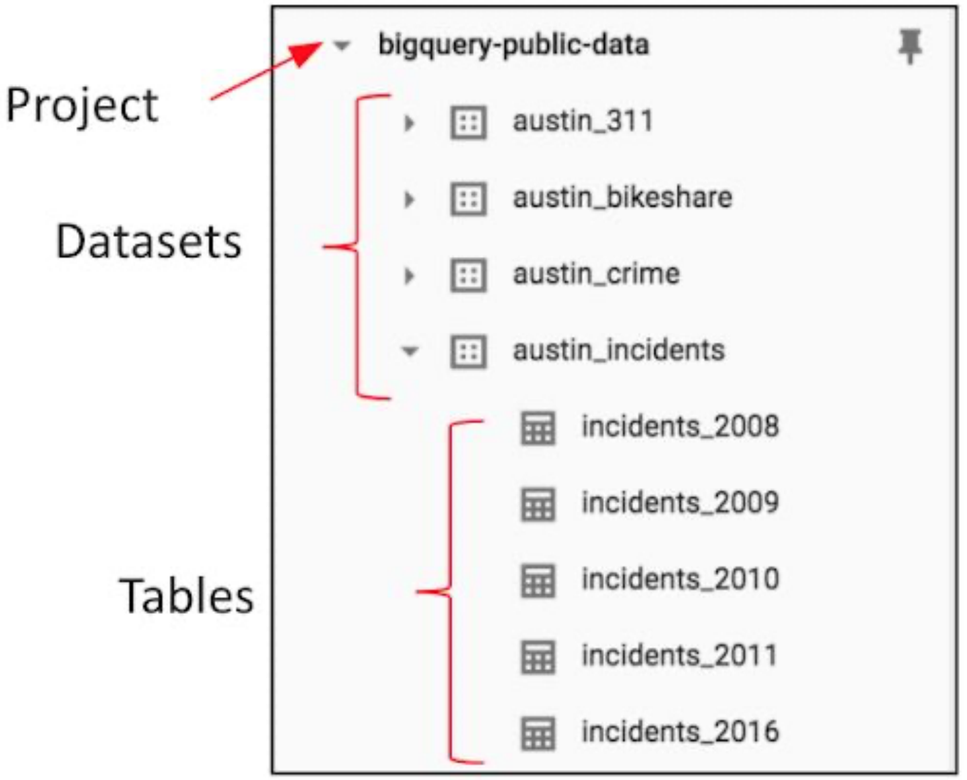
Bigquery



BigQuery hierarchy

Project -> Dataset -> Tables (-> Partitions)

- For each query, BigQuery executes a full-column scan.
- BigQuery performance and query costs are based on the amount of data scanned.
- You can set the geographic location of a Dataset at creation time only.
- All tables that are referenced in a query must be stored in datasets in the same location.
- When you copy a table (bq cp), the datasets that contain the source table and destination table must reside in the same location.
  - You can copy a dataset (NOT with bq cp, but with BigQuery Data Transfer Service) within a region or from one region to another
- Dataset names are case-sensitive



BigQuery: Controlling access to datasets

Common BigQuery predefined roles

Exam Tips: *It's a common practice to have a Dataset in one project and perform queries from another one (split billing!).*

Admin	Full Access to all datasets
Data Editor	Access to edit all contents of the datasets
Data Owner	Full access to datasets and all of their contents
Data Viewer	Access to view datasets and all of their contents
Job User	Access to run jobs
Metadata Viewer	Access to view table and dataset metadata
User	Access to run queries and create datasets
Read Sessions User	Access to create and use read sessions

Capability	dataViewer	dataEditor	dataOwner	user	jobUser	admin
List/get projects	✓	✓	✓	✓	✓	✓
List tables	✓	✓	✓	✓	⊘	✓
Get table data/metadata	✓	✓	✓	⊘	⊘	✓
Create tables	⊘	✓	✓	⊘	⊘	✓
Modify/delete tables	⊘	✓	✓	⊘	⊘	✓
List/get datasets	✓	✓	✓	✓	⊘	✓
Create new datasets	⊘	✓	✓	✓	⊘	✓
Modify/delete datasets	⊘	⊘	✓	Self-created datasets	⊘	✓
Create jobs/queries	⊘	⊘	⊘	✓	✓	✓
Cancel jobs	⊘	⊘	⊘	Self-created jobs	Self-created jobs	Any jobs
Get/list saved queries	⊘	⊘	⊘	✓	⊘	✓
Create/update/delete saved queries	⊘	⊘	⊘	⊘	⊘	✓
Get transfers	⊘	⊘	⊘	✓	⊘	✓
Create/update/delete transfers	⊘	⊘	⊘	⊘	⊘	✓

BigQuery: Controlling access to datasets

You can grant access at the following BigQuery resource levels:

- organization or Google Cloud project level
- dataset level
- table or view level
  a. Authorized Views
- You can also restrict access to data on more granular level by using the following methods:
  a. column-level access control
  b. dynamic data masking (aka “some columns may be hidden, depending on privileges”)
     i. Works together with column-level security.
     ii. no need to modify existing queries by excluding the columns that the user cannot access
  c. row-level security (aka “some rows may be hidden, depending on privileges”)
     i. One table can have multiple row-level access policies. Row-level access policies can coexist on a table with column-level security as well as dataset-level, table-level, and project-level access controls.

BigQuery: Controlling access to datasets

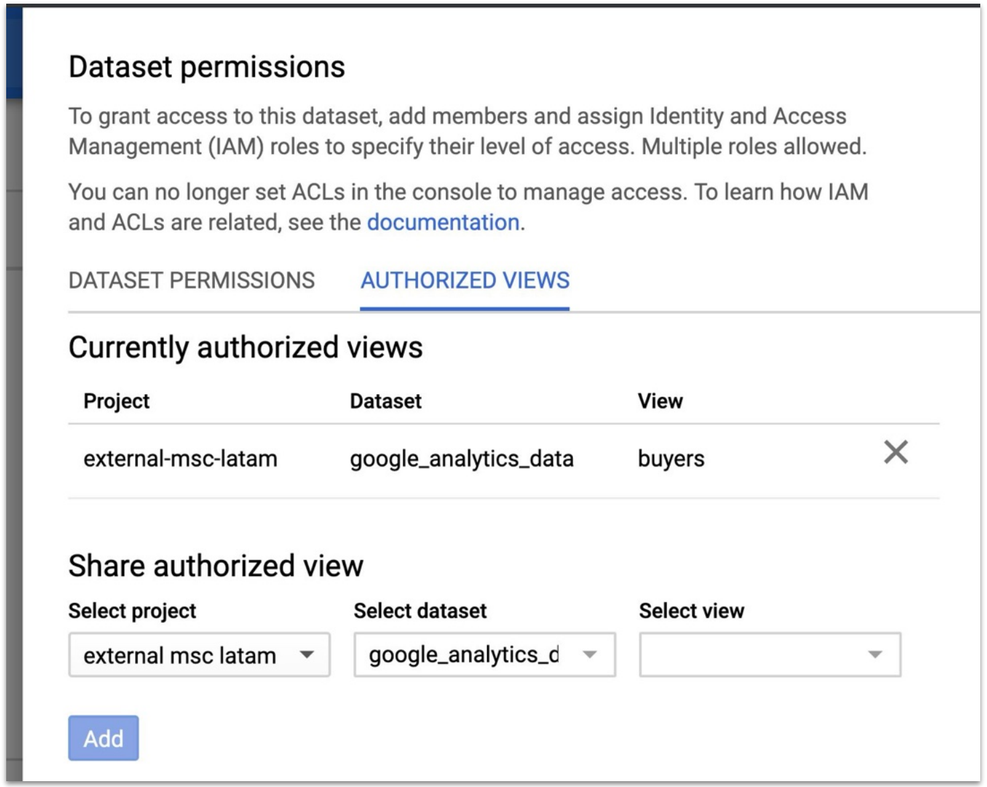
Authorized Views

1. **View:** View is a virtual table defined by a SQL query. When you create a view, you query it in the same way you query a table

2. **Query:** When a user queries the view, the query results contain data only from the tables and fields specified in the query that defines the view.

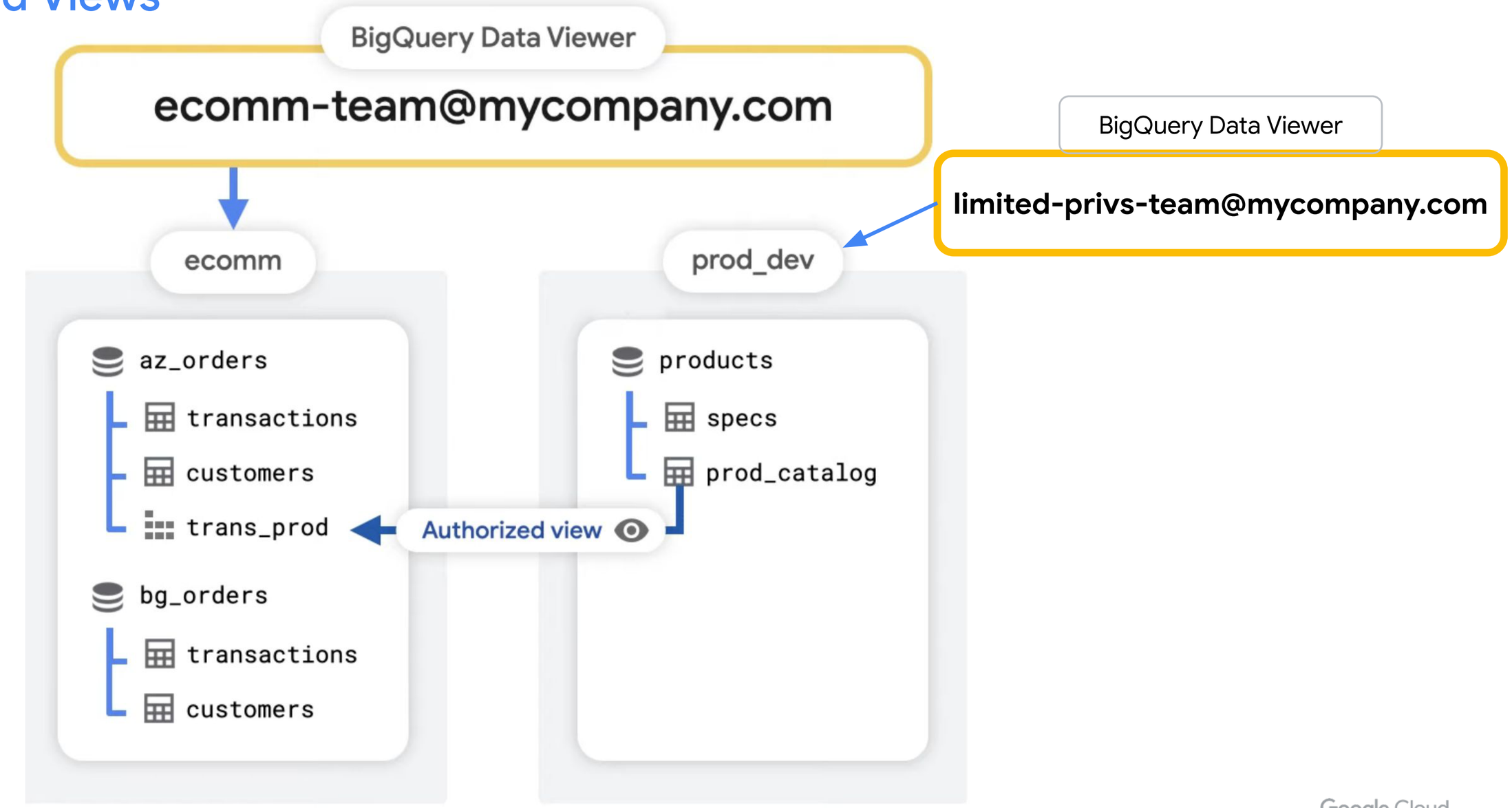
3. **Authorized Views:** An authorized view allows you to share query results with particular users and groups without giving them access to the underlying tables.

Exam Tip: *Authorized Views were especially useful when there were no table/column-level permissions. However, they're still often-used way to selectively share access to datasets (and they pop up on the exam!).*
MAKE SURE TO UNDERSTAND HOW TO CREATE AND SHARE SUCH A VIEW.



BigQuery: Controlling access to datasets

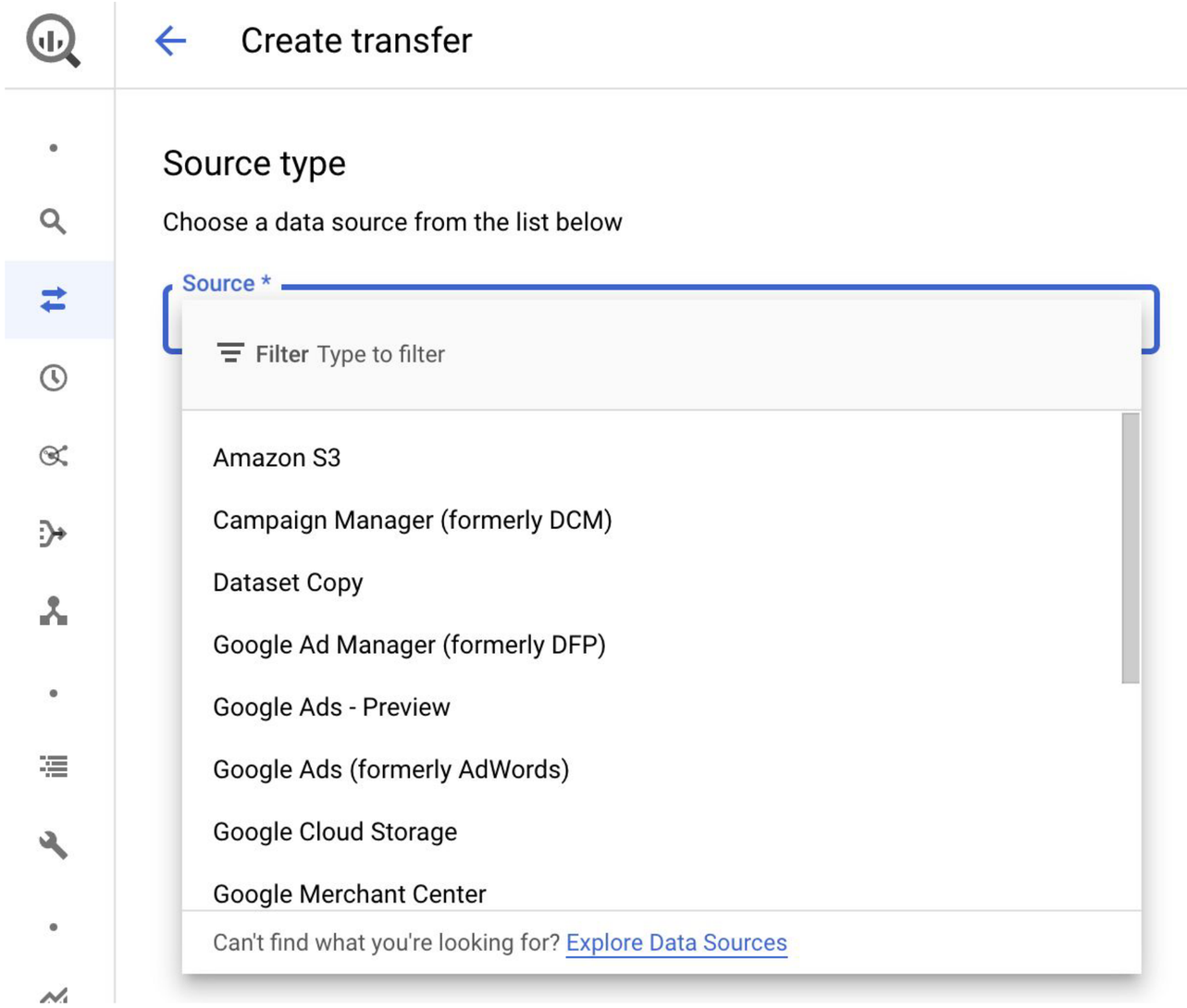
Authorized Views



BigQuery - Data Transfer Service

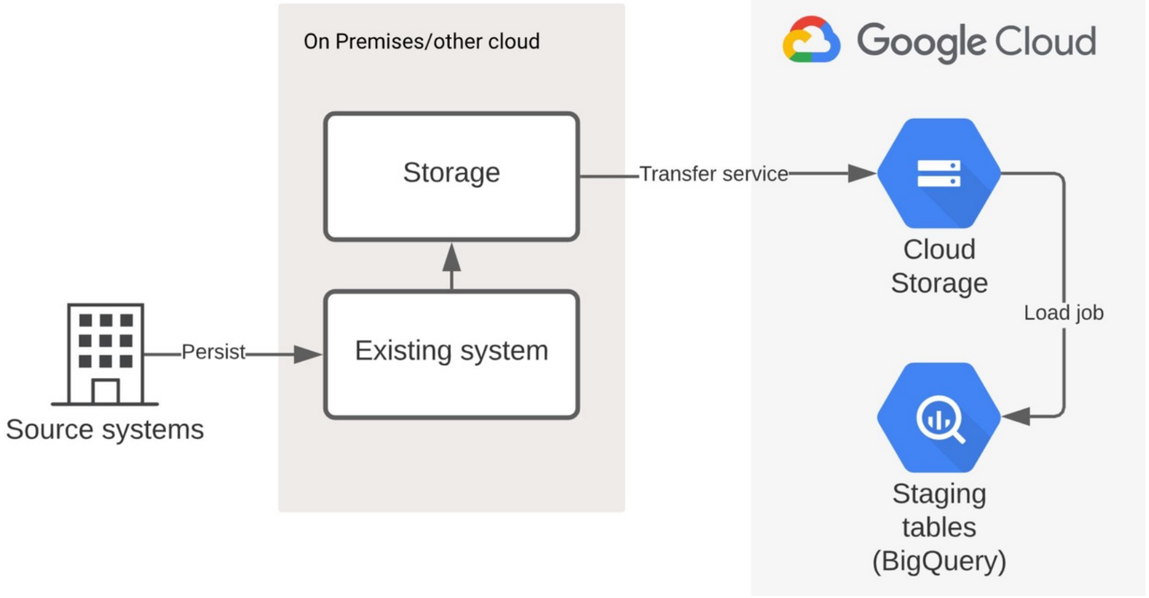
Mostly useful for regular data transfers to BigQuery

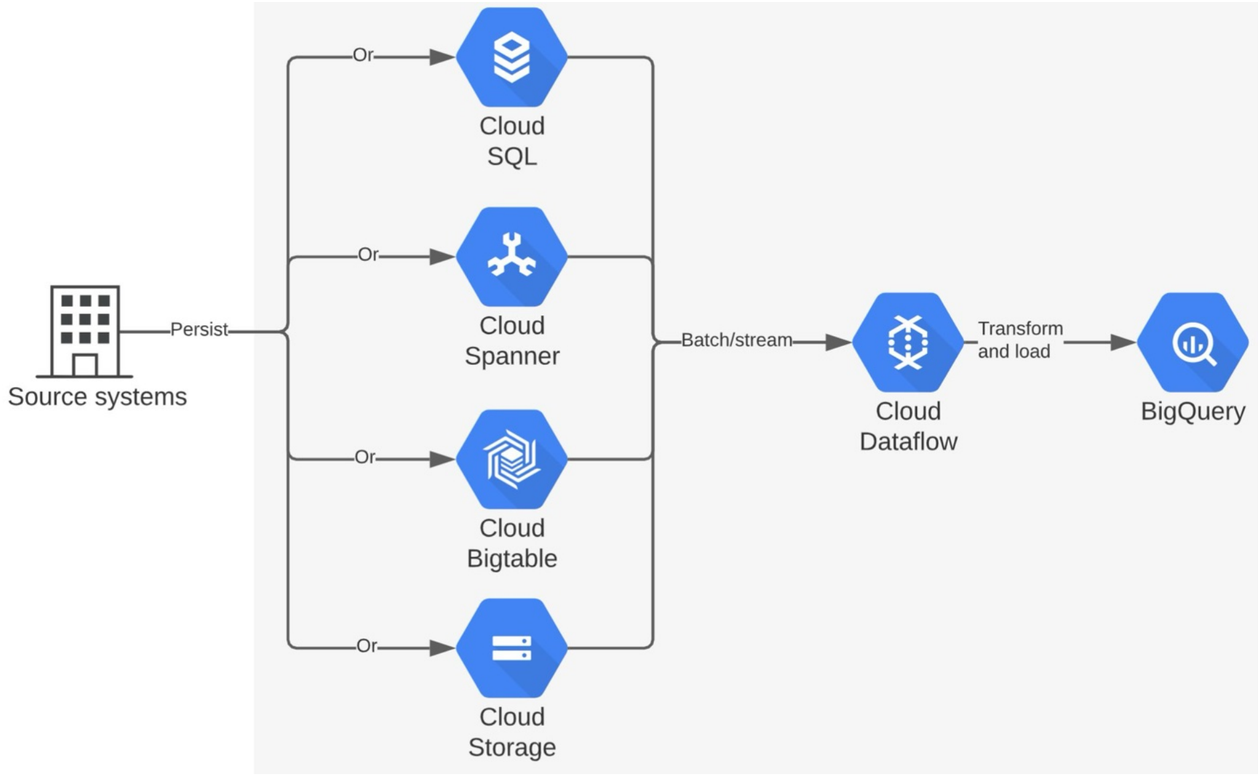
- BigQuery Data Transfer Service automates data movement from various sources into BigQuery on a scheduled, managed basis.
- You can initiate data backfills to recover from any outages or gaps.



BigQuery - Batch vs Streaming inserts

Most common architectures





Exam Tip: *There is additional cost for streaming (both inserts and reads) in BigQuery.*

BigQuery: Controlling access to datasets

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- table or view level
  a. Authorized Views
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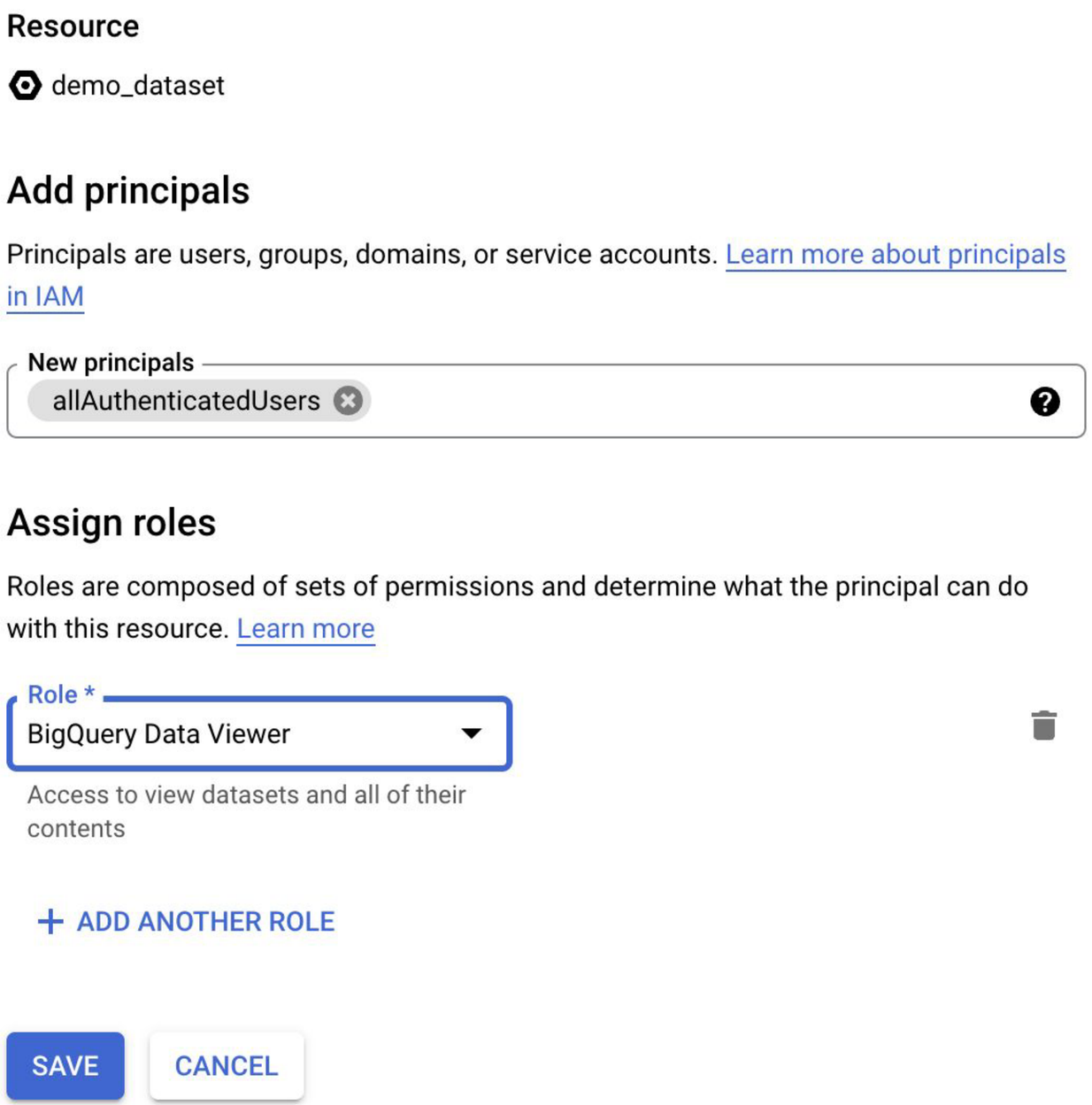
BigQuery: Sharing Datasets with others

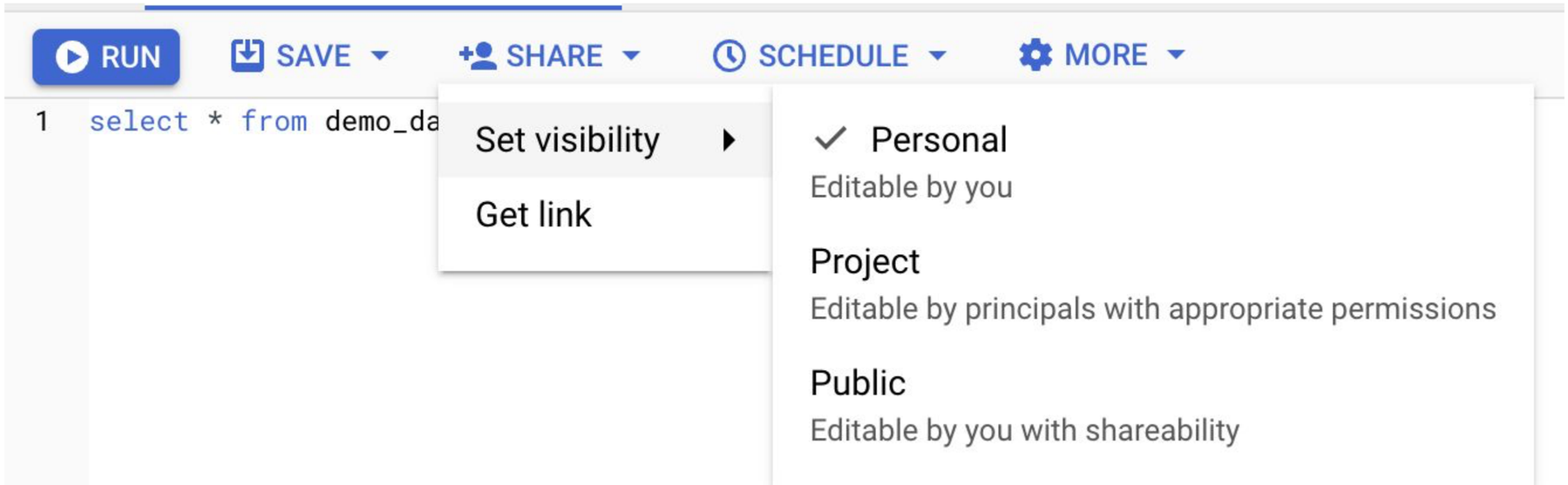
AllAuthenticatedUsers

The special setting allAuthenticatedUsers makes a dataset public. Authenticated users must use BigQuery within their own project and have access to run BigQuery jobs so that they can query the Public Dataset. The billing for the query goes to their project, even though the query is using public or shared data. In summary, the cost of a query is always assigned to the active project from where the query is executed.



BigQuery: Sharing Queries with others

Mostly for collaboration

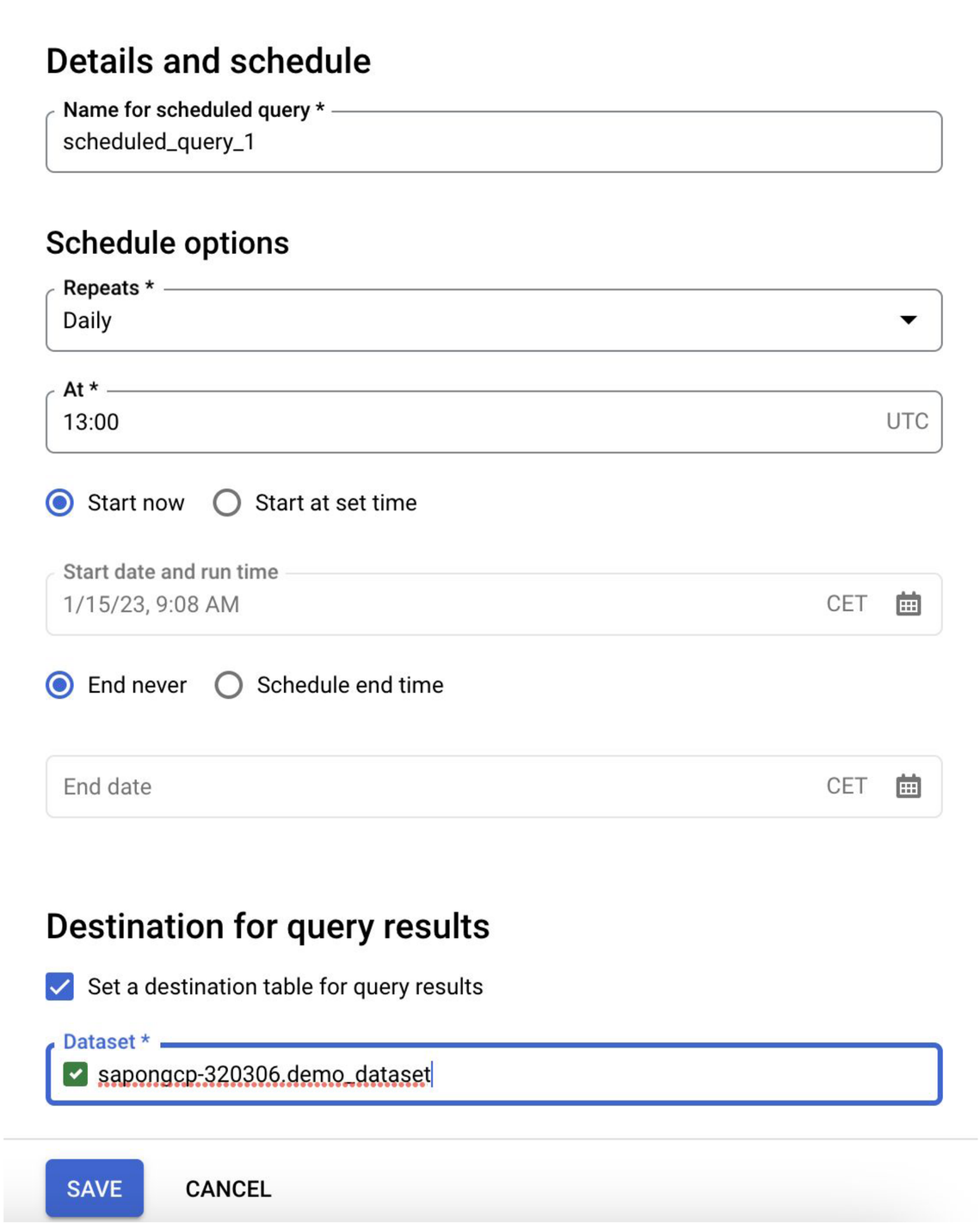


- Query needs to be saved first, before it's shared;
- Can share incomplete / invalid queries -> collaboration;
- Project-level saved queries are visible to principals with the required permissions;
- Public saved queries are visible to anyone with a link to the query;

BigQuery: Scheduling queries

Mostly useful for regular execution

- Scheduled queries use features of BigQuery Data Transfer Service.
- If the destination table for your results doesn't exist when you set up the scheduled query, BigQuery attempts to create the table for you.
- You can set up a scheduled query to authenticate as a service account.



BigQuery: Query results caching

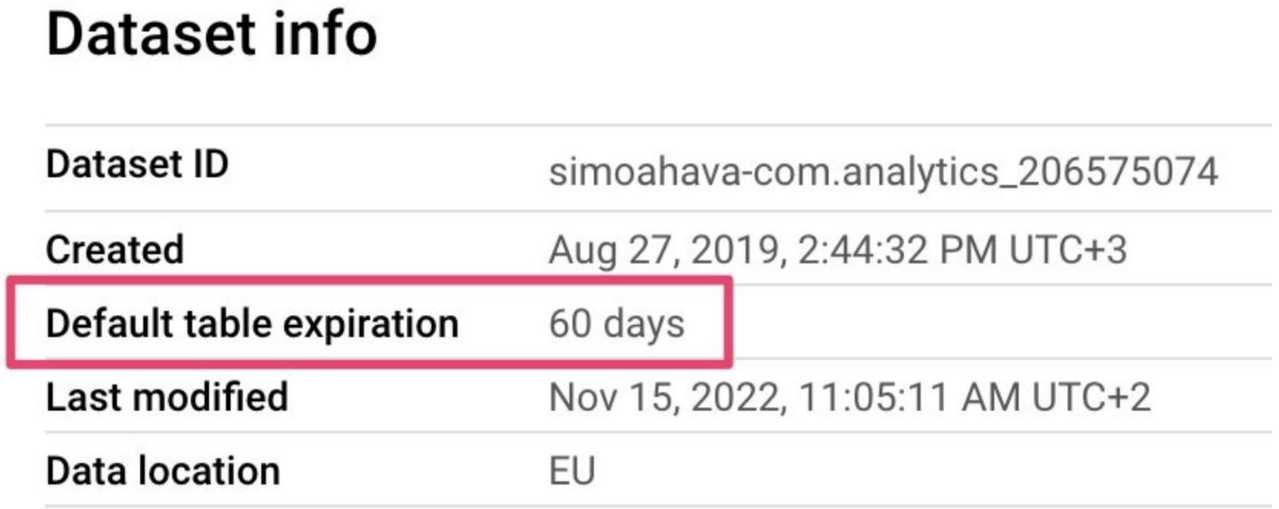
Limit Access by Data Lifecycle Stages

- Query results are cached to improve performance and reduce costs for repeated queries
- Cache is per user
- Still subject to quota policies
- Cache results have a size limit of 128 MB compressed
- No charge for queries that use cached results
- Results are cached for approximately 24 hours
- Lifetime extended when a query returns a cached result
- Use of cached results can be turned off (useful for benchmarking)

BigQuery: table/partition (automatic) data expiration

Can be set for dataset / table / partition

Best practice for data lifecycle management.
Expiration in BigQuery automatically implements retention policy.



- Dataset expiration
  - = “default table expiration time” for a dataset
- Table expiration
  - If Dataset expiration is set, each table inherits this setting by default
- Partition expiration:
  - The setting applies to all partitions in the table, but is calculated independently for each partition based on the partition time.
  - At any point after a table is created, you can update the table's partition expiration

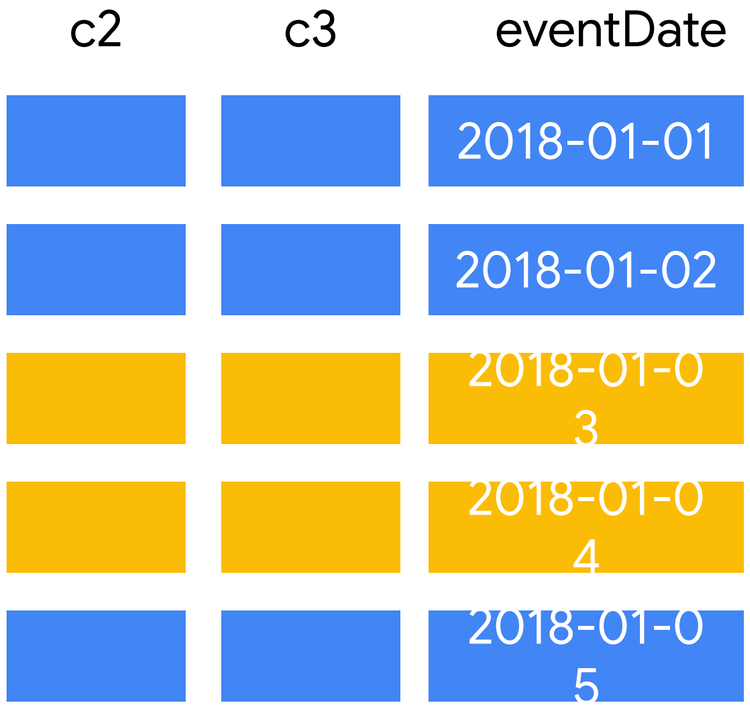
BigQuery: Table Partitioning

Partitioning versus sharding:

- Table sharding is the practice of storing data in multiple tables, using a naming prefix such as [PREFIX]_YYYYMMDD. Partitioning is recommended over table sharding, because partitioned tables perform better.

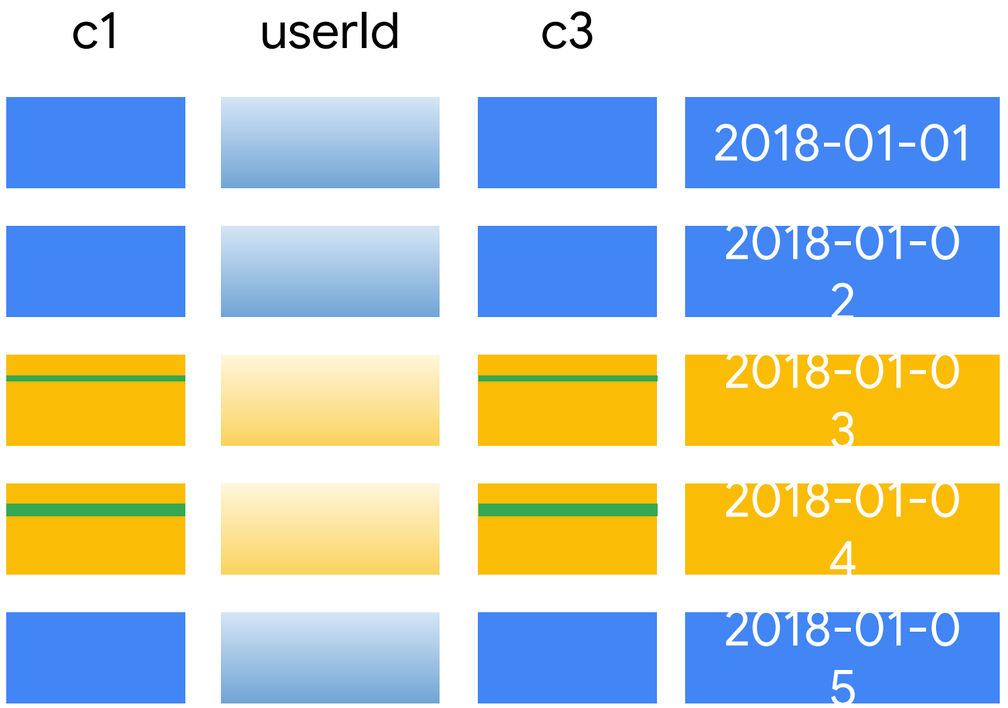
You can partition BigQuery tables by:

- Time-unit column: Tables are partitioned based on a TIMESTAMP, DATE, or DATETIME column in the table.
- Ingestion time: Tables are partitioned based on the timestamp when BigQuery ingests the data.
- Integer range: Tables are partitioned based on an integer column.




```
SELECT * FROM ...
WHERE eventDate BETWEEN
“2018-01-03” AND
“2018-01-04”
```

BigQuery: Table Clustering



SELECT c1, c3 FROM ... WHERE userId BETWEEN 52 and 63
AND eventDate BETWEEN “2018-01-03” AND “2018-01-04”

BigQuery - table partitioning vs clustering

Decision making

- Clustering gives you more granularity than partitioning alone allows
- Use clustering if your queries commonly use filters or aggregation against multiple particular columns.

Use case	Recommendation
You're using on-demand pricing and require strict cost guarantees before running queries.	Partitioned tables
Your segment size is less than 1 GB after partitioning the table.	Clustered tables
You require a large number of partitions beyond the BigQuery limits	Clustered tables
Frequent mutations in your data modify a large number of partitions.	Clustered tables
You frequently run queries to filter data on certain fixed columns.	Partitions plus clustering

BigQuery: table partitioning AND clustering

Both partitioning and clustering can improve performance and reduce query cost

Orders table

Not Clustered; Not partitioned

Order_Date	Country	Status
2022-08-02	US	Shipped
2022-08-04	JP	Shipped
2022-08-05	UK	Canceled
2022-08-06	KE	Shipped
2022-08-02	KE	Canceled
2022-08-05	US	Processing
2022-08-04	JP	Processing
2022-08-04	KE	Shipped
2022-08-06	UK	Canceled
2022-08-02	UK	Processing
2022-08-05	JP	Canceled
2022-08-06	UK	Processing
2022-08-05	US	Shipped
2022-08-06	JP	Processing
2022-08-02	KE	Shipped
2022-08-04	US	Shipped

Orders table

Clustered by Country; Not partitioned

Order_Date	Country	Status
2022-08-04	JP	Shipped
2022-08-04	JP	Processing
2022-08-05	JP	Canceled
2022-08-06	JP	Processing
2022-08-06	KE	Shipped
2022-08-02	KE	Canceled
2022-08-04	KE	Shipped
2022-08-02	KE	Shipped
2022-08-05	UK	Processing
2022-08-06	UK	Canceled
2022-08-02	UK	Canceled
2022-08-06	UK	Processing
2022-08-02	US	Shipped
2022-08-05	US	Processing
2022-08-05	US	Shipped
2022-08-04	US	Shipped

Orders table

Clustered by Country; Partitioned by Order_Date (Daily)

	Order_Date	Country	Status
Partition: 2022-08-02	2022-08-02	KE	Shipped
	2022-08-02	KE	Canceled
Clusters: Country	2022-08-02	UK	Processing
	2022-08-02	US	Shipped

	Order_Date	Country	Status
Partition: 2022-08-04	2022-08-04	JP	Shipped
	2022-08-04	JP	Processing
Cluster: Country	2022-08-04	KE	Shipped
	2022-08-04	US	Shipped

	Order_Date	Country	Status
Partition: 2022-08-05	2022-08-05	JP	Canceled
	2022-08-05	UK	Canceled
Cluster: Country	2022-08-05	US	Shipped
	2022-08-05	US	Processing

	Order_Date	Country	Status
Partition: 2022-08-06	2022-08-06	JP	Processing
	2022-08-06	KE	Shipped
Cluster: Country	2022-08-06	UK	Canceled
	2022-08-06	UK	Processing

Exam Tip: *You can combine partitioning with clustering. Data is first partitioned and then data in each partition is clustered by the clustering columns.*

BigQuery

#GCPSketchnote

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8.5.2020

What is BigQuery?

ENTERPRISE DATA WAREHOUSE

INGEST → STORE → ANALYZE → VISUALIZE

BATCH DATA

STREAMING DATA

Google will allocate as many servers as needed to run your query

99.99% SLA

ON DEMAND INSIGHTS

REAL-TIME INSIGHTS

Unique BigQuery FEATURES

BQ OMNI (Private Alpha)
- Enables hybrid & multi-cloud queries

Data Storage

Query Engine

Anthos Clusters

BQ ML
- Create model
- Predict

BI ENGINE

BigQuery BI Engine

Data Studio

Sheets

Partner BI Tools

DATA QnA (Private Alpha)
- Get answers through NLP

Business User

Chat

Data QnA

Get answers through NLP

GEOSPACIAL

CONNECTED SHEETS

BigQuery PRICING

FREE!

Free storage for all public datasets

Query upto 1TB/month for free

Batch Load is free

Streaming Inserts

Export is free

$ =

Storage

- ACTIVE <90 days
- LONG TERM >90 days

Query

- ON DEMAND $ per query
- FLAT RATE $ for dedicated resources

SECURITY for BigQuery

0 Avoid risk of data loss

1 Identity and Access Management

2 VPC controls

3 Customer managed encryption key (CMEK)

How it WORKS!

GCS, HTTPs Post	Web, IoT, Mobile	ETL, ELT data	GCS, s3, Teradata, ...
BATCH INGESTION	STREAMING INGESTION	QUERY MATERIALIZATION	DATA TRANSFER SERVICE (DTS)

INGEST

AUTOMATIC BACKUP & RESTORE

PUBLIC DATA SETS

ODBC and JDBC drivers (at no cost)

SQL ANSI:2011 compliant

COMPUTE

QUERY

Visualize

STORAGE

Looker

Data Studio

Connected Sheets

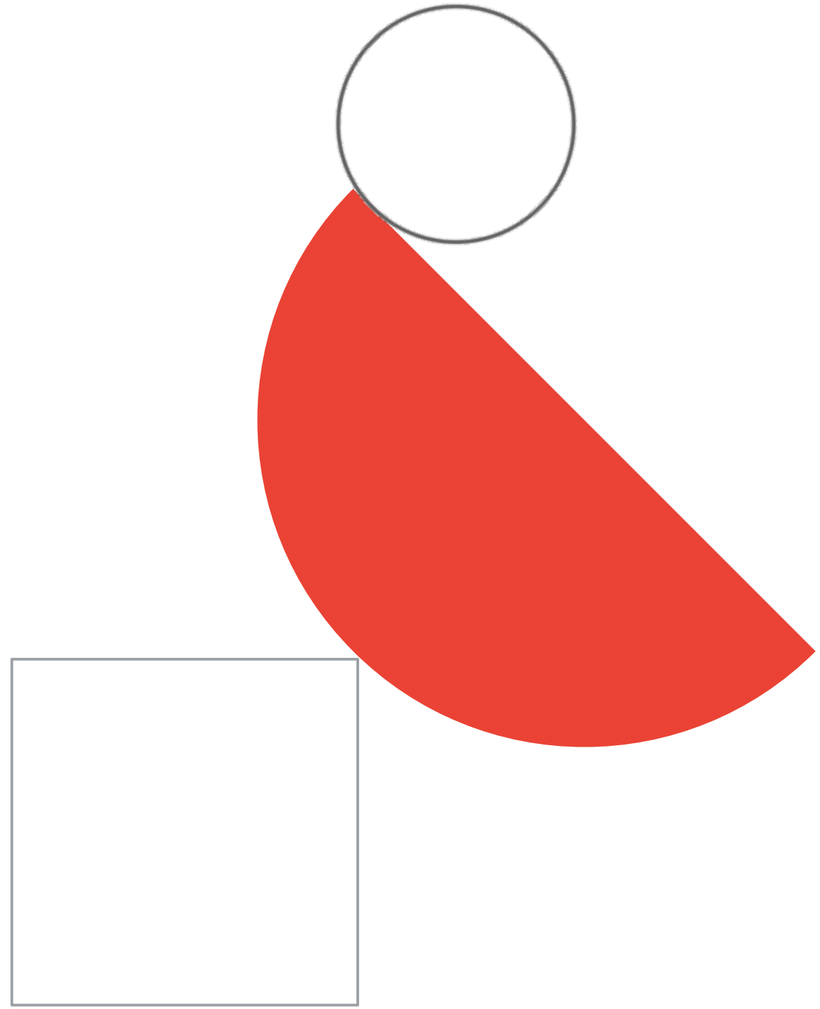
Partner BI Tools

BigQuery Use case example

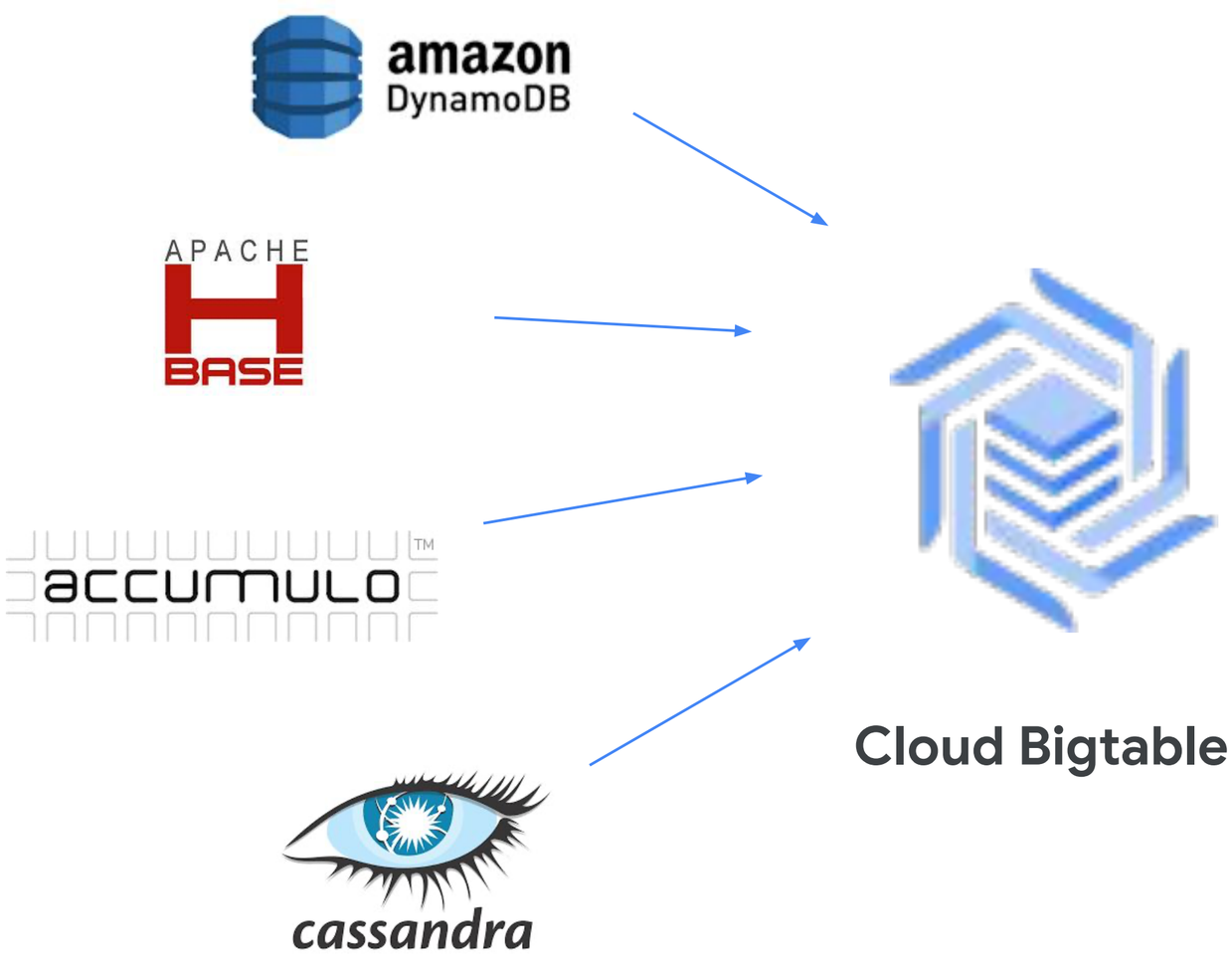
Data Analytics

Trigger	Ingest	Enrich	Analyze	Visualize
Google Cloud Storage: Mobile, Web, Data Store, IoT	Batch Load, Pub/Sub, Streaming Inserts	Dataflow	BigQuery, AI Platform, Bigtable	Studio, Third-party BI, Google Sheets

Bigtable



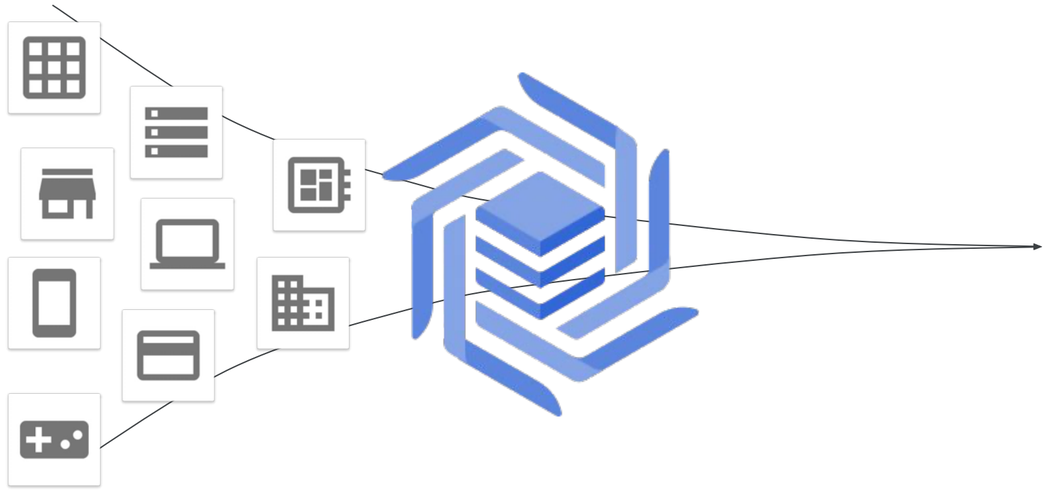
Bigtable is a common migration target for key-value, wide-column and time-series databases



- **Petabyte-scale**
- **fully managed** NoSQL database service for use cases where **low latency** random data access, **scalability** and **reliability** are critical.
- **scales seamlessly**
- **integrates** with the Apache® ecosystem and supports the HBase™ API.

Bigtable is all about speeeeed

High throughput



10MB/s write throughput per node

Up to **220MB/s** scan throughput

10.000 queries (r/w) **per second per node**

Low latency

Consistent 99th percentile **low single digit** read and write latency

What is Bigtable good for?

Use Case Examples

- **Time-series** data, such as CPU and memory usage over time for multiple servers.
- **Marketing data**, such as purchase histories and customer preferences.
- **Financial data**, such as transaction histories, stock prices, and currency exchange rates.
- **Internet of Things** data, such as usage reports from energy meters and home appliances.
- **Graph data**, such as information about how users are connected to one another.

Applications that need...

- Very high throughput
- Scalability
- Non-Structured key/value data where each value is no larger than 10MB

Storage Engine

- Batch MapReduce
- Stream Processing/Analytics
- ML applications

Exam Tip: *types of apps where you'd consider using Bigtable: recommendation engines, personalizing user experience, Internet of Things, real-time analytics, fraud detection, migrating from HBase or Cassandra, Fintech, gaming, high-throughput data streaming for creating / improving ML models.*

What is Bigtable not good for?

Not good for...

- Not a relational database
- No SQL Queries or Joins
- No Multi-Row Transactions

Considerations

- You need full SQL support for OLTP
  → consider Spanner or CloudSQL
- Interactive querying for OLAP
  → consider BigQuery
- Need to store immutable blobs larger than 10MB (e.g. movies, images)
  → consider Cloud Storage

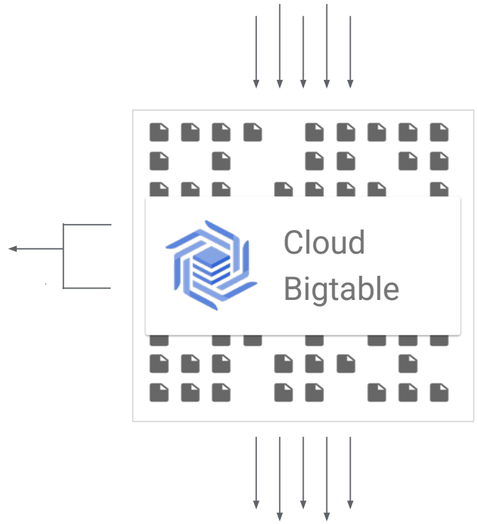
Bigtable for analytics... ?

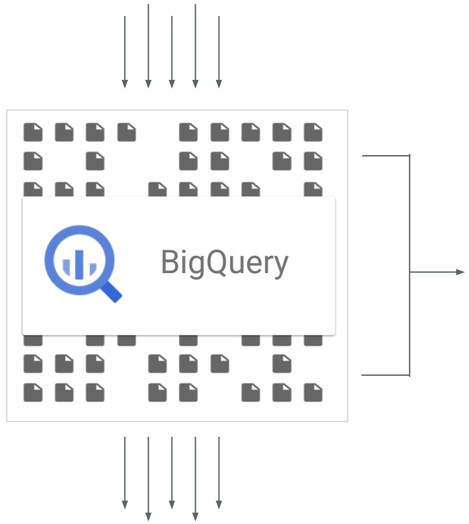
Bigtable vs BigQuery

NoSQL wide column database

Low latency per-entry access

Heavy read/write events





Enterprise data warehouse for relational structured data

Large scale, ad-hoc SQL-based OLAP analysis

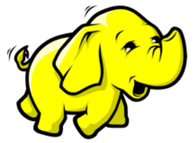
Organizational insights

Analyze data from Cloud Bigtable database

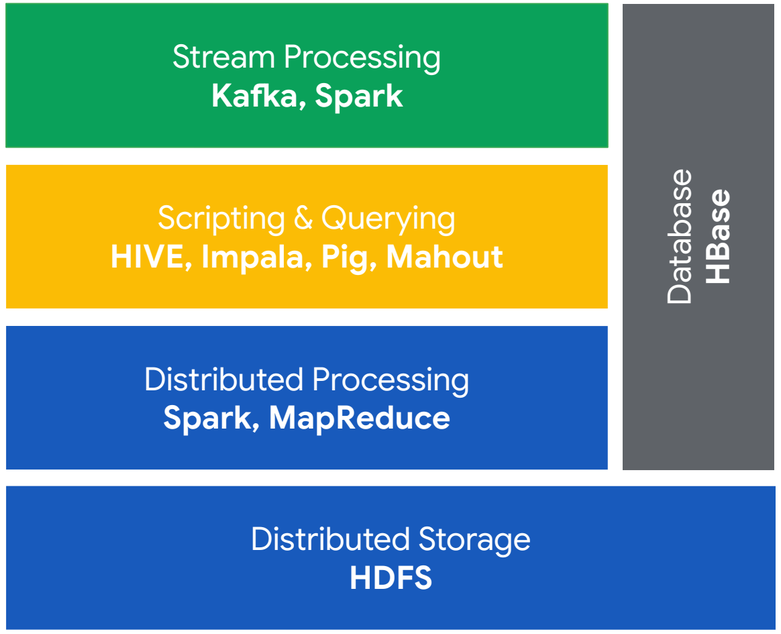
Optimized for	**Point read/write**	**Ad-hoc analysis and reporting**
Typical target	**User/entity level**	**Cohort /population level**

Bigtable: Hadoop migration and modernization

"Before"



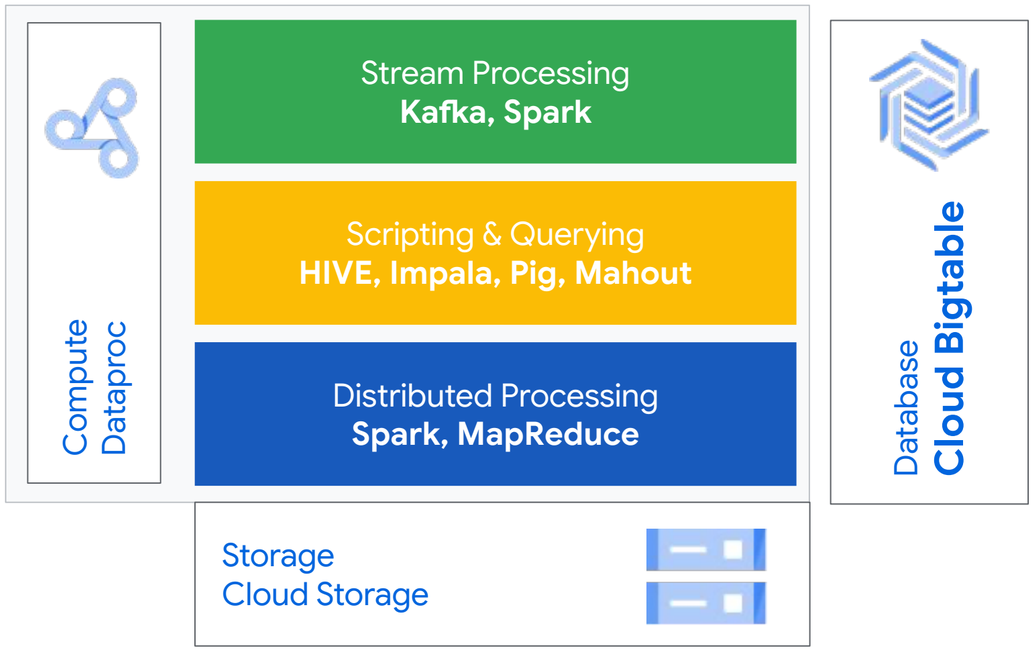
Apache Hadoop/HBase



Simplified
Hadoop Stack

"After"

Data Ecosystem / Cloud Bigtable



Google Cloud
Storage and Databases

Exam Tip: *Main goal: decoupling of storage & compute. As a consequence, you can treat Dataproc clusters as job-specific / ephemeral*

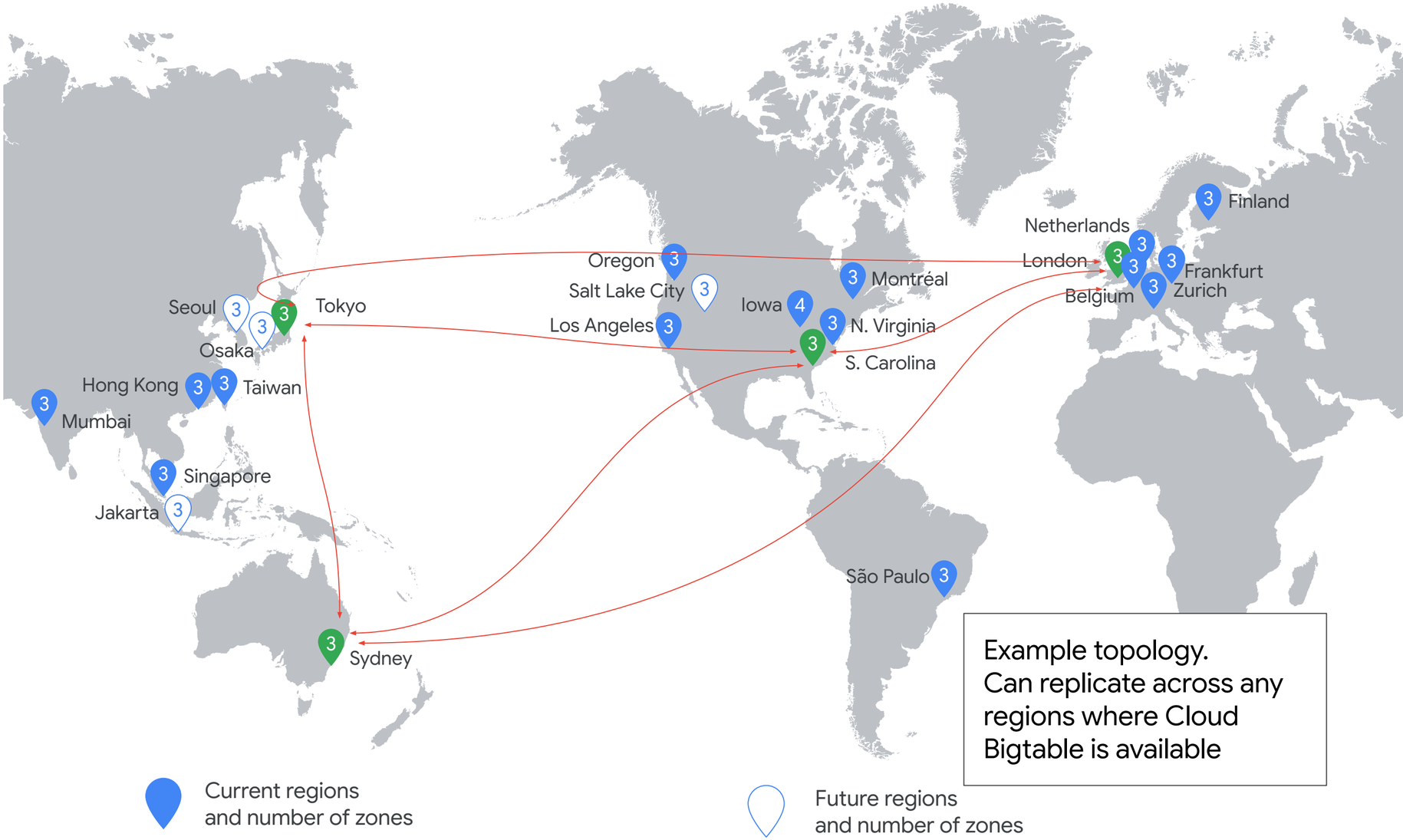
Bigtable: Replication

Regional replication

- SLA up to 99.999%
- Isolate serving and analytics
- Independently scale clusters
- Automatic failover in case of a zonal failure

Global replication

- **Increases durability/availability beyond one region**
- **Fastest region-specific access**
- **Option for DR replica for regulated customers**



Cloud Bigtable

#GCPSketchnotes

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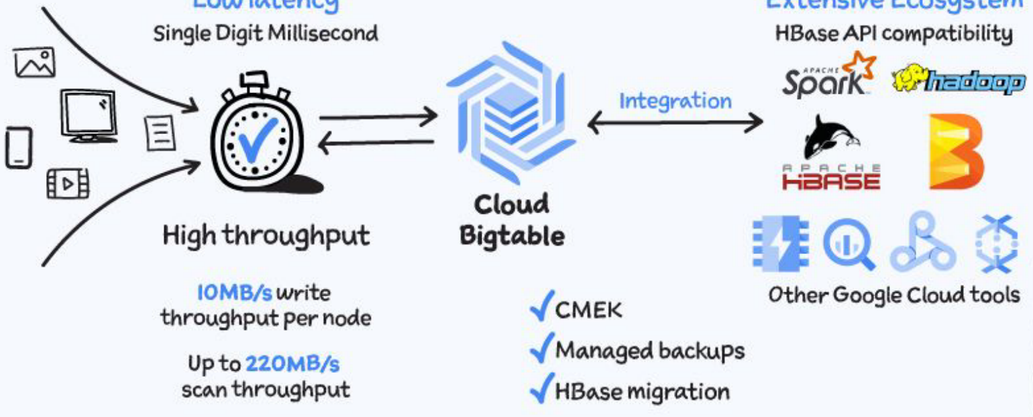
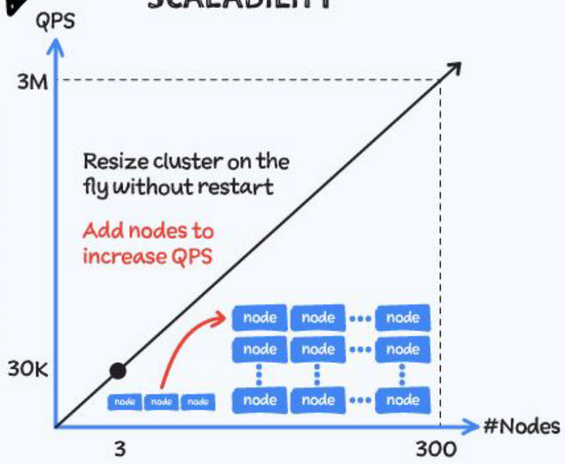
What is Cloud Bigtable?

FULLY MANAGED PETABYTE-SCALE NOSQL DATABASE
For heavy reads/writes



SCALABILITY



Each node provides upto 10,000 QPS (read/write)

FAILOVER FOR HIGH AVAILABILITY (HA)

Single/multi-region/global Replication

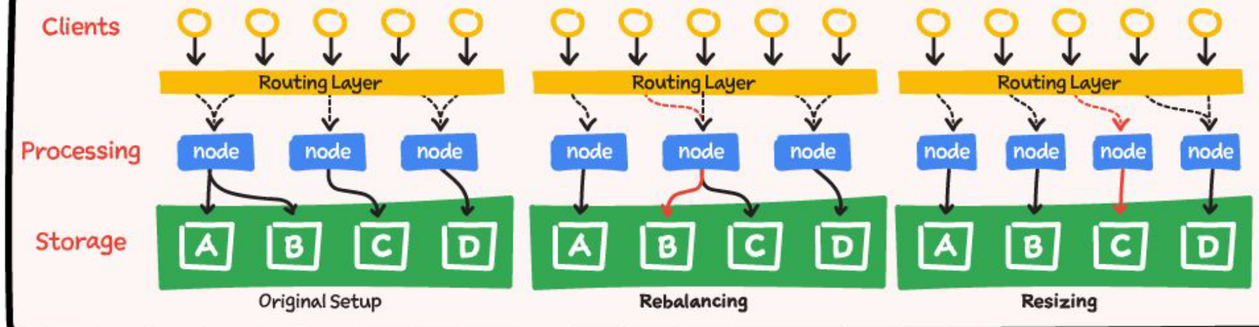
No manual steps to ensure consistency, repair data, or synchronize writes/deletes

How does Cloud Bigtable Optimize throughput?

Cloud Bigtable separates processing from storage, each node has access to a group of database rows

Rebalance load automatically to improve performance

Resize nodes (with no downtime) for best overall throughput

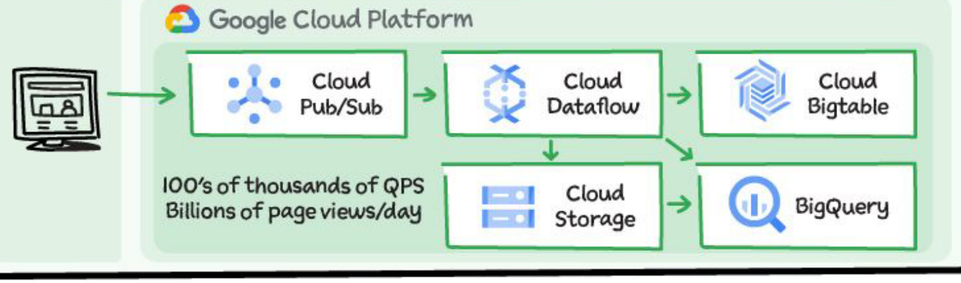


Cloud Bigtable «Use case examples»

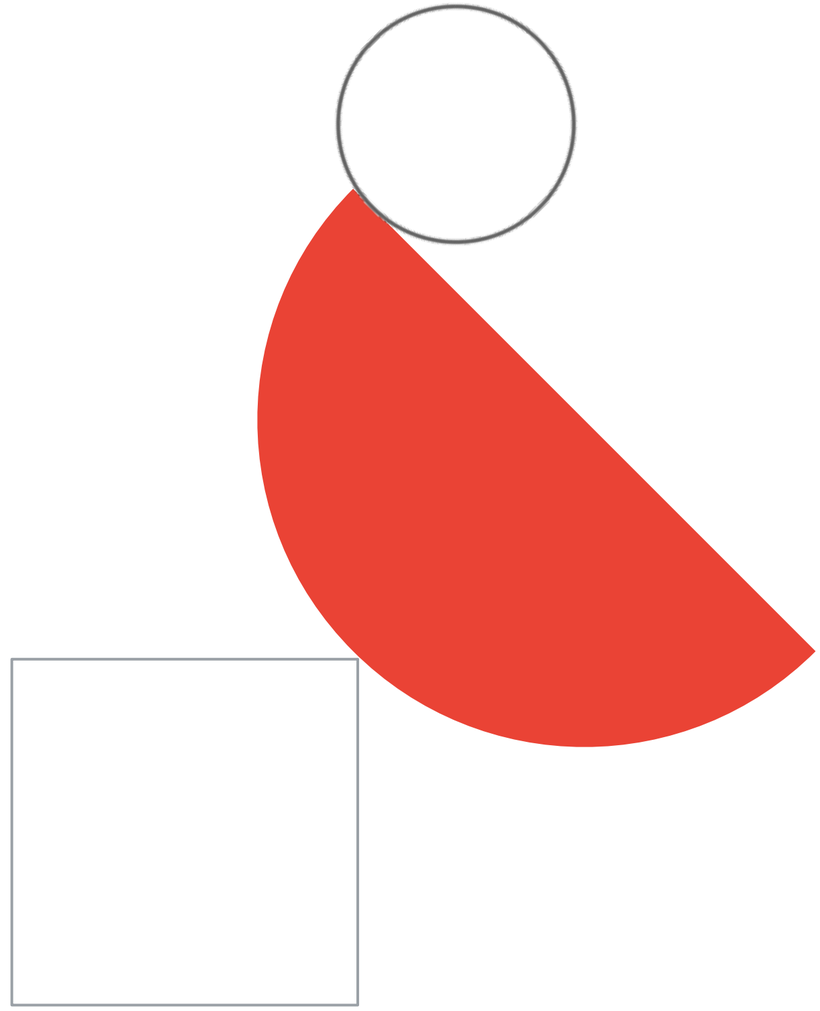
REAL-TIME ANALYTICS FOR HUGE WORKLOADS

FinTech · AdTech · Gaming · IoT · ML/AI Personalization

REAL-TIME AD BIDDING PLATFORM



Comparing GCP storage solutions



SQL vs noSQL

SQL (aka ‘Relational’)	NoSQL (aka ‘Non-relational’)
“traditional” table-based RDBMSes	key-value, wide column, document
Strongly typed, fixed schemas	Dynamic schemas
Almost all ACID-compliant	Mostly BASE
Considerable percentage of logic can be done in database	Most of logic needs to be offloaded to application layer
Default choice for most monoliths	Suitable for some microservices
performance capped at some point (vertical scaling only, plus sharding, offloading read-only etc)	Processing nodes often separate from storage nodes (if network is fast enough)
In GCP: Cloud SQL, Cloud Spanner Outside of GCP: MySQL, Oracle, PostgreSQL, Microsoft SQL Server.	In GCP: Firestore, Bigtable Outside of GCP: MongoDB, Redis, Cassandra, HBase, CouchDB

OLTP vs OLAP

OLTransactionalP	**OLAnalyticalP**
For processing data in transaction-oriented apps	Multi-dimensional, analytical queries used in BI, reporting, data mining etc
Large amounts of transactions	Large volume of data
A mix of Inserts, Updates, Deletes on individual records.	Loading data from source + selects. Optimized for high throughput reads on large number of records
Tables are normalized	Tables are not normalized
ACID & (mostly) SQL	SQL (sometimes NoSQL)
Cloud SQL, Cloud Spanner	BigQuery

Exam Tip: *Here you'll find a GREAT Decision tree for database choices on AWS, Microsoft Azure, Google Cloud Platform, and cloud-agnostic*

Cloud Storage

Overview	Ideal for
• Fully managed, highly reliable	• Images and videos
• Cost-efficient, scalable object/blob store	• Objects and blobs
• Objects access via HTTP requests	• Unstructured data
• Object name is the only key	• Static website hosting

Cloud Datastore

Overview

- Fully managed NoSQL
- Scalable

Ideal for

- Semi-structured application data
- Durable key-value data
- Hierarchical data
- Managing multiple indexes
- Transactions

Cloud Firestore

Overview

- Fully managed, serverless, NoSQL
- Scalable
- Native mobile and web client libraries
- Real-time updates

Ideal for

- Document-oriented data
- Large collections of small documents
- Native mobile and web clients
- Durable key-value data
- Hierarchical data
- Managing multiple indexes
- Transactions

Cloud Bigtable

Overview

- High performance wide column NoSQL database service
- Sparsely populated table
- Can scale to billions of rows and thousands of columns
- Can store TB to PB of data

Ideal for

- Operational applications
- Analytical applications
- Storing large amounts of single-keyed data
- MapReduce operations

Cloud SQL

Overview	Ideal for

• Managed service
  ○ Replication
  ○ Failover
  ○ Backups
	• Web frameworks

• MySQL, PostgreSQL, and SQL Server • Relational database service	• Structured data • OLTP workloads
• Proxy allows for secure access to your Cloud SQL Second Generation instances without whitelisting	• Applications using MySQL/PGS

Cloud Spanner

Overview

- Mission-critical relational database service
- Transactional consistency
- Global scale
- High availability
- Multi-region replication
- 99.999% SLA

Ideal for

- Mission-critical applications
- High transactions
- Scale and consistency requirements

BigQuery

Overview

- Low-cost enterprise data warehouse for analytics
- Fully managed
- Petabyte scale
- Fast response times
- Serverless

Ideal for

- Online Analytical Processing (OLAP) workloads
- Big data exploration and processing
- Reporting via Business Intelligence (BI) tools