High-Throughput BigQuery and Bigtable Streaming Features

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01	Streaming into BigQuery and visualizing results
02	High-throughput streaming with Cloud Bigtable
03	Optimizing Cloud Bigtable performance

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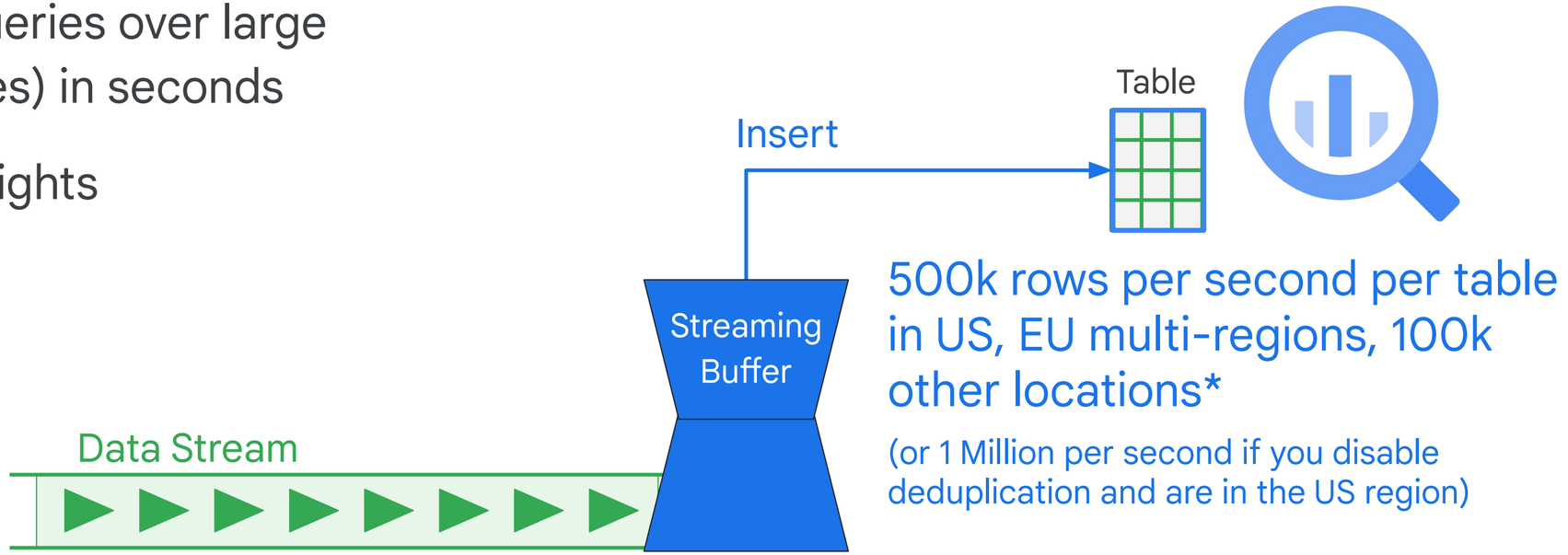
BigQuery allows you to stream records into a table; query results incorporate latest data

- Interactive SQL Queries over large datasets (petabytes) in seconds
- Near-real-time insights



Note:
Unlike load jobs, there is a cost for streaming inserts (see **quota and limits**)

Insert streaming data into a BigQuery table

```
export GOOGLE_APPLICATION_CREDENTIALS="/home/user/Downloads/[FILE_NAME].json"
```

Credentials

The service must have Cloud IAM permissions set in the Web UI

```
pip install google-cloud-bigquery
```

Install API

Python

```
from google.cloud import bigquery
client = bigquery.Client(project='PROJECT_ID')

dataset_ref = bigquery_client.dataset('my_datasset_id')
table_ref = dataset_ref.table('my_table_id')
table = bigquery_client.get_table(table_ref)

# read data from Cloud Pub/Sub and place into row format
# static example customer orders in units:
rows_to_insert = [
    (u'customer 1', 5),
    (u'customer 2', 17),
    ]
errors = bigquery_client.insert_rows(table, rows_to_insert)
```

Create a client

Get table access from API

Access dataset and table

Insert rows into table

Perform insert

Review streaming data in BigQuery

Query editor

```
1 select * from cloud-training-demos.demos.current_conditions;
```

Run | Save query | Save view | Schedule query | More

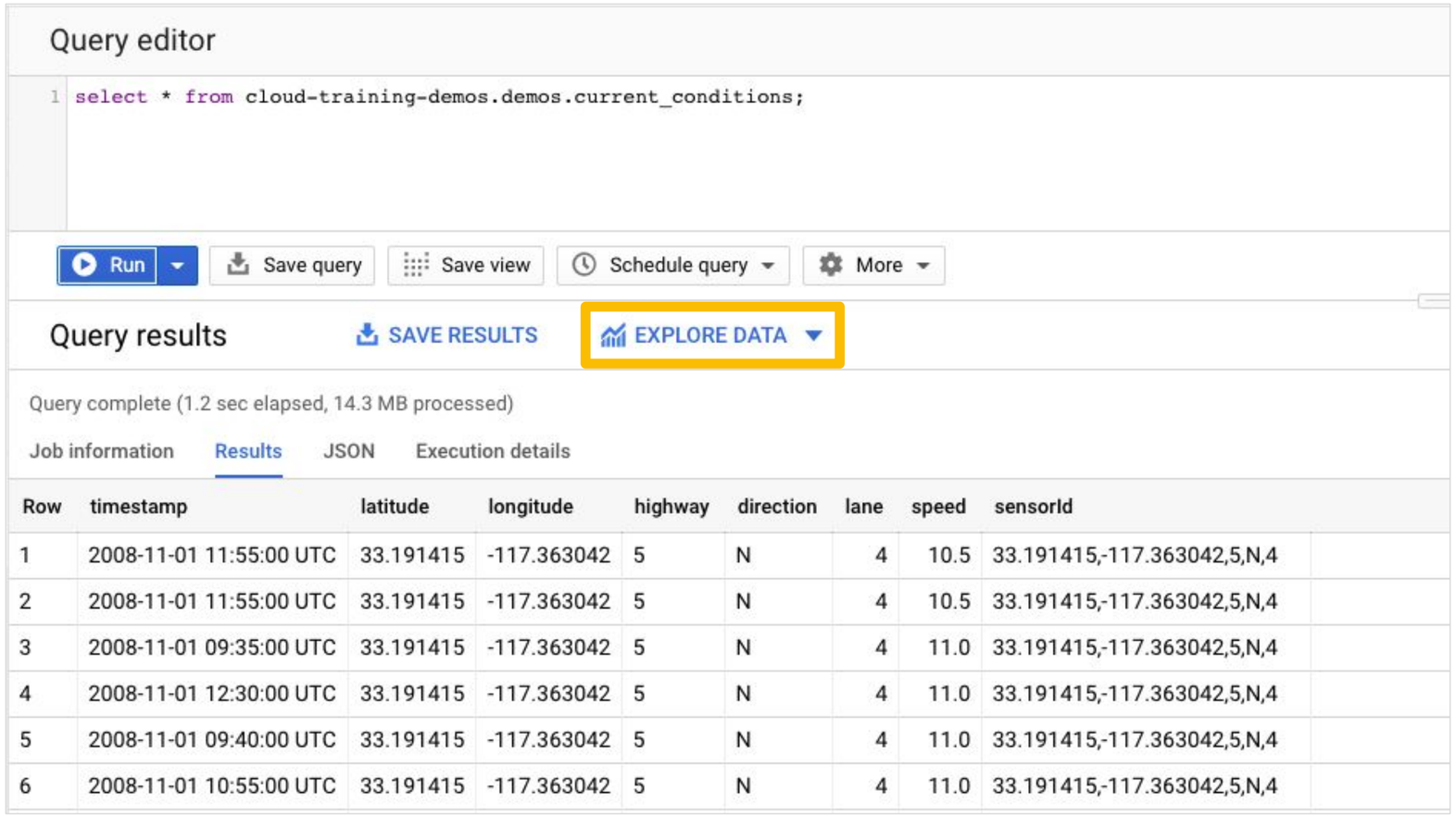
Query results | SAVE RESULTS | EXPLORE DATA

Query complete (1.2 sec elapsed, 14.3 MB processed)

Job information | Results | JSON | Execution details

Row	timestamp	latitude	longitude	highway	direction	lane	speed	sensorId
1	2008-11-01 11:55:00 UTC	33.191415	-117.363042	5	N	4	10.5	33.191415,-117.363042,5,N,4
2	2008-11-01 11:55:00 UTC	33.191415	-117.363042	5	N	4	10.5	33.191415,-117.363042,5,N,4
3	2008-11-01 09:35:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4
4	2008-11-01 12:30:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4
5	2008-11-01 09:40:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4
6	2008-11-01 10:55:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4

Want to visualize insights? Explore Google Data Studio insights right from within BigQuery



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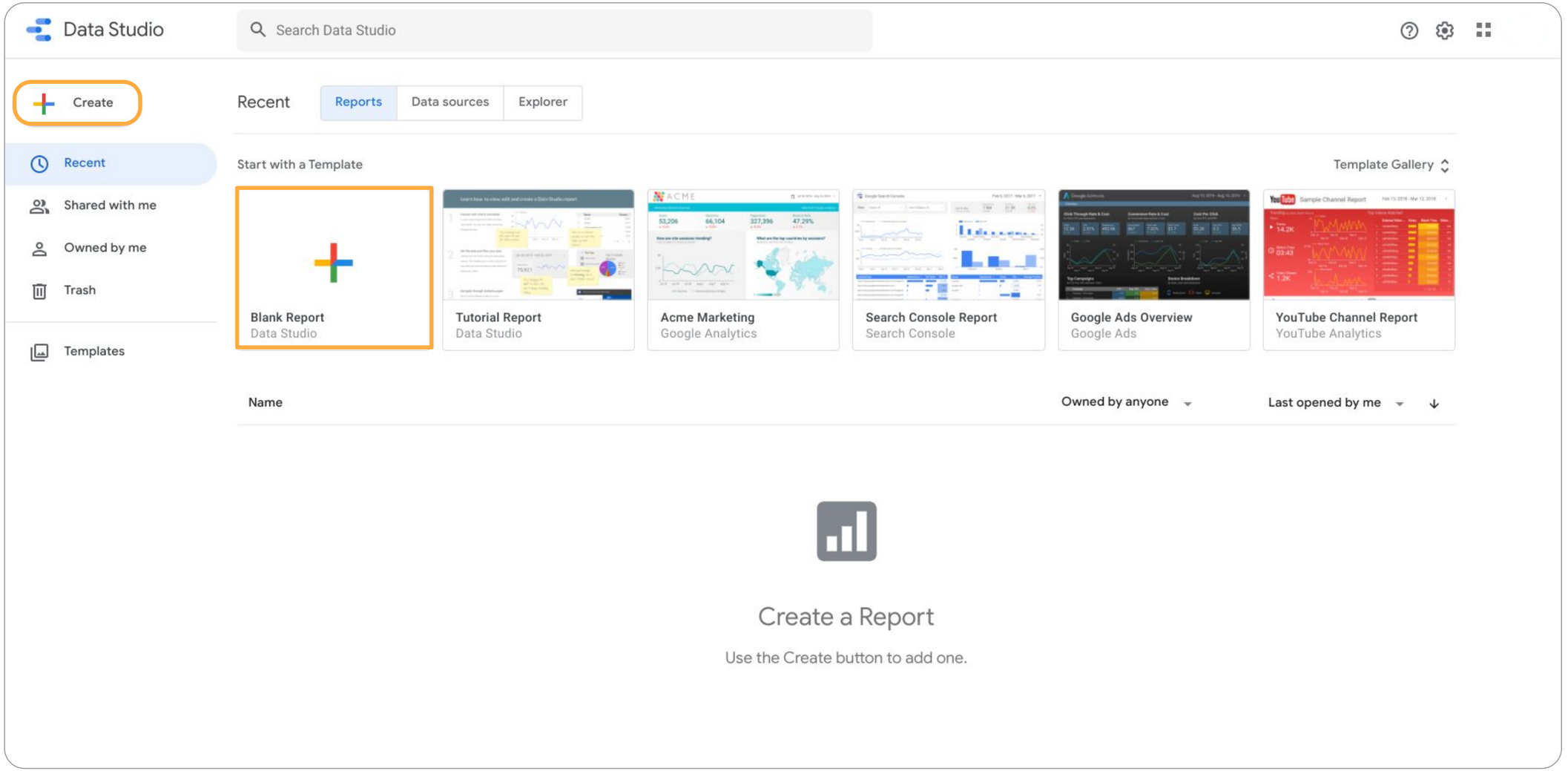
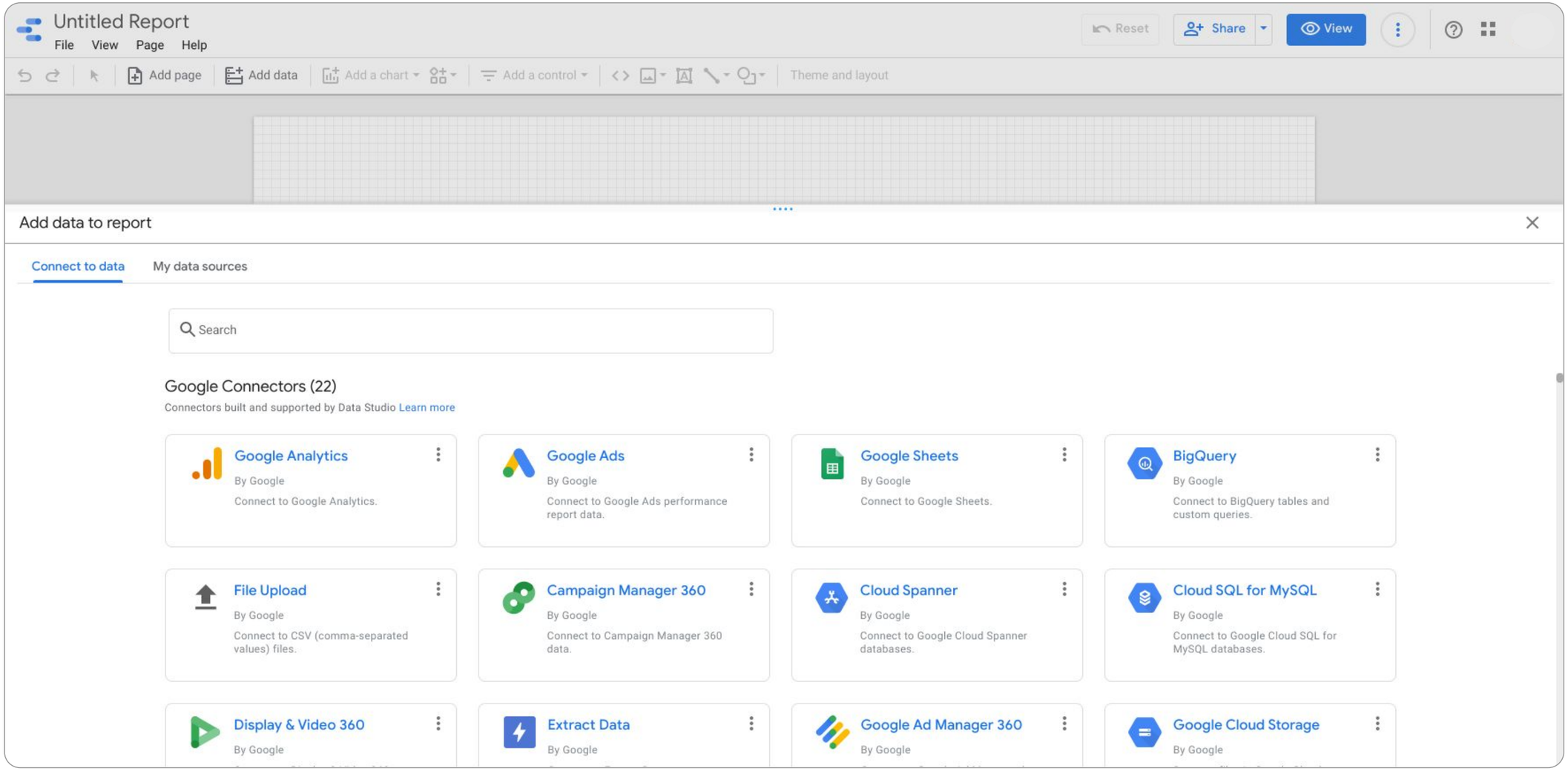
4	2008-11-01 12:30:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4
5	2008-11-01 09:40:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4
6	2008-11-01 10:55:00 UTC	33.191415	-117.363042	5	N	4	11.0	33.191415,-117.363042,5,N,4

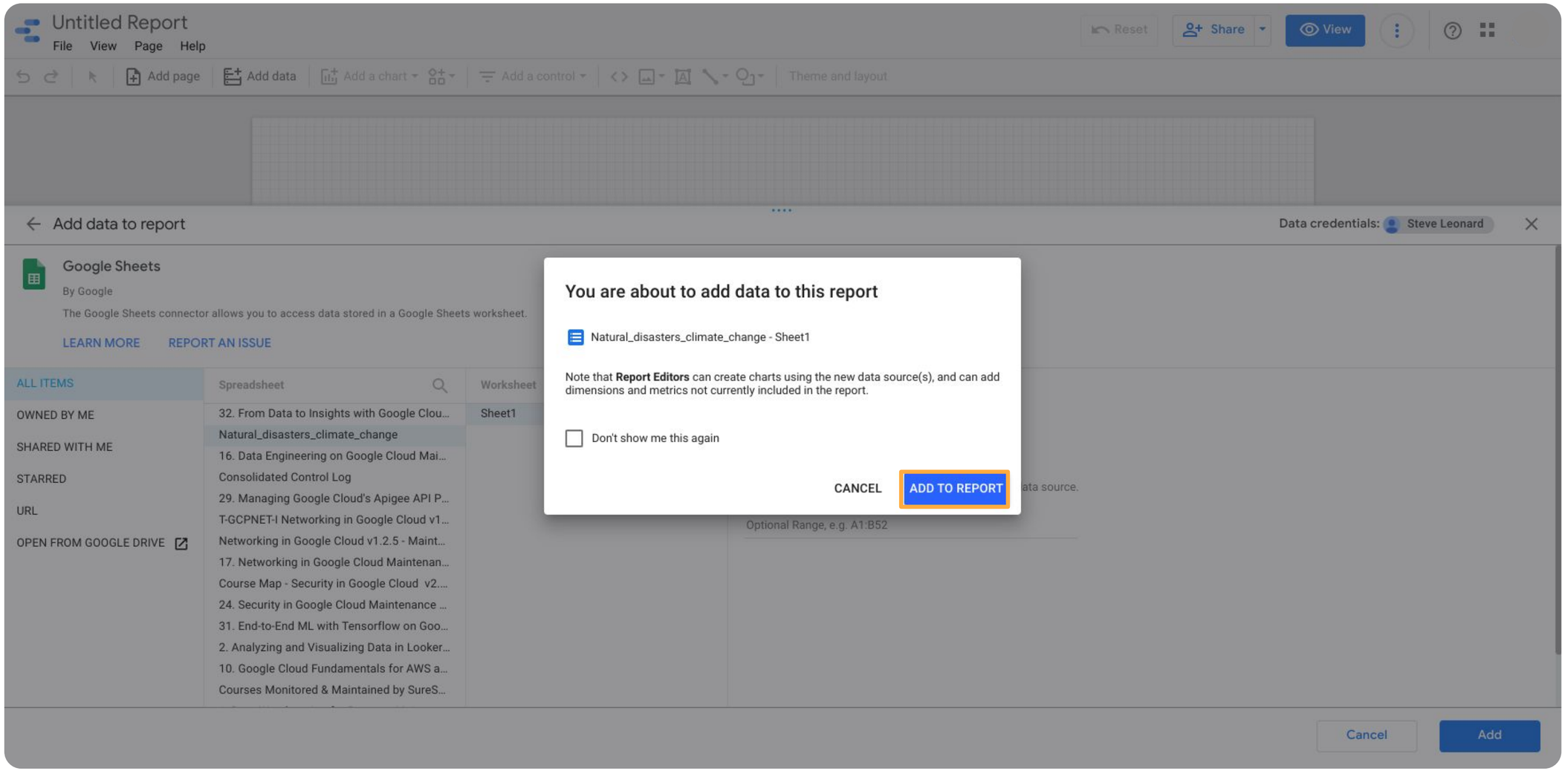
Create new reports in the Data Studio UI



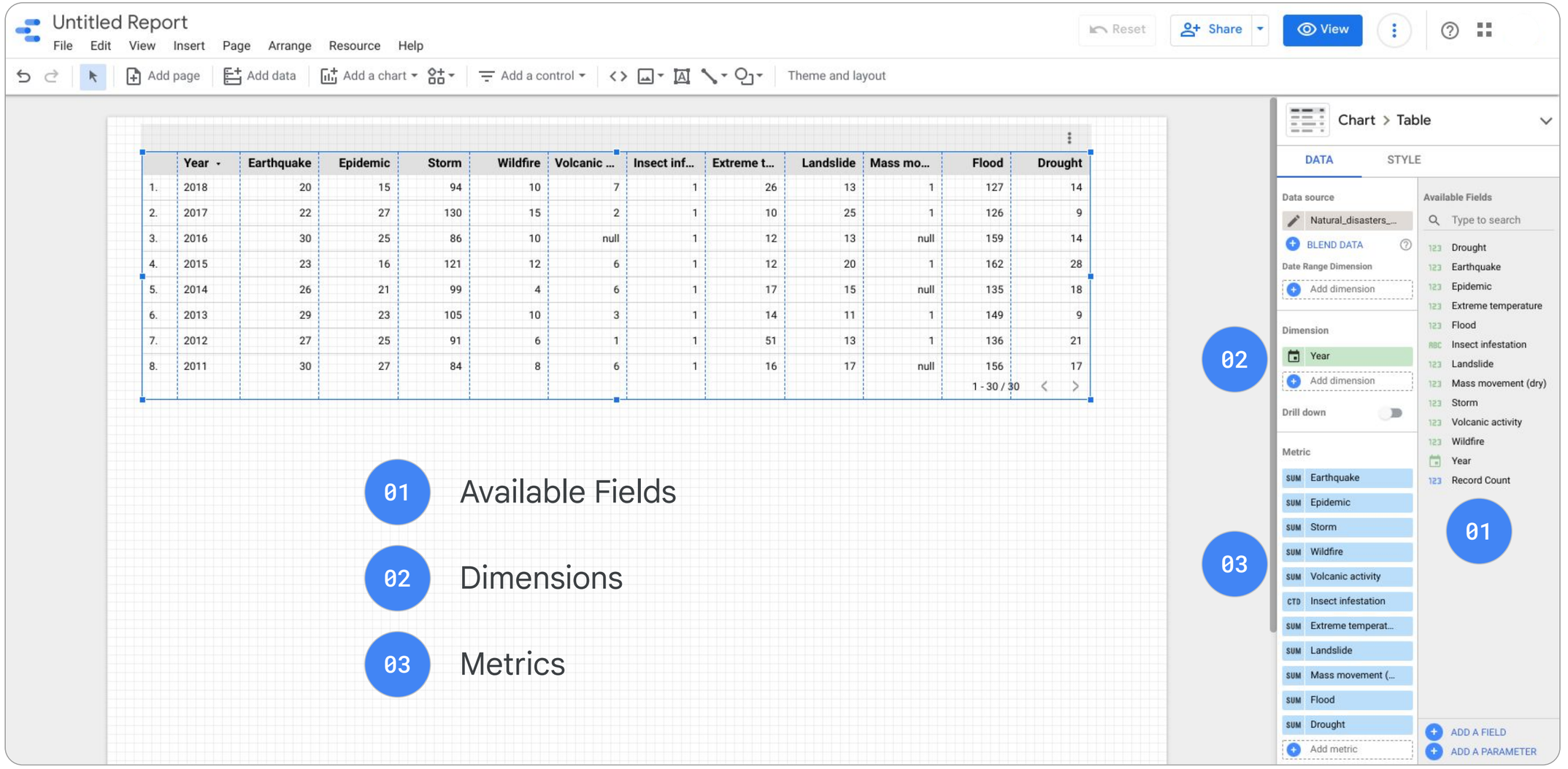
Connect to multiple different types of data sources



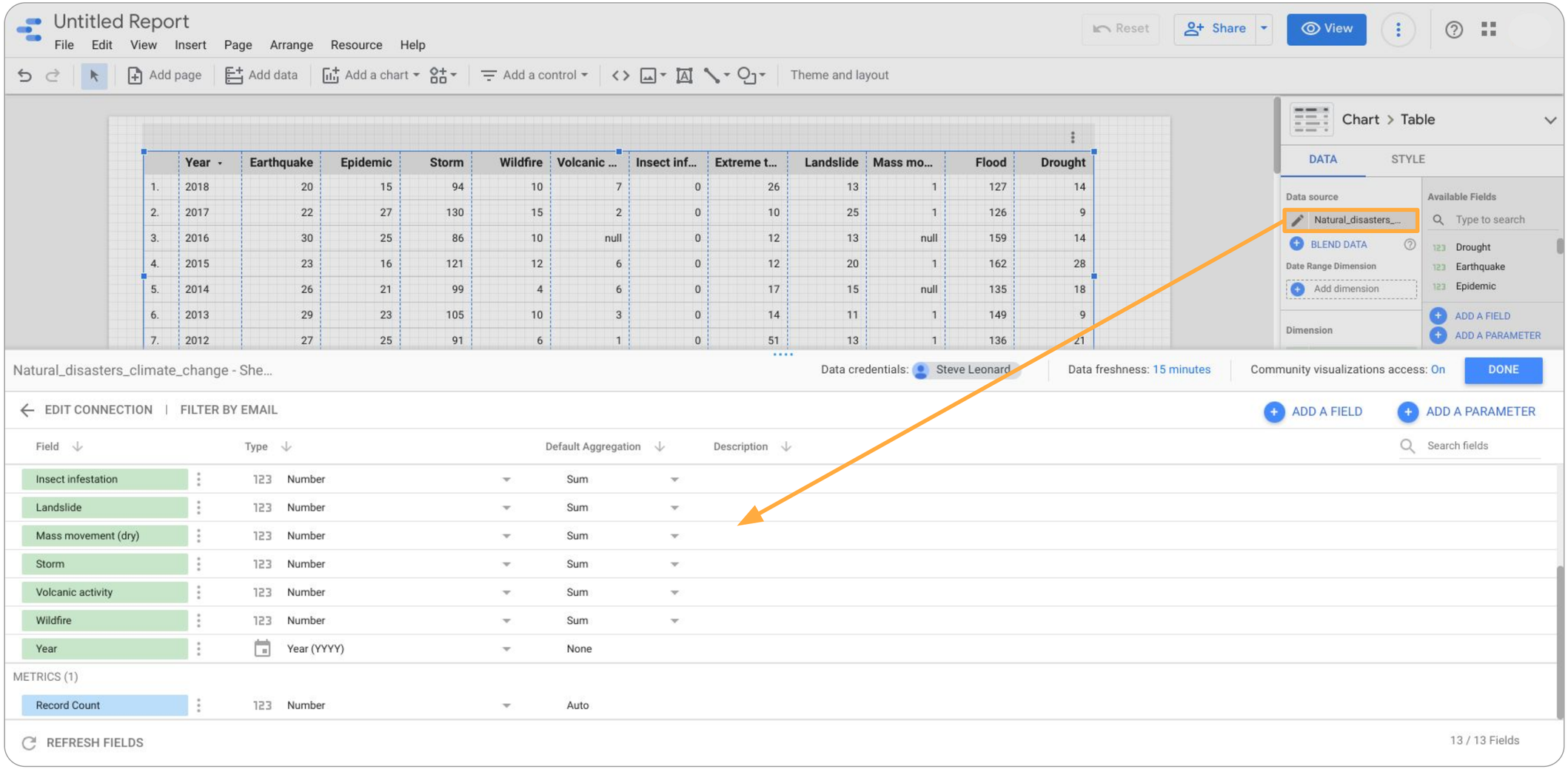
Add the data source to your report



Select your data fields to build your visualizations

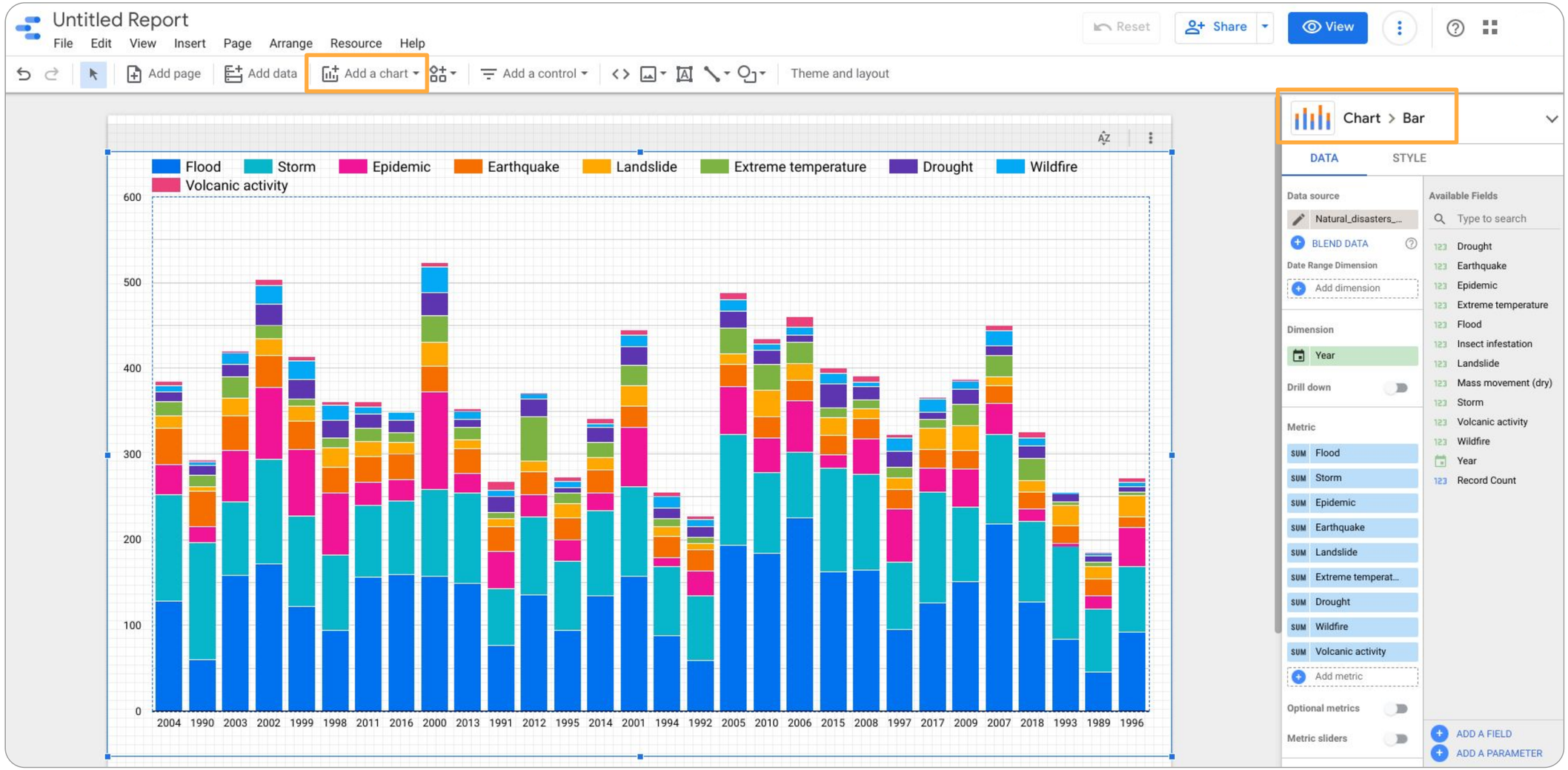


Edit your data source fields, if necessary

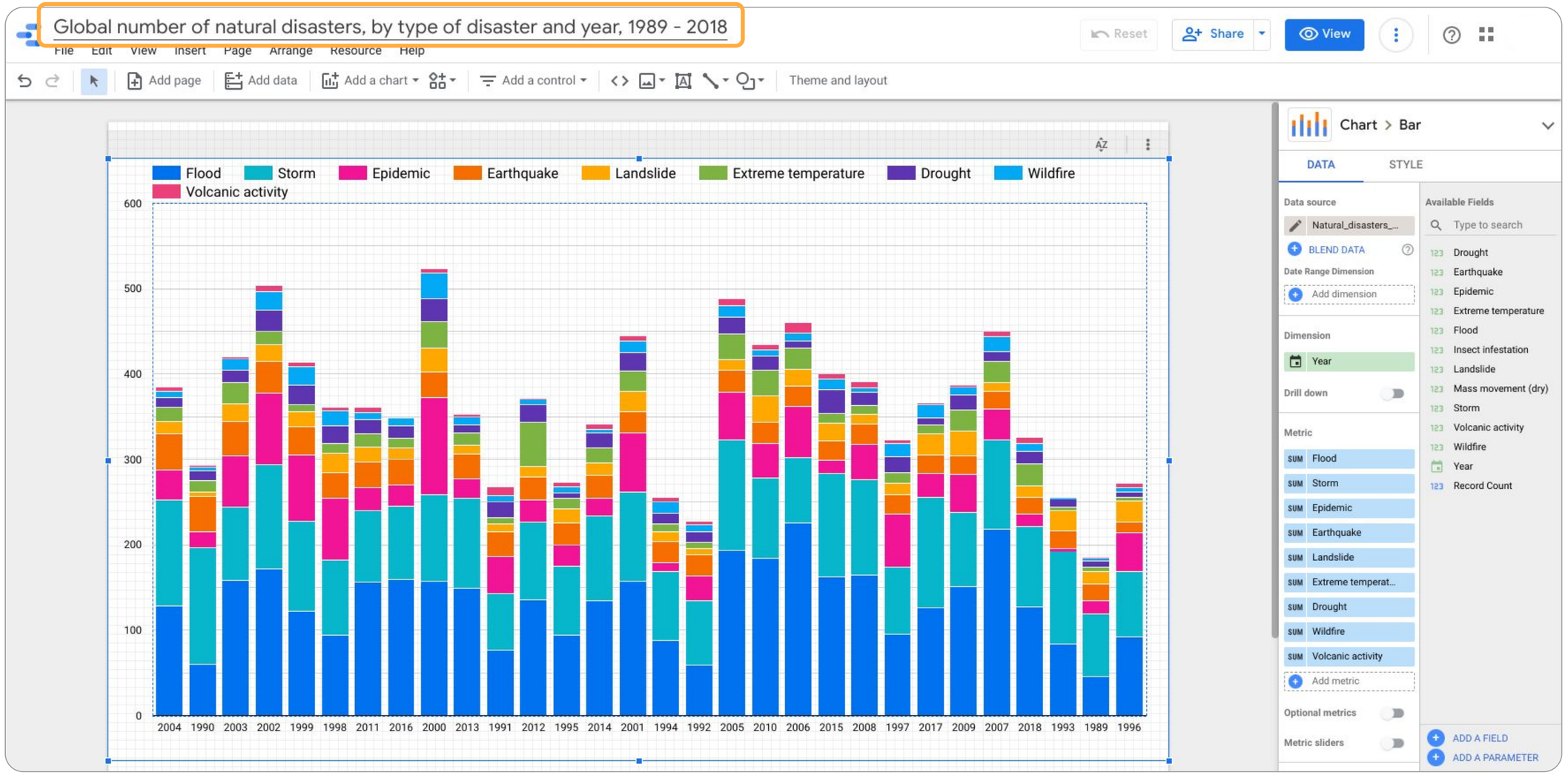


	Year	Earthquake	Epidemic	Storm	Wildfire	Volcanic ...	Insect inf...	Extreme t...	Landslide	Mass mo...	Flood	Drought
1.	2018	20	15	94	10	7	0	26	13	1	127	14
2.	2017	22	27	130	15	2	0	10	25	1	126	9
3.	2016	30	25	86	10	null	0	12	13	null	159	14
4.	2015	23	16	121	12	6	0	12	20	1	162	28
5.	2014	26	21	99	4	6	0	17	15	null	135	18
6.	2013	29	23	105	10	3	0	14	11	1	149	9
7.	2012	27	25	91	6	1	0	51	13	1	136	21

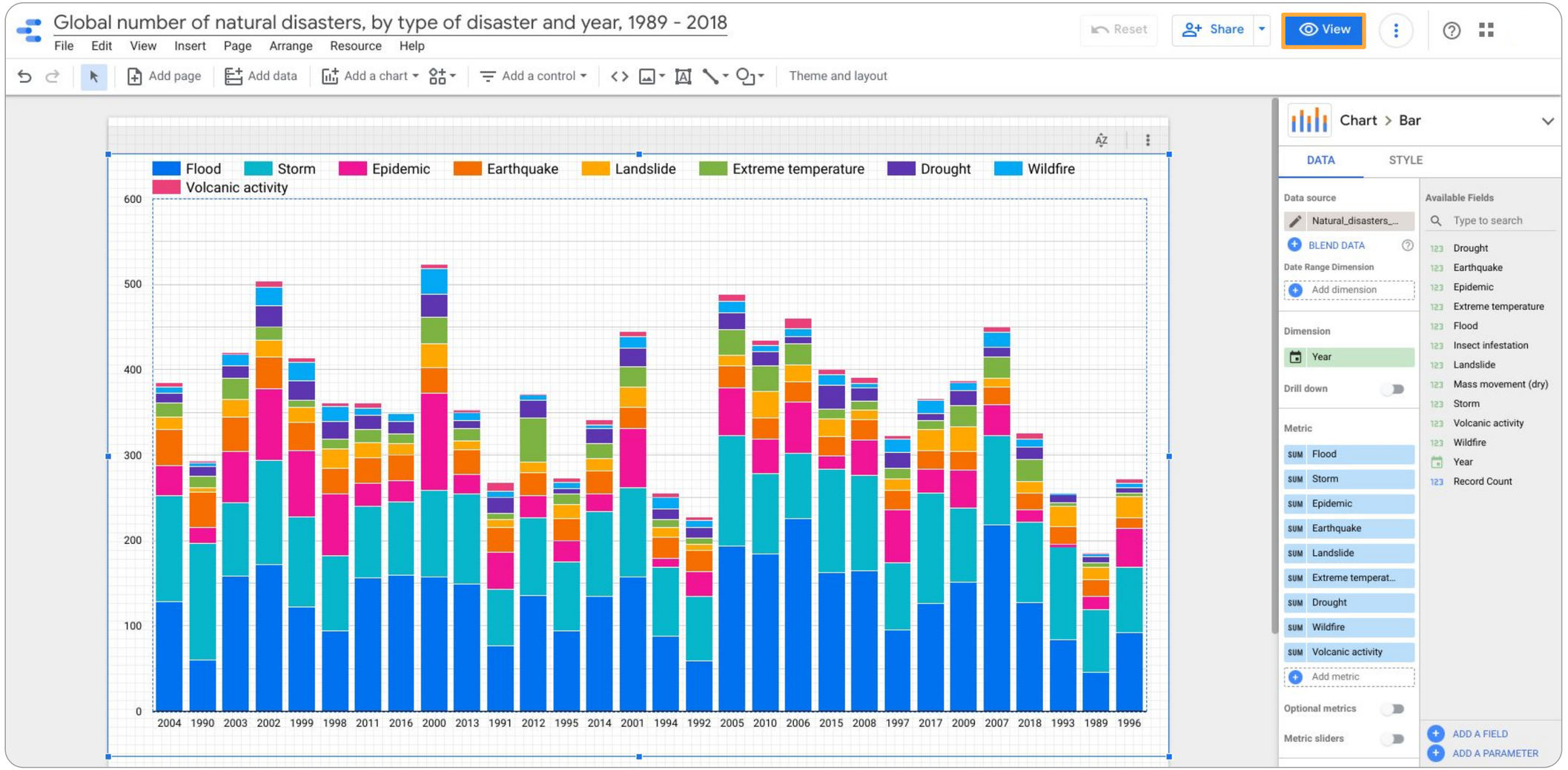
Create charts to visualize data relationships



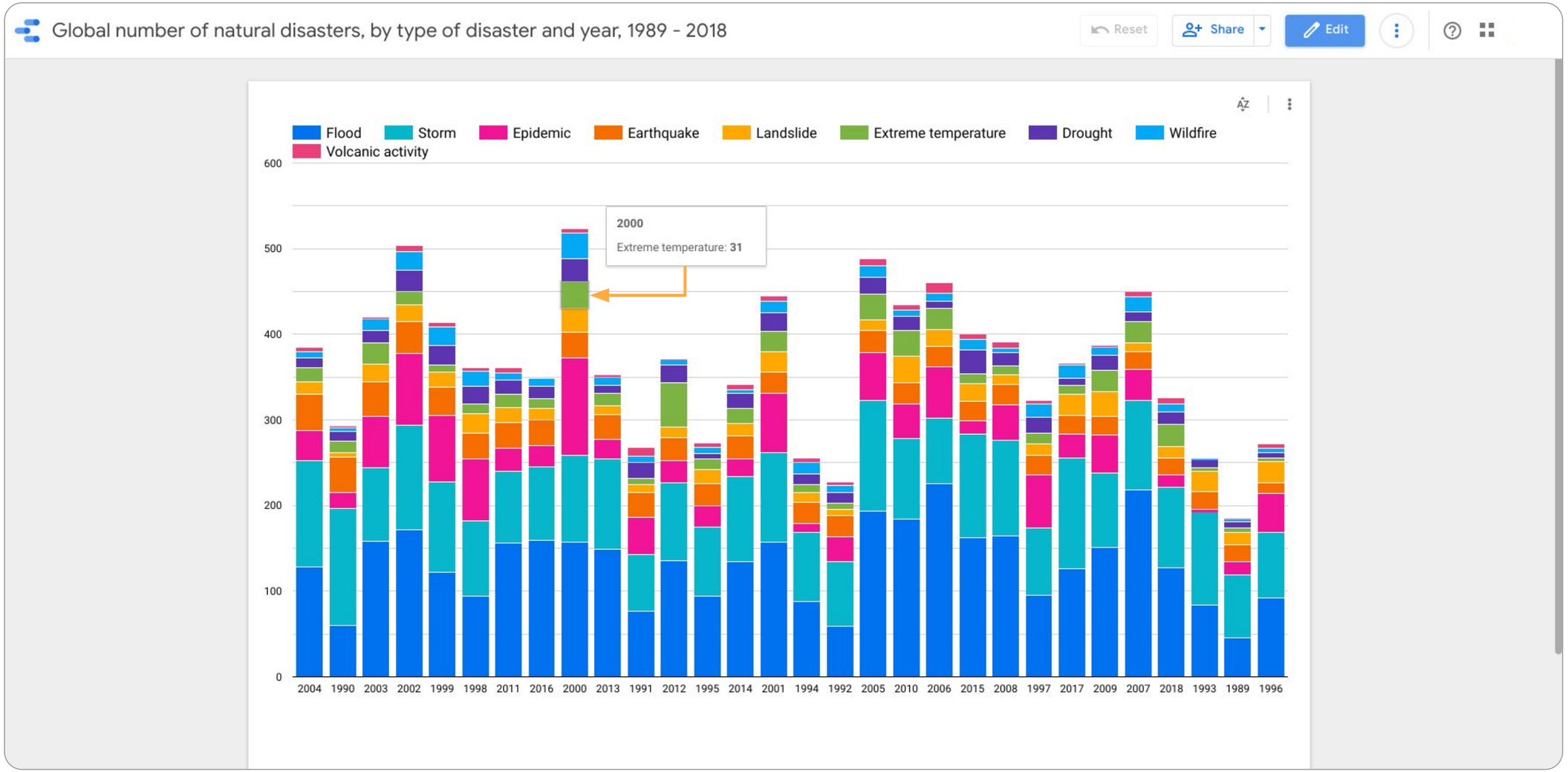
Add a descriptive name to your report



View the end-user version of the report

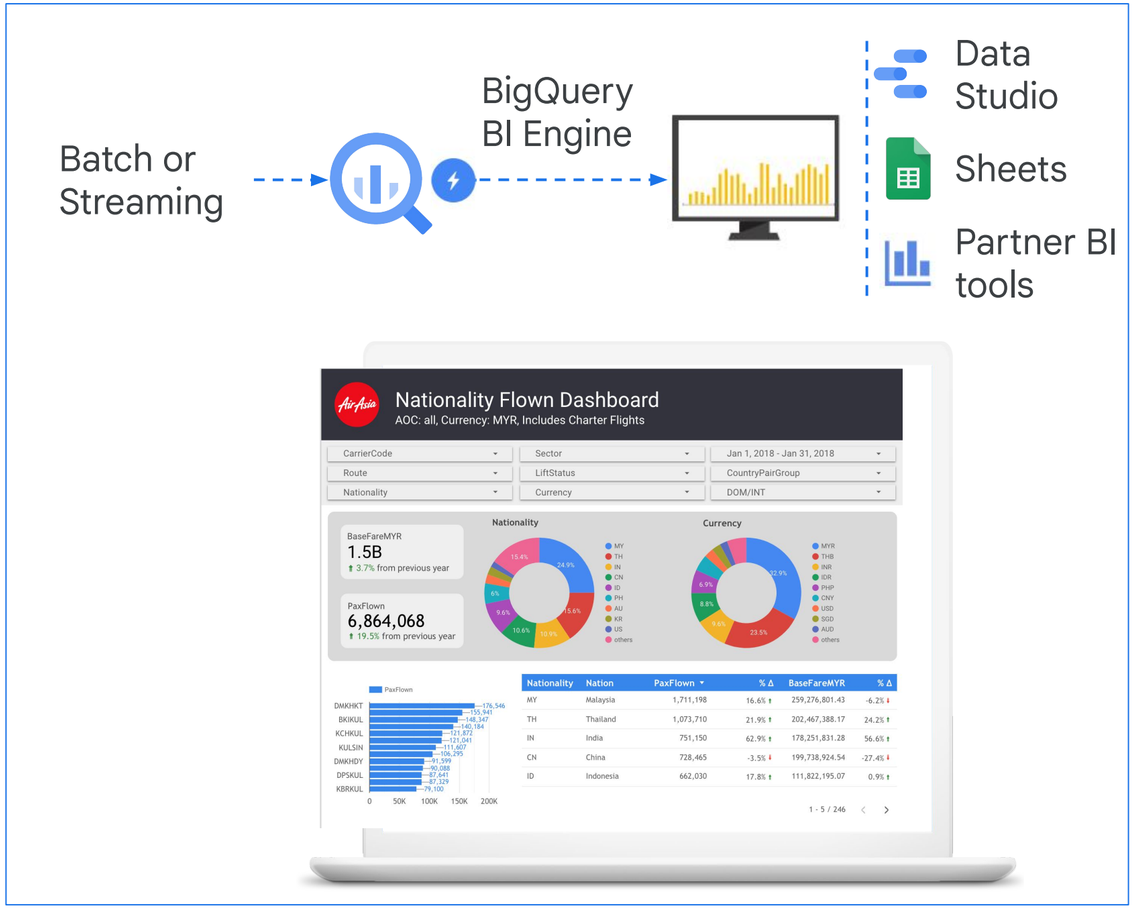


View your report as an end-user



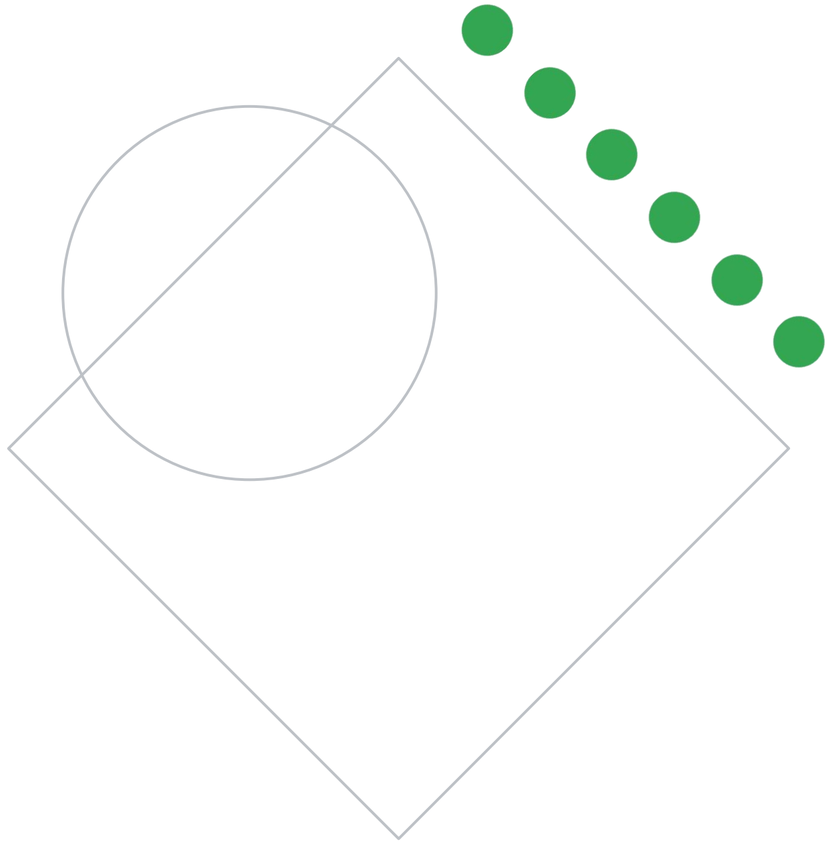
Add value: BI Engine for dashboard performance

- No need to manage OLAP cubes or separate BI servers for dashboard performance.
- Natively integrates with BigQuery streaming for real-time data refresh.
- Column oriented in-memory BI execution engine.



Lab Intro

Streaming Data Processing:
Streaming Analytics and Dashboards



Lab objectives

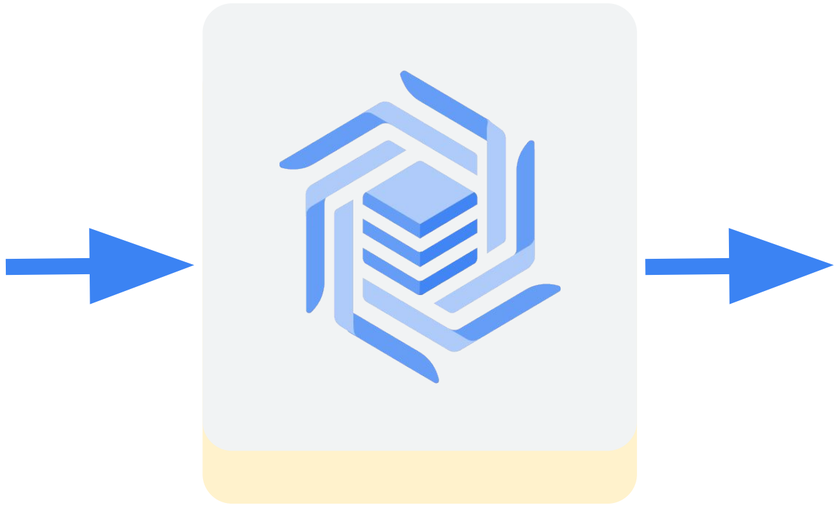
01 Connect to BigQuery data source from Google Data Studio

02 Create reports and charts to visualize the BigQuery data

High-Throughput BigQuery and Bigtable Streaming Features

01	Streaming into BigQuery and visualizing results
02	High-throughput streaming with Cloud Bigtable
03	Optimizing Cloud Bigtable performance

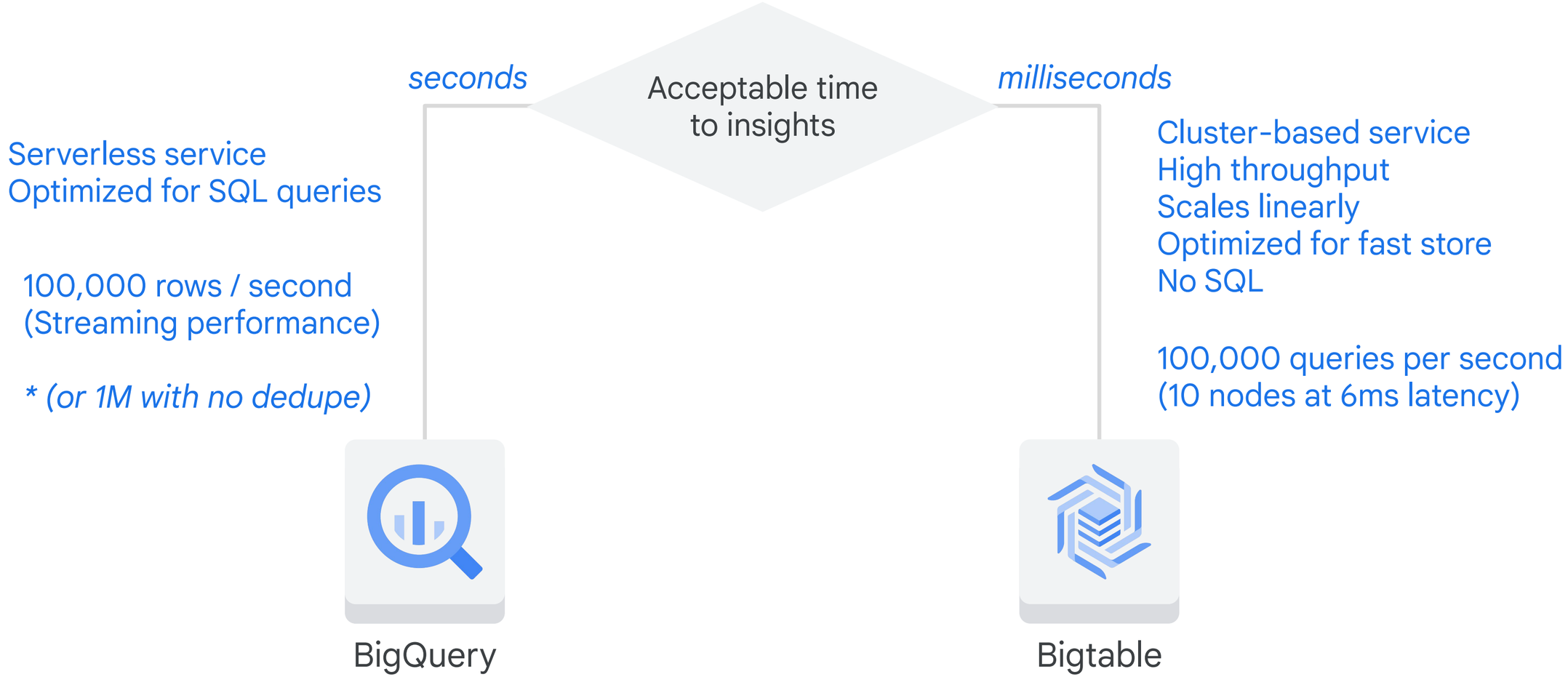
Cloud Bigtable



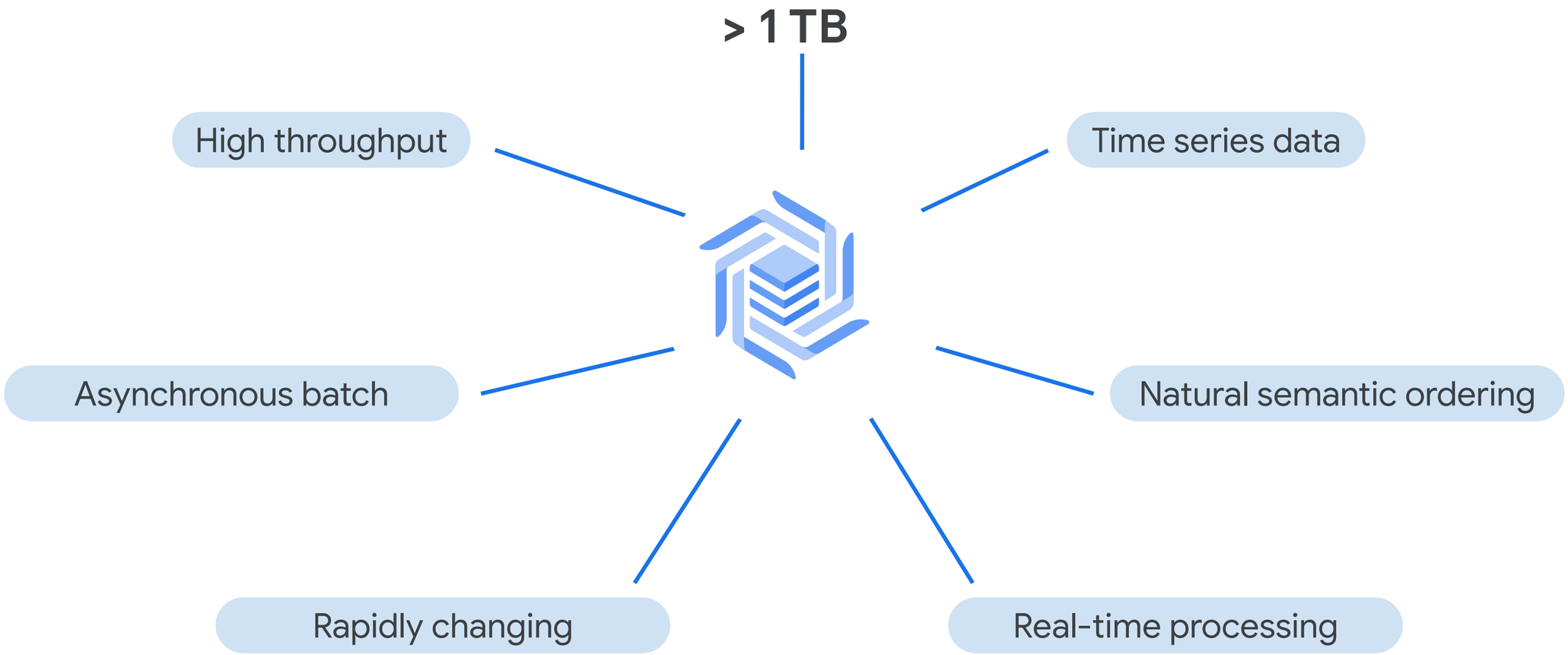
Qualities that Bigtable contributes to data engineering solutions:

- NoSQL Queries over large datasets (petabytes) in milliseconds
- Very fast for specific cases

How to choose between Bigtable and BigQuery



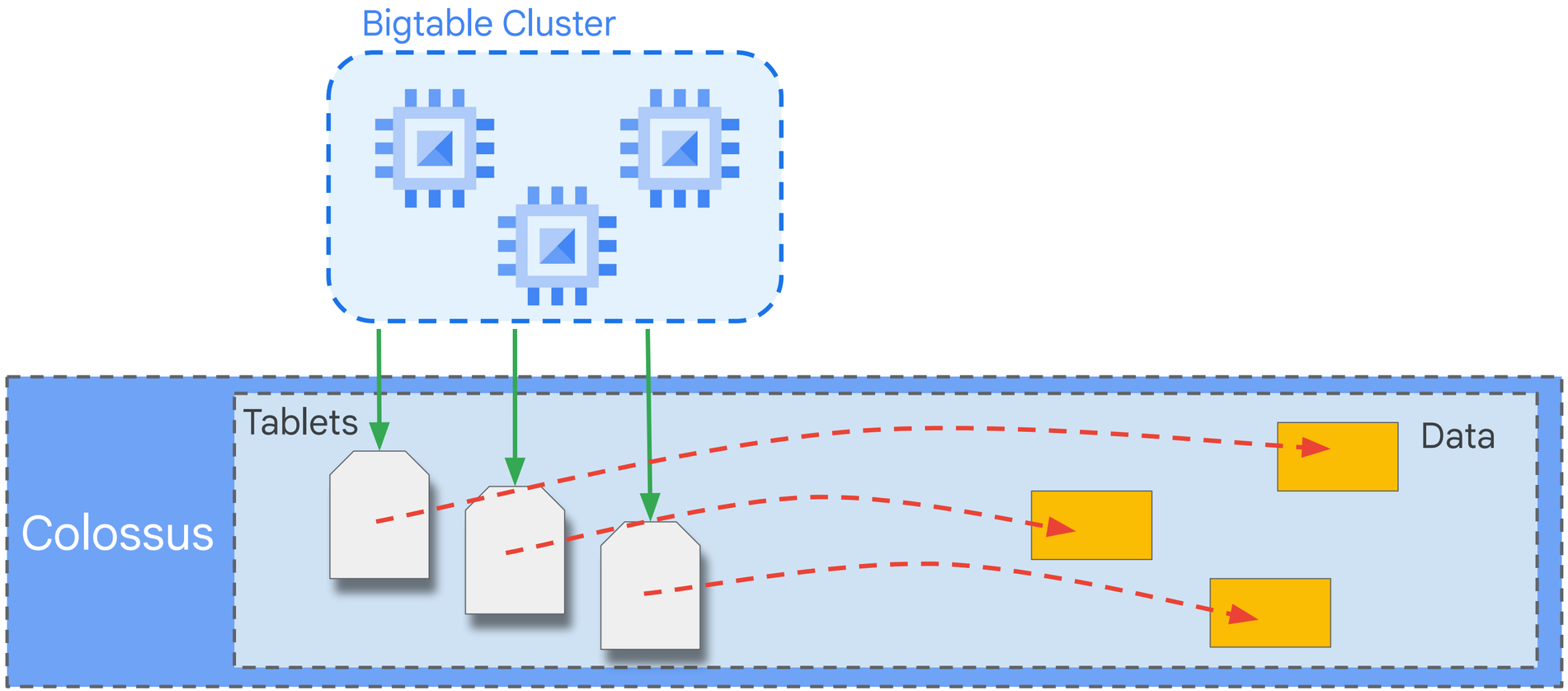
Consider Bigtable for these requirements



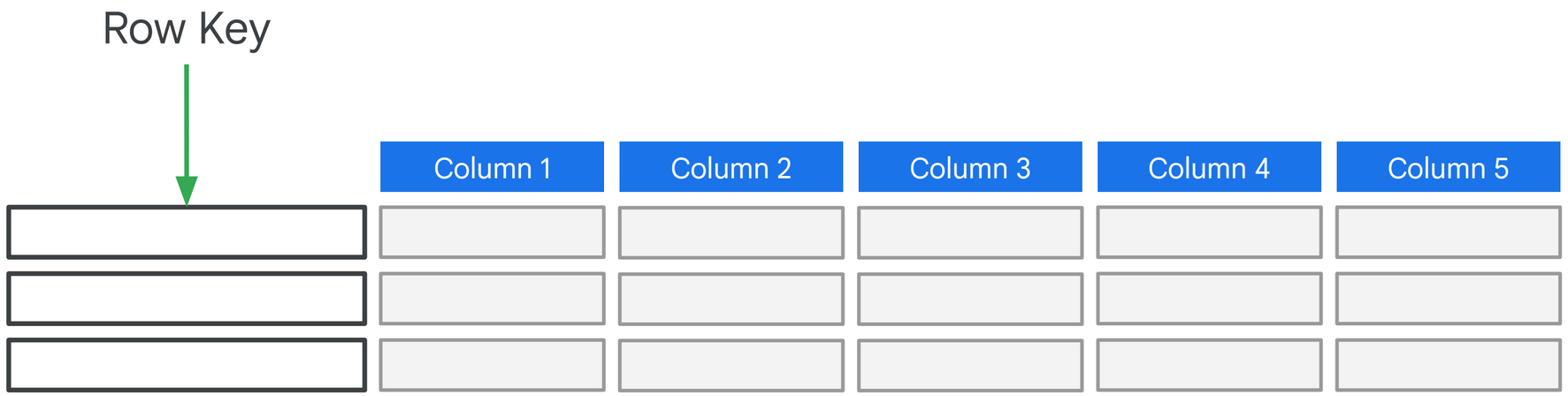
The most common use of Bigtable

Productionize a real-time lookup as part of an application, where speed and efficiency are desired beyond that of other databases.

How does Bigtable work?



Bigtable design idea is "simplify for speed"



The Row Key is the index.

And you get only one.

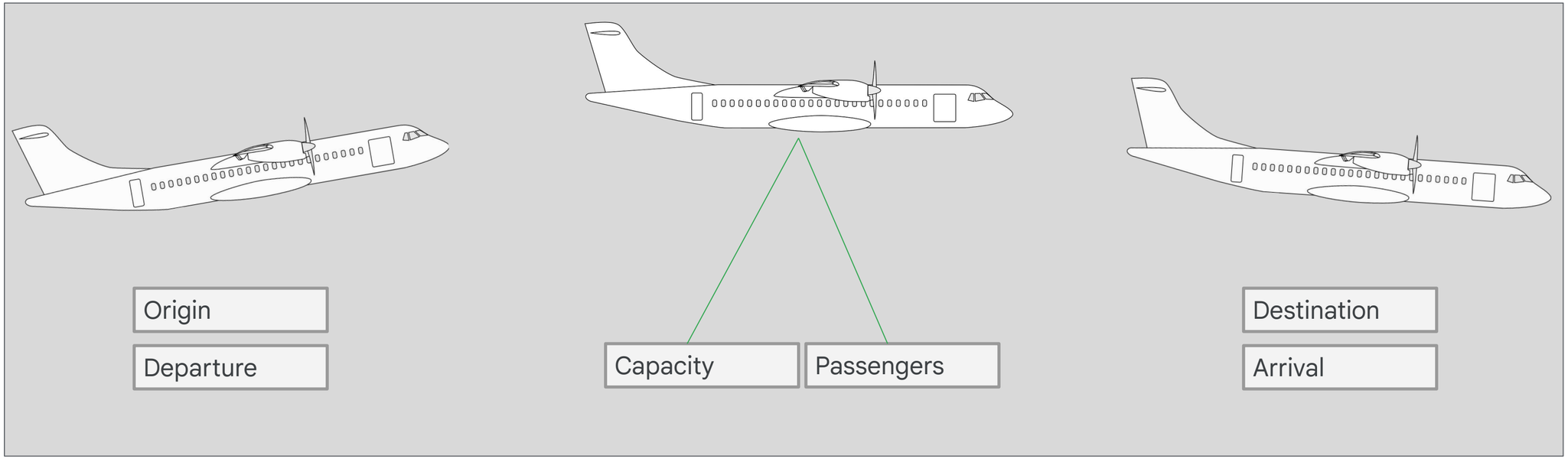
But speed depends on your data and Row Key

Flights of the world: Reviewing the data

Make

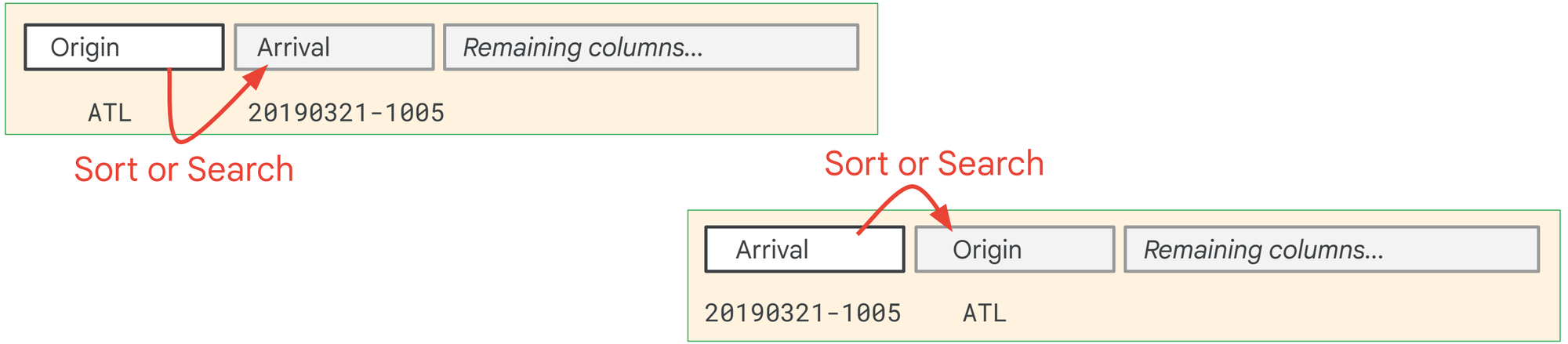
Model

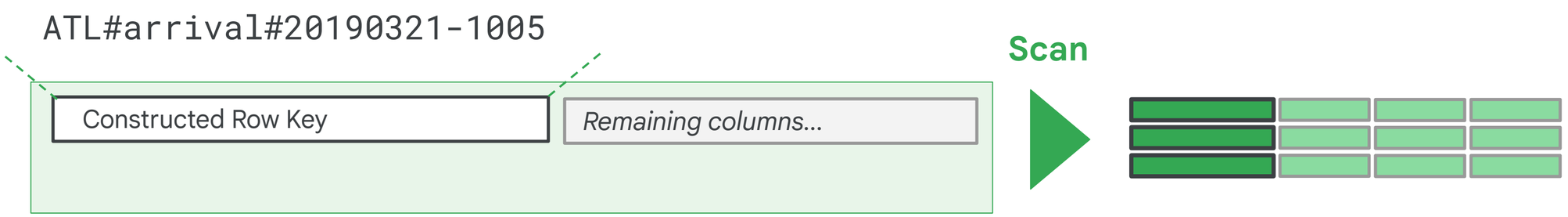
Age



What is the best Row Key?

Query: All flights originating in Atlanta and arriving between March 21st and 29th





Bigtable schema organization

Column Families

	Flight_Information					Aircraft_Information			
Row Key	Origin	Destination	Departure	Arrival	Passengers	Capacity	Make	Model	Age
ATL#arrival#20190321-1121	ATL	LON	20190321-0311	20190321-1121	158	162	B	737	18
ATL#arrival#20190321-1201	ATL	MEX	20190321-0821	20190321-1201	187	189	B	737	8
ATL#arrival#20190321-1716	ATL	YVR	20190321-1014	20190321-1716	201	259	B	757	23

Queries that use the row key, a row prefix, or a row range are the most efficient

Query: Current arrival delay for flights from Atlanta

1

row key based on atlanta arrivals
e.g. `ORIGIN#arrival`
`( ATL#arrival#20190321-1005 )`

Puts latest flights at bottom of table

2

reverse timestamp to the rowkey
e.g. `ORIGIN#arrival#RTS`
`( ATL#arrival#560549313 )`

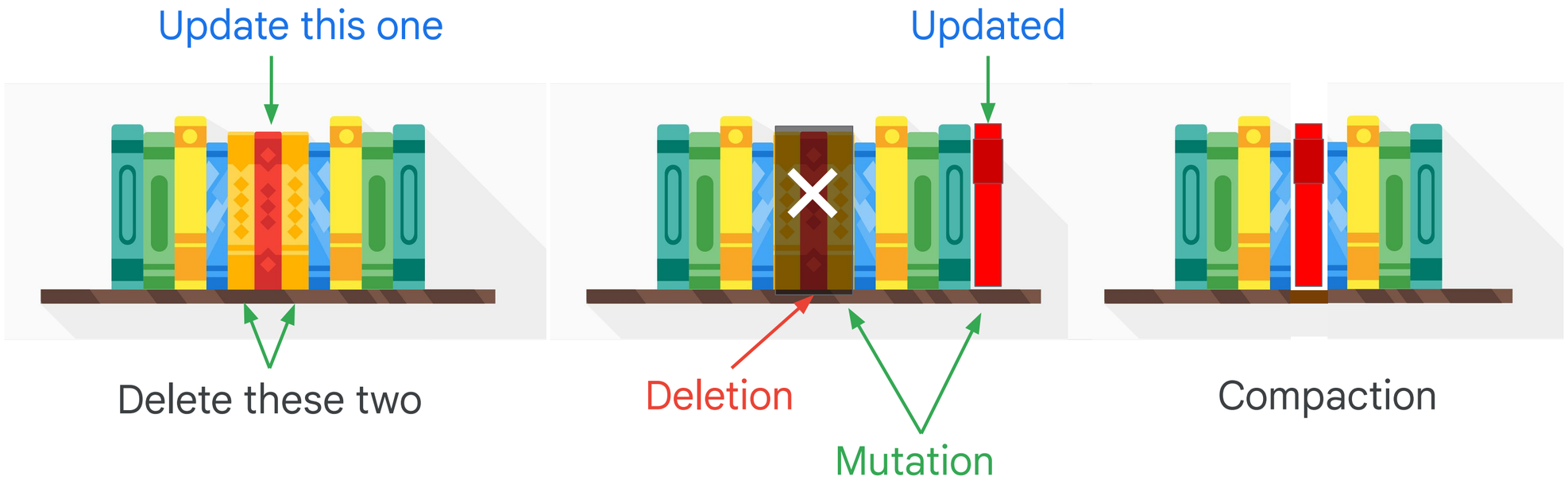
Puts latest flights at top of table

Use reverse timestamps when your most common query is for the latest values

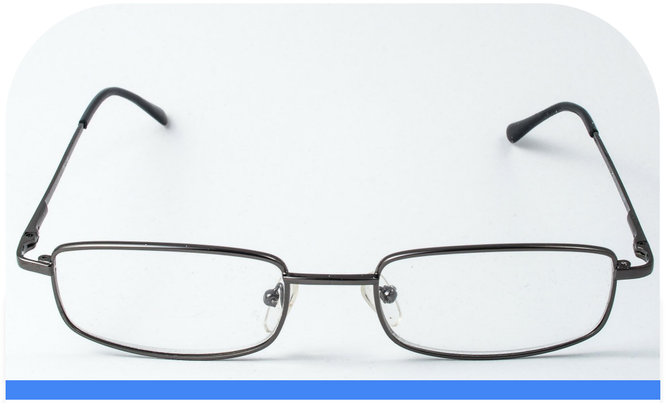
Query: Current arrival delay for flights from Atlanta

```
// key is ORIGIN#arrival#REVTS
String key = info.getORIGIN() //
   + "#arrival"  //
   + "#" + (Long.MAX_VALUE - ts.getMillis()); // reverse timestamp
```

What happens when data in Bigtable is changed?



Optimizing data organization for performance



Group related data for more efficient reads

Distribute data evenly for more efficient writes

Place identical values in the same row or adjoining rows for more efficient compression

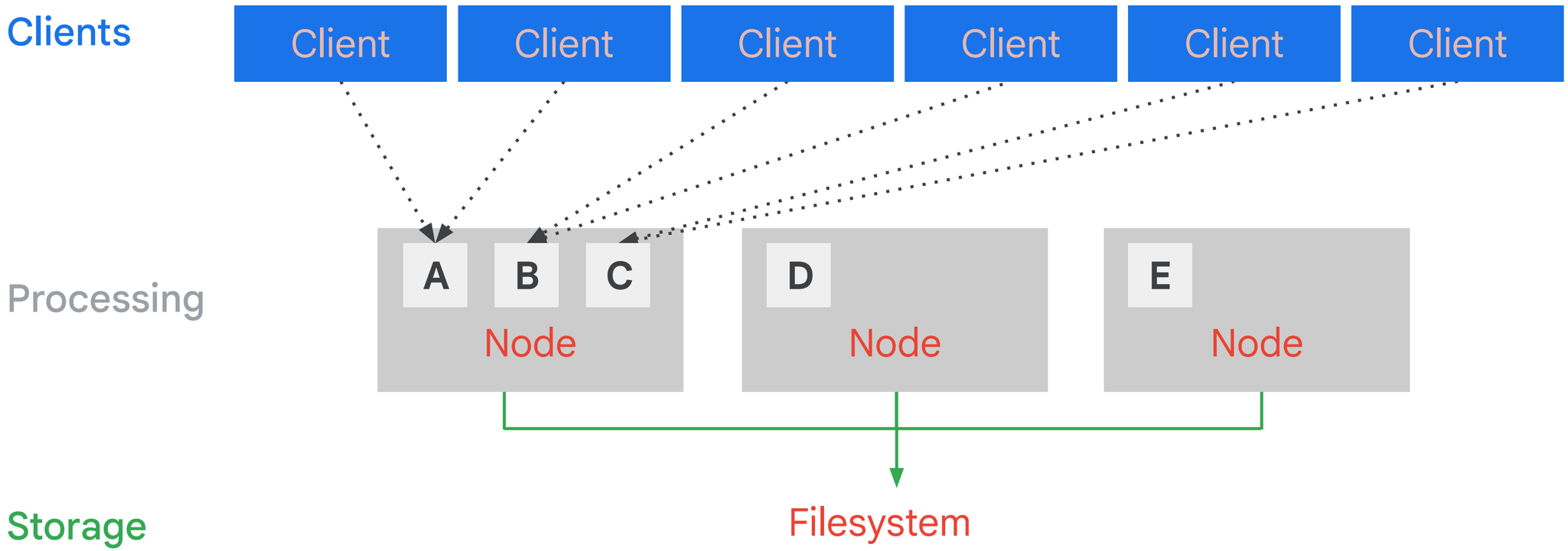
Example row key:

```
DehliIndia#2019031411841
```

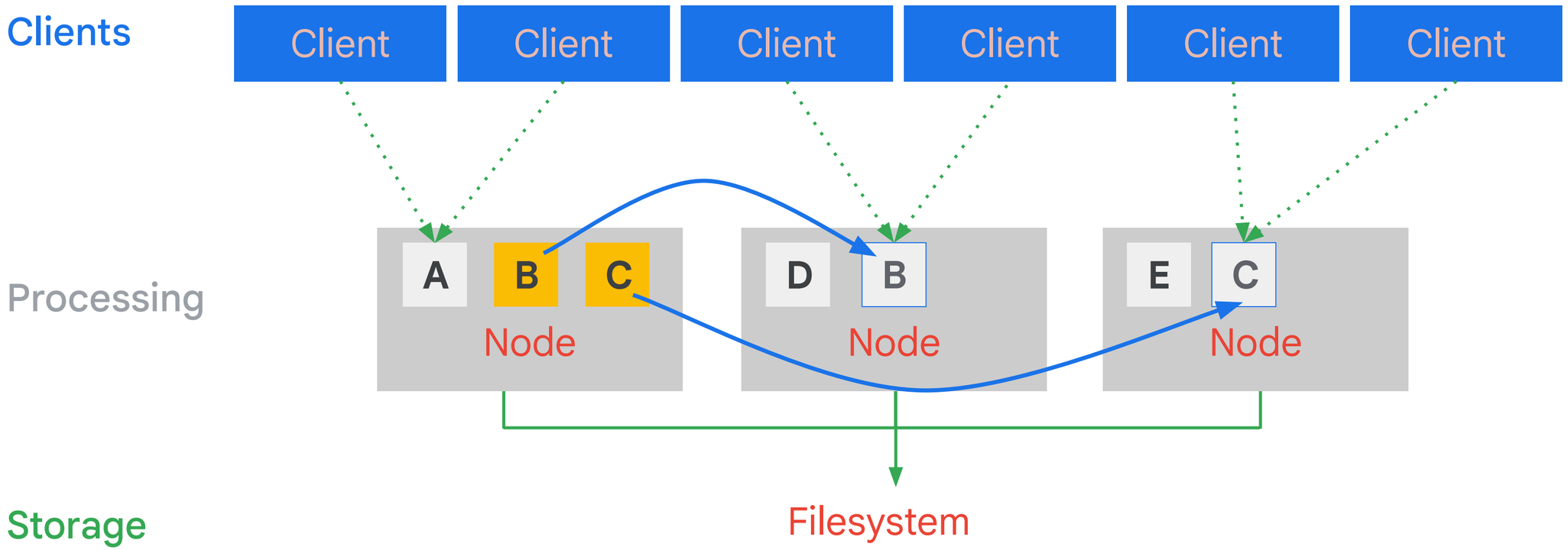
Use column families

Use row keys to organize identical data

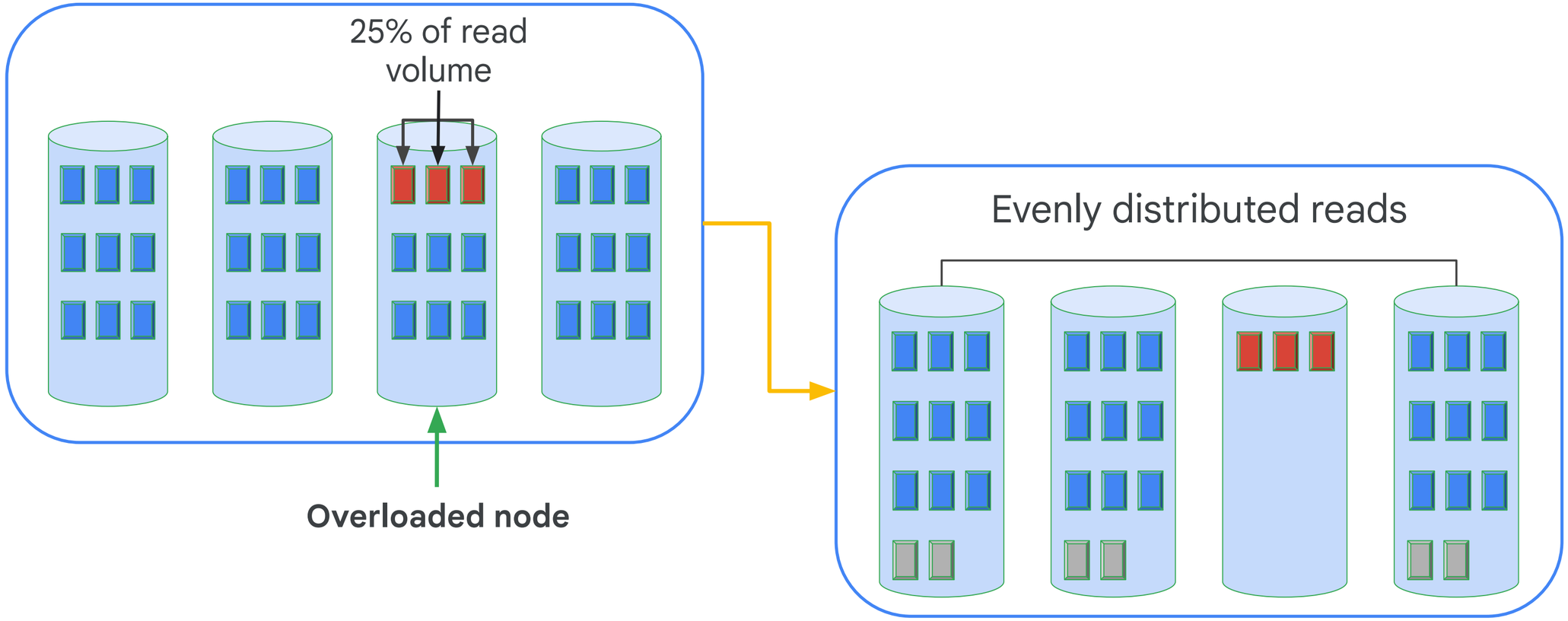
Bigtable self-improves by learning access patterns ...



...and rebalances data accordingly



Rebalance strategy: Distribute reads



Real world use case: Spotify

Spotify®

In 2019, Spotify ran the largest Dataflow job ever at the time with Bigtable "...used as a remediation tool between Dataflow jobs in order for them to process and store more data in a parallel way, rather than the need to always regroup the data"

High-Throughput BigQuery and Bigtable Streaming Features

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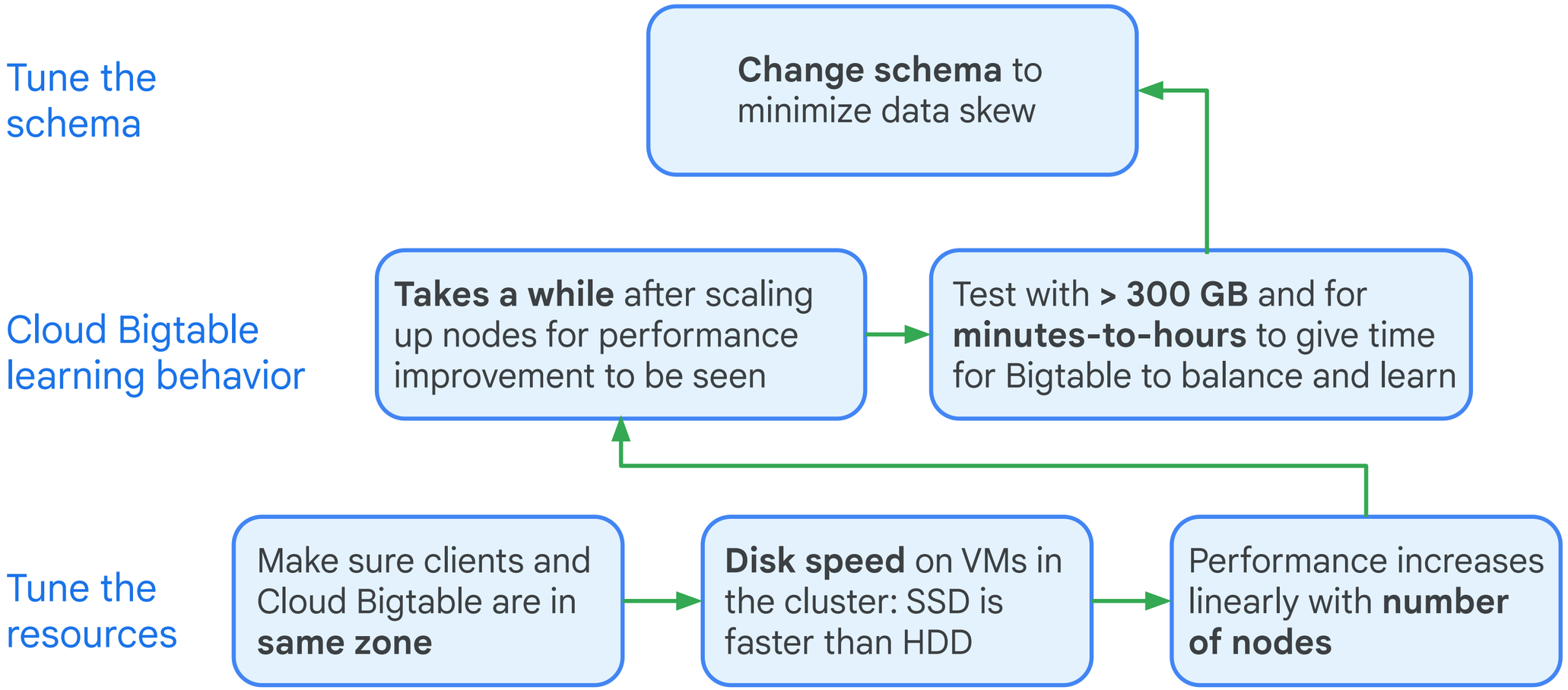
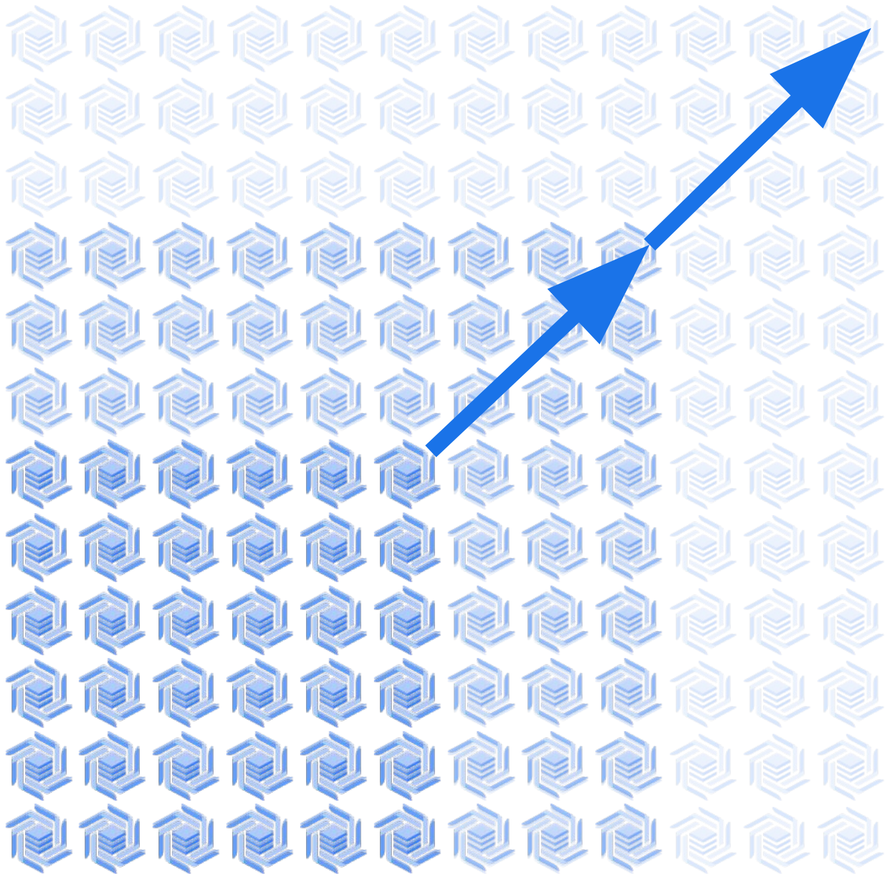
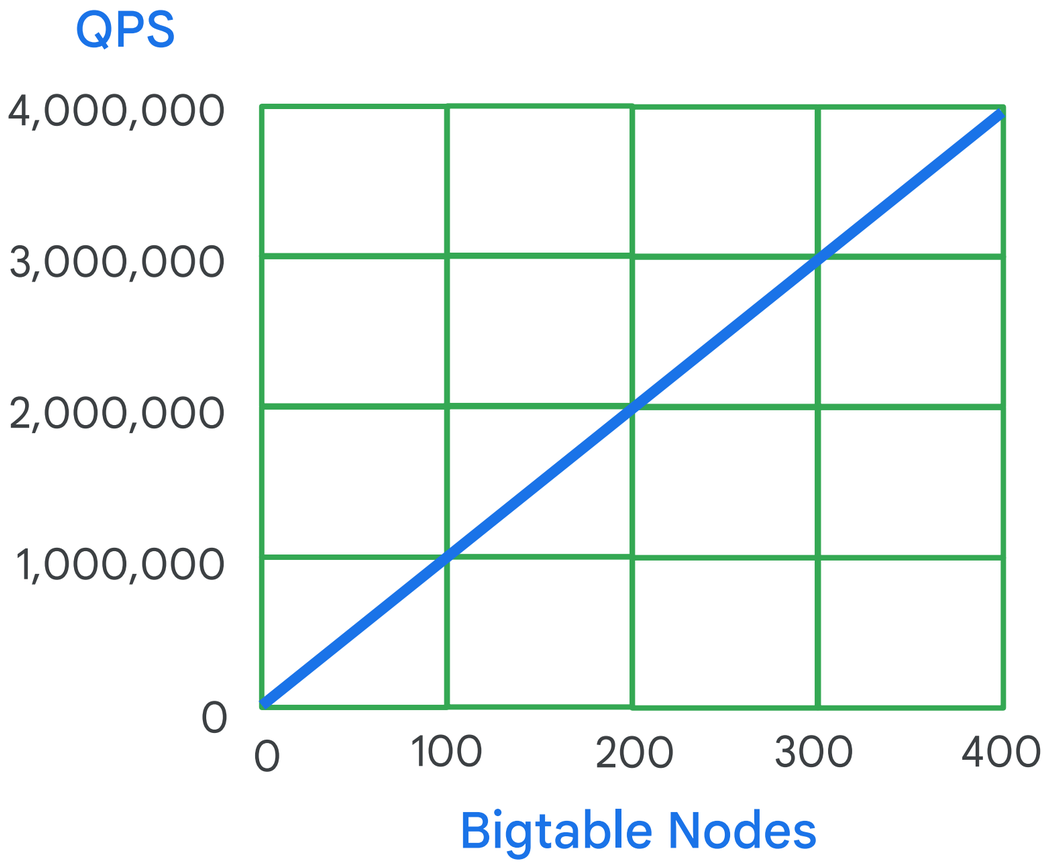
Optimizing Bigtable performance



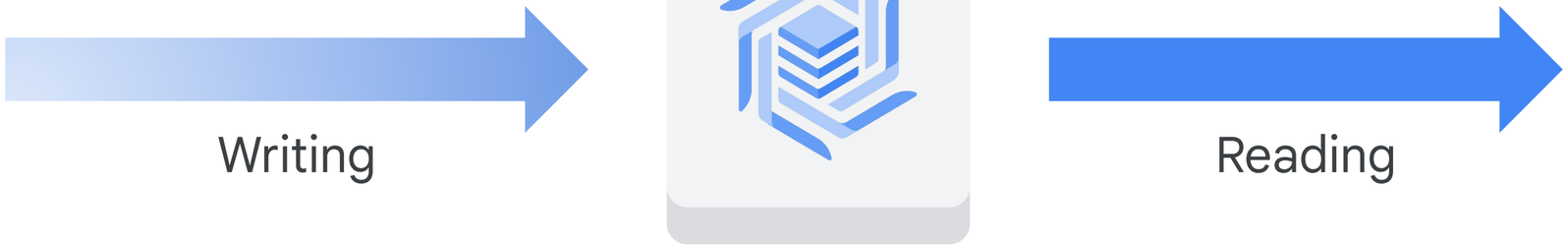
Throughput can be controlled by node count





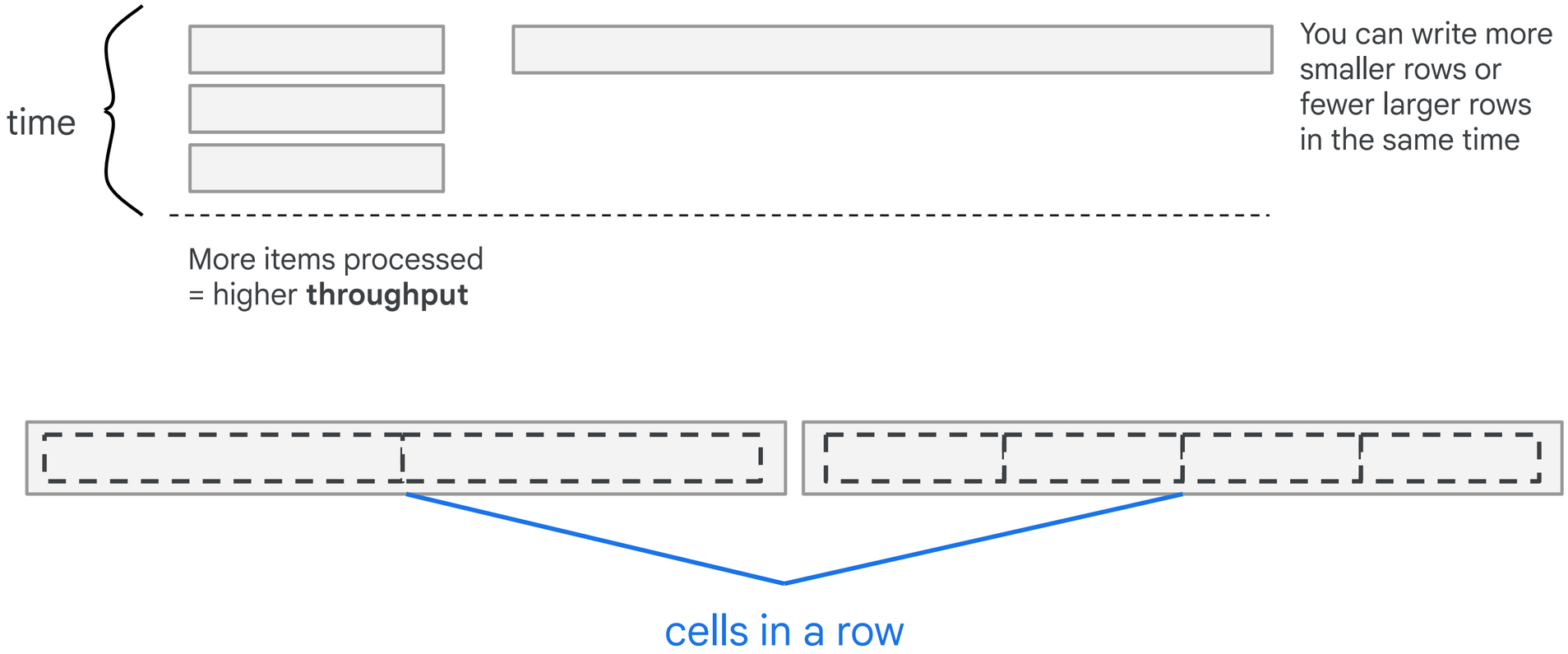
Features for Bigtable streaming

Incoming streaming data is independent



Application reading of data is controllable

Schema design is the primary control for streaming

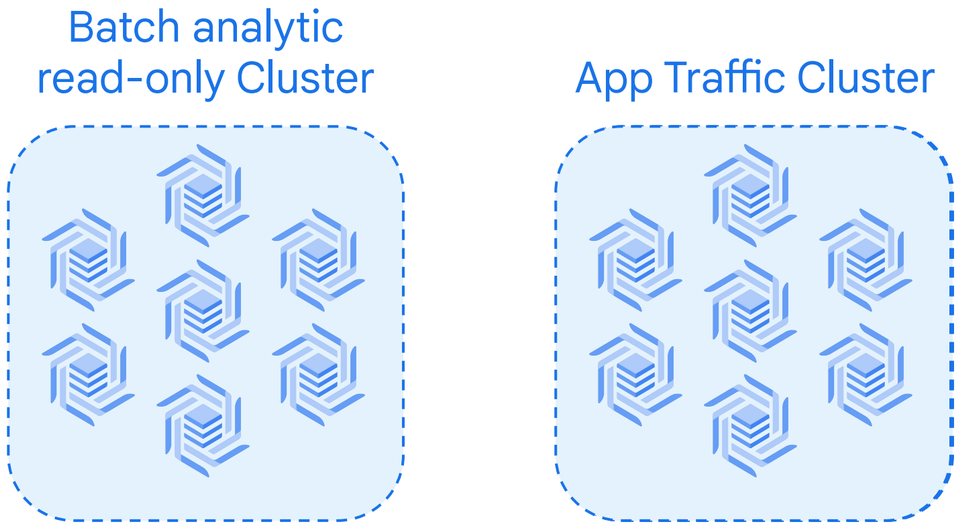


Use Bigtable replications to improve availability

Why perform replication?

- Isolate serving applications from batch reads
- Improve availability
- Provide near-real-time backup
- Ensure your data has a global presence

```
gcloud bigtable clusters create CLUSTER_ID \
    --instance=INSTANCE_ID \
    --zone=ZONE \
    [--num-nodes=NUM_NODES] \
    [--storage-type=STORAGE_TYPE]
```



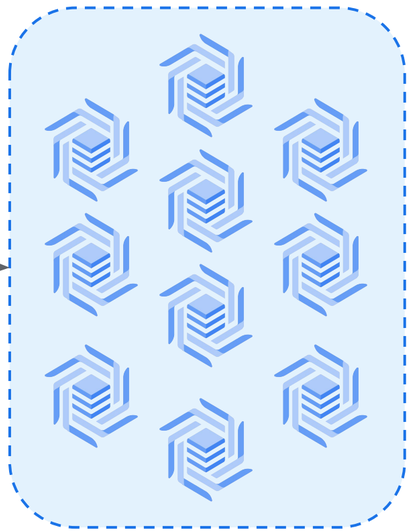
Run performance tests carefully for Bigtable streaming

Ideal

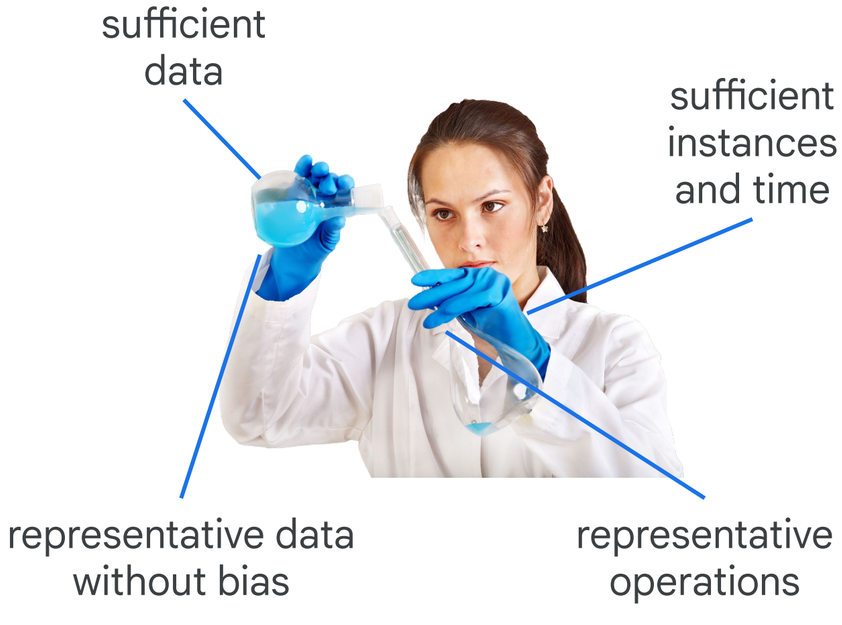
10-node cluster (SSD)

1kb rows

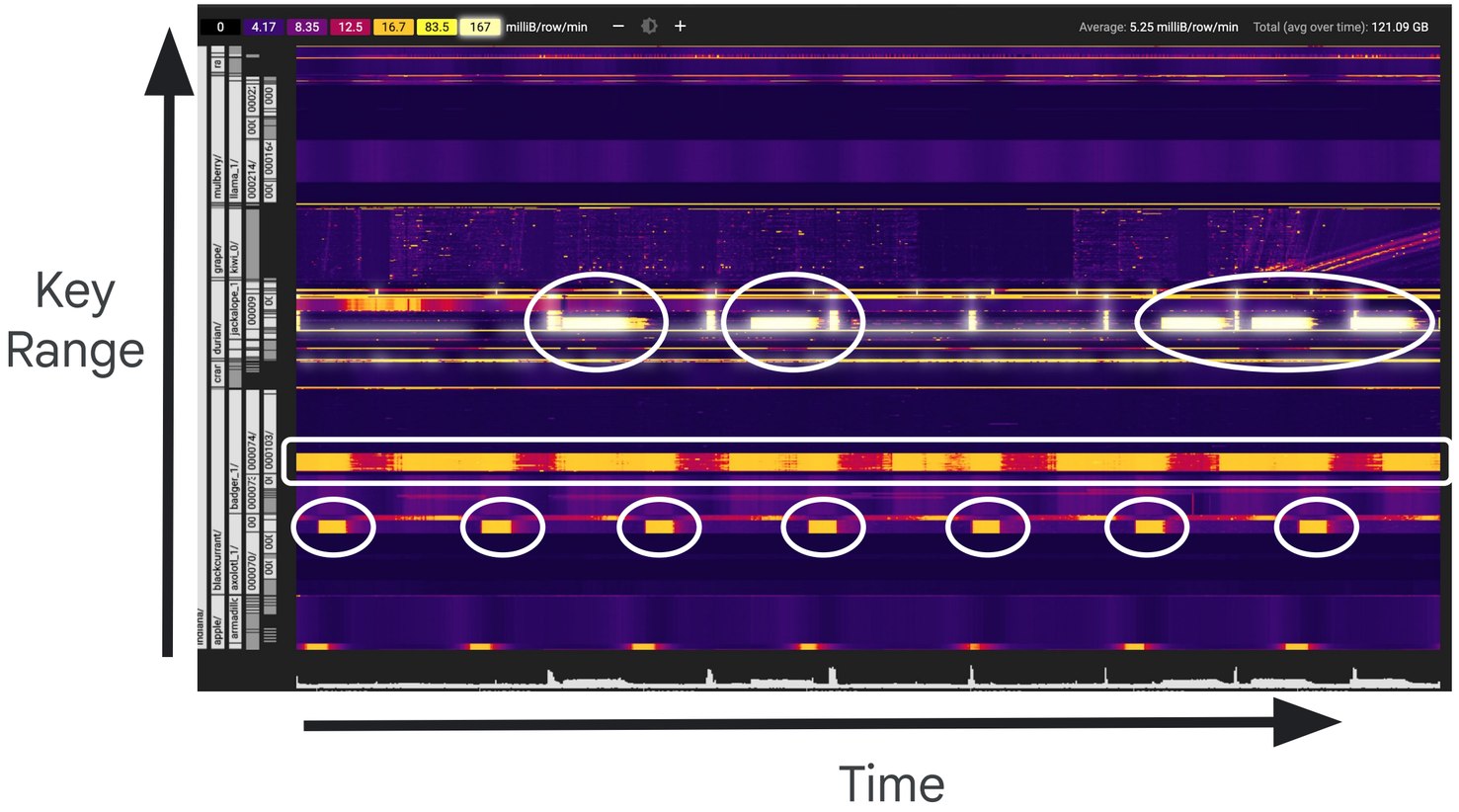
Write-only workload



Real



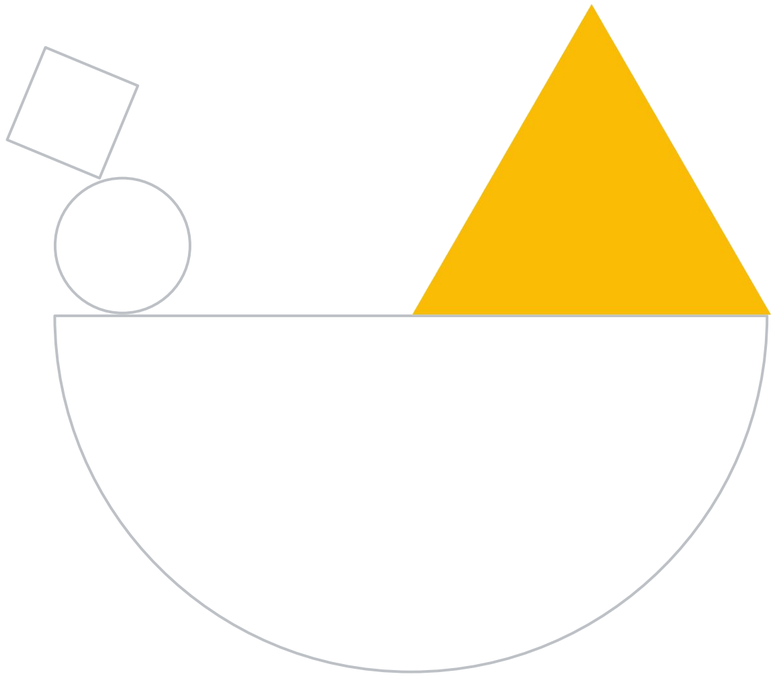
Key Visualizer exposes read/write access patterns over time and key space



- find/prevent hotspots
- find rows with too much data
- see if your key schema is balanced

Lab Intro

Streaming Data Processing:
Streaming Data Pipelines into Bigtable



Lab objectives

01 Launch Dataflow pipeline to read from Pub/Sub and write into Bigtable

02 Open an HBase shell to query the Bigtable database