GCP Dataflow Architecture

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Agenda

1. Overview of Dataflow Runner architecture
2. Overview of Dataflow Runner core features
3. GCP Horizontal services integrations
4. New Dataflow Runner features
Google Cloud Dataflow Service

- Streaming Engine
- Dynamic Work Rebalancer
- Flexible Resources
- Resource Auto-scaler
- Graph Optimization

Optional GCP Services
- Cloud IAM
- Compute Engine
- Cloud Network
- Virtual Private Cloud
- Key Management Service
- Stackdriver

- Dataflow SQL
- Shuffle Service
- Intelligent Watermarking
- Monitoring
- Log Collection
Dataflow features

Graph optimization

- Producer - Consumer Fusion
- Sibling Fusion
- Others...
Dataflow features

Monitoring

- Dataflow job page
  - Enhanced observability features
Dataflow features

Centralized Logging

- Single searchable logging via GCP logging
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Dataflow SQL
Shuffle Service
Intelligent Watermarking
Monitoring
Log Collection
At a very high level: a user submits a processing pipeline to our managed service, which optimizes it and runs a pool of virtual machines (sometimes called workers) to do the work.
Dataflow & Compute Engine

Region endpoint
- Deploys and controls Dataflow workers and stores Job Metadata
- Region is **us-central1** by default, unless explicitly set using the region parameter

Zone
- Defines the locations of the Dataflow workers
- Defaults to a zone in the region selected based on available zone capacity. It can be overridden using the zone parameter.

The zone does not need to be in the same region as the endpoint. Reasons you may want to do this include:
- Security and Compliance
- Data locality
- Resilience and geographic separation

**Caution:** If you override the zone and the zone is in a different region than the regional endpoint, there may be negative impact on performance, network traffic, and network latency.
Dataflow & Compute Engine

Identity Access Management
There are a minimum of 2 service accounts used by the Dataflow service

- **Dataflow Service Account**
  
  `(service-<project-number>@dataflow-service-producer-prod.iam.gserviceaccount.com)`
  
  - Used for worker creation, monitoring etc...

- **Controller Service Account**
  
  `<project-number>-compute@developer.gserviceaccount.com`
  
  - Used by the workers to access resources needed by the pipeline, for example files on a Google Cloud Storage Bucket
  - Can be overridden using `--serviceAccount`
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Optional GCP Services

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Sink Services

- Dataflow SQL
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Dataflow features

Batch Dynamic Work Redistribution

- Redistribute hot keys for more even workload distribution.
- Fully automated
Dataflow Shuffle - Batch

- **Compute**
  - Petabit network

- **Dataflow Shuffle**
  - Region
    - Zone ‘a’
      - Shuffle proxy
        - Distributed in-memory file system
        - Distributed on-disk file system
  - Autozone placement

- Zone ‘b’
- Zone ‘c’
Dataflow Streaming Engine

Benefits

- Smoother autoscaling
- Better supportability
- Less worker resources

Diagram:
- User code
- Worker
- Window state storage
- Streaming shuffle
- Streaming engine
Dataflow SQL UI

No coding required

- Write SQL in BigQuery UI
- Use Schemas from Data Catalog
- Submit Dataflow jobs

```sql
SELECT payload.userId, payload.productId
FROM pubsub.topic.project.transactions
WHERE
payload.location.latitude < 40.72
AND
payload.location.latitude > 40.699
AND
payload.location.longitude < -73.969
AND
payload.location.longitude > -74.747
```
Dataflow features

Flexible Resource Scheduling

- FlexRS reduces batch processing costs by using advanced scheduling techniques, the Cloud Dataflow Shuffle service, and a combination of preemptible virtual machine (VM) instances and regular VMs.
- Jobs with FlexRS use service-based Cloud Dataflow Shuffle for joining and grouping.
Dataflow Templates

No coding required

- Select one of 20+ Google-provided templates or use your own
- Popular ETL sources and sinks
- Streaming and Batch modes
- Launch from GCS or Pub/Sub browsers
GPU Support

Attach Graphical Processing Units (GPU) to your Dataflow workers to accelerate ML model training, batch and Streaming predictions, and general data processing.

What you can do with it

- Select from a range of GPU types (NVIDIA K80, P100, P4, T4, and V100s) for your job
- Accelerate ML workloads (preprocessing, feature engineering, ML inference)
Dataflow Prime

Dataflow Serverless

- Serverless Auto Tuning Infrastructure
- Serverless Smart Diagnostics
- Simplified Billing

- “Streaming ML” for real time insights
- Unified Batch and Streaming
- Open, intelligent and flexible platform

Ingest and distribute data reliably with Serverless and OSS systems

Store and analyze at scale with serverless and OSS systems

Governance, Security, Lineage and Workflow Management
Summary

1. Architecture
2. DAG optimization
3. Shuffle Service
4. Streaming Engine
5. Monitoring / Logging
6. Flexible Resource Scheduling
7. Out of the box Templates
8. SQL UI
9. Dataflow Prime