Fault Tolerant Integration of Apache Beam With Relational Database

Aug 4th 2021

Intro: Speakers

Piaw Na

Senior Staff Software Engineer

- Infrastructure
- Niantic Lightship

Savitha Jayasankar

Software Engineer

- Infrastructure
- Distributed data processing

Intro: Niantic Inc.

Games + Platform

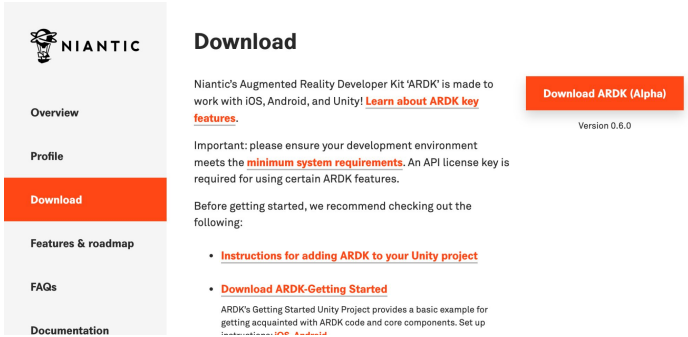
Games

Deliver best-in-class AR experiences

CATAN
WORLD
EXPLORERS

Platform

Deliver best-in-class AR developer platform



Outline

- Motivation
- Implementation Attempts
- Successful Implementation
- Results
- Lessons Learned

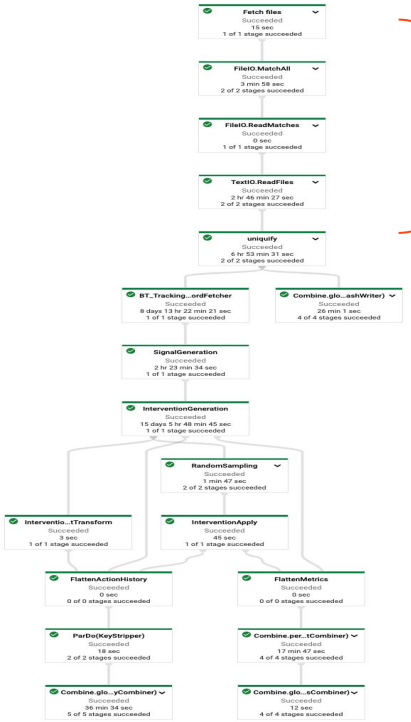
Motivation

- Provide metrics as the CoreInfra Dataflow Pipeline detects malicious explorers and visualize through Grafana.

Simple Right?

- CoreInfra runs as a dataflow periodically
    - Dataflows read from GCP BigTable and write to GCP Spanner.
- Dataflow time ≠ Event time ≠ Client Time
- Prometheus does not allow backdating of metrics
- Keeping Production cost low.

Core Infra DataFlow Pipeline



Input/Extraction Layer
- Flat files
- Hbase Tables

Transformation Layer
- Data manipulations based on conditions

Output / Loading Layer
- RDMS
- GCP Spanner

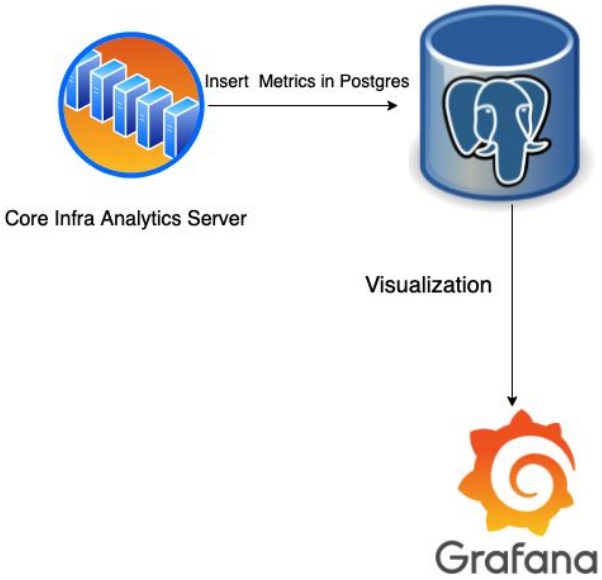
Statistics about Pipeline

- Millions of active Niantic Explorers per hour
- Billions of trackable Niantic Explorer components
- 10 GCP Spanner nodes for Niantic Explorer component history
- 1 Postgres node for Core Infra metrics and action history
- 1 dataflow per hour per game
    - 200 vCPUs (based on game volume)
    - 16 threads per vCPU
    - 30-45 minutes for dataflow completion.

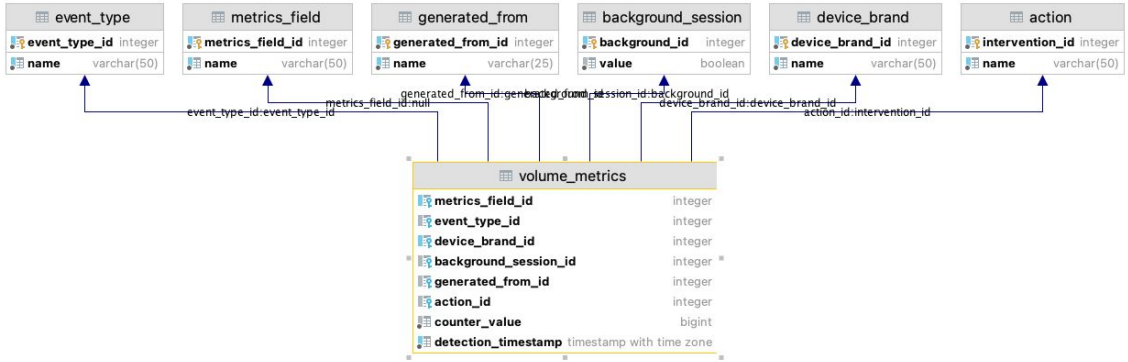
Attempted Implementation

- Dataflow with Prometheus Implementation : Pull Metrics System
- Dataflow with Prometheus with PushGateway : Push Metrics System
  - Remote Storage in BigQuery
  - Remote Storage in GCP Spanner

CoreInfra Metrics Architecture



- Replaced Prometheus with Postgres DB for metrics Storage
- Customised metrics
- Datetime can be customised to client time or processing time based on the metrics requirement



Dataflow and RDBMs

Naive implementations didn’t work:

- Cloud SQL Postgres: Rejects Connection Requests after 150 connections
- JDBCIO : Beam runner writes multiple times for fault tolerance ; risk of duplicates
- Postgres: More connections → high CPU utilization
- Even scaling up (max CPU + max memory) Postgres instance didn’t alleviate the above problems

Insight : Computation through dataflow

- Use *Combiners* to combine per-metric information
- Use .*withfanout*/.*withHotKeyFanout* to initiate the combine function without waiting for all input to come in*
- Each worker then batch inserts to Postgres by using Prepared Insert Statements
- If the DB connection request failed, the connection request would be tried again.

*fanout input value need to be evaluated on a trial basis

Dataflow Implementation using Java

```
metricsMergedCollectionWithFlatten
  .apply(ParDo.of(new MetricsDBWriter())
```

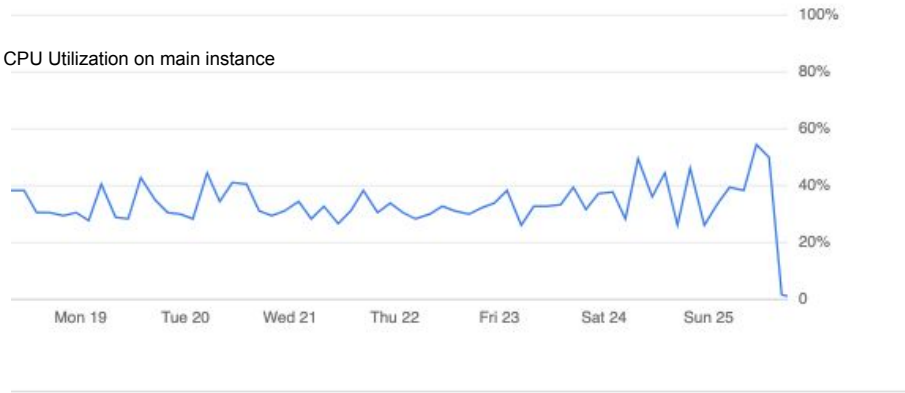
```
metricsMergedCollectionWithFlatten
  .apply("EventCombiner",
    Combine.<String, Event, Event>perKey(new
EventCombiner()).withHotKeyFanout(2))
  .apply("MetricsCombiner",
    Combine.globally(new
MetricsCombiner(flow.getDBConnection(), gameServer))
  .withFanout(2));
```

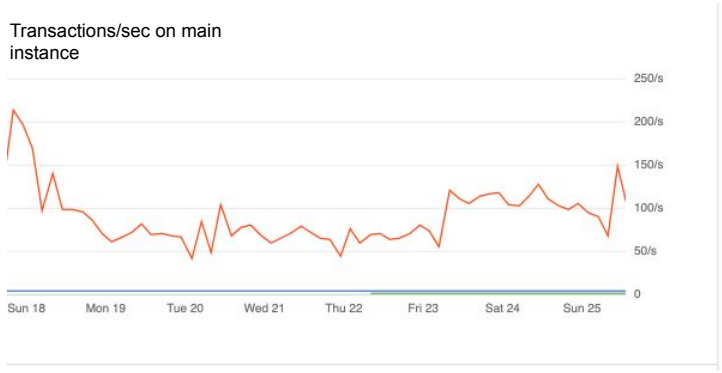
Results

- Scaled down Postgres Instance
- Write performance no longer bottleneck
  - batch inserts are faster than GCP BigQuery streaming inserts
- Saved Compute Cost.
- Improved latency over BigQuery.
- Overall Dataflow elapsed time was improved,
  - replaced other BigQuery usages with Postgres tables
- Zero code changes for porting to other cloud providers.
- Fixed cost of analytics related queries.

Typical dataflow numbers

History_records per 30 mins	6,556,245
Batch-insert-succeeded per 30 mins	11,331
inserts/second	1,806



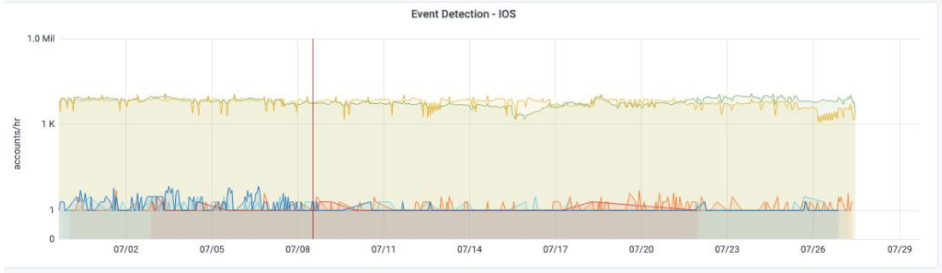


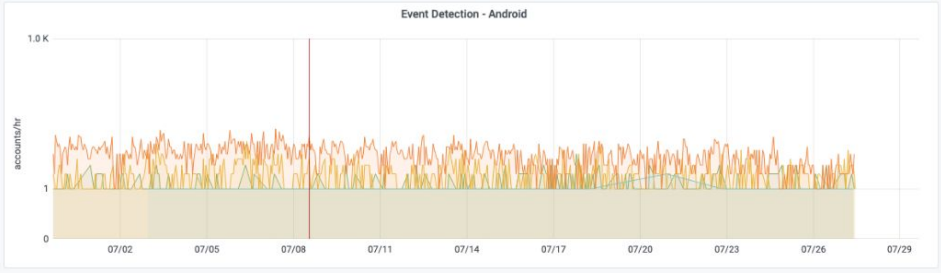
Refinements

- Ensure proper use of RDBMS techniques like implementing data normalization
  - Started with jsonb column into RDBMS columns
  - Index on new columns for improved query performance
- Harden against GCP CloudSQL outages
- Setup Monitoring against Postgres outages
- Scale down over-provisioned Postgres instance

Lessons learned

- Postgres can perform 100k appends/second on SSD.
- Don’t be afraid of Postgres/RDBM
  - Dataflow can write to Postgres at scale with proper organization of dataflow stages
  - Unlike BigQuery/Spanner/Bigtable, it’s the same for all cloud platforms
  - Postgres is cheap!
- Grafana can be decoupled from Prometheus
  - Grafana can alert without prometheus in the picture





Thank you. Questions?

Niantic is Hiring: https://careers.nianticlabs.com/openings/

Reach out to us on

Piaw Na: pna@nianticlabs.com

Savitha Jayasankar: sjayasankar@nianticlabs.com