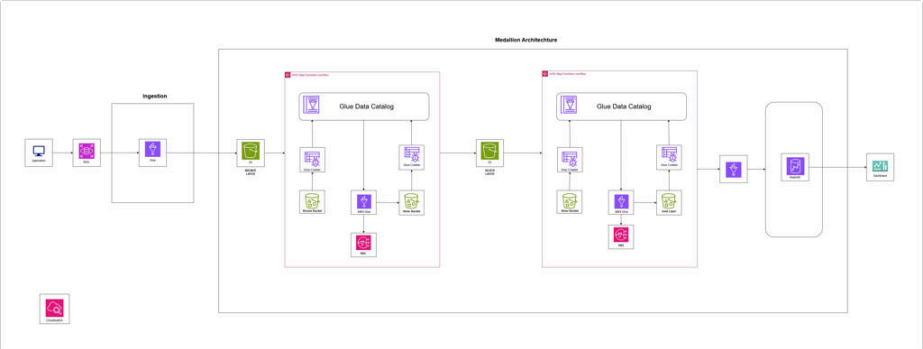
Proximity-Based Service Provider Data Pipeline

1 Overview

This project implements a lakehouse-based data pipeline for a proximity-based service provider platform. It leverages AWS Glue, S3, Redshift, Step Functions, and Power BI to deliver scalable and automated analytics for bookings and service provider performance.

2 Architecture

The architecture follows a Medallion Architecture model, processing data from PostgreSQL to a Power BI dashboard. In the architecture, the data is saved to an S3 bucket after every successful transformation is completed.



3 Infrastructure (Terraform)

The infrastructure is provisioned using Terraform, ensuring reproducibility and scalability.

3.1 S3 Buckets

S3 buckets are used to store data extracted from the rds as parquet files

- prox-bronze-bucket: Stores raw data (Bronze)
- prox-silver-bucket: Stores cleaned data (Silver)
- prox-gold-bucket: Stores star schema data (Gold)

3.2 AWS Glue

AWS Glue is a tool that is used to perform ETL (Extract, Transform, Load)

- Crawlers: bronze_crawler, silver_crawler, gold_crawler
- Jobs:
  - bronze-ingestion-job: Extracts data from RDS to Bronze
  - transformations-job: Processes Bronze to Silver
  - gold-data-curation-job: Creates star schema in Gold
  - s3-to-redshift-job: Loads Gold data to Redshift

3.3 Redshift

Redshift is a data warehouse

- Configured with VPC, Subnet Group, and Security Group
- Cluster with public schema
- Fact and dimension tables created using compatible DDL

3.4 IAM Roles

Access that makes services assume the role of a user

- Roles for Glue and Redshift with scoped S3 access

3.5 SNS

Allows notifications to be sent to users

- Topic: prox-notifications for Step Functions alerts

4 ETL Pipeline

The ETL pipeline processes data through Bronze, Silver, and Gold layers before loading into Redshift.

4.1 Bronze Layer (Raw Data Ingestion)

- Job: bronze-ingestion-job
- Extracts data from RDS (PostgreSQL) using JDBC
- Writes CSV/JSON to prox-bronze-bucket
- Crawled by bronze_crawler

4.2 Silver Layer (Data Cleaning & Validation)

- Job: transformations-job
- Reads Bronze data via Glue catalog
- Enforces schema, checks foreign keys, deduplicates
- Writes Parquet to prox-silver-bucket
- Crawled by silver_crawler

4.3 Gold Layer (Star Schema)

- Job: gold-data-curation-job
- Creates fact and dimension tables:
  - fact_booking
  - dim_user, dim_service, dim_location, dim_dispute, dim_review, dim_date
- Stored in prox-gold-bucket as Parquet
- Crawled by gold_crawler

4.4 Load to Redshift

- Job: s3-to-redshift-job
- Checks for table existence, creates if absent
- Uses from_jdbc.conf() with Redshift JDBC (IAM role)
- Loads Parquet files from prox-gold-bucket to Redshift public schema

5 Orchestration (AWS Step Functions)

A Step Function orchestrates the ETL pipeline with the following flow:

1. Bronze Ingestion Job
2. Crawl Bronze
3. Silver Transformation Job
4. Crawl Silver
5. Gold Curation Job
6. Crawl Gold
7. Load to Redshift
8. SNS Success Notification

- Includes wait and status checks for crawlers using getCrawler
- Applies retries and backoff strategies to Glue/Crawler tasks
- Failure paths send notifications to prox-notifications SNS topic

6 CI/CD Pipelines

CI/CD is implemented using GitHub Actions for automated deployment and validation.

6.1 Main Branch

- Deploys Glue scripts to S3 buckets:
  - Bronze: bronze_ingestion_script.py, transformations_script.py
  - Gold: gold_data_curation_script.py, s3_to_redshift_script.py
- Workflow:
  - Retrieves bucket names using terraform output
  - Checks bucket existence
  - Uploads/updates scripts using aws s3 cp
- Runs on push or pull request to main

6.2 Test Branch

- Validates Terraform code with terraform fmt, init, and validate
- Runs on push or pull request to test

7 Power BI Dashboard (Booking Insights)

The dashboard provides insights into booking data using Redshift in Import Mode.

7.1 Data Source

- Redshift tables: fact_booking, dim_user, dim_date, dim_service, dim_location, dim_dispute, dim_review

7.2 Page: Booking Insights

7.2.1 Slicers (Left Sidebar)

- Date: dim_date[full_date]
- User Type: dim_user[user_type]
- Service Category: dim_service[category]
- Location: dim_location[city]

7.2.2 Visuals

Visual	Type	Fields Used
Total Bookings	Card	fact_booking[booking_id]
Revenue Generated	Card	fact_booking[booking_fee]
Bookings Over Time	Line Chart	Axis: dim_date[full_date], Values: Total Booking
Top 5 Cities by Bookings	Bar Chart	Axis: dim_location[city], Values: Total Bookings
Booking Status Breakdown	Donut Chart	fact_booking[booking_status], Total Bookings
Avg Booking Fee per Category	Bar Chart	Axis: dim_service[category], Values: Avg Booking

8 Security

- Glue jobs run with IAM roles scoped to necessary actions
- SNS notifications replace direct error failures
- GitHub Secrets used for AWS credentials in CI/CD

9 Deployment Instructions

9.1 Clone the Repository

```
git clone git clone https://github.com/Andrew-Marfo/PROX.git
```

9.2 Provision Infrastructure

```
cd aws_infra/terraform
terraform init
terraform plan
terraform apply
```

9.3 Trigger CI/CD

- Push to main: Deploys Glue scripts
- Push to test: Validates Terraform code

9.4 Execute Step Function

- Start execution from the AWS Console
- Confirm success via SNS or CloudWatch logs

9.5 Power BI

- Connect to Redshift (Import Mode)
- Import all dim_and fact_tables
- Use visuals/DAX as specified in Booking Insights