

Web E-Wallet: A GCP Implementation

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Project Group: I

Business Problem

- In this digital age, businesses, especially in emerging markets, face challenges in providing seamless, secure, and cost-effective payment solutions. Customers demand a convenient way to store, transfer, and transact money digitally without the complexity of traditional banking.
- The "E-wallet" is a web-based application designed to revolutionize the way users manage their funds, make payments, and transfer money.

Objective and Scope

- By building this software, we aim to offer secure and convenient digital financial transactions for users with an easy to navigate UI/UX whiles offering apt backend services.
- The application allows users to register for an account, manage funds, view transaction histories, and transfer money to other users.
- Supports operations like account creation, balance checks, credit and debit transactions, and user authentication.
- Users can fund their wallets using credit/debit cards and transfer funds to recipients via email or wallet number.

cost-benefit analysis for using GCP versus On-Premise Resources

Focus	GCP	On-Premise
Aspect	GCP	On-Premise
Initial Setup Costs	Minimal; pay-as-you-go. No upfront hardware investment.	High upfront costs for purchasing servers, storage, and networking equipment.
Scalability Costs	Flexible scaling; pay only for resources used.	Expensive and time-consuming; requires new hardware purchases.
Maintenance Costs	Managed by Google (updates, patches, and hardware).	Requires dedicated IT staff and resources for ongoing maintenance.
Resource Utilization	Highly efficient through auto scaling.	Often underutilized, leading to sunk costs.

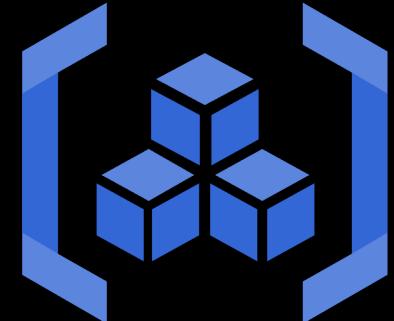
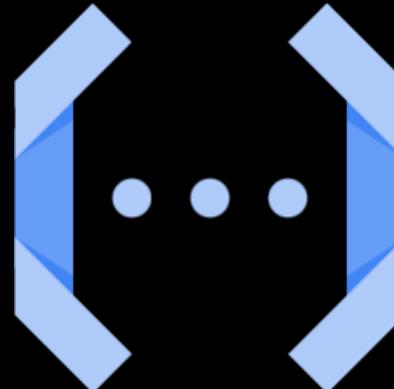
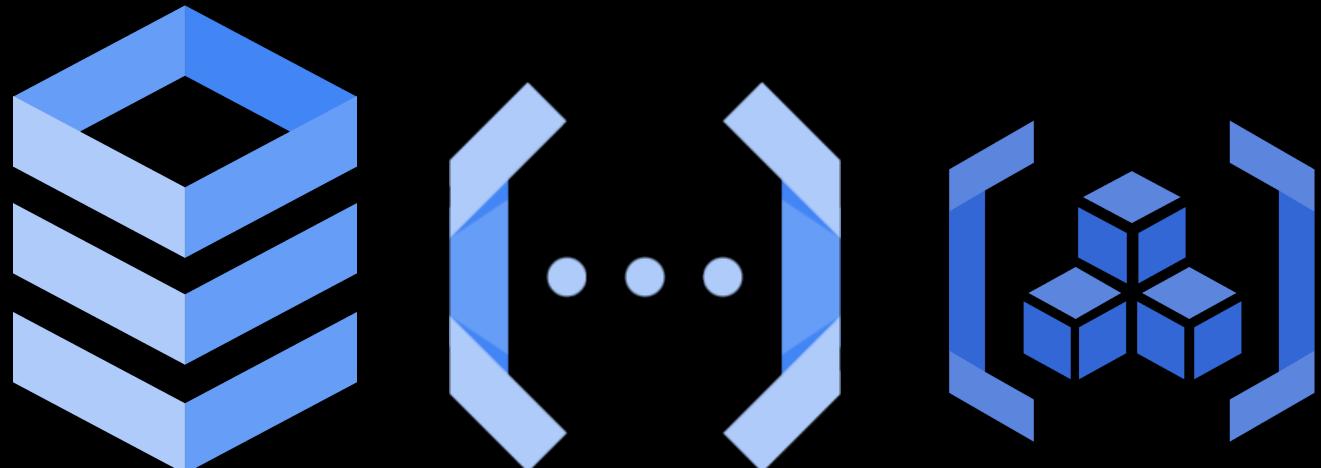
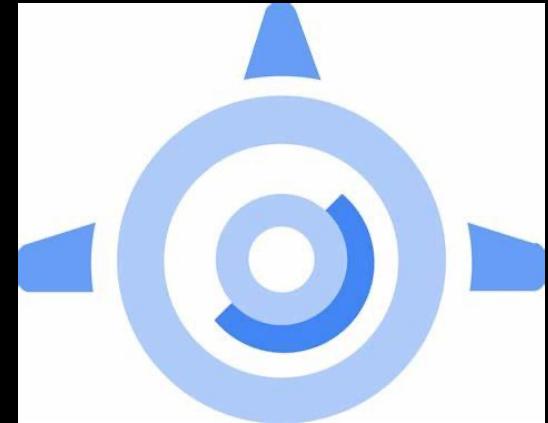
WHY GCP?

GCP offers affordable cloud services for small to mid sized business with serverless options which handles our infrastructure, while we focus more on development and business.

Our architecture setup is completely serverless and configured for scaling which gcp is equipped to handle once the volume of transactions, customer base, traffic etc. increases over time.

Components Of GCP Adopted

- To achieve the set objective, we have adopted the use of these GCP's cloud services listed below:
- VPC
- Artifacts Registry
- Cloud Run
- App Engine
- Cloud SQL



Components Of GCP Adopted

- To achieve the set objective, we have adopted the use of these GCP's cloud services listed below:

- Pub Sub
- Cloud Function
- Cloud Storage
- Log Explorer



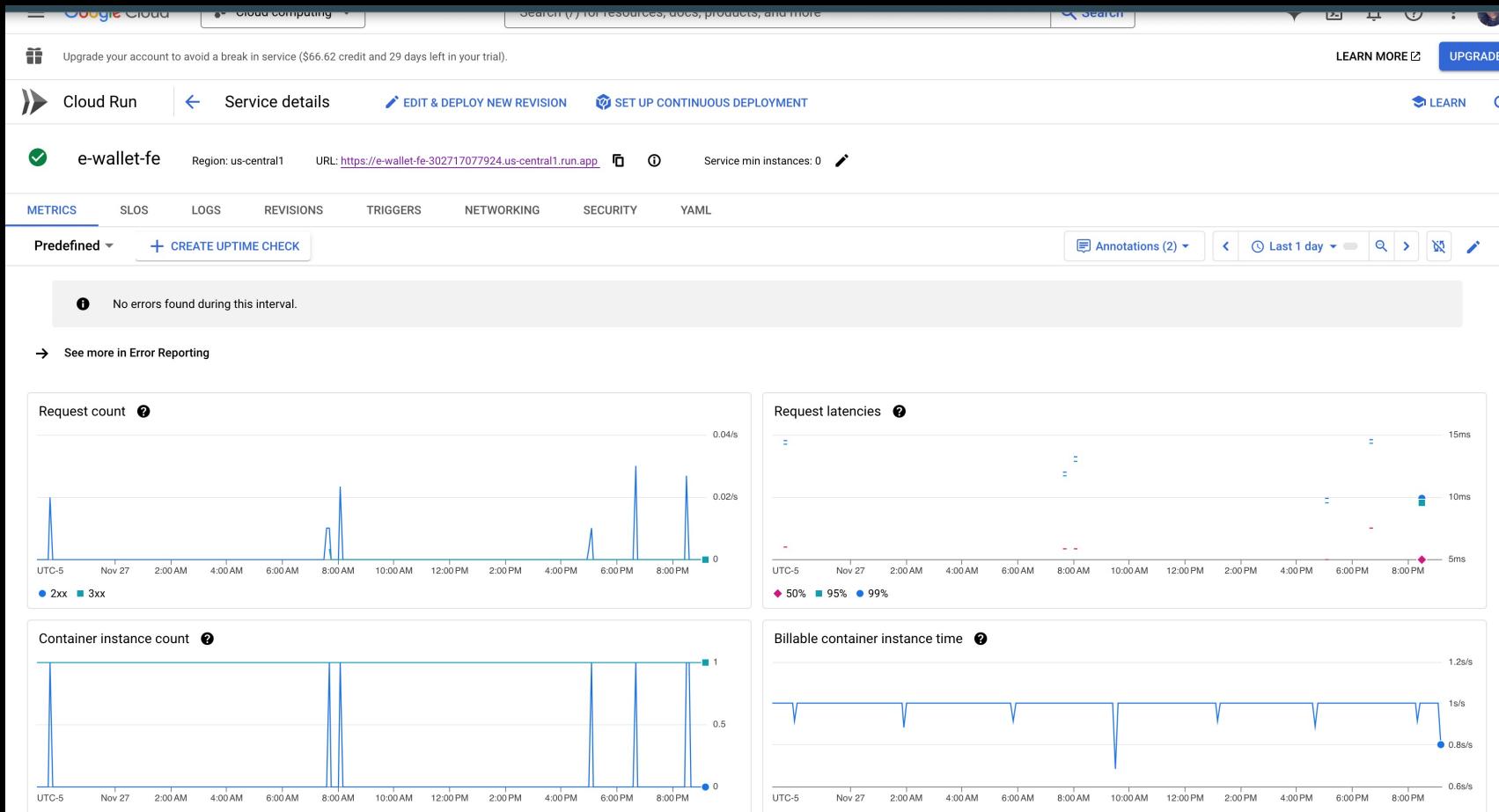
Services: Artifacts Registry for Docker Image

The screenshot shows the Google Cloud Artifact Registry interface. At the top, there's a navigation bar with 'Google Cloud' and 'Cloud computing' dropdowns, a search bar, and user account information. A prominent message box in the center says 'Turn on vulnerability scanning' with a sub-message about monitoring known vulnerabilities. Below this, a table lists several repositories:

	Name	Format	Type	Location	Scanning	Description	Labels
<input type="checkbox"/>	e-wallet-be	Docker	Standard	us-central1 (Iowa)	Disabled		
<input type="checkbox"/>	e-wallet-fe	Docker	Standard	us-central1 (Iowa)	Disabled		
<input type="checkbox"/>	gcf-artifacts	Docker	Standard	us-central1 (Iowa)	Disabled	This...	goog-manag...:
<input type="checkbox"/>	gcr.io	Docker	Standard	us (multiple regions in United States)	Disabled		
<input type="checkbox"/>	us.gcr.io	Docker	Standard	us (multiple regions in United States)	Disabled		

A sidebar on the left shows 'Repositories' and 'Settings'. On the right, a modal window titled 'Select a repository' has tabs for 'PERMISSIONS' and 'LABELS', with a note indicating at least one resource must be selected.

Services: Cloud Run Service



Services: App Engine for Backend Deployment

Screenshot of the Google Cloud Platform App Engine Instances page.

The left sidebar shows navigation links: Dashboard, Services, Versions, Instances (selected), Task queues, Cron jobs, Security scans, Firewall rules, Quotas, Memcache, Search, and Settings.

The main area displays a chart titled "CPU Utilization" showing usage over the last hour. The Y-axis ranges from 4.5% to 6%. The X-axis shows time from UTC-5 to 9:05 PM. A single data series, "CPU: 5.221%", is plotted as a blue line. A legend at the bottom indicates the line color.

Below the chart, the "Instances" section lists one instance:

ID	Debug mode	Start Time	External IP	Health check status
aef-default-20241014t000458-dttc	Disabled	Nov 27, 2024, 7:33:59 AM	34.67.45.91	Healthy

Services: Pub/Sub for Queuing requests

The screenshot shows the Google Cloud Pub/Sub interface for managing a subscription named "eventarc-us-central1-ewallet-messaging-523967-sub-448". The left sidebar lists "Pub/Sub" and "Pub/Sub Lite" sections. The main panel displays the subscription details under the "DETAILS" tab, including:

- Subscription name:** projects/sunny-vehicle-436819-f5/subscriptions/eventarc-us-central1-ewallet-messaging-523967-sub-448
- Subscription state:** active
- Topic name:** projects/sunny-vehicle-436819-f5/topics/ewallet-messaging

The "DETAILS" tab also includes sections for METRICS, MESSAGES, and various delivery and authentication settings. On the right side, there are tabs for PERMISSIONS and LABELS, and a sidebar for managing roles and inheritance.

PERMISSIONS

Edit or delete roles below, or select "Add principal" to grant new access.

Show inherited roles in table
Display roles inherited from the parent resources in the table below

Role / Principal

Inheritance

- Cloud Build Service Agent (1)
- Cloud Functions Service Agent (1)
- Editor (1)
- Eventarc Service Agent (1)
- Owner (7)

LABELS

eventarc-us-central1-ewallet-messaging-523967-sub-448

goog-drz-e... : us-central1 goog-drz-e... : 10ad0fb... goog-eventarc

Services: Cloud SQL for database

The screenshot shows the Google Cloud Console interface for managing Cloud SQL instances. The main navigation bar at the top includes links for YouTube, Gmail, Maps, Google Cloud, Cloud computing, Cloud SQL, INSTRUCTION, vscode - Google S..., and Performance Testi... . The Cloud SQL tab is selected.

The left sidebar contains a navigation menu for the SQL service, with the "Overview" tab currently selected. Other options include Cloud SQL Studio, System insights, Query insights, Connections, Users, Databases, Backups, Replicas, and Operations. A "Release Notes" link is also present at the bottom of the sidebar.

The main content area displays the "ewallet" instance details. It shows the PostgreSQL 16 version and a chart titled "CPU utilization" for the last 1 day. The chart indicates a significant spike in CPU usage around 8:00 AM UTC-5 on Nov 27, followed by a steady state around 10% utilization. Below the chart, there is a link to "Go to Query insights for more in-depth info on queries and performance".

The "Instance Issues" section lists four items: Security (Allows unencrypted direct connections, Auditing not enabled), Configuration (vCPUs: 4, Memory: 16 GB, SSD storage: 100 GB), Enterprise edition (UPGRADE), and Database version (PostgreSQL 16.4). There is also a note about integrating with BigQuery.

Services: Virtual Private Cloud

The screenshot shows the Google Cloud VPC network details page for a project named "e-wallet-vpc". The "SUBNETS" tab is selected. A single subnet, "public-subnet", is listed with the following details:

Name	Region	Stack Type	Primary IPv4 range	Secondary IPv4 ranges	IPv6 ranges	Reserved internal ranges
public-subnet	us-central1	IPv4 (single-stack)	10.0.0.0/24			None

Below the subnet table, there is a section titled "Reserved proxy-only subnets for load balancing" which is currently empty.

On the right side of the screen, a sidebar titled "Select a subnet" displays the message "Please select at least one resource." with a small informational icon.

Services: Cloud Functions For delivering Email

The screenshot shows the Google Cloud Platform interface for managing Cloud Functions. The top navigation bar includes 'Google Cloud' and 'Cloud computing' dropdowns, a search bar with 'cloud functions', and various user and system icons. A banner at the top encourages upgrading the account.

The main content area is titled 'Function details' for the function 'ewallet-messaging'. It shows the function was deployed on Oct 14, 2024, at 12:07:47 AM, with a URL: <https://us-central1-sunny-vehicle-436819-f5.cloudfunctions.net/ewallet-messaging>. There are buttons for 'EDIT', 'DELETE', and 'COPY'.

The 'TRIGGER' tab is selected, displaying the configuration for an 'Eventarc trigger'. The trigger is named 'ewallet-messaging-523967'. It is configured to receive events from a Cloud Pub/Sub topic 'google.cloud.pubsub.topic.v1.messagePublished' in the project 'projects/sunny-vehicle-436819-f5/topics/ewallet-messaging' located in the 'us-central1' region. The service account used is '302717077924-compute@developer.gserviceaccount.com'. The retry policy is set to 'Disabled'.

Other tabs visible include 'METRICS', 'DETAILS', 'SOURCE', 'VARIABLES', 'PERMISSIONS', 'LOGS', and 'TESTING'. A 'View in Cloud Run' button is also present.

Services: Log Explorer

The screenshot shows the Google Cloud Log Explorer interface. At the top, there's a navigation bar with 'Google Cloud' and 'Cloud computing' dropdowns, a search bar ('Search (/) for resources, docs, products, and more'), and a 'Search' button. Below the navigation is a banner for upgrading account credits.

The main area is titled 'Logs Explorer' and includes a 'Project logs' dropdown, a search bar ('Search all fields'), and filters for 'All resources', 'All log names', 'All severities', and 'Correlate by'. There are also buttons for 'Run query' and 'Show query'.

On the left, a sidebar displays a tree view of log fields under 'RESOURCE TYPE' (GAE Application, Cloud Run Revision, Application Load Balancer, Cloud SQL Database) and 'SEVERITY' (Info, Default, Error). The 'Info' node under 'Default' has 31 entries, while 'Error' has 1 entry.

The central part of the screen features a 'Timeline' at the top, showing a horizontal axis from Nov 27, 9:24:20.473PM to Nov 27, 9:24:58.474PM. Below the timeline is a table titled '62 results' with columns 'SEVERITY', 'TIME', and 'SUMMARY'. The table lists log entries, such as multiple 'GET /readiness_check' requests from 'GoogleHC 1.0' and database connection logs.

SEVERITY	TIME	SUMMARY
> i	2024-11-27 21:24:48.423	GET 200 2 B 0 ms GoogleHC 1.0 /readiness_check
> i	2024-11-27 21:24:49.011	GET 200 2 B 0 ms GoogleHC 1.0 /readiness_check
> i	2024-11-27 21:24:49.120	GET 200 2 B 0 ms GoogleHC 1.0 /readiness_check
> i	2024-11-27 21:24:49.123	GET 200 2 B 0 ms GoogleHC 1.0 /readiness_check
> i	2024-11-27 21:24:54.011	GET 200 2 B 0 ms GoogleHC 1.0 /readiness_check
> i	2024-11-27 21:24:54.120	GET 200 2 B 0 ms GoogleHC 1.0 /readiness_check
> *	2024-11-27 21:24:57.000	Sender's wallet: 100055
> *	2024-11-27 21:24:57.000	Recipient's wallet: 100054
> *	2024-11-27 21:24:57.000	Connected to PostgreSQL database
> *	2024-11-27 21:24:57.000	Getting balance for wallet ID: 100055
> *	2024-11-27 21:24:57.000	Connection to PostgreSQL closed
> *	2024-11-27 21:24:57.000	Balance: 120.00
> *	2024-11-27 21:24:57.000	Connected to PostgreSQL database
> *	2024-11-27 21:24:57.000	Getting balance for wallet ID: 100054
> *	2024-11-27 21:24:57.000	Connection to PostgreSQL closed
> *	2024-11-27 21:24:57.000	Balance: 10.00
> *	2024-11-27 21:24:57.000	Connected to PostgreSQL database
> *	2024-11-27 21:24:57.000	Connection to PostgreSQL closed
> *	2024-11-27 21:24:57.000	Connected to PostgreSQL database

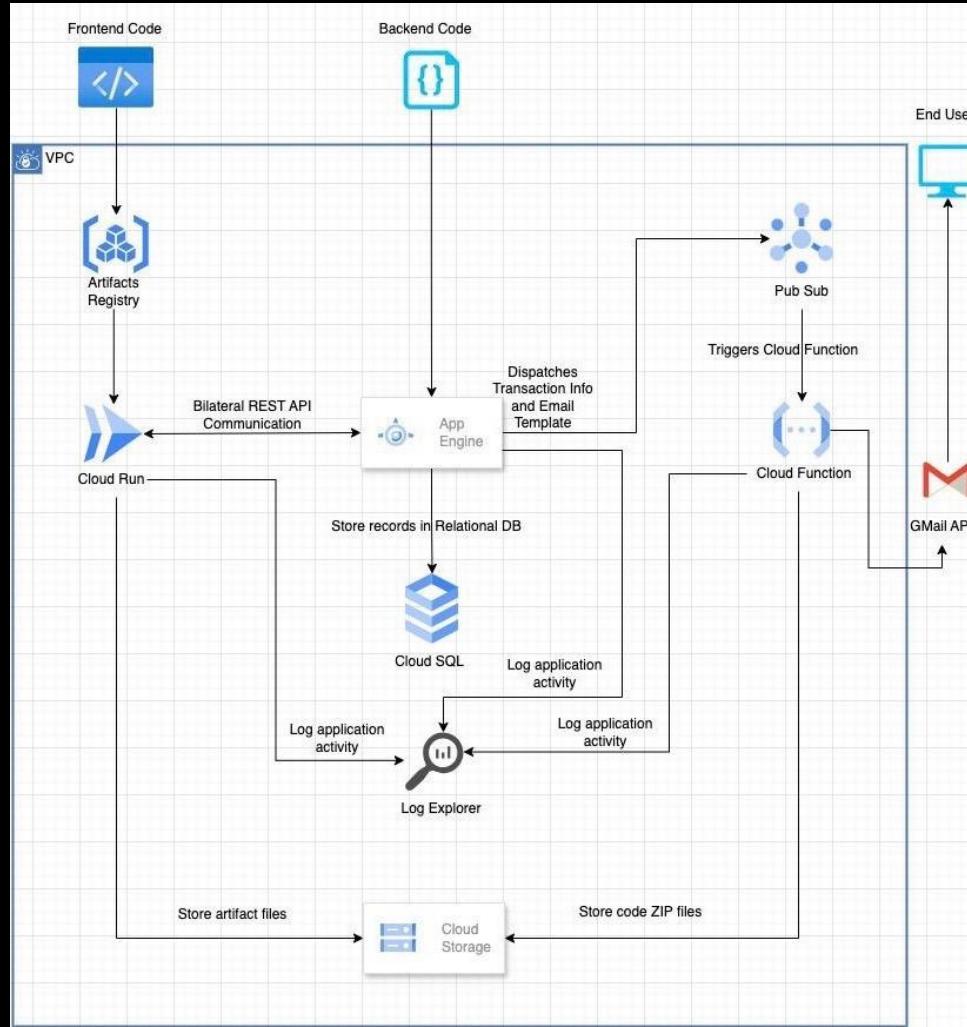
Services: Cloud storage for hosting function artifacts

The screenshot shows the Google Cloud Storage Buckets page. The left sidebar has 'Cloud Storage' selected under 'Buckets'. The main area displays a table of buckets:

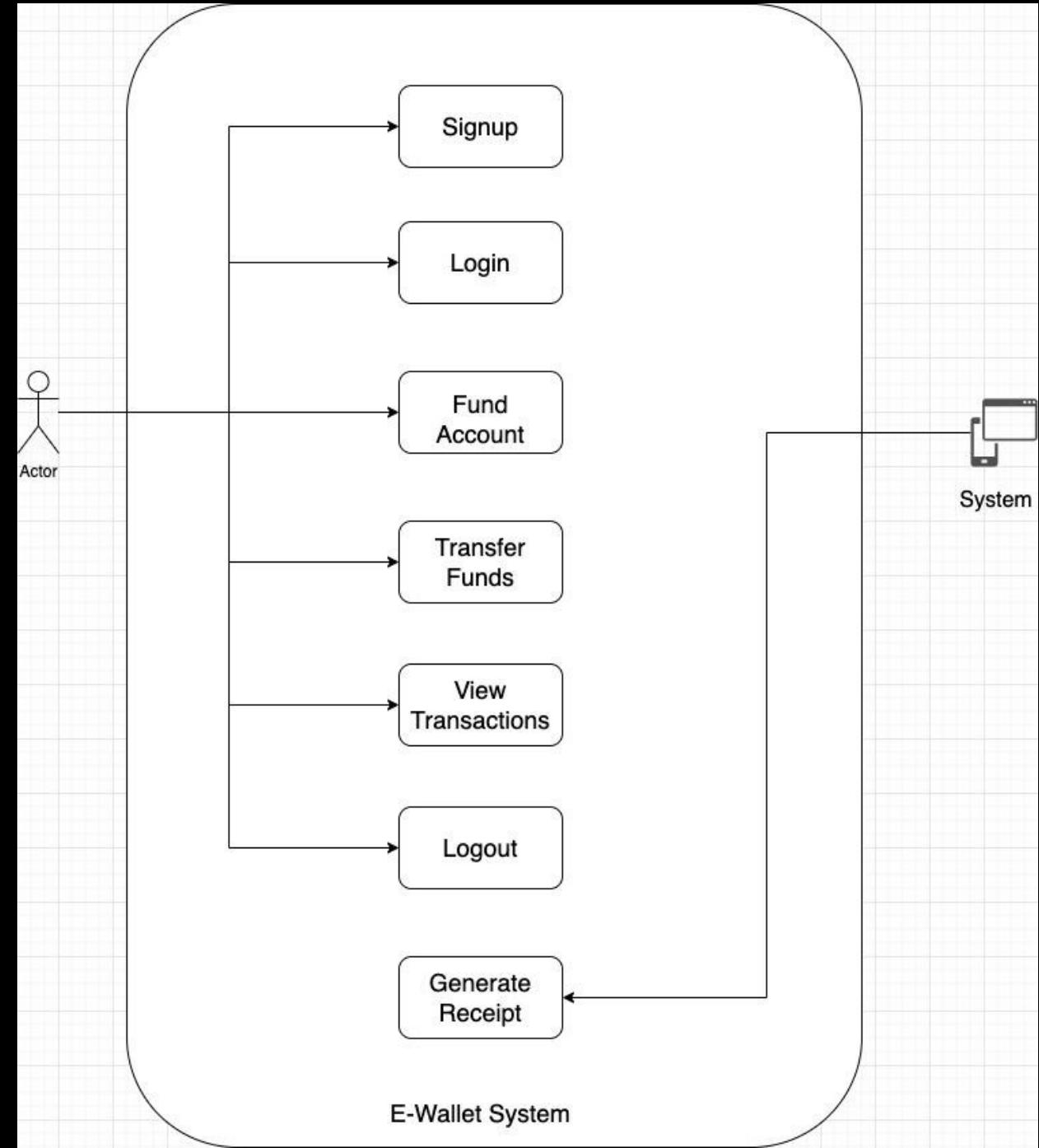
Name	Created	Location type	Location	Default storage class	Last modified	Public access	Access control
gcf-v2-sources-302717077924-us-centra...	Oct 13, 2024, 10:45:17 PM	Region	us-central1	Standard	Oct 13, 2024, 10:45:17 PM	Not public	Uniform
gcf-v2-uploads-302717077924-us-centra...	Oct 13, 2024, 10:45:16 PM	Region	us-central1	Standard	Oct 13, 2024, 10:45:16 PM	Not public	Uniform
staging.sunny-vehicle-436819-f5.appspot...	Oct 13, 2024, 3:10:39 PM	Multi-region	us	Standard	Oct 13, 2024, 3:10:39 PM	Subject to object ACLs	Fine-grained
sunny-vehicle-436819-f5.appspot.com	Oct 13, 2024, 3:10:38 PM	Multi-region	us	Standard	Oct 13, 2024, 3:10:38 PM	Subject to object ACLs	Fine-grained

Cloud Architecture Diagram

- This shows our diagrammatic representation of the development flow and user flow.



Use Case Diagram



Data Ingestion for funds transfer

app#/login

Subscription Build... INSTRUCTION vscode - Google S... Actimize Impleme... Performance Testi... 11 Must Have QA T... QA Analy...

Login

Sign In to your account

Email Address

Password

Login [Forgot password?](#)

Sign up

Click the button below to signup. A wallet will be created for you automatically if your details are correct.

Register Now!

central1.run.app#/register

Subscription Build... INSTRUCTION vscode - Google S... Actimize Impleme... Performance Testi... 11 Must Have QA T... QA Analy...

Register

Create your account

Name: Teefah

Email: Tobbie

Username: lyisa@laurentian.ca

Password:|

Create Account

Data Ingestion for funds transfer

central1.run.app#/register

Register

Create your account

Teefah

Tobbie

lyisa@laurentian.ca

.....

.....

app#/login

Login

Sign In to your account

Email Address

Password

[Forgot password?](#)

Sign up

Click the button below to signup. A wallet will be created for you automatically if your details are correct.

User registered successfully.
You can now login.

Login

Sign In to your account

Email Address

Password

[Forgot password?](#)

Sign up

Click the button below to signup. A wallet will be created for you automatically if your details are correct.

Data Ingestion for funds transfer

 **E-Wallet Email Notification**

Hi Teefah Tobbie, we wish to inform you that a Credit transaction occurred on your E-wallet.

The details of the transaction are shown below:

Reference ID:	17
Sender Account No:	100050
Sender Wallet Name:	Pool Account
Date and Time:	28-11-2024 1:33:28 AM
Amount:	\$10
Narration:	Funding Account
Account Balance:	\$130.00

...

— Dashboard — Wallet — transactions

 **Transactions Found**

 **Funding Successful. Your new balance is \$130.00**

[Home](#) / Transactions

Transactions Table

This table shows list of transactions completed in recent times.

Id	Type	Sender	Receiver	Amount	Date
1	Credit	Pool Account	Teefah Tobbie	\$10.00	Nov 27, 2024, 8:33:28 PM
2	Credit	Pool Account	Teefah Tobbie	\$20.00	Nov 27, 2024, 8:32:35 PM
3	Credit	Pool Account	Teefah Tobbie	\$100.00	Nov 27, 2024, 8:28:45 PM

Data Ingestion for funds transfer

The image displays two screenshots of a mobile application interface for managing a wallet. The left screenshot shows a modal dialog titled "Transfer Funds" where a user is selecting a recipient. The right screenshot shows the main "Fund Wallet" screen where a transfer has been completed.

Transfer Funds Modal (Left):

- Recipient Selection:** "Choose Email or Wallet Number to get recipient details".
 - Input Fields:** Radio buttons for "Email Address" and "Wallet No".
- Recipient Details:**
 - Email address:** hasansarfraz0715@gmail.com
 - Wallet No:** 100054
 - First Name:** Hasan
 - Last Name:** Sarfraz
 - Amount:** \$ 10
 - Narration:** Testing funds transfer
- Buttons:** "Reset" and "Transfer Funds" (green button).

Fund Wallet Main Screen (Right):

- Header:** Dashboard - Wallet - Transactions
- Success Message:** Transfer successful. Your new balance is \$120.00
- Form Fields:**
 - Name on Card:** Name
 - Card No:** Card Number
 - Exp Date:** MMYY
 - CVV:** CVV
 - Amount:** \$ 0
- Buttons:** "Transfer Funds" (purple button) and "Fund Wallet" (green button).

Data Ingestion for funds transfer

 E-Wallet Email Notification

Hi Teefah Tobbie, we wish to inform you that a Debit transaction occurred on your E-wallet.

The details of the transaction are shown below:

Reference ID:	18
Recipient Account No:	XXXXX
Recipient Wallet Name:	Hasan Sarfraz
Date and Time:	28-11-2024 1:42:09 AM
Amount:	\$10
Narration:	Testing funds transfer
Account Balance:	\$120.00

...

[Reply](#) [Forward](#)



THANK YOU
FOR COMING TO
OUR GCP
PRESENTATION.