Architecture Project #1

Overview: Running App

Software Architecture Course

Project Part 1

A small sized company has a running application which allows users to track their running habits and get motivated by visualizing their progress.

Unfortunately, customers have been complaining about problems and the business is losing customers to the competition.

In this document we have devised a one month plan to tackle the three immediate pain points with an improve in our software architecture. Also , we will suggest a long term plan to have the best possible architecture available for the given requirements.

Pain Points

- the app is not responsive during a run, especially trying to start and stop it
- some customers mentioned that their runs are disappearing from the web dashboard
- when customers finish a run, it takes more than one day to view on the dashboard

Primary Goals

- make the mobile app more responsive during a run
- have better data consistency on web dashboard
- immediately view runs on dashboard after a run ends

Secondary Goals

- Reduce cost of total cloud account

Scope: Our Running application System and their interactions

Intended audience: CEO, CTO, and CFO are the primary audience for this presentation. Eventually it will be extended to the development team in order to provide clarity on the goals to follow ahead.

Assumptions:

- The dev team is capable to work on the code and provide required refactoring.
- The devops team is capable to work and manage our cloud provider
- The QA team can actually reproduce the issues and test the app is running.
- No staff change is likely to happen on the suggested time frame.
- We will utilize a bit over half the IT team separated at 3 teams of 6 devs/devops/qa, for 2 consecutive sprints.
- The allocation of staff is agreed upon and no changes to the plan will be done on the next month

Limitations: From the 4 suggested diagrams on C$ models, We will not be generating component and code diagrams. Instead we will create System Context and Container diagrams along with Deployment Diagrams , which will map our current platform to the physical cloud architecture, for current setup, one month attack plan and the final solution. This will help us visualize better the high level architectural changes proposed.

Tools: This document utilizes Markdown files for text notes and PlantUML for diagram generations.

The diagrams follow the C4 Diagrams model of visualization.

The text editor of choice was VSCode using the PlantUML plugin and the NodeJS c4builder project.

Github:https://github.com/SilvioAmaral/SolutionAchitecture

1 System Context Diagram

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\1 System Context Diagram
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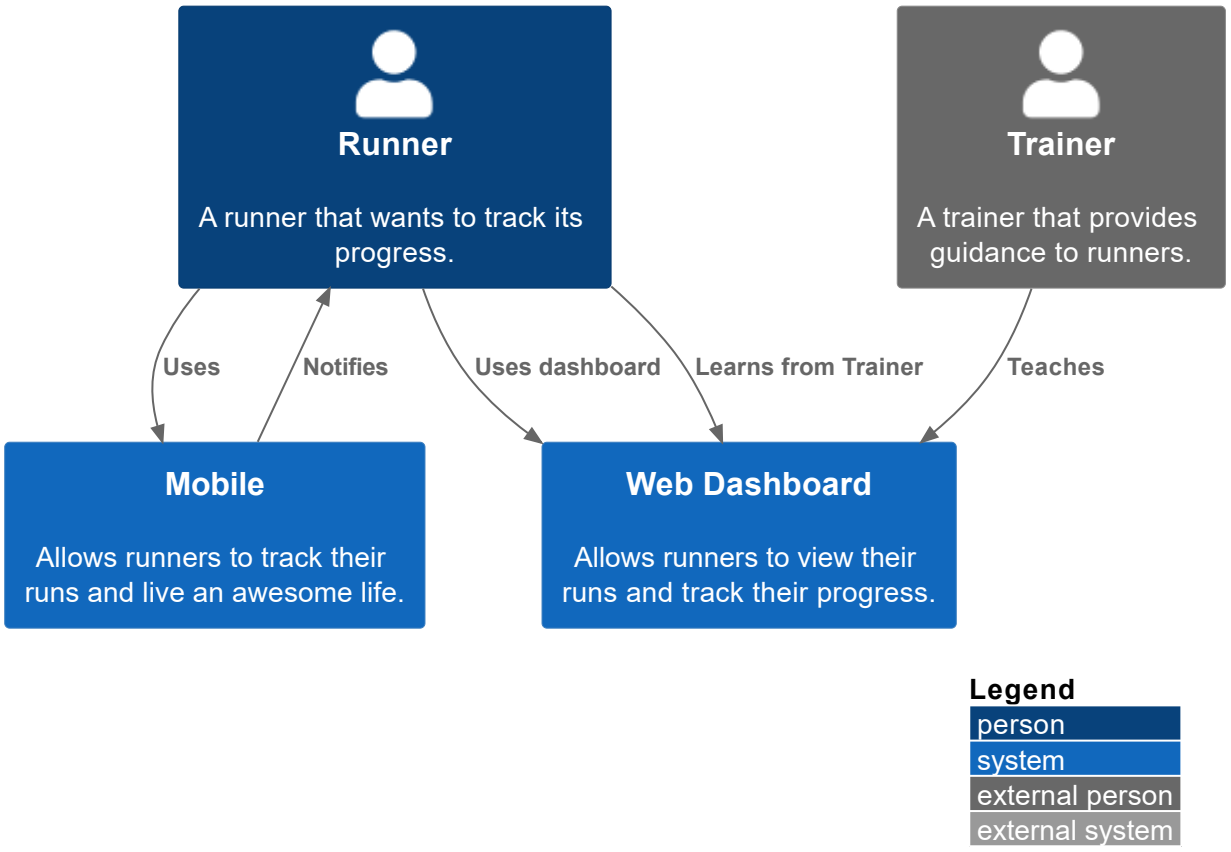


Level 1: System Context

The system context diagram represents a high-level overview of the interactions of the main components of the current architecture.

Primary Elements

There are currently one main user and two main components on this application. The primary elements are as follow:

- Our main users are runners that want to track and improve their running habits. These persons range from teens to seniors of all genders.
- The first main component is the mobile application, designed to allow users to select a running program, track their runs with GPS data , count calories of each run , and enhance the running experience with a music playlist.
- The second main component is a web dashboard that is designed to give users an overview of their runs and track their progress over time. They can also manage their accounts and purchase advanced plans with live trainer support.

Secondary Elements

- Trainers are professional runners that provide services guiding our beginner runners into their journey. They are considered External persons to our application, as they connect directly to the customer via external providers (zoom, webex).

Analysis of problems

As listed on our overview page, some of the main problems we have are

- the app is not responsive during a run, especially trying to start and stop it

We can see that the responsiveness of the run is due to the mobile app storing all data points and doing one single POST with all datapoints to the API.

- some customers mentioned that their runs are disappearing from the web dashboard

Due to the amount of data that the mobile app accumulates, sometimes the app crashes or sometimes the upload of data fails silently, therefore never showing on dashboard.

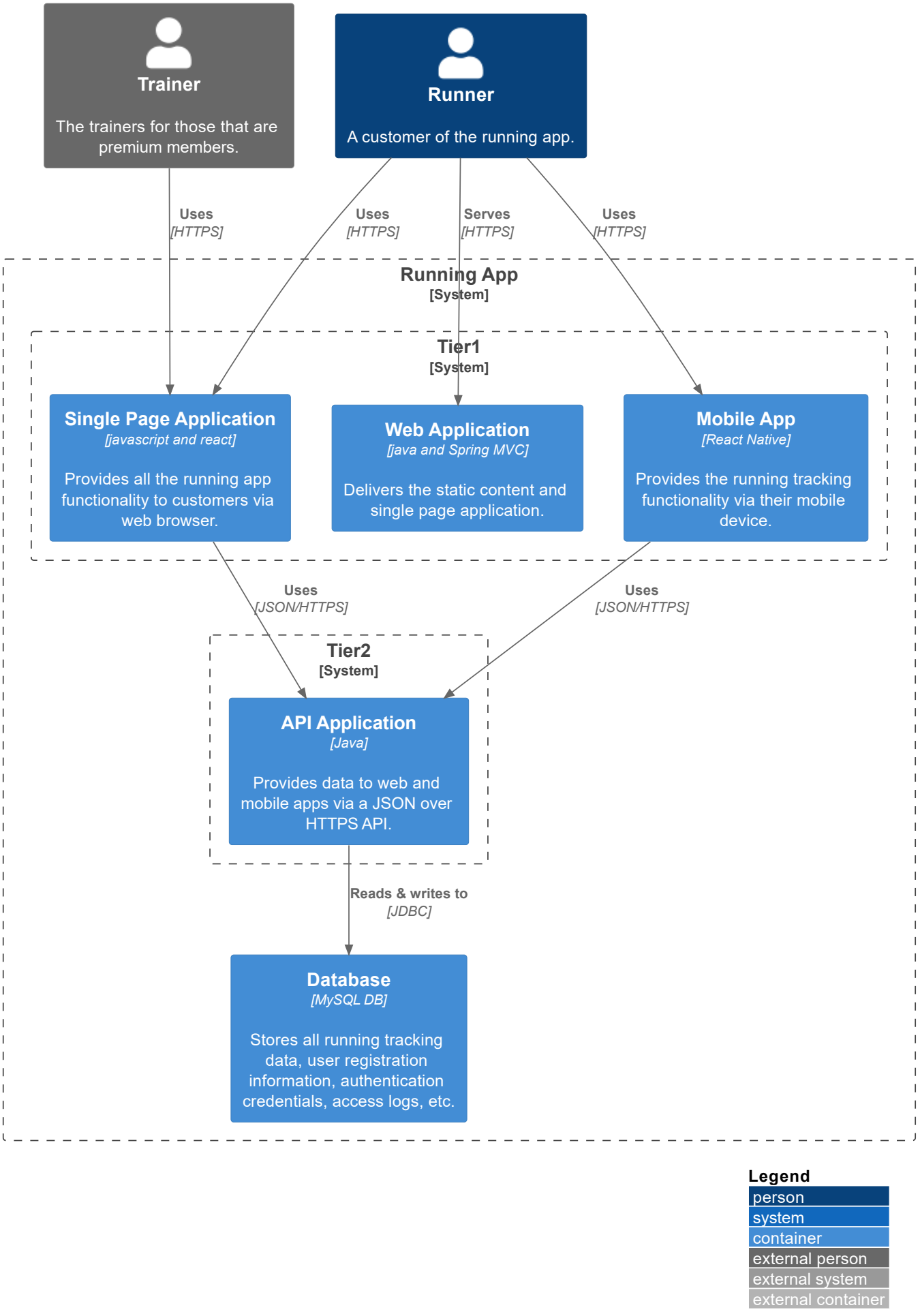
- when customers finish a run, it takes more than one day to view on the dashboard

The data written on the DB after each run gets processed overnight and its then created on the dashboard part of the application.

Exclusions: We will no longer be listing the trainers on our diagrams, as it is not a source of problems and therefore not the main focus of this optimization project.

1.1 Container Diagram

`\1 System Context Diagram\1.1 Container Diagram`



Level 2: Container diagram

Each part of our application is a two tier app, which means we have a code layer for presentation and one for business logic. Code quality is lower because of this, but this problem will be handled at a separate moment.

The presentation layer on mobile is coded on react native. The presentation layer on web is coded on React/HTML/CSS and delivered via a web service to the client. Both presentation layers communicate to the API using JSON via RESTful calls over HTTPS.

2 Current Deployment Diagram

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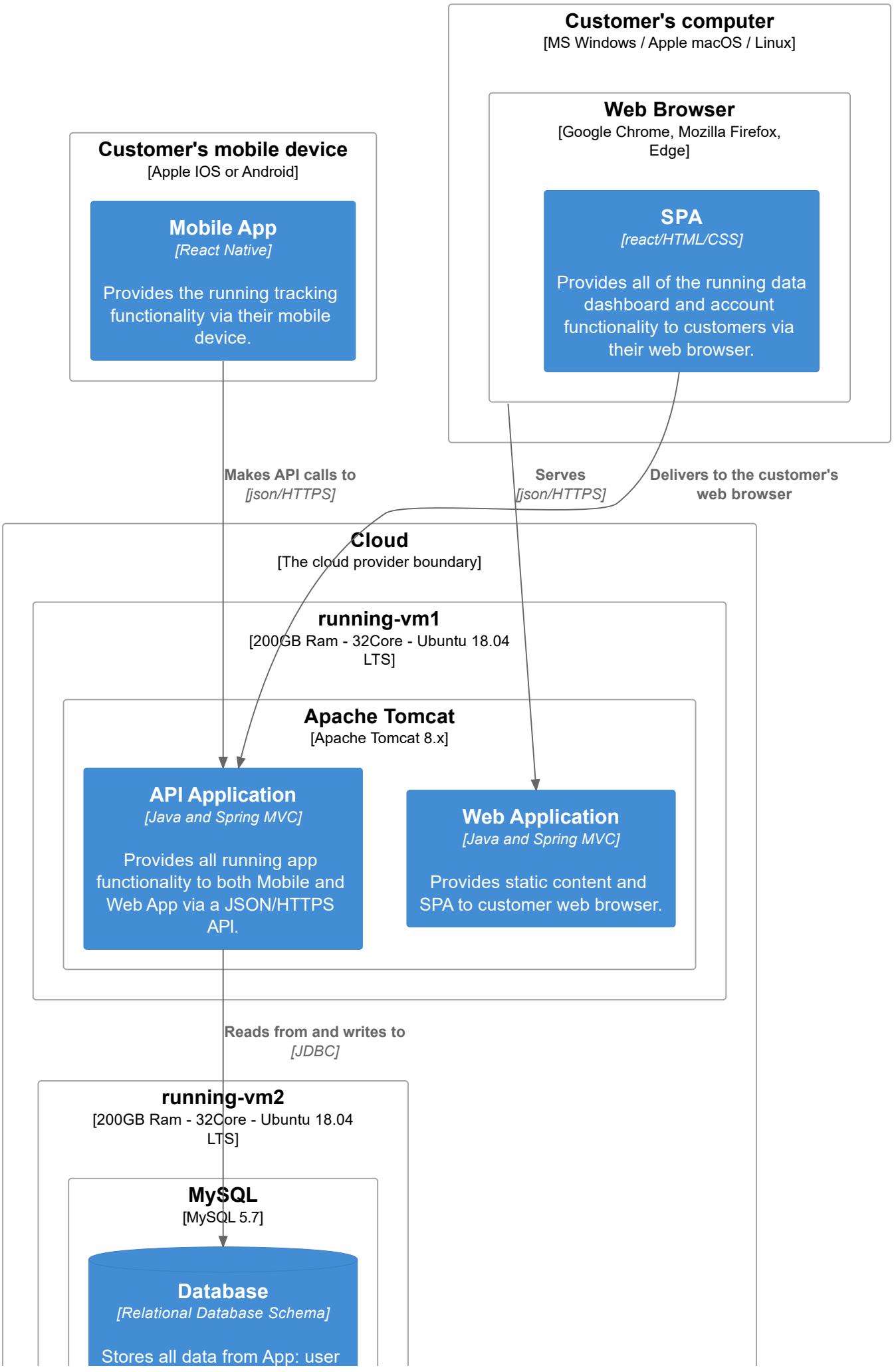
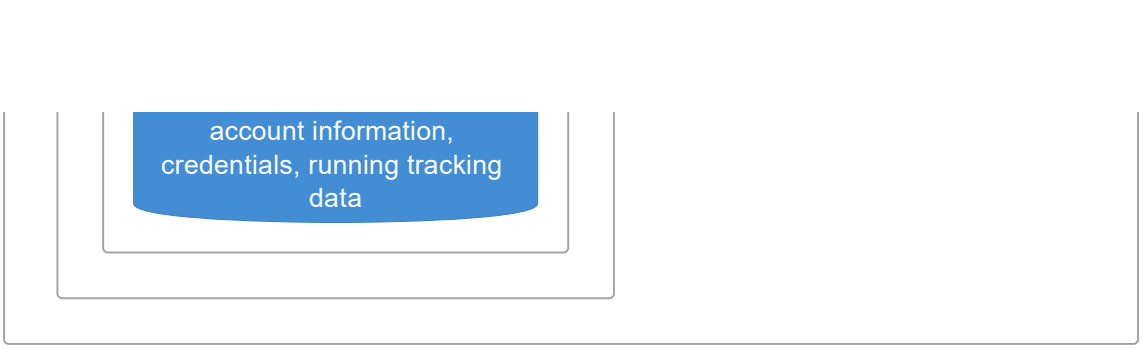
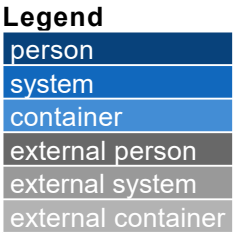

Customer's computer
[MS Windows / Apple macOS / Linux]
Web Browser
[Google Chrome, Mozilla Firefox, Edge]
SPA
[react/HTML/CSS]
Provides all of the running data dashboard and account functionality to customers via their web browser.
Customer's mobile device
[Apple IOS or Android]
Mobile App
[React Native]
Provides the running tracking functionality via their mobile device.
Makes API calls to
[json/HTTPS]
Serves
[json/HTTPS]
Delivers to the customer's web browser
Cloud
[The cloud provider boundary]
running-vm1
[200GB Ram - 32Core - Ubuntu 18.04 LTS]
Apache Tomcat
[Apache Tomcat 8.x]
API Application
[Java and Spring MVC]
Provides all running app functionality to both Mobile and Web App via a JSON/HTTPS API.
Web Application
[Java and Spring MVC]
Provides static content and SPA to customer web browser.
Reads from and writes to
[JDBC]
running-vm2
[200GB Ram - 32Core - Ubuntu 18.04 LTS]
MySQL
[MySQL 5.7]
Database
[Relational Database Schema]
Stores all data from App: user





Deployment diagram

This section we view how containers in the static model are mapped to infrastructure.

Currently we have the mobile app installed on the client directly fetching data from the single API server instance. The executable files are hosted by the respective platform marketplaces.

There are two VM instances of 200GB RAM and 32vCPUs. On the first instance , we have:

- our web server that delivers a SPA app and static content to the web clients. The SPA then runs on the browser and communicates directly to the API.
- the API layer is also on the the first VM instance and receives all requests from reads and writes all data to the database.

The Database is installed on the second VM of the same size , and it runs a single MySQL database instance that is managed by our cloud services provider.

3 One Month Plan

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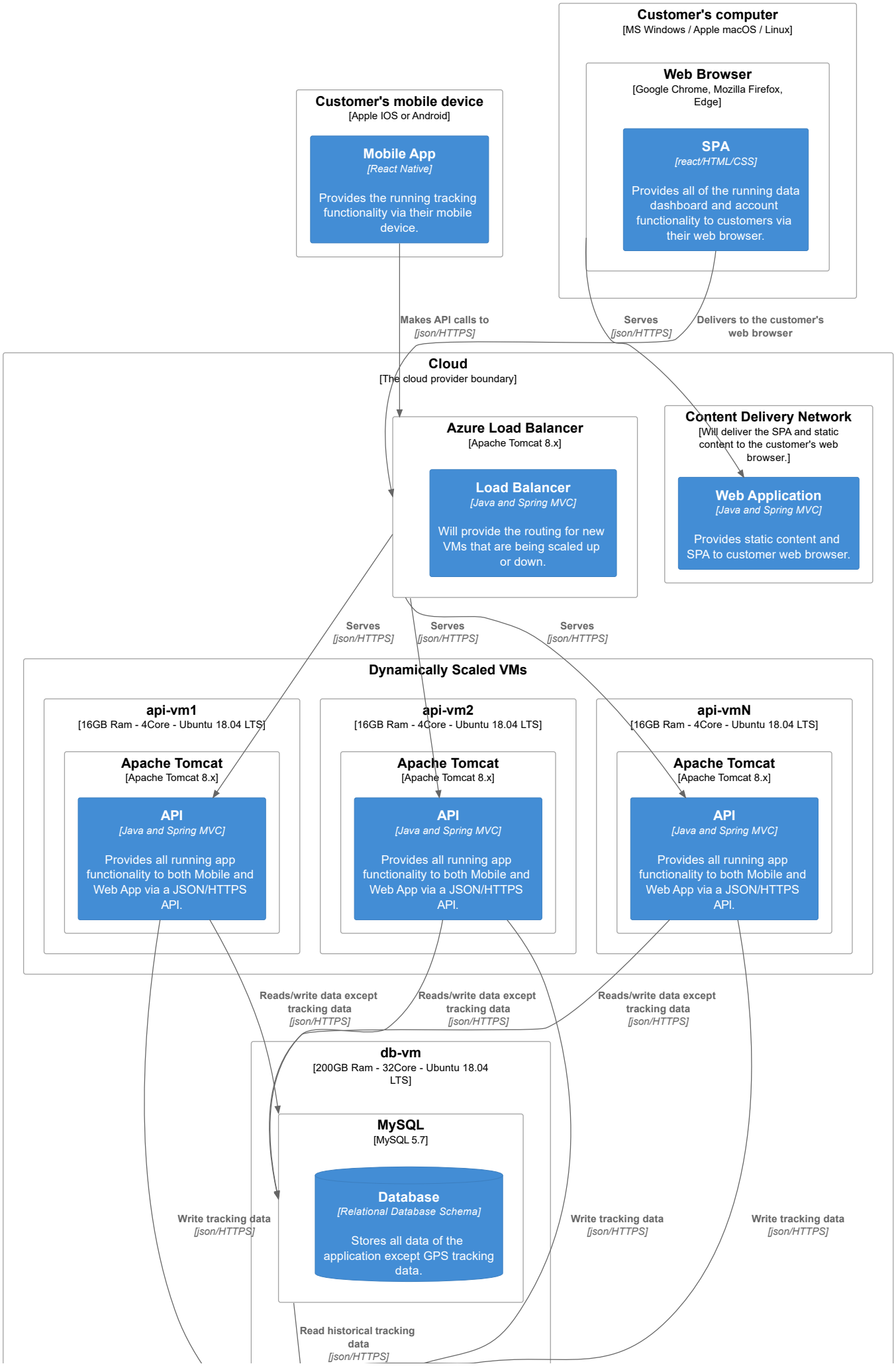
Customer's computer
[MS Windows / Apple macOS / Linux]
Web Browser
[Google Chrome, Mozilla Firefox, Edge]
SPA
[react/HTML/CSS]
Provides all of the running data dashboard and account functionality to customers via their web browser.
Customer's mobile device
[Apple IOS or Android]
Mobile App
[React Native]
Provides the running tracking functionality via their mobile device.
Makes API calls to
[json/HTTPS]
Serves
[json/HTTPS]
Delivers to the customer's web browser
Cloud
[The cloud provider boundary]
Azure Load Balancer
[Apache Tomcat 8.x]
Load Balancer
[Java and Spring MVC]
Will provide the routing for new VMs that are being scaled up or down.
Content Delivery Network
[Will deliver the SPA and static content to the customer's web browser.]
Web Application
[Java and Spring MVC]
Provides static content and SPA to customer web browser.
Serves
[json/HTTPS]
Serves
[json/HTTPS]
Serves
[json/HTTPS]
Dynamically Scaled VMs
api-vm1
[16GB Ram - 4Core - Ubuntu 18.04 LTS]
Apache Tomcat
[Apache Tomcat 8.x]
API
[Java and Spring MVC]
Provides all running app functionality to both Mobile and Web App via a JSON/HTTPS API.
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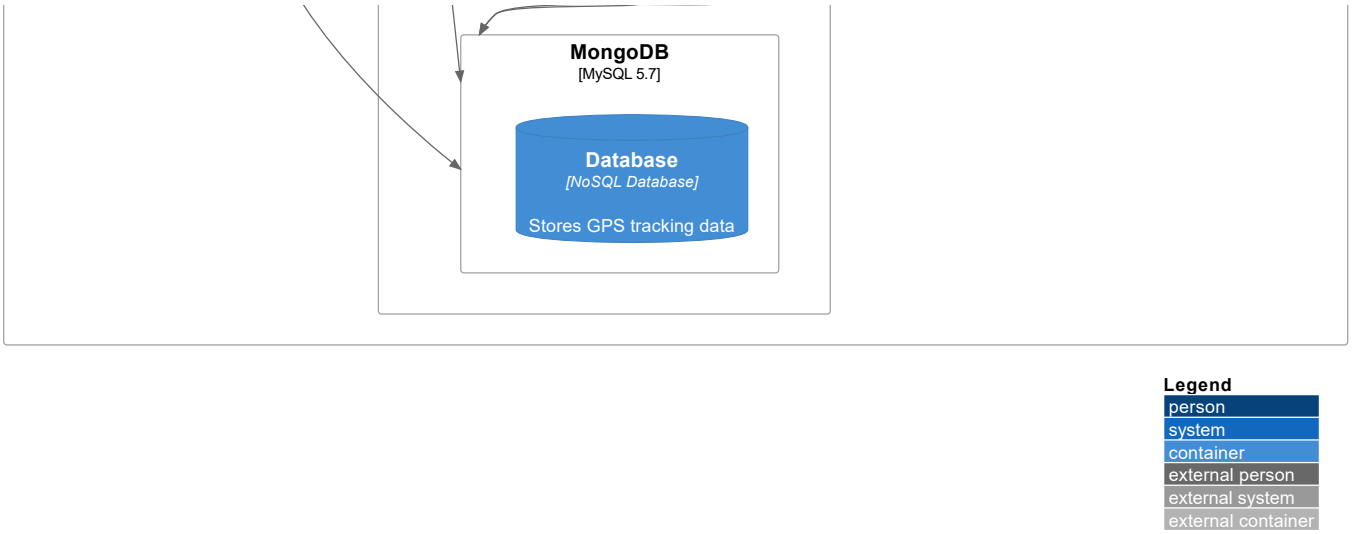
api-vmN
[16GB Ram - 4Core - Ubuntu 18.04 LTS]
Apache Tomcat
[Apache Tomcat 8.x]
API
[Java and Spring MVC]
Provides all running app functionality to both Mobile and Web App via a JSON/HTTPS API.
Reads/write data except tracking data
[json/HTTPS]
Reads/write data except tracking data
[json/HTTPS]
Reads/write data except tracking data
[json/HTTPS]
db-vm
[200GB Ram - 32Core - Ubuntu 18.04 LTS]
MySQL
[MySQL 5.7]
Database
[Relational Database Schema]
Stores all data of the application except GPS tracking data.
Write tracking data
[json/HTTPS]
Write tracking data
[json/HTTPS]
Write tracking data
[json/HTTPS]
Read historical tracking data
[json/HTTPS]



One Month Attack Plan

Analyzing our users habits, we can notice that most of them follow conventional running times of early morning and end of day. This is causing our servers to be overloaded at these times and vastly underutilized the rest of the day, specially at night.

To improve the user experience for our consumers, we will do the following modifications to our architecture:

In order to maximize the elasticity of the resources, we will add a load balancing layer in front our API services and we will host this services into many more VMs to be able to scale up and down throughout the day. Due to this migration , we will be able to reduce the size of the actual VM Instance 1.

Also, the mobile app will be modified to send each individual point of the tracking data at a smaller intervals, therefore avoiding large chunks of data coming in at once. Therefore the "STOP RUN" functionality of our app will only carry the overall run directly to the dashboard tables processed at the client mobile phone.

For the Database server we will create a second Database responsible for write-intensive GPS tracking data that is provided on each run coming from the mobile apps via API. Each run will then have the entry to the overall data on the dashboard tables but if the client want to view the exact tracking of the run it will be linked to this data. This aims to remove the write overhead from the tables that are currently responsible for the tracking data separating it from the read part of the application.

4 Long Term Plan

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\4 Long Term Plan
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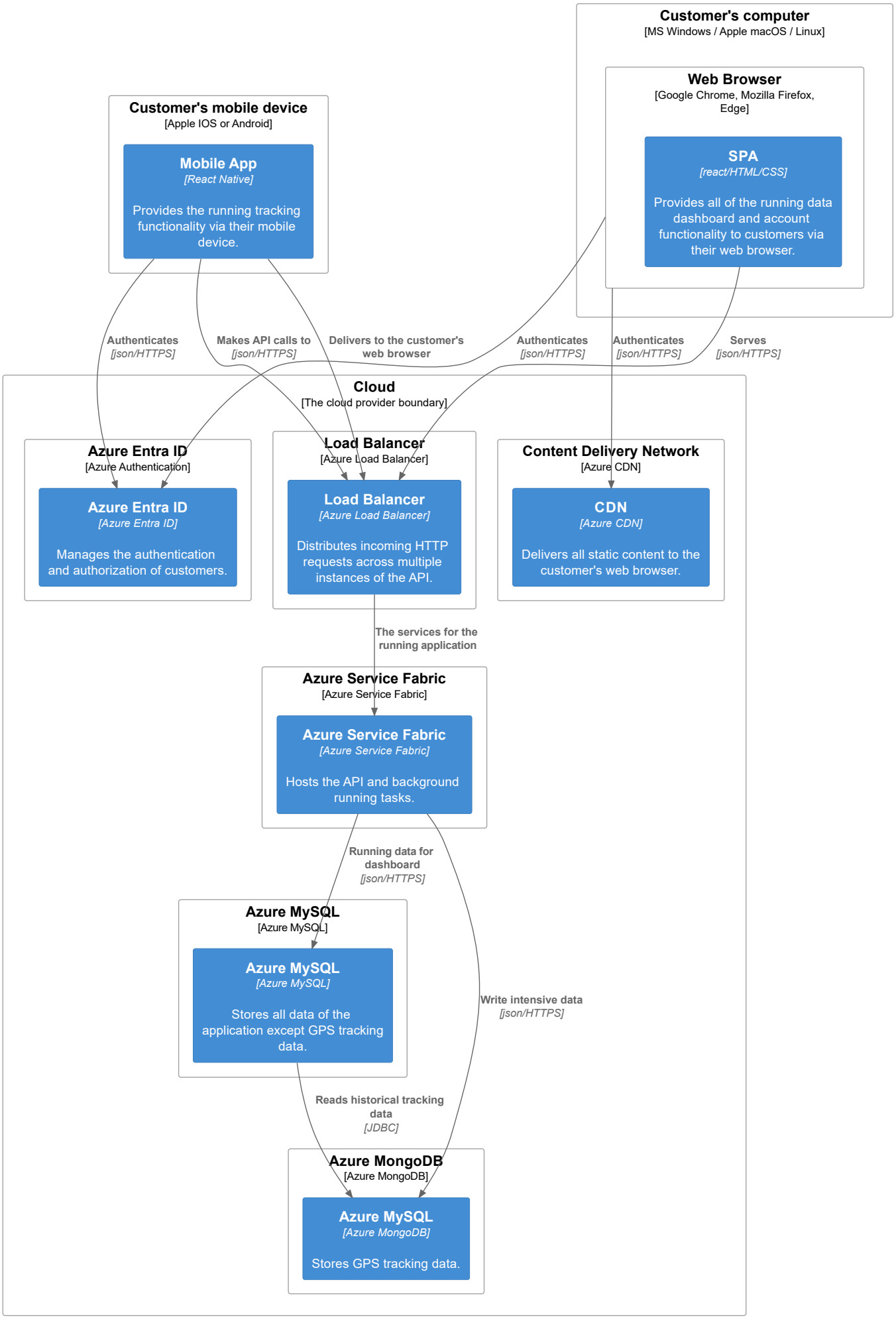
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Provides all of the running data dashboard and account functionality to customers via their web browser.
Customer's mobile device
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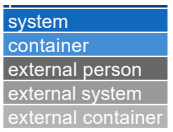
Provides the running tracking functionality via their mobile device.
Authenticates
[json/HTTPS]
Makes API calls to
[json/HTTPS]
Delivers to the customer's web browser
Authenticates
[json/HTTPS]
Authenticates
[json/HTTPS]
Serves
[json/HTTPS]
Cloud
[The cloud provider boundary]
Azure Entra ID
[Azure Authentication]
Azure Entra ID
[Azure Entra ID]
Manages the authentication and authorization of customers.
Load Balancer
[Azure Load Balancer]
Load Balancer
[Azure Load Balancer]
Distributes incoming HTTP requests across multiple instances of the API.
Content Delivery Network
[Azure CDN]
CDN
[Azure CDN]
Delivers all static content to the customer's web browser.
The services for the running application
Azure Service Fabric
[Azure Service Fabric]
Azure Service Fabric
[Azure Service Fabric]
Hosts the API and background running tasks.
Running data for dashboard
[json/HTTPS]
Azure MySQL
[Azure MySQL]
Azure MySQL
[Azure MySQL]
Stores all data of the application except GPS tracking data.
Write intensive data
[json/HTTPS]
Reads historical tracking data
[JDBC]
Azure MongoDB
[Azure MongoDB]
Azure MySQL
[Azure MongoDB]
Stores GPS tracking data.
Legend
person



One Month Attack Plan

Having solved the most immediate problems and having more time to work, we can actually fine tune this architecture and utilize more of the cloud resources, moving all services to the cloud. We will use Azure as an example but all cloud providers have the same services , only under different names.

For client authentication we can move all IDs to Azure Entra ID and manage all authentication and authorization directly at the cloud.

In order to maximize the elasticity of the resources, scaling up at peak hours and scaling down at night, we will convert all API layer into Azure Service Fabric services. Due to this migration , we will be able to get rid of the overhead of managing the virtual machines and use our service directly on the cloud, while reducing costs even more.

Since our services are still scalable , we will still need a load balancer layer to manage the many instances running

Also, the mobile app will be modified to send each individual point of the tracking data at a smaller interval, therefore avoiding large chunks of data coming in at once. Therefore the "STOP RUN" functionality of our app will only carry the overall run directly to the dashboard tables.

For the Database server we will create a second Database responsible for write-intensive GPS tracking data that is provided on each run coming from the mobile apps via API. This aims to remove the load from the tables that are currently responsible for read operations of dashboard data.