Bordeaux INP
ENSEIRB
MATMECA

Distributed Geolocalisation System based on OpenStreetMap

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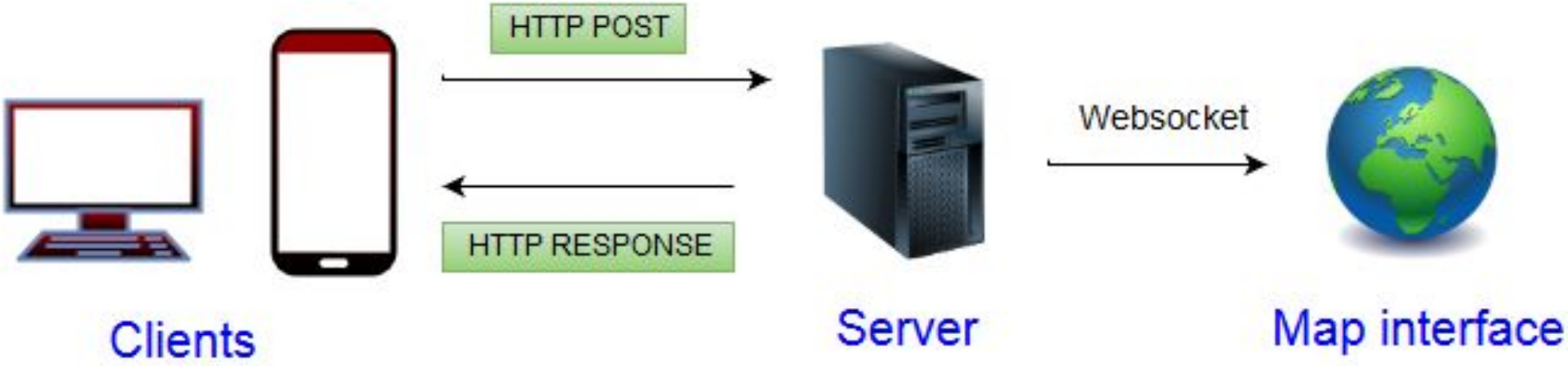
Introduction

Aim : Simulate the movements of vehicles on a defined geographic zone.

- Every group manage its own server
- The servers must interact with each other (manage different zones)
- Real time simulation of vehicles in each area

→ Necessity of a common communication protocol

Overview


HTTP POST
HTTP RESPONSE
Websocket
Clients
Server
Map interface

Communication Protocol

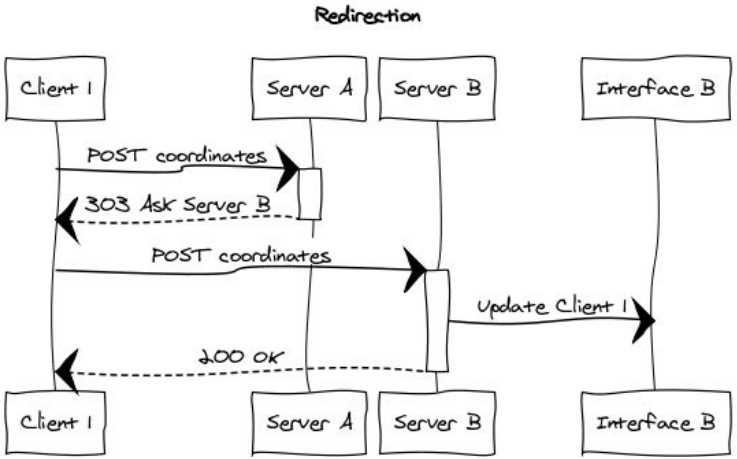
Several rules have been established:

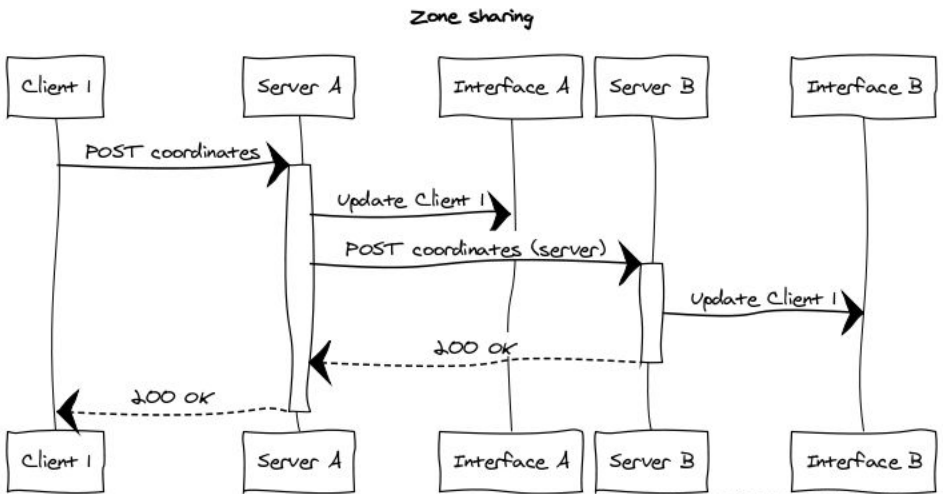
- Unique file/message format (JSON)
- HTTP messages

Client-Server and Server-Server protocol have been specified:

- Identification of the client default server
- Server’s response: ok, redirect, error

Interactions





Server

- Node.js + Express.js
  - Javascript
    - same language for the interface
    - easy JSON (de)serialisation
    - asynchronous events
  - Web framework
    - routing
    - templates
- Client messages validation (Joi)
  - security
  - robustness

```
server:
      host: string (IP:port)
      zone:
            minlat: float (-90 to 90)
            maxlat: float (-90 to 90)
            minlon: float (-180 to 180)
            maxlon: float (-180 to 180)

client:
      ID: string
      Position:
            lat: float (-90 to 90)
            lon: float (-180 to 180)
```

Real-time visualisation

- HTML5 websockets
  - real-time updates
  - asynchronous
  - bidirectional
- Web browser is a display client
- Leaflet.js
  - open-source library
  - interactive javascript maps

The server pushes changes to the interface in real-time on each client request.

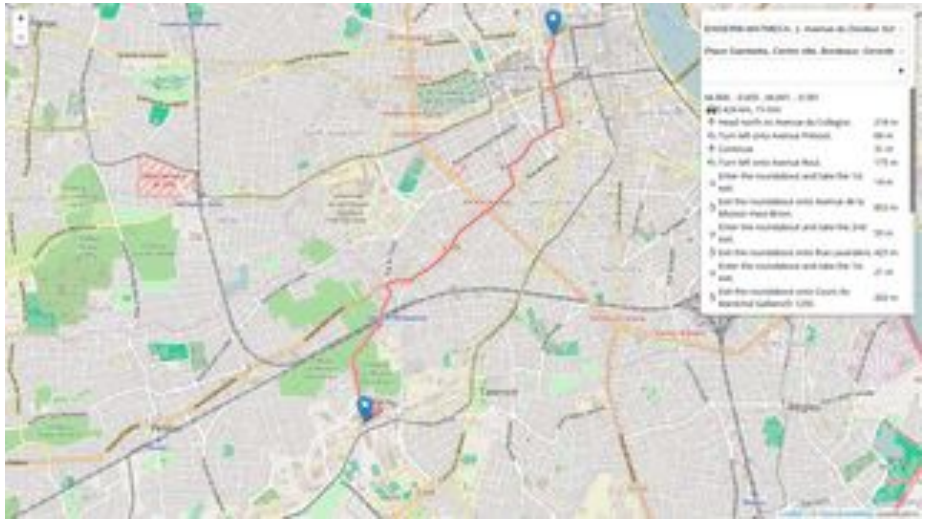
Client

- Simulate car movements and send the positions to the server
- Simulate movement: Algorithms, Routing service, GPS
- 2 clients implemented: Pyroutelib, Mapzen

Pyroutelib

- Pyroutelib computes the shortest path
  - Efficient and fast for short distances
  - Slow-down or crash for longer distances
- Displays progress

Mapzen



- Leaflet Routing Machine
  - OpenStreetMap tiles
  - Mapzen Routing API
  - Nominatim geocoding
- Compute each steps average speed
  - travel time from Mapzen
  - distance with *harvesine*
- Game loop
- Regular position post to the server

Difficulties

- Security
  - browsers implements Cross-Origin Resources Sharing
  - redirections are not allowed with CORS
  - solution: local proxy server (all requests to the local host)
- Protocol
  - redirection after a POST => redirect GET request response
  - solution: check request and response methods/uri
- Possible enhancements
  - redirections are OK (200 status code)
  - JSON response can contain a precise status (prevent interference with HTTP)

Conclusion

- Network programming techniques
- Multiple clients implementations
- Two programing languages/paradigms and multiple libraries
- Exchange between teams
- Security checks and safety
- Cartography