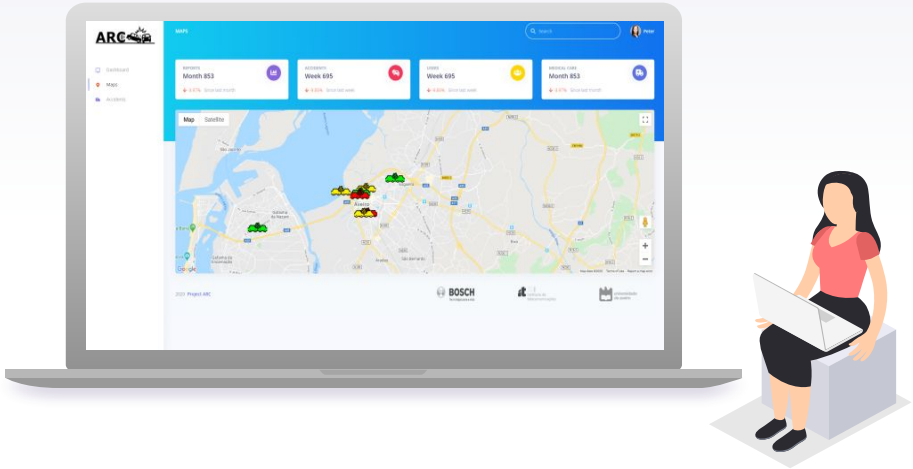
V2X: Emergency Medical Service



Authored by

Lúcia Sousa, Manuel Couto, Rafael Dias,
Raquel Pinto, Rodrigo Martins

Under the guidance of

Susana Sargento, Pedro Rito, Miguel Luís

PEI 2020/2021

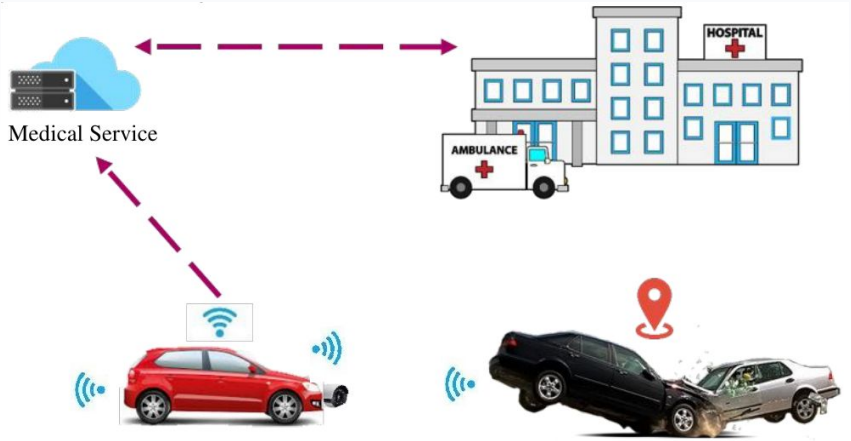
universidade de aveiro

instituto de telecomunicações

BOSCH
Tecnologia para a vida

Context and state-of-the-art

- Using V2X enabled vehicles and gateways with cellular communications.
- When an accidented vehicle is detected, the gateway assembles and sends this information to a dedicated dashboard handled by emergency service operators.
- This process occurs almost instantaneously.
- CAMs (**C**ooperative **A**wareness **M**essage)
- DENMs (**D**ecentralized **E**nvironmental **N**otification **M**essage)



Vehicular Communications

A nearby car gets closer to the accident

A vehicle near the accident **starts livestream.**

3

Gateway selected and start livestream

2

Gateway is selected based on a **new algorithm.**

Information is sent to Infrastructure

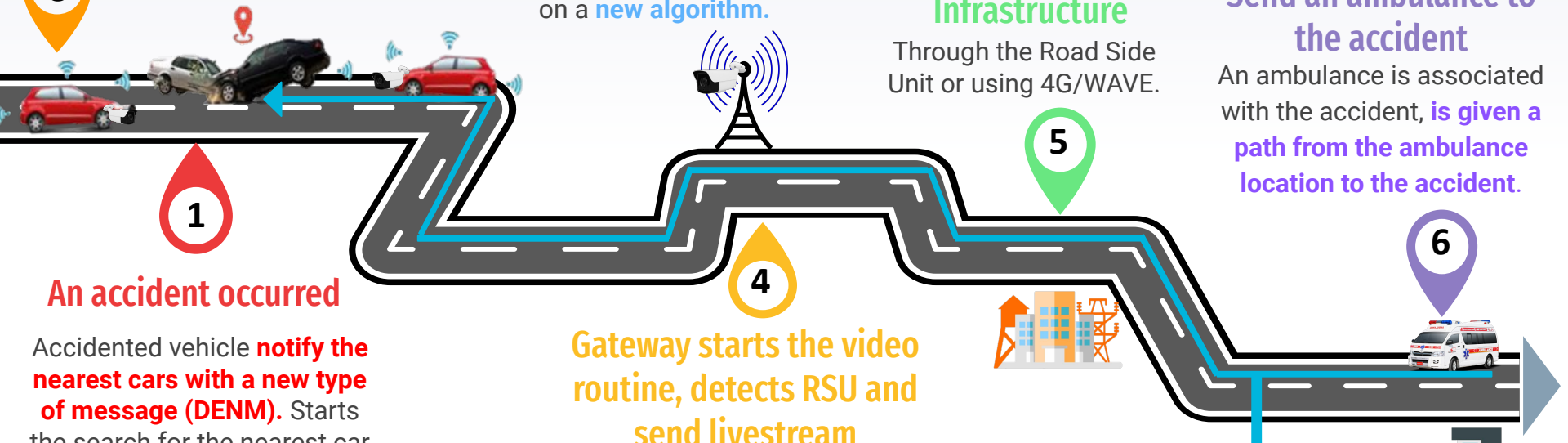
Through the Road Side Unit or using 4G/WAVE.

5

Send an ambulance to the accident

An ambulance is associated with the accident, **is given a path from the ambulance location to the accident.**

6



1

An accident occurred

Accidented vehicle **notify the nearest cars with a new type of message (DENM).** Starts the search for the nearest car to use as the gateway.

4

Gateway starts the video routine, detects RSU and send livestream

If the vehicle does not find an RSU the information is sent via 4G. **Start livestream of a nearby street camera, if found.**

Path for the ambulance.

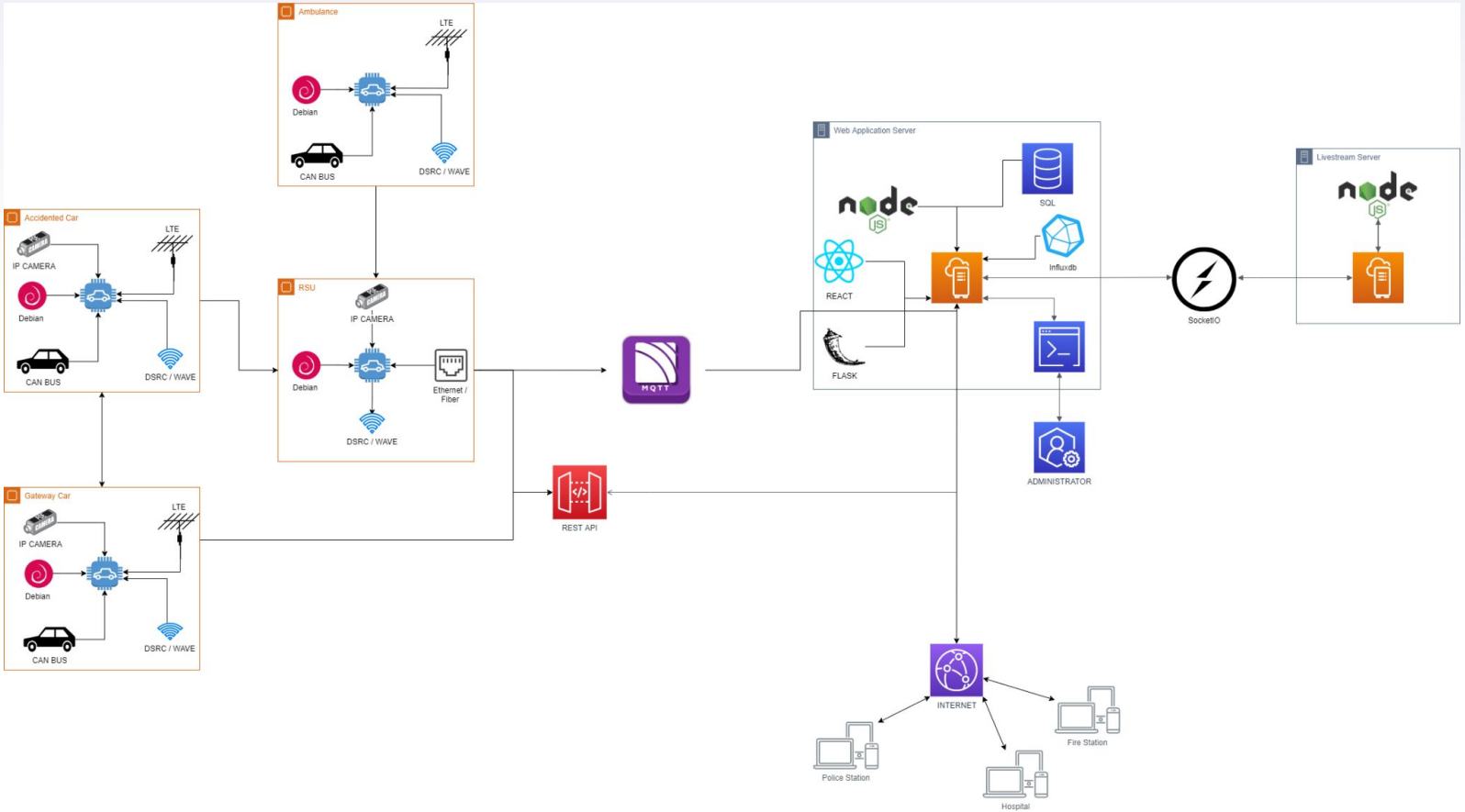
Goals

Reduce the response time of emergency services when an accident occurs.

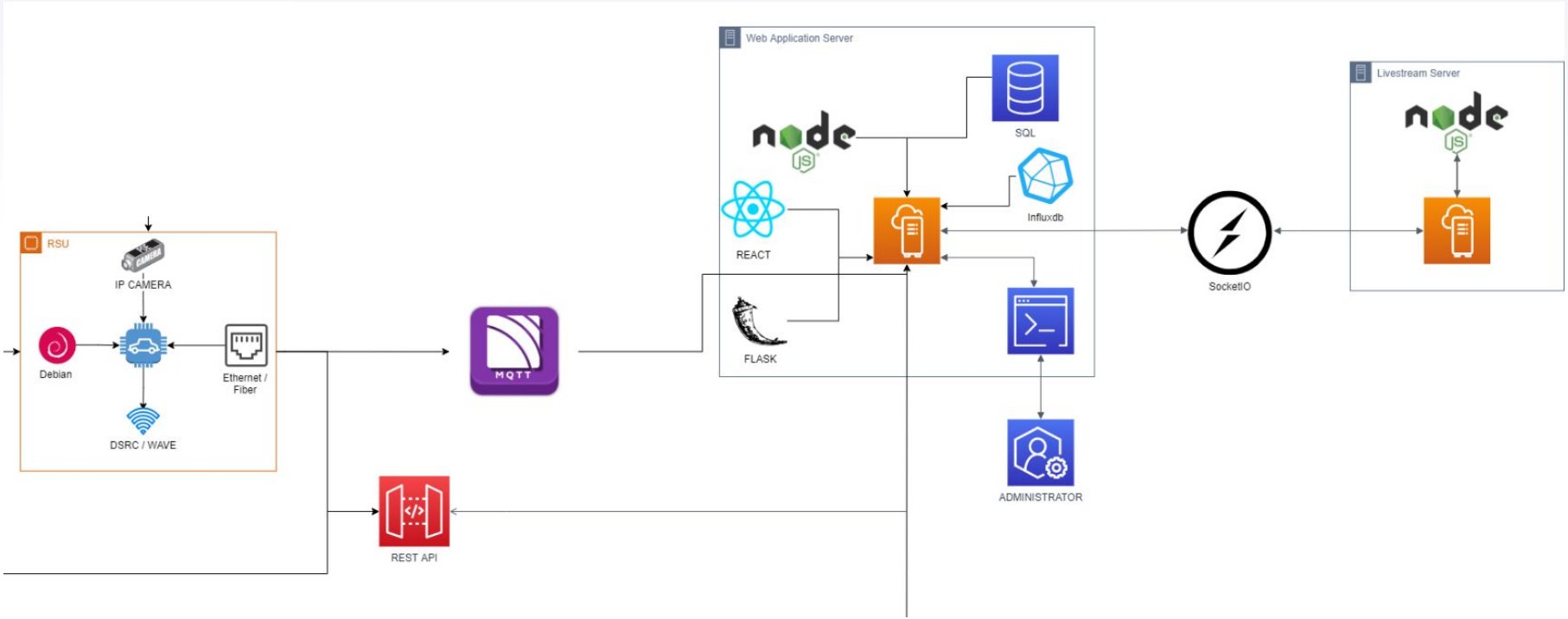
Video and data, containing only relevant images and information.

Implement more relevant features to the web app.

Deployment diagram



Web App deployment diagram



Detection of CAMs and DENMs

Packet filter

Filters all network packages and gives information to the algorithm function

UDP Tunnel

Only CAMs and DENMs are allowed to pass the filter

Algorithm

Hardware Used

OBU (**O**n**B**oard **U**nit)

GPS Module

Ip Camera

Communication between Cars

CAM - Cooperative Awareness Message

Allows OBUs to detect the presence of nearby cars

Communication between Cars when the accident happens

DENM - Decentralized Environmental Notification Message

Allows OBUs to notify nearby cars and RSUs that they had an accident

Communication module

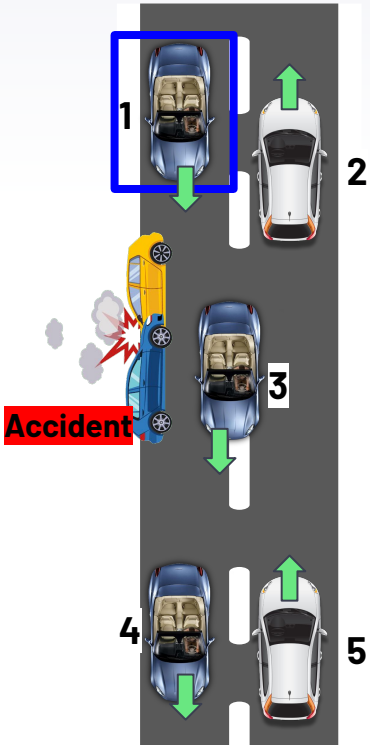
- Sends CAMs periodically (10 times per second);
- Sends 1 DENM when detects an accident;
- CAMs and DENMs are standard;
- The DENM message contains all the relevant information about the accident;
- CAMS and DENMs are no longer hardcoded.

Gateway selection algorithm

```
function gateway_selection(CAMs, DENM)
for CAM in CAMs
        d = distance(DENM.lat, DENM.lon, CAM.lat, CAM.lon)
        comp_heading = comp(DENM.heading, CAM.heading)
        if(pos < 0 AND distance >= 10 AND CAM.speed > 0)
                score(CAM)
                camData.insert({station_id,infoCam} )
        camData.sort()
```

- The cars will be evaluated based on their heading, position, distance and velocity;
- This way the car closest to the accident and with the lowest speed will be chosen.

Tests and Results



Discarded cars: 2,3,4
Possible gateways: 1, 5
Gateway Selected: 1

Camera submodule

- Ability to provide livestream to the Web App.
- Livestream ends if the car moves 50 meters away from the accident.
- Send video of the accident

Performance results

Base Communication Module Results

	Emergency Message Upload (s)	Gateway Selection (s)	Video Encode (s)	Video Upload (s)
Average Time	2.37324	1.70E-03	1.92344	3.29992
Standard Deviation	0.68770	1.63299E-04	0.06771	1.07851
95% Confidence	0.42624	1.01212E-04	0.04196	0.66845

New Communication Module Results

	DENM Upload (s)	Gateway Selection (s)	Link RTSP Upload (s)
Average Time	0.24896	4.258246E-04	0.01619988
Standard Deviation	0.04512	4.00E-05	0.00071
95% Confidence	0.24896	4.258246E-04	0.0161998

Performance results

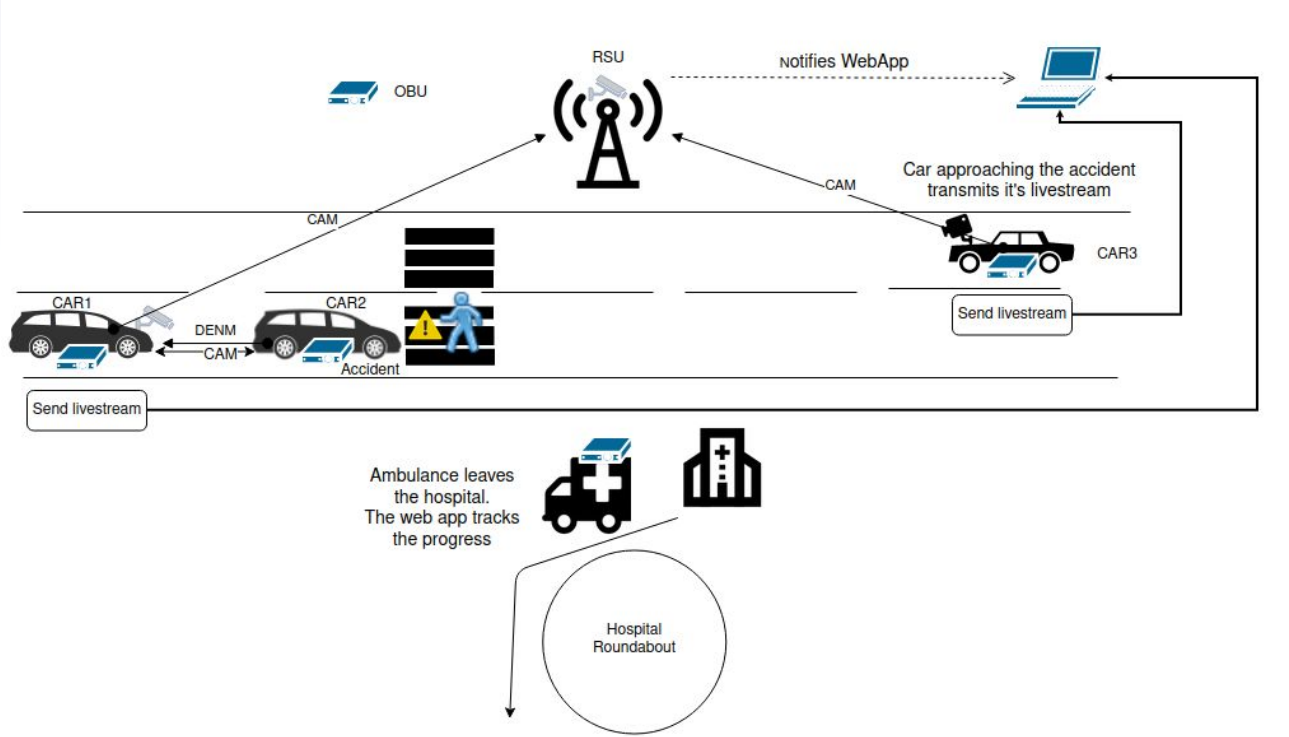
Live Location Tracker Results

	Decode (s)	Insert (s)
Average Time	1.11E-05	0.9836583138
Standard Deviation	1.288175384E-05	0.9969841458

Dependencies and Assumptions

- A permanent internet connection is needed for the emergency services to access all the data;
- A server capable enough to handle all the information;
- The hardware can't be damaged when the accident happens;
- The emergency vehicles must be able to send CAM messages to inform where they are located.
- All the vehicles and nearby photoage sources involved (crashed cars, gateway vehicle & street cameras) must be equipped with a vehicular communication system;
- A camera needs to be integrated on the gateway vehicle in order to record images of the accident;

Video Conditions



Project video

Link: https://youtu.be/aJ7VuirHihY

Discussion

- The goals were achieved;
- Improved performance times;
- Future Work:
  - Create a dataset for statistics regarding accidents on the front page: how many accidents per month and per district;
  - Text and Video Chat with emergency services;
  - Better signposting of congested areas;
  - Improve database queries.

THANKS!

Any questions?