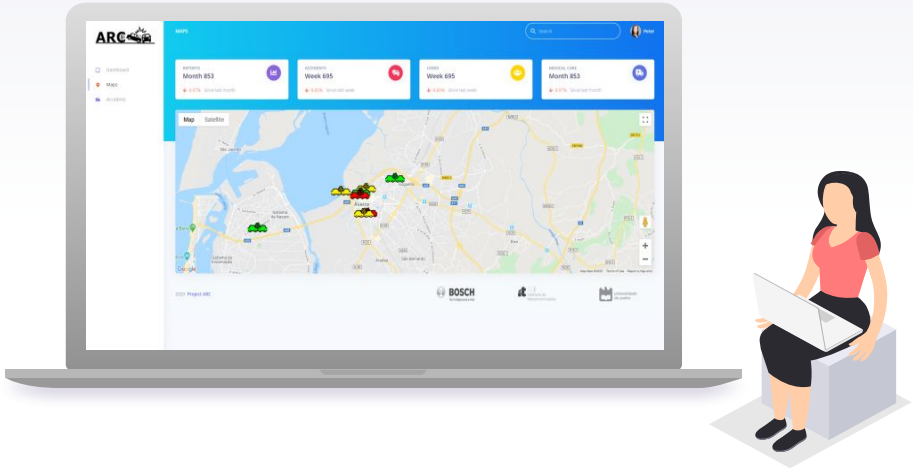
V2X: Emergency Medical Service



Authored by

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

Under the guidance of

Susana Sargento, Pedro Rito, Miguel Luís

universidade de aveiro

25 YEARS instituto de telecomunicações

BOSCH
Tecnologia para a vida

Context and state-of-the-art

- The management team needs to deploy and configure the web application in the emergency institution;
- Create all the necessary user and administrative accounts;
- Review error logs;
- Update the system.

When an accident happens, the selected team will receive a notification:

- Review the data sent and assess the gravity of the accident;
- Send what means they deem necessary ranging from police officers, paramedics and, firefighters -> it will be possible to see them heading to the scene in the webapp.

Context and state-of-the-art

5GCar:

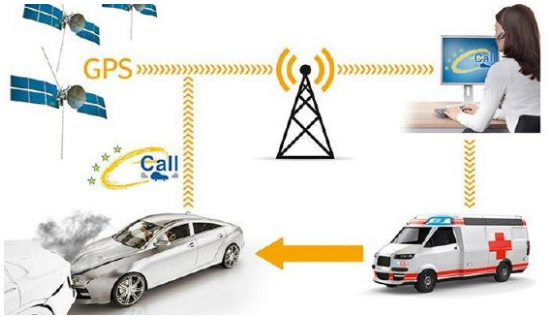
- European driving aid project;
- Detects vulnerable road users;
- Warn cars of their position to avoid collisions.

eCall:

- European initiative;
- When it detects an accident it sends a message to the 112 number with some information attached.

Backscatter communication (Boosting Crosswalk Awareness):

- Warning cars when a nearby zebra crossing is in use;
- Passive sensors;
- Communicate with cars through vehicle networks.



Requirements Gathering

To gather as many ideas as possible and identify viable solutions to our problem:

- Find related work; 
- Meetings with the colleagues who developed the previous version of the system to understand what we have in hands. 
- A brainstorm was performed; 

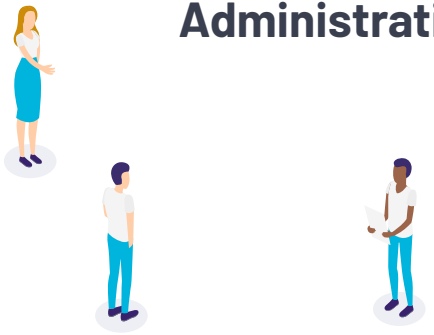
After that we decided to add new features like:

- Add denms - Decentralized Environmental Notification Messages
- Vehicle service — Module that sends messages
- Improve the gateway selection algorithm
- Add live location of emergency vehicles in web app maps
- Add new statistics about the accidents
- Add new car details such as number of persons in the car and their position

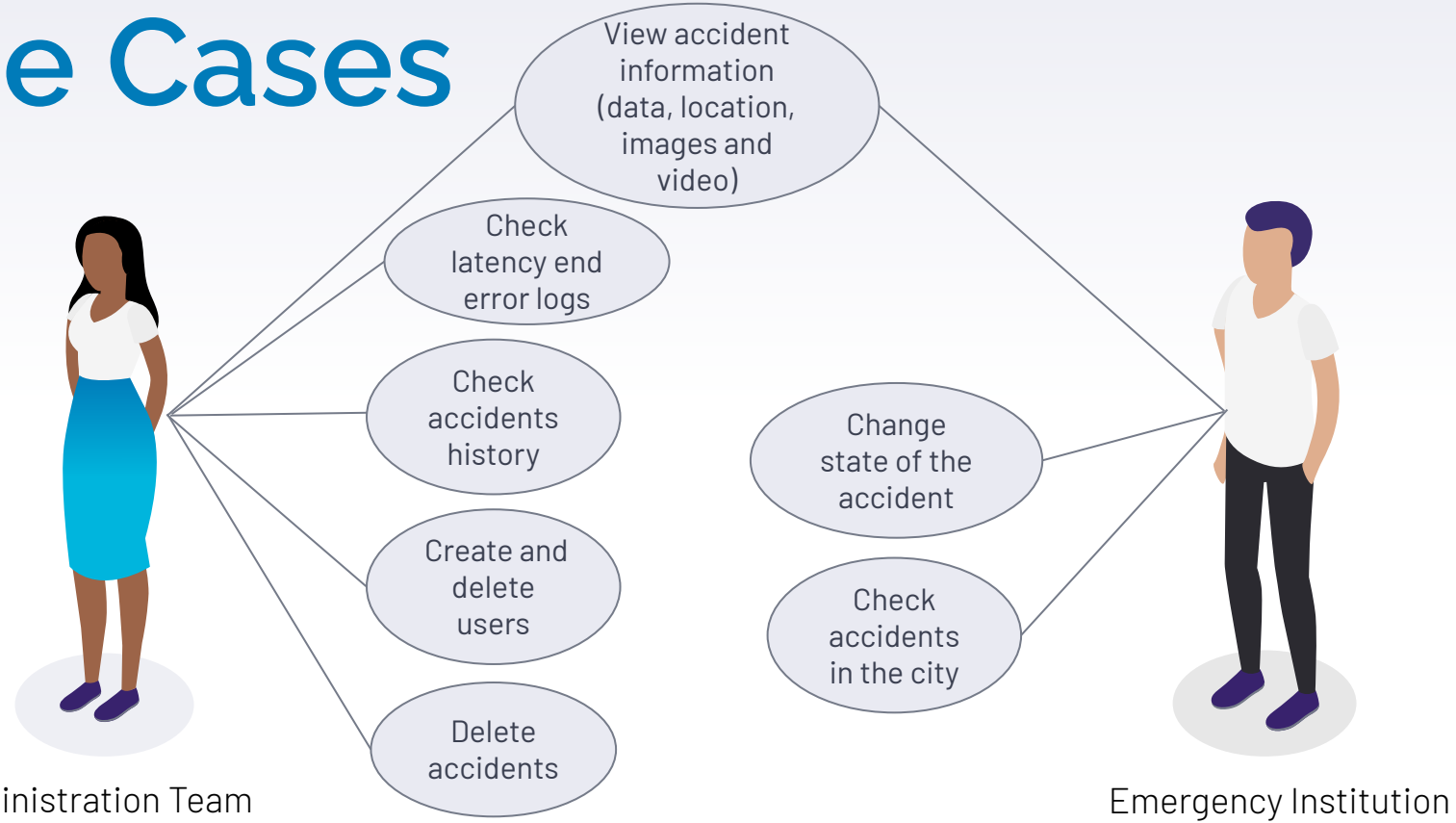
Actors

The target users are emergency institutions such as police, medical services and firefighters/paramedics.
The main actors are:

Emergency Institution Administration Team



Use Cases


View accident information (data, location, images and video)
Check latency end error logs
Check accidents history
Create and delete users
Delete accidents
Change state of the accident
Check accidents in the city
Administration Team
Emergency Institution

Functional requirements

- 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;
- Improve the decision algorithm of the gateway car for a relevant image of the accident;

Functional requirements

- To access the information that comes from the gateway vehicle, new functionalities must be created in a web app for that purpose;
- Receive up-to-date information for emergency services follow-up;
- There will be a separation of information to be shown to each user. Therefore, each user must have an account.

Non-functional requirements

- **Usability**: the web application must be easy to use so that the data is understood as quickly as possible by users;
- **Reliability**: The fact that the system handles emergency cases, has a direct impact on the importance of the system to perform its required functions without failing;
- **Efficiency**: the system must be able to process and display all the information from the accidented car to the web application in 5 seconds or less;

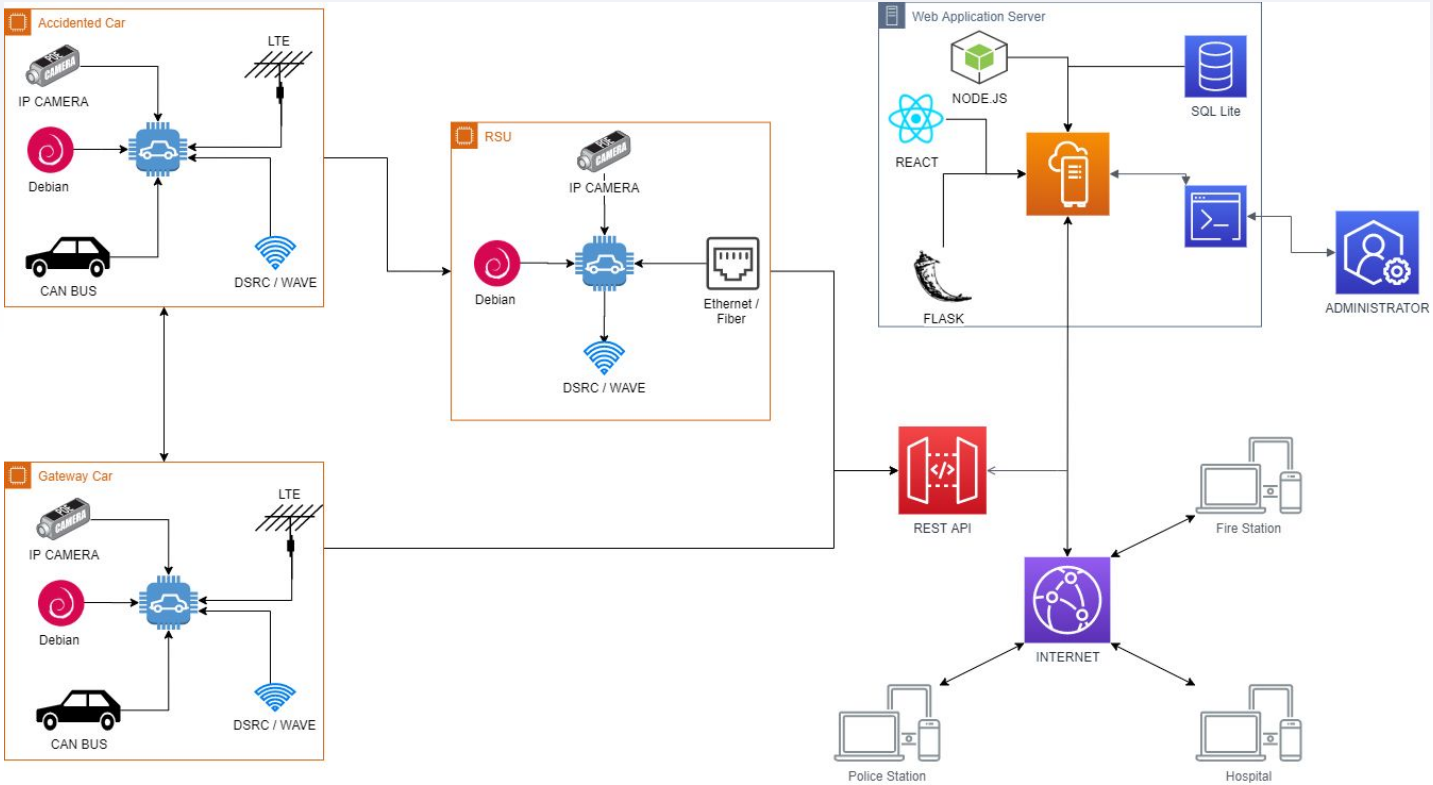
Non-functional requirements

- **Capacity**: the web app must be able to analyze and keep records of several accidents at the same time;
- **Availability**: since the system is designed to help in emergency situations it must have at least 99% uptime so that no help request is lost;
- **Security**: the web application and the roadside unit's internet interface must be secure and robust against attackers;
- **Recoverability**: in the event of a crash or malfunction, resetting should be easy and painless;
- **Maintainability**: the system and the web application should be easy to maintain and upgrade.

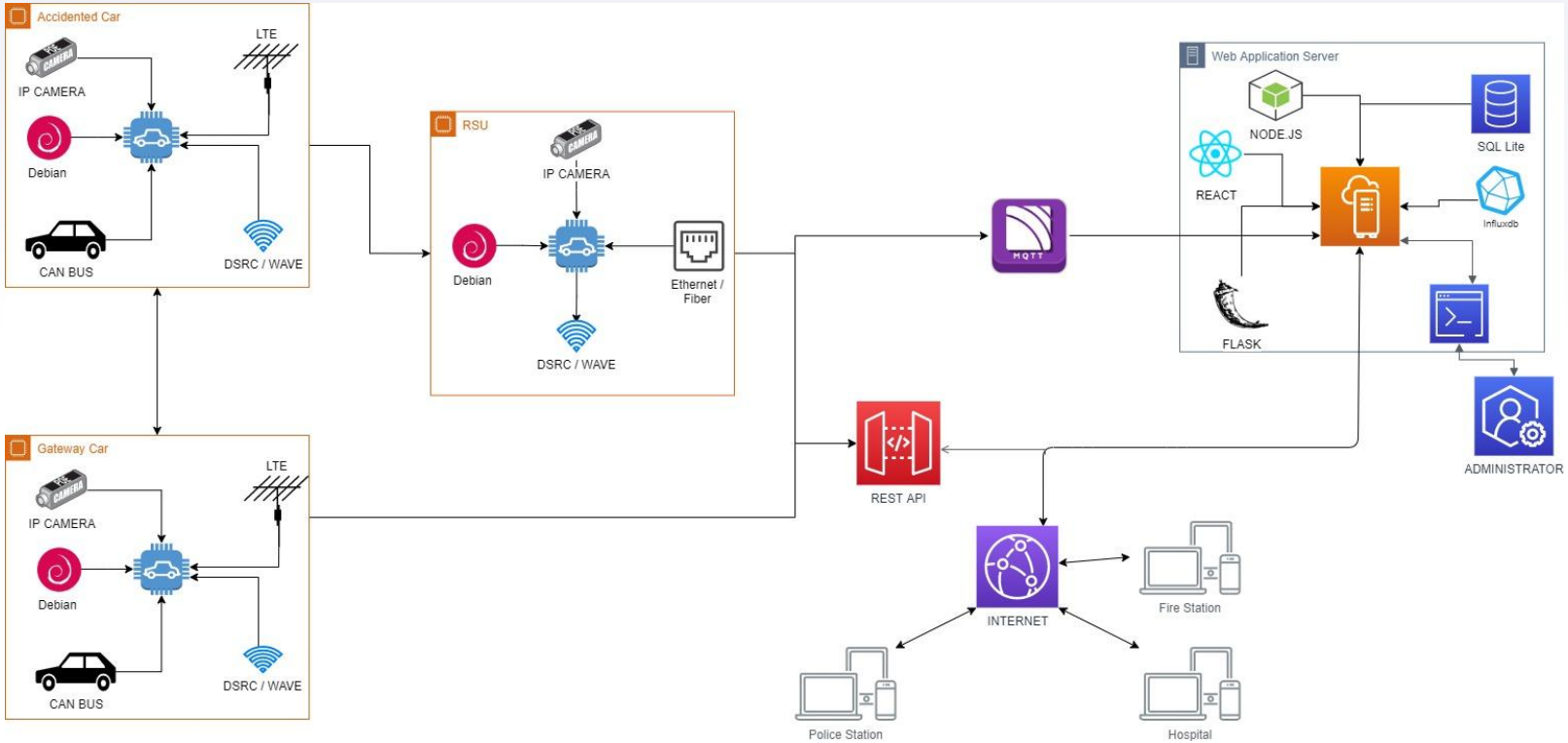
Dependencies and Assumptions

- 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.

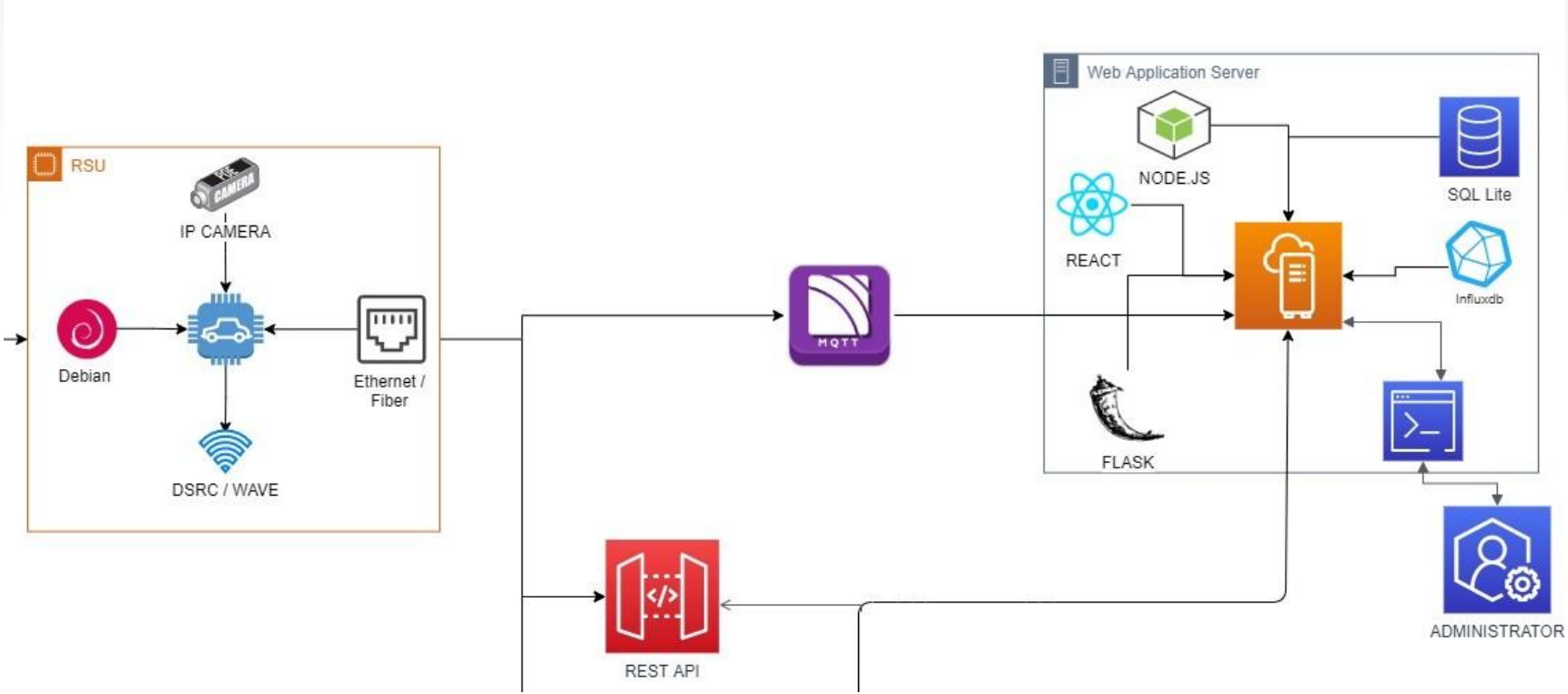
Base available diagram



Current deployment diagram



Web App deployment diagram



System Mock-up

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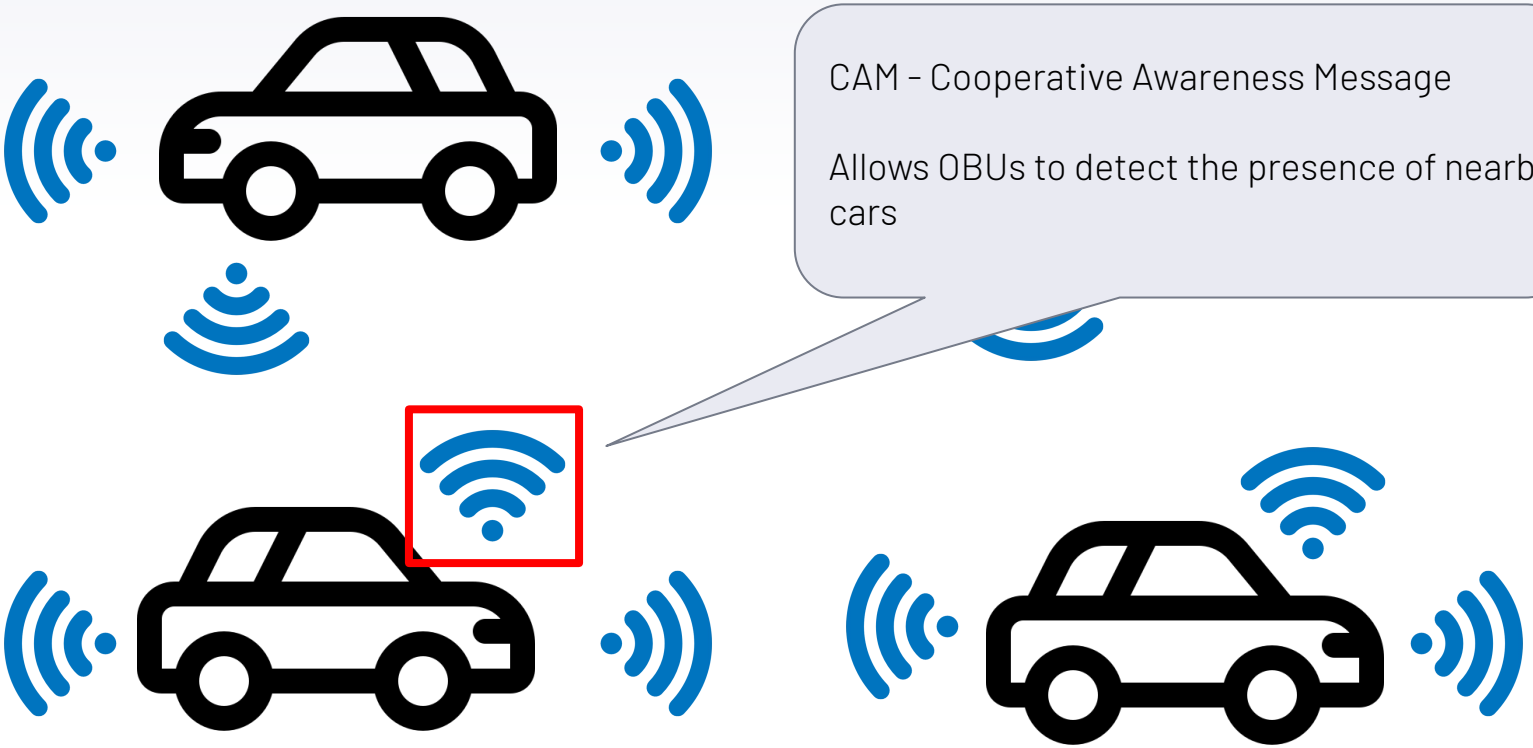

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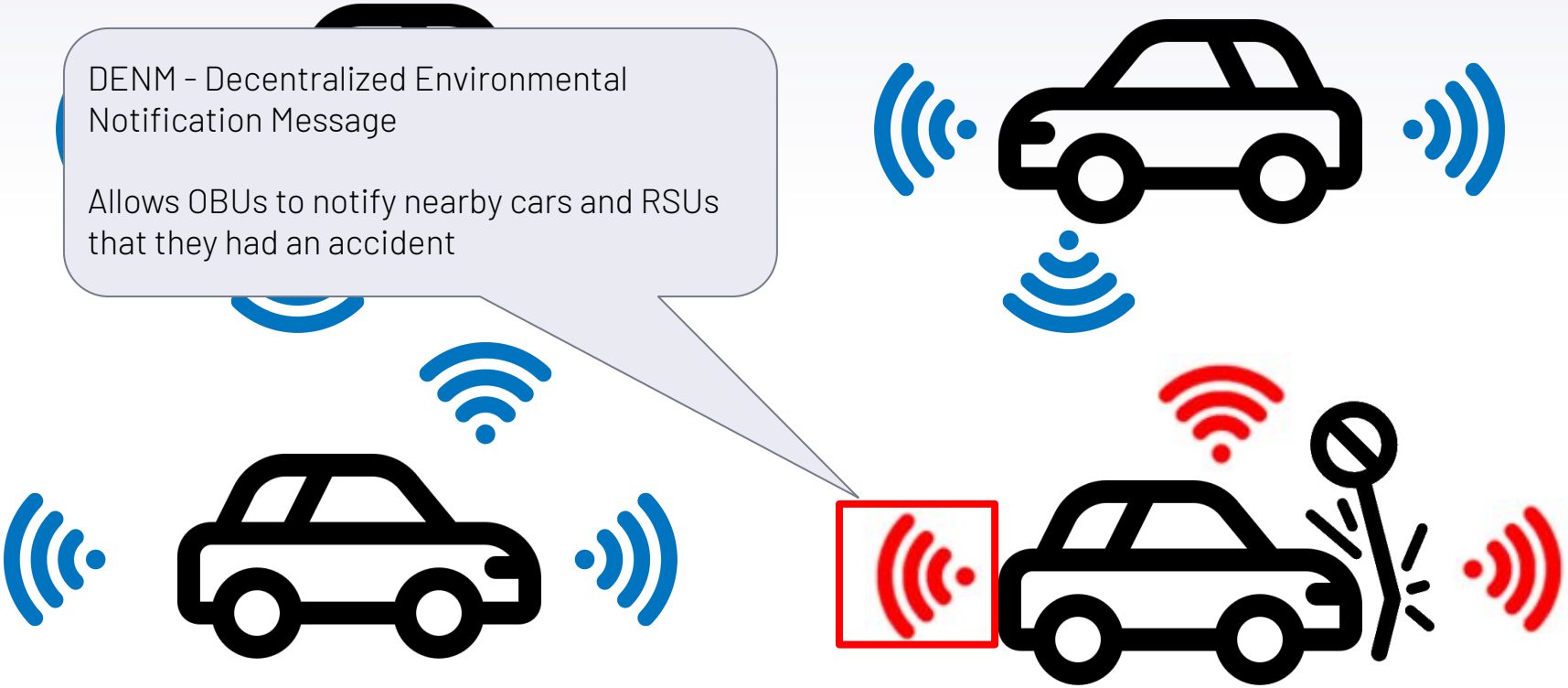
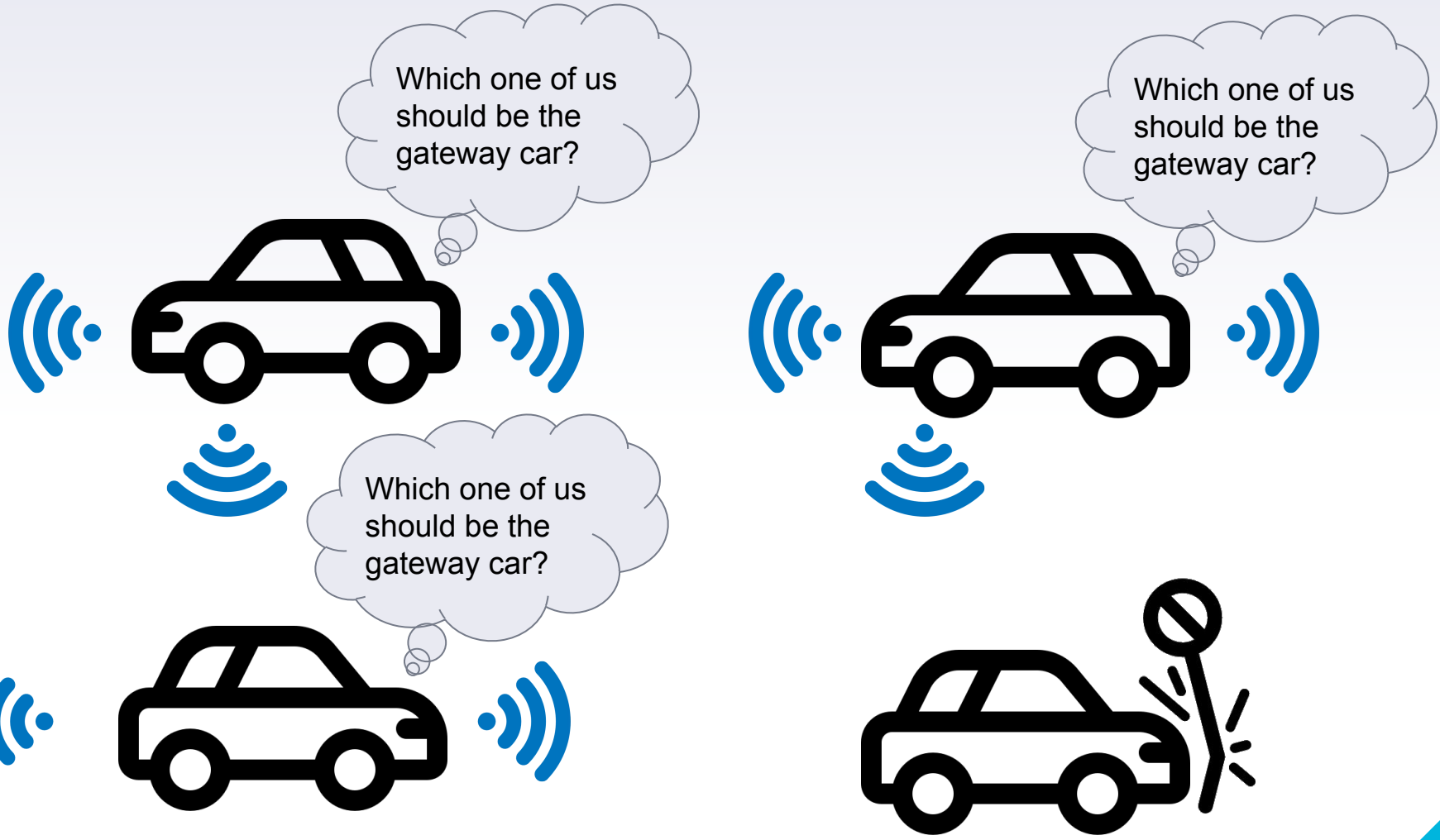


Base communication module

- Sends CAMs periodically (10 times per second)
- Useful information about the accident is inside an extra container in the CAM
- CAMs non standard

New 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


Which one of us should be the gateway car?
Which one of us should be the gateway car?
Which one of us should be the gateway car?

Base gateway selection algorithm

- The cars are evaluated based on the fact that they are behind the crashed car therefore this algorithm is only useful if there is a car behind the accident

New gateway selection algorithm

- Takes into account the path taken by all cars involved
- The cars will be evaluated based on their point of view during and before the accident
- This way the car with better footage will be chosen

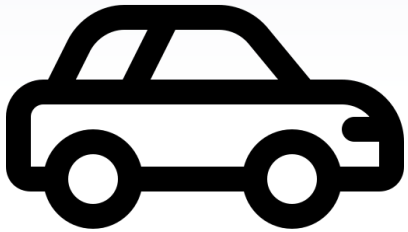
System Mock-up

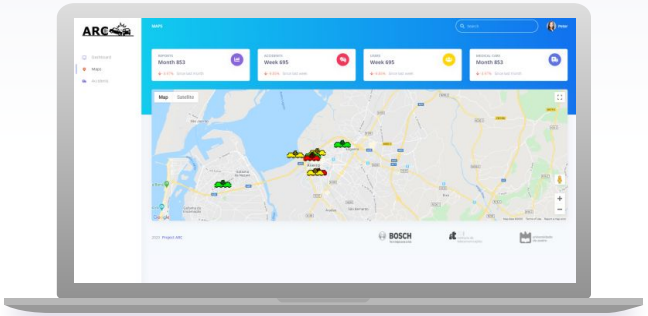
Base camera submodule

- Sends the last 12 seconds until the moment of the accident

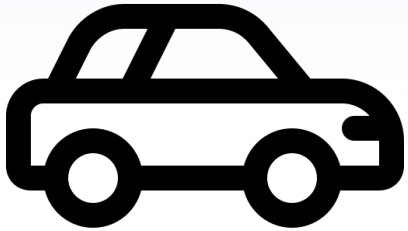
New camera submodule

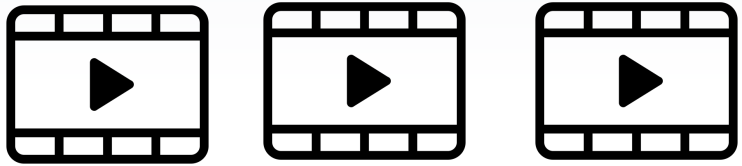
- Sends 6 seconds before and after the moment of the accident (12 seconds video)
- Ability to provide livestream to the Web App



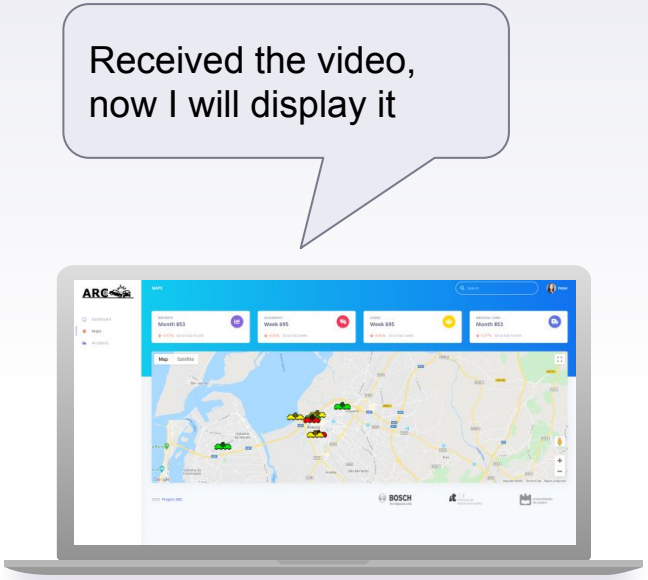


Information about the accident being sent to the web app





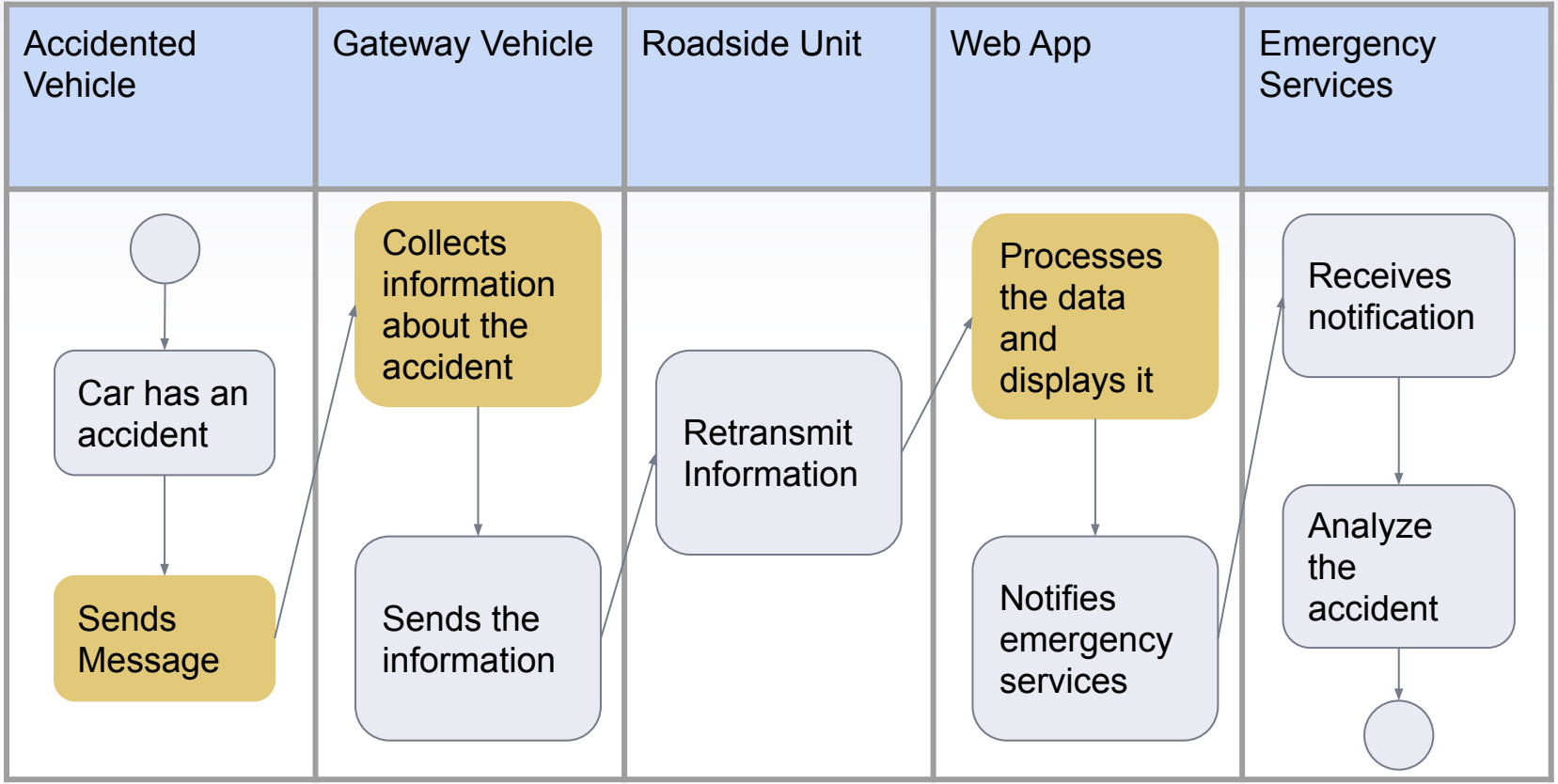
Video/livestream of the accident being sent to the web app



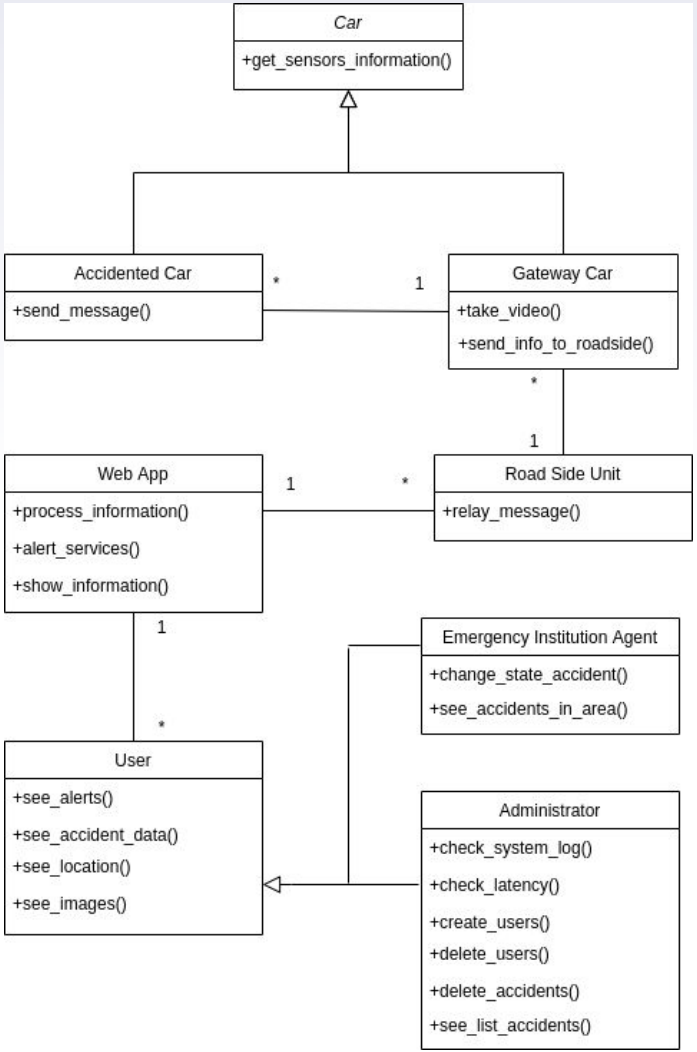
Improved Web App

- Live location of emergency services (possible by using an optimized database to store live information)
- Graphs with useful information about the accidents (how many per day, maps with dangerous zones)
- In the severity calculation take into account the current weather
- Web App can request footage
- Web App can talk with emergency vehicles

Message Flow



Domain Model



THANKS!

Any questions?