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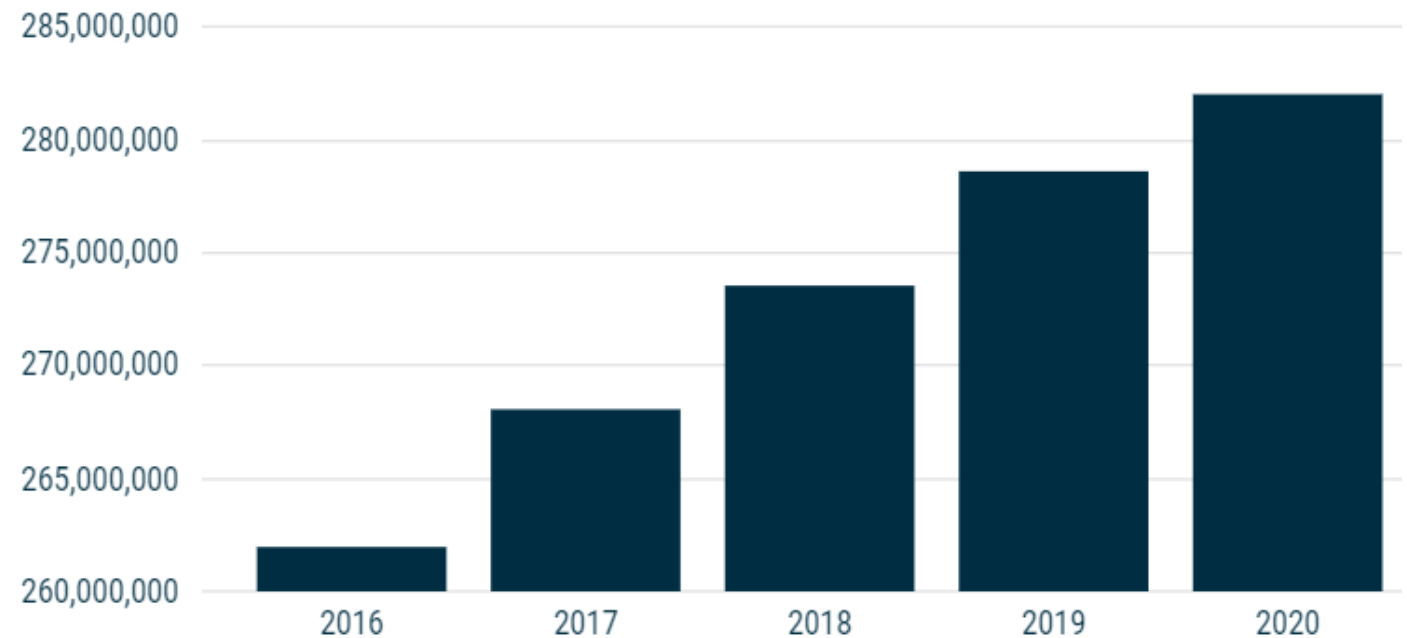
Summary: A Mobile App for Intelligent Transport Systems with Vehicle Communications Integration. A monitoring system for the road infrastructure equipped with ITS technology, capable of identifying risky driving conditions.

# Motivation

- Increasingly high number of vehicles
  - Road degradation
  - Congestion
  - Accidents
- Climate change
  - Dangerous weather events

VRUs are the most endangered!

- C-ITS and V2X
- Cooperative Awareness



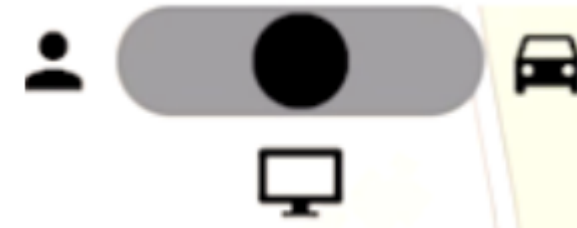
Vehicles in use in Europe

# Objectives / User Modes

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## Objectives:

- Warn road users
  - Weather events
  - Road events
- Directly involve VRUs
  - Location sharing
  - Report of events
- Traffic Control Centre monitoring
- Vehicular communications
  - Sensors sharing
  - Tolling
  - EV charging



User mode switch

## User Modes:

- VRU mode (left)
- TCC mode (centre)
- OBU mode (right)

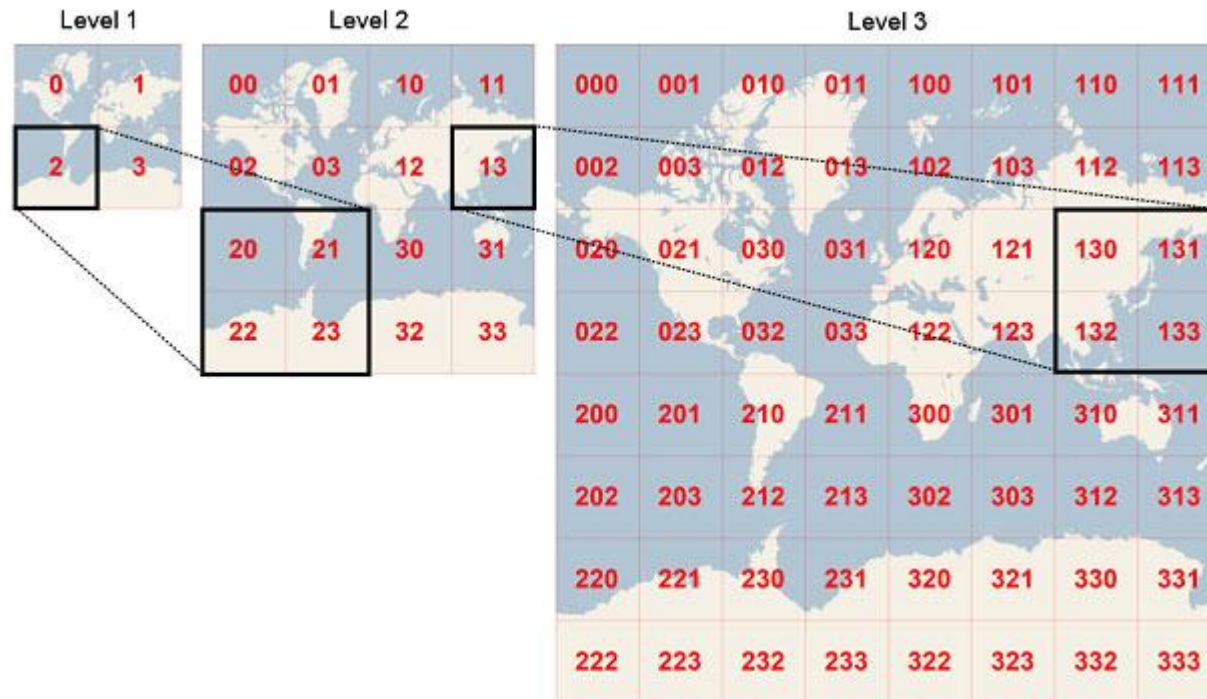
# Message Queuing Telemetry Transport

All information is exchanged using an MQTT broker.

Lightweight protocol with a publish/subscribe model.

its\_center/inqueue/json/7/cam/0/3/3/1/1/0/0/1/1/3/0/2

Topic structure and quadtree allows for a user to subscribe only to it's nearby messages!



# Mobile App Development

Multi-platform:

- Android (72.37%)
- iOS (26.98%)

Single code base (Typescript and Javascript only!):

- React Native
- Expo

Stateless message storage with periodic refresh for stable performance.



# Cooperative, Connected and Automated Mobility Messages

- CPM
  - Cooperative Perception Message
- CAM
  - Cooperative Awareness Message
- IVIM
  - I2V Information Message



CPMs and CAMs



IVIM

# CCAM Messages

- VAM
  - VRU Awareness Message
- DENM
  - Decentralized Environmental Notification Message



VAMs



DENMs  
Menu

# A-To-Be Messages

- HEARTBEAT
- SAEM
  - Service Announcement Essential Message
- TPM
  - Tolling Payment Message
- HDMAP
  - High Definition Map



HEARTBEAT



SAEM and  
TPM

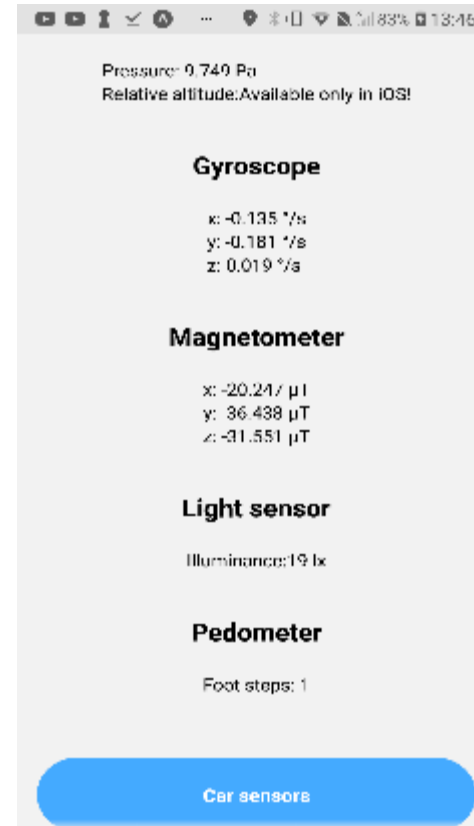


HDMAp

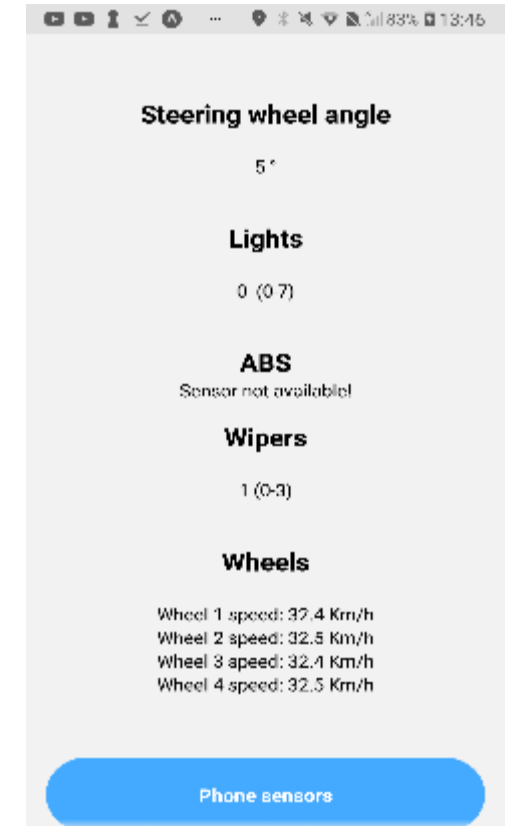


# Sensor Messages

- VSM
  - Vehicular Sensor Message
- SPVSM
  - SmartPhone VSM
  - Expo-Sensors
- OVSM
  - OBD-II VSM
- SNVSM
  - SoNar VSM



Phone  
Sensors



Vehicle  
Sensors

# Future Work

