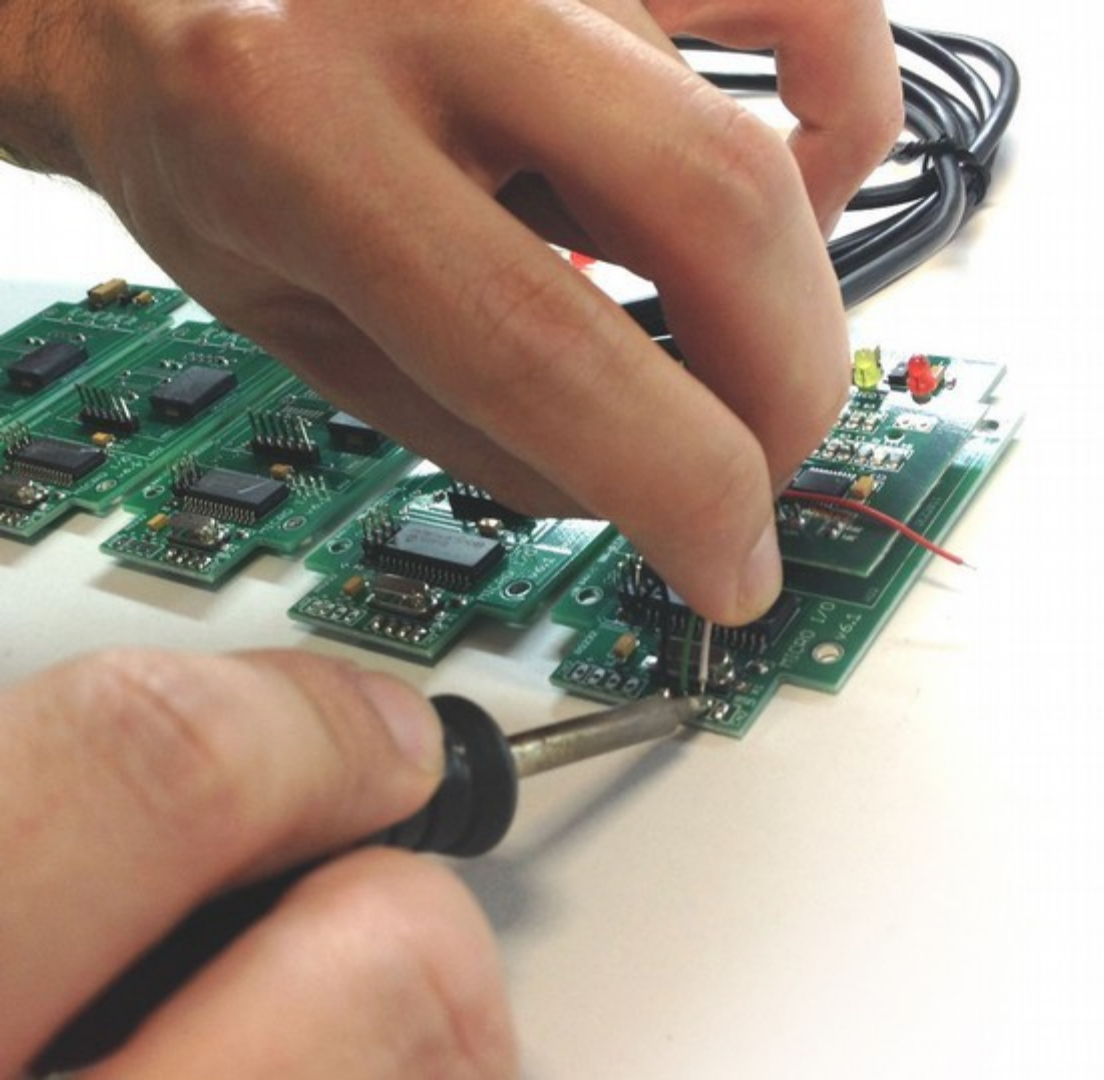


## Vehicular Communications

WFCS 2016 Industry day, 3<sup>rd</sup> May | Rui Rebelo, Hardware Director





Multidisciplinary team

Development of vertical solutions

Know-how and expertise

- embedded systems
- communications
- internet of things

# Core business areas



Accesses



Payments



Attendance



Mobility

## Integrated Management Systems





## Some of our customers and partners





## Projects of relevance metropolitan area networks

### Intelligent Parking System

- fully autonomous vehicular sensors/tags
- strict power and bandwidth requirements

### WMAN-NG

- very low power metropolitan network
- high urban M2M services compatibility

### Future Cities

- 80 unit wide environmental sensor network
- continuous real-time data streaming

### Consortia

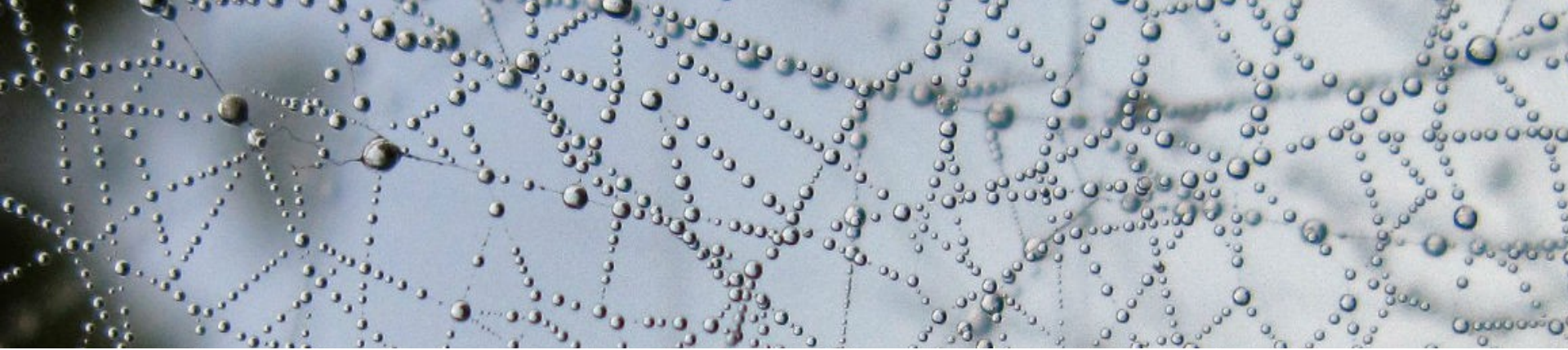
- BikeEmotion
- CitiBrain





## Vehicular communications analysis

- Is 802.11p the answer for our (specific) needs?
- Or is GSM/GPRS the answer? Could there be another way?
- Opportunistic or continuous communications?
- Long range communications?

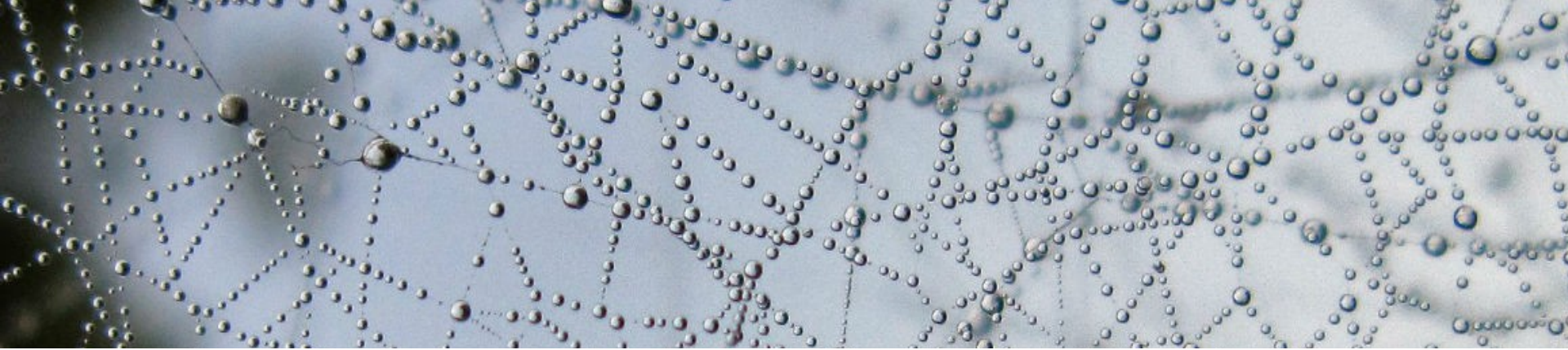


## Vehicular communications

### application specific details

- How to stratify the communications layers?
- Is the cellular communications cost worth it?
- Which are the power consumption implications?
- Is SIGFOX an alternative?





## Vehicular communications challenges

- High bandwidth requirements?
- Low power consumption and high autonomy
- Miniaturization, discretion and integration
- Robustness, user and environment proof



bike  
emotion®

# BikeEmotion

## 5<sup>th</sup> Generation Bike-sharing System

### Key user features

- electric bicycles (pedelec)
- RFID identification
- multilanguage display
- GPS location
- mobile app
- user friendly kiosks
- physical/virtual docking stations

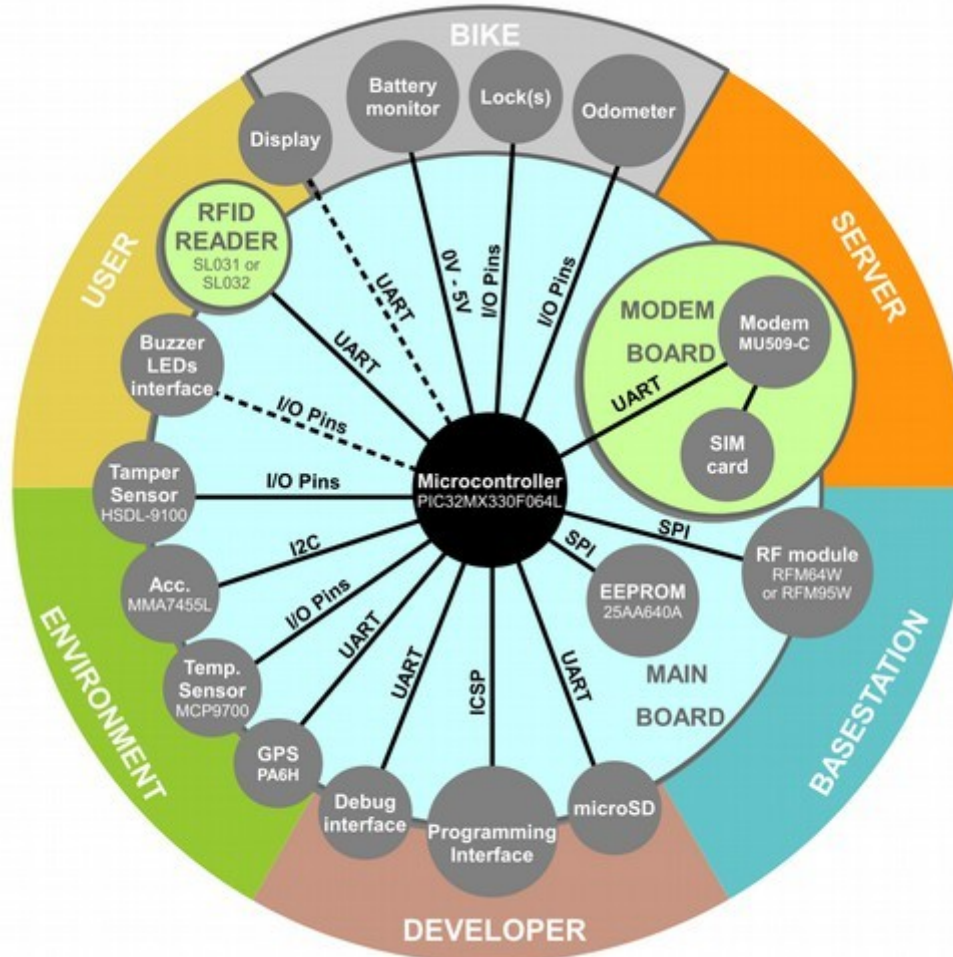
### Server side

- cloud based solution
- management backoffice
- (soft) real-time fleet management
- intelligent redistribution algorithms



# BikeEmotion

## Low level architecture



# BikeEmotion

## V2I communications

### GSM/CDMA

- continuous communications
- low latency for better user experience
- high power consumption
- no need for high bandwidth



Wasn't 4G supposed to be trully global?  
Thank you TELCO's...



# BikeEmotion

## V2I communications

### LoRa/LoRaWAN

- redundant interface
- low power consumption
- low bandwidth
- not (fully) worldwide compatible
- between station kiosks, other gateways and beacons
- suitable for indoor location auxiliary services



# BikeEmotion

## In-bike communications

### Communication BUS

- console
- motor controller
- smart lock system
- charging and battery controller

### Bike harness communications

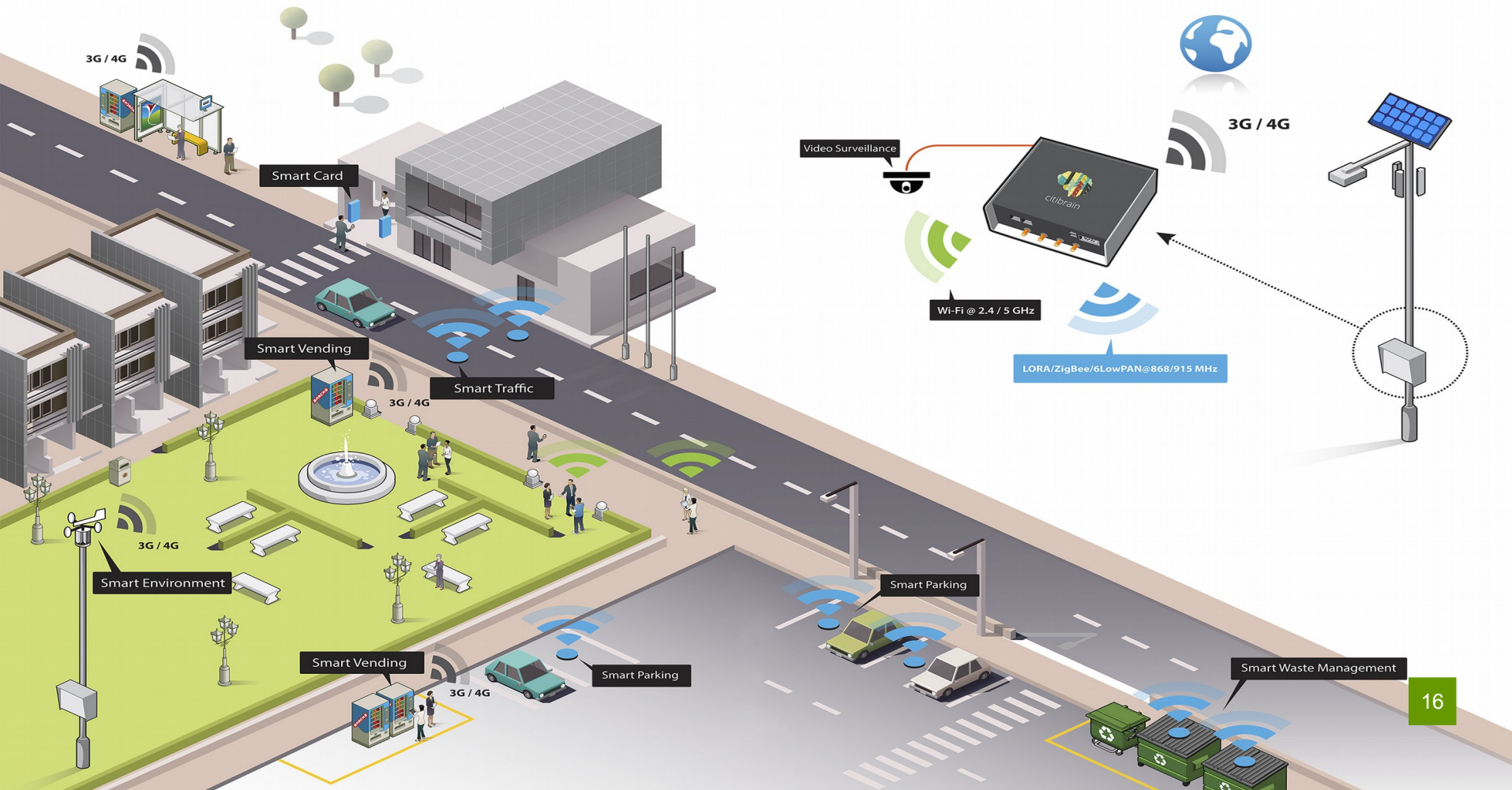
- Is CAN a solution?
- Selected protocol: RS485



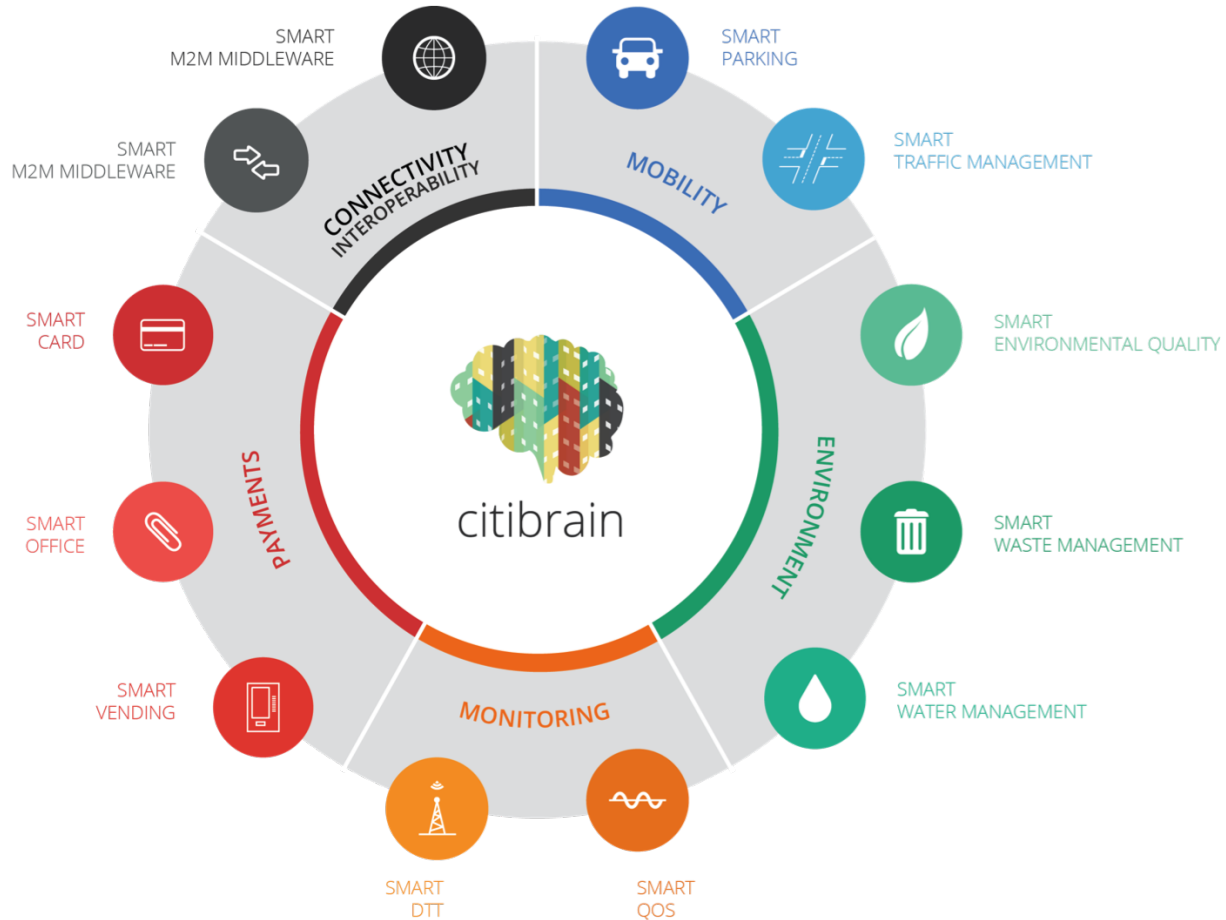


citibrain

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# Smart Parking

## Motivation

- Faster and easier parking
- Decrease traffic congestion in city centers
- Driver guidance to free parking spaces, increasing customer satisfaction
- Reduction of pollution levels

A year of looking for parking spaces in the Los Angeles business district:

- 38 times around the world
- 730 tonnes of CO<sub>2</sub>
- 180.000 liters of fuel

Not to mention the waste in HR!



# Smart Parking

Information | Guidance | Payments

## Vehicular sensors

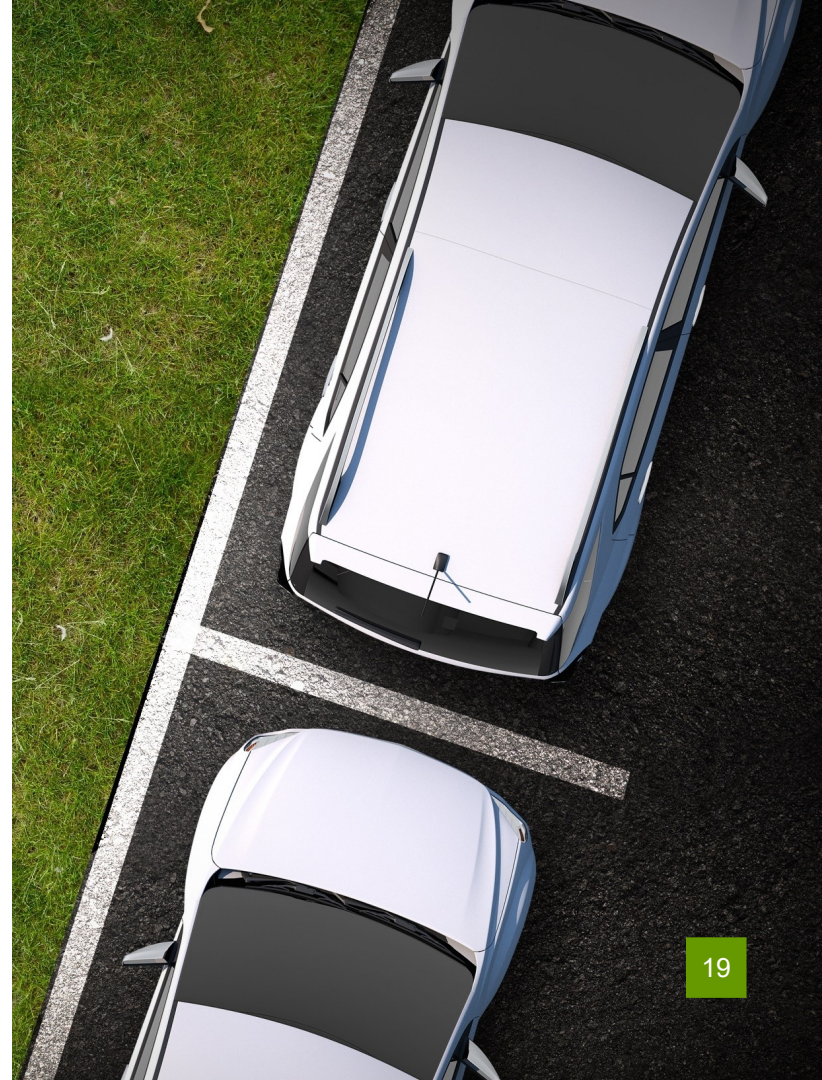
- magnetic detection
- battery powered
- LoRa/SIGFOX communications

## System interoperability

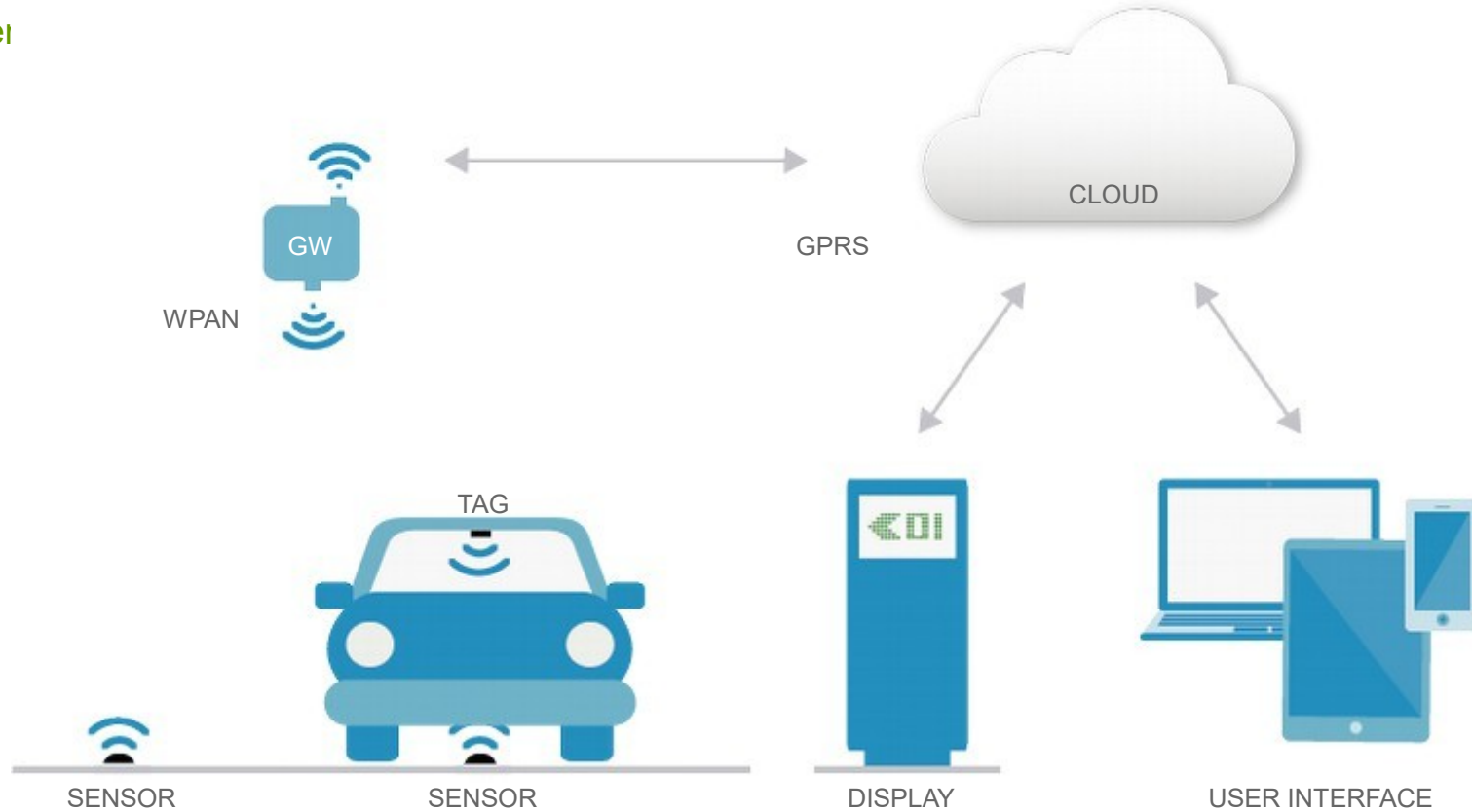
- vehicular identifications tags
- payments/parkingmeeters
- actuators (LED displays/alarms/barriers/lights)

## Multiple user platforms

- management/monitoring platforms
- driver guidance/payment mobile app
- parking enforcement officers interface



# Smart Parking system

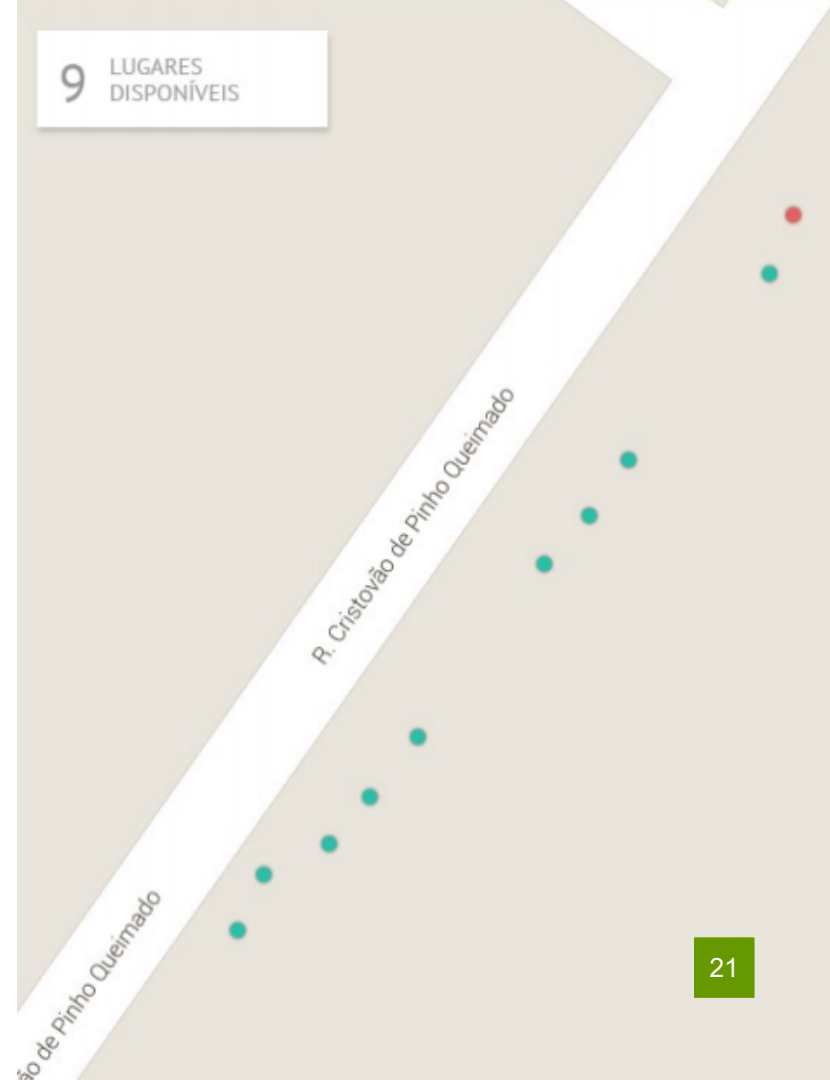




# Smart Parking

## Vehicle identification tag

- Low power on board device
- Vehicular identification/parking space paring
- Via Verde's DSRC like packaging/device
- Communication with parking sensors
- Communication with gateway (optional)



Thank you

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