



**17TH ANNUAL**  
UK LIGHT RAIL  
CONFERENCE

# **Digitisation and autonomous driving**



This is what  
we are



# Zaragoza

700,000 inhabitants:  
The 4<sup>th</sup> most populous city of Spain

Geostrategic hub:  
Equidistant (300 km) from Madrid, Barcelona, Bilbao and Valencia



# Line 1

Length: 12,8 km

Number of stops: 25

Number of trams: 21

Length of trams: 32 m

Capacity: 200 passengers

Supply: Catenary, except in the city center: Gran Vía – Chimenea (2 km)

Frequency (peak hour): 5'

Total trip North-South: 40'

Distance between stops: 500 m

Interchangers: 3

Intermodal parking lots: 2

Depots and workshops: 2

Begginig 1st Phase: August 2009

Begginig 2nd Phase: February 2011

Complete line: March 2013





# More than 100,000 passengers / day

The tramway line with the highest demand in Spain

2019 demand: 28,873,814 passengers

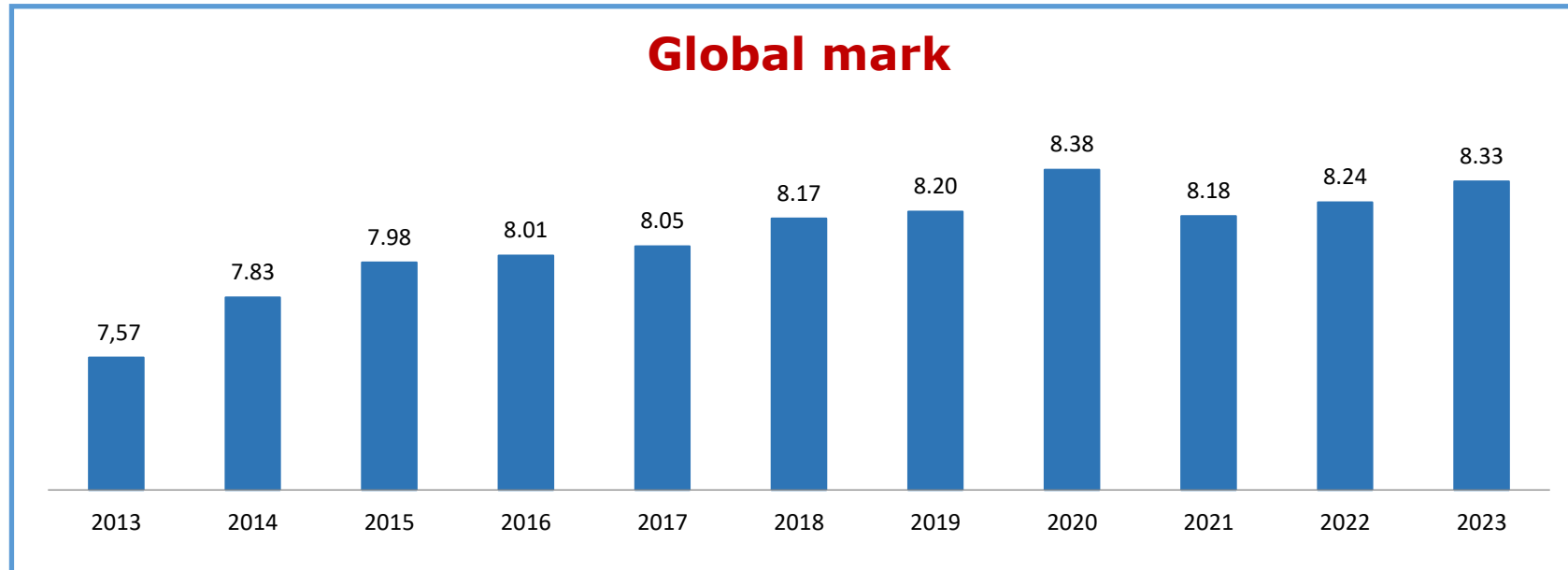
15% less traffic in average in the whole city

Up to 30% in the city centre

28% of Zaragoza's public transport with only one line

# Customer satisfaction survey

Trying to give the best service



**Best rated points:** Environment (8.68), Information (8.60), Safety (8.42) and Punctuality (8.41)



Digitization  
and technological  
excellence



# Onboard Energy Storage System

The longest stretch without catenary in Spain

Hybrid technology of **ultracapacitors and batteries**

Tram recharges at the stops by a **lowering third rail energization system**





# Dynamic Priority System

Developed by the Zaragoza City Council

172 junctions along the line and 13 traffic light junctions per km

Commercial average speed of 19.5 km / h

200 security cameras and 1 central computer

# Digital depot

The first CAF's 100% digital depot in the world



# A technological revolution

Three main blocks



**LeadMind**  
EASING YOUR WAY TO FUTURE MOBILITY




**Digital SOG-MES**  
Advanced Maintenance Execution System (Tablets)




NFC  
Calibrated tools traceability




GMAO  
Integration skills matrix in GMAO




Warehouse QR Mobile APP




Corporate Screens  
Internal communication



E-Learning  
RS Academy



PMGMAO  
Maintenance Plan Document Management System

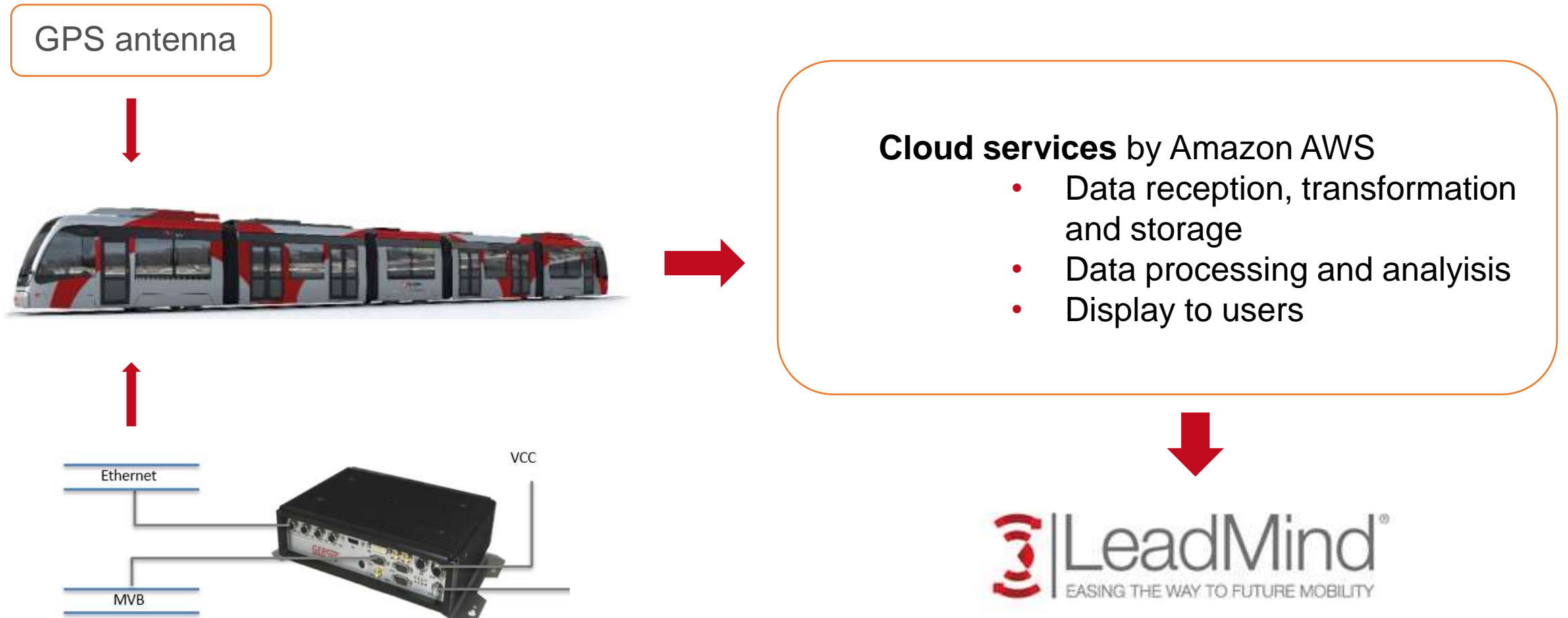


visual factory  
CALIBRE

Calibrated tools management software

# LeadMind

How it works



# LeadMind

How it works



FLEET  
MANAGEMENT



EXPLORATION &  
DIAGNOSTICS



ADVANCED  
ANALYTICS

# Maintenance Performance Digitalization

Digital Advanced Maintenance performance system for maintenance through tablets:

- Paperless system to develop maintenance works
- Based on its integration with ERP – CMMS
- Automatic and digitalized work documentation (preventive maintenance works check list)

Traceability of calibrated tools via NFC

Integration skills matrix in CMMS



# Complementary functions



Warehouse  
QR Mobile APP



Corporate Screens  
Internal communication



E-Learning  
RS Academy



PMGMAO  
Maintenance Plan Document  
Management System



Calibrated tools  
management  
software

# Additional functions



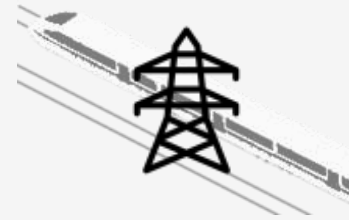
## LeadMind

Wheelset Life Extension

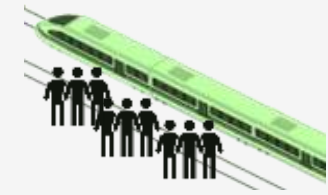


## RFID

Train asset traceability



## Energy Efficiency Studies



## Passengers Counting

Real Time Info Intermodality  
Demand forecast



# ... and what for?



## SAVINGS - AVAILABILITY

Maintenance savings and fleet availability



## DATA INTEGRATION

Central and automatic data integration for decision-making improvement



## PEOPLE

Cultural transformation



## AVOID REPETITIVE FAILURES

Ease of diagnosis. Detection of hidden failures. Prioritization of work needs. Provide employees with tools and learning abilities

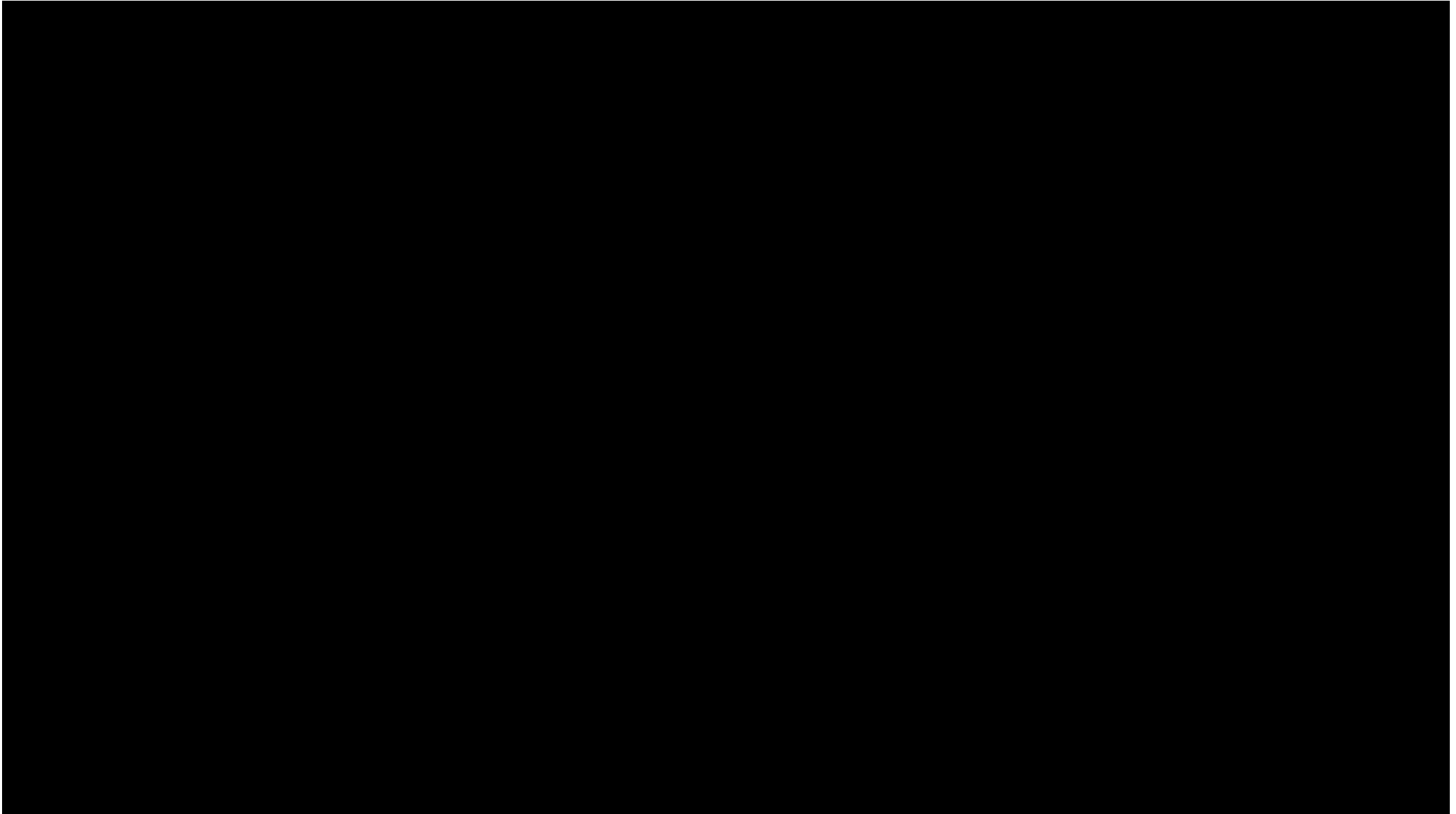


## SMART ASSET MANAGEMENT

Change the way of maintaining and operating:

- More proactive and dynamic attitude
- Changes in maintenance organization

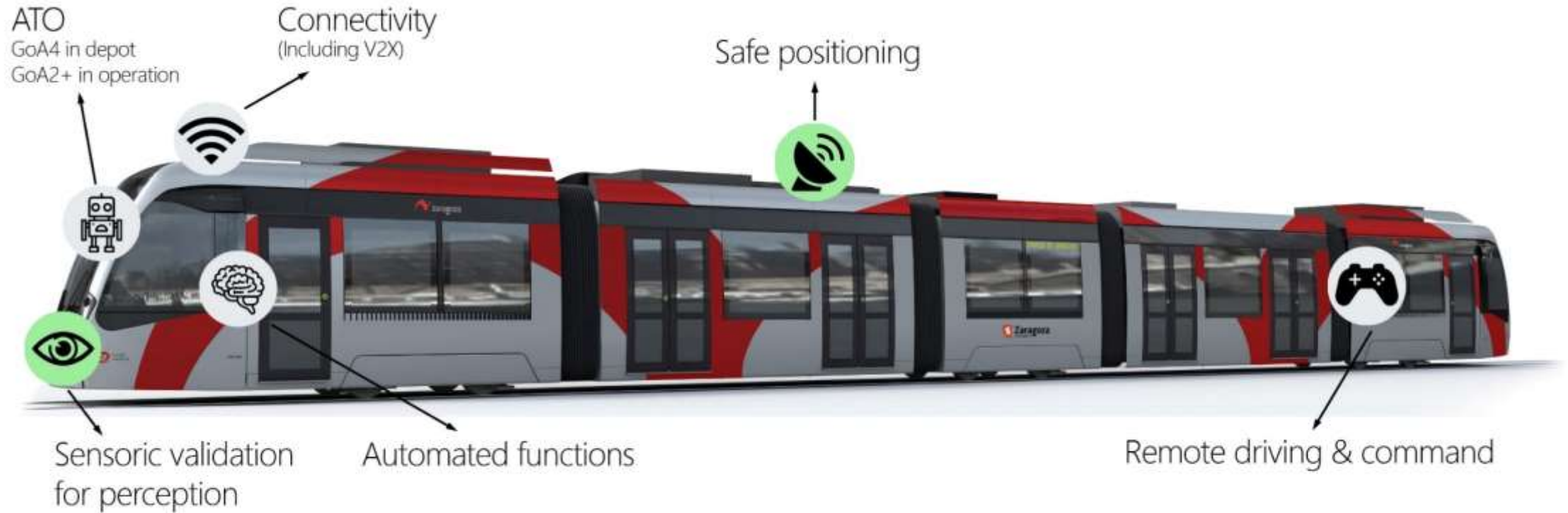
# Digital depot video





# Autonomous driving

# TAURO Project: technical enablers



# Objectives: two main lines

## Safe Positioning



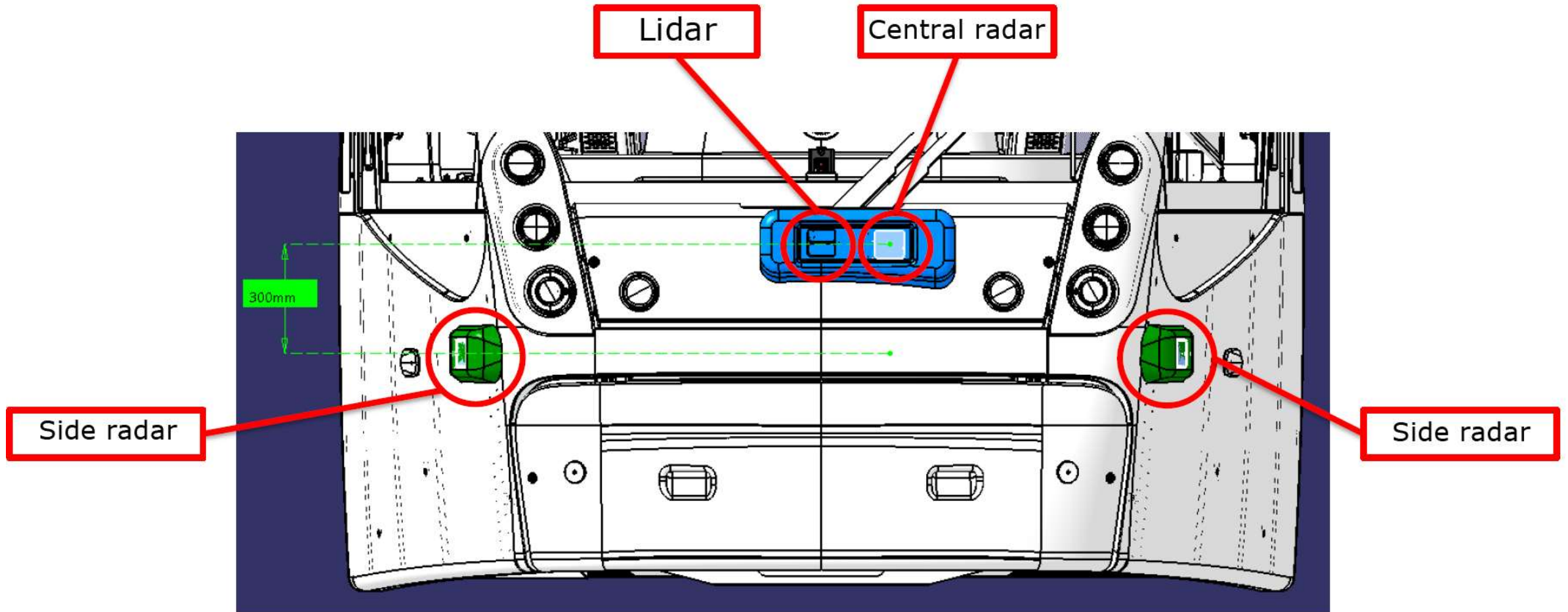
- ✓ Generation of the digital map.
- ✓ Feasibility analysis of the use of Radar and Lidar for localisation.
- ✓ Integration with data from other sensors to achieve a secure positioning (GNSS, Odometry, etc.).
- ✓ Search for an integrated proposal with all available information.

## Sensoric validation for perception

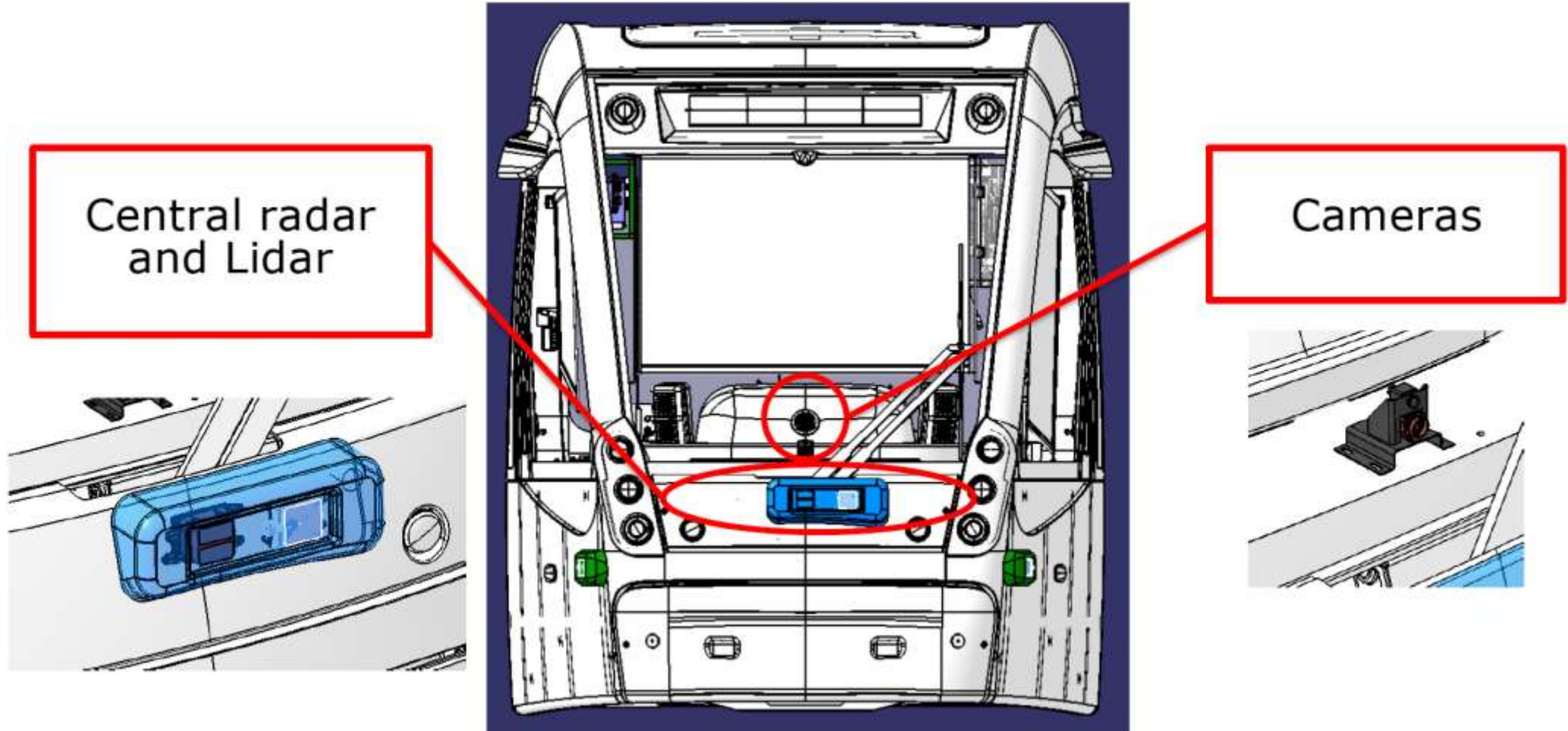


- ✓ Analysis of prediction results using different combinations of perception sensors (Cameras, Radars, Lidar, etc.).
- ✓ Compatibility and identification of restrictive use cases with each sensor.
- ✓ Study of the impact of environmental conditions on the outcome.

# Three radars in each cabin



# Solid-state Lidar and two cameras



Tauro project video





Improved  
service



# Two new Urbos 100

Five-module vehicles purchased with the support of the European Funds and the Zaragoza City Council

Zaragoza's fleet will increase up to **23 trams**

Improving **frequencies and capacity by a 10%**



# Safer and more sustainable

Full LED, high performance HVACs and improved batteries to **reduce energy consumption**

**Wider cabin windows** to enhance visibility

Improved **impact absorption system**

**Full-length low floor** and 100% accessible

# In operation in 2024





# Sharing Experiences

# Destination Zaragoza

306 cities from 71 countries



# Thank you

[marcos.espanol@lostranviasdezaragoza.es](mailto:marcos.espanol@lostranviasdezaragoza.es)

[www.linkedin.com/in/marcos-espa%C3%B1ol-sicart/](https://www.linkedin.com/in/marcos-espa%C3%B1ol-sicart/)

[www.tranviasdezaragoza.es](http://www.tranviasdezaragoza.es)



