IoT European Large-Scale Pilots

AUTOPILOT

Activity Group

27th February, Lisbon
Francisco Sánchez, CTAG
Outline

• Automotive context introduction
• AUTOPILOT Project
• AUTOPILOT Test-Site Spain
• Summary
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The evolution of Mobility
The evolution of Mobility
The evolution of Mobility
Mobility Trends

- Co-funded by the European Commission

Trends:
- Aging of the population
- Increase of urban population
- Intelligent Infrastructures
- Artificial Intelligence
- Connected Vehicles
- Autonomous Vehicles
- Electrification
- MaaS

Programme:
- IoT
- European Large-Scale Pilots Programme
The evolution towards IoT

<table>
<thead>
<tr>
<th>World Population</th>
<th>6.3 Billion</th>
<th>6.8 Billion</th>
<th>7.2 Billion</th>
<th>7.6 Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected Devices</td>
<td>500 Million</td>
<td>12.5 Billion</td>
<td>25 Billion</td>
<td>50 Billion</td>
</tr>
<tr>
<td>Connected Devices Per Person</td>
<td>0.08</td>
<td>1.84</td>
<td>3.47</td>
<td>6.58</td>
</tr>
</tbody>
</table>
The dream towards autonomous driving

1950s. Autonomous driving vision

1950s. Autonomous Highway System Tests. GM y RCA desarrollaron prototipos de conducción automatizada con control por radio de velocidad y dirección.
The importance of electronics

“80% percent of innovation is electronic”
“Impossible to comply with regulation without electronic systems”
-Automotive OEM

- Advanced Driver Assistance
- Active-Passive Safety
- Green Powertrain
- Radar / Vision
- Telematics
- Infotainment

Electronic cost as % of total car cost

2.5% 5% 10% 15% 22% 30% 35% 50%

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From ADAS to automated driving

1950
- Passive safety system development
  - Safety Belt (1959)
  - Passenger Airbag (1987)

1970
- Active safety development
  - ABS (1978)
  - ESC (1985)

1990
- Driver Assistance System introduction (ADAS)
  - First ADAS: ACC (1998)

2010
- New driver assistance systems
- Market penetration increase
- From passive systems to active intervention systems

Present and Future
- Increase of active interventions and new assistance functions
- Usage of cooperative systems
- New HMI devices
- Multisensor and multisystem Platform development
- Advanced data fusion techniques
- Autonomous Driving

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From ADAS to automated driving

Source: Strategy Analytics

- Parking/Reversing
- Night Vision
- LDWS
- Head-Up-Display
- E-Call Telematics
- Drowsiness Monitor
- Distance Warning / AEB
- Blindspot Detection
- Adaptive Front Lighting
Connected and Automated Driving

- **Motivation**

  Autonomous driving has enormous potential to improve traffic safety (human error is involved in 90% of the accidents) and traffic efficiency, enhancing comfort and offering a better use of time.

- **Scenarios**
The race towards autonomous driving
Automated driving levels

Levels of Automated Driving

- **Level 0**: No Automation
  - Driver is continuously exercising longitudinal and lateral control
  - System does not intervene
  - No vehicle system active

- **Level 1**: Assisted
  - Driver must monitor the system at all times
  - System can cope with limited situations
  - System has longitudinal and lateral control in specific use case

- **Level 2**: Partial Automation
  - Driver is required to monitor the system
  - System has longitudinal and lateral control in specific use case
  - System can cope with limited situations

- **Level 3**: Conditional Automation
  - Driver is required to monitor the system
  - System has longitudinal and lateral control in specific use case
  - System can cope with limited situations

- **Level 4**: High Automation
  - Driver is not required during defined use case
  - System has longitudinal and lateral control
  - System can cope with all situations automatically in defined use case

- **Level 5**: Full Automation
  - System can cope with all situations automatically during entire journey
  - No driver required

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CAD Roadmap and perspectives

Autonomous or partially autonomous vehicles to be sold in 2035

- 30 million
- 60% reduction in carbon dioxide (CO₂) emissions through optimised, autonomous driving
- 50 minutes of additional free time thanks to autonomous vehicles that will allow users to spend travel time working, relaxing, or accessing entertainment
- 15% smaller parking spots, thanks to self-parking autonomous vehicles that do not require open-door space for dropping off passengers

Fuente: CARTRE EU Project
CAD complexity

ESCENARIOS

AUTOVIA

RURAL

URBANO

ESPECIALES

COMPLEJIDAD

...?

VEHÍCULO AUTÓNOMO CONECTADO

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Co-funded by the European Commission

CAD challenges

- Legislation
- Connectivity
- Testing and Validation
- Sensors and perception
- Functions and control
- HMI and Human Factors
- Road and infrastructure adaptation
CAD challenges. The key role of connectivity

- Intelligent vehicles and intelligent roads and intelligent infrastructures
- Hybrid communication networks (cellular, DSRC, ...)
- V2X (V2C, V2I, V2VRU, ...)
- Cooperative services Day 1, Day 1.5 and beyond
- New connectivity services devoted to the automated and autonomous vehicle
- Cooperative sensing
- IoT
- Artificial intelligence, Cloud Computing
- Data privacy
- Ciber-security
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**AUTOPILOT. Project information**

**5 Large Scale Pilots on IoT** are funded by the European Commission

- **AUTOPILOT** is the Pilot about Connected and Automated Driving
- 3 Years Innovation Action: 01/01/2017 – 31/12/2019
- 44 beneficiaries – coordinator: ERTICO
- Budget: 25 m€ - EU contribution: 20 m€
- European Commission: DG CONNECT unit E.4 – IoT / H.2 Smart Mobility & living / A.1 Robotics & Artificial Intelligence

The 5 Large scale pilots are cross coordinated and supported by 2 CSA:

- CREATE-IoT (create-iot.eu)
- U4IoT (www.u4iot.eu)
**AUTOPILOT.**

**AUTOPILOT** - AUTOMATED DRIVING PROGRESSED BY INTERNET OF THINGS – is developing an IoT connected vehicle platform and IoT architecture based on the existing and forthcoming standards, as well as open source and vendor solutions. The IoT ecosystem accommodates vehicles, road infrastructure and connected IoT objects, with particular attention to safety critical aspects of automated driving. The project develops a range of services combining autonomous driving and IoT, such as car sharing, autonomous valet parking, and better digital maps for autonomous vehicles.
AUTOPILOT. Project information

Co-funded by the European Commission

IoT Large-Scale Pilots Programme

IOT to transform automated driving

Vehicle IoT integration

Local Dynamic Map (LDM)

 Autonomous driving functions

Vehicle IoT enabled platform

Data fusion

In vehicle sensors

AD-IoT Communication (3G/4G, ITS-G5, LTE-V2X)
AUTOPILOT. Targets

- Develop global IoT platforms and architecture
  - for the provision of automated driving application and services
- Provide Vehicle IoT platform integration
  - to make the vehicle an IoT device dealing with IoT sensor data
- Deploy an Eco-system of IoT sensors (Pedestrian, vehicles, infrastructure ...)
- Use and assess advanced connectivity technology (pre-5G, LTE-V2X, ITS-G5)
- Assess IoT suitability and benefits for the automated driving, the users and for the business exploitation
- Contribute to the IoT and Functional Safety standardisation
1. Use existing sensor devices connected to the internet (camera, intelligent traffic light, Smart phones, environment sensing devices …)
2. Sensor redundancy: pedestrian detected by IoT device and in-vehicle sensors
3. IoT platform federation and native wireless security (e.g. Cellular) provide the required basis to support sharing data among the relevant stakeholders
4. Create new services and business models over IoT/Cloud platform e.g. Mobility as a Service allowing 3rd party service providers
5. IoT Cloud platform to provide “augmented reality” information to vehicles: e.g. traffic jam, obstacles …
AUTOPilot. Pilot sites

Use cases

<table>
<thead>
<tr>
<th>Use cases</th>
<th>FI</th>
<th>FR</th>
<th>IT</th>
<th>NL</th>
<th>SP</th>
<th>KR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valet Parking</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Highway Pilot</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Platooning</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Urban Driving</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Car Sharing</td>
<td>X</td>
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AUTOPilot test-site Vigo.
SISCOGA$^4$CAD Corridor
AUTOPROTEST TEST-SITE VIGO.
SISCOGA\textsuperscript{4CAD} Corridor

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<table>
<thead>
<tr>
<th>Traffic Authority Road Enabler</th>
<th>Enabling the road infrastructure adaptation and use for piloting AUTOPILOT use cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Manufacturer</td>
<td>• Wide expertise in C-ITS services, AD functions</td>
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<tr>
<td></td>
<td>• 2 vehicles for being automated and equipped with IoT platform.</td>
</tr>
<tr>
<td>Test Site Leader</td>
<td>• Developing &amp; testing of automated driving applications</td>
</tr>
<tr>
<td></td>
<td>• Developing &amp; testing of C-ITS and connected vehicle services</td>
</tr>
<tr>
<td></td>
<td>• Background in Pilot managing</td>
</tr>
<tr>
<td></td>
<td>• 1 Vehicles automated with IoT platform</td>
</tr>
</tbody>
</table>
AUTOPILOT.
Test-site Vigo
AUTOPilot.
Test-site Vigo. General IoT architecture
3 C4 Picasso Prototypes → 1 from CTAG and 2 from PSA
• 360° sensors, map unit, DGPS and rapid prototyping platforms for function and perception algorithms.
• Communication system → V2X (802.11p, G5) and Cellular
• IoT in vehicle platform
AUTOPilot.
Test-site Vigo. Timeschedule

2017
- WP1 Requirements, specifications & architecture
- WP2 Development, integration & verification
- Framework definition

2018
- WP3 Large scale pilots
- Pilot preparation
- Technical evaluation, impact assessment, user acceptance and legal issues
- WP4 Evaluation

2019
- WP5 Communication - Dissemination - Exploitation
- WP6 Coordination
- WP1

• Parking Slot Booking
  • The driver publishes a parking slot request
  • The Parking service checks the available parking slots and sends back a parking slot book confirmation
  • The vehicle/driver drives to the parking drop off/pick up place and leaves the car

• Drop-off: Map reception, route following and parking maneuver
  • Parking service sends the map of the parking with the path to the slot.
  • The AD prototype follows the path to the slot using information from in vehicle and parking sensors.
  • Once the assigned slot is detected, the AD prototype performs the parking maneuver.
  • The AD prototype goes off and an information message is sent to the driver.

• Pick-up: unparking maneuver and route following
  • The driver is in the pick up area and sends a request to take the vehicle back.
  • The AD prototype starts, leaves the slot and follows the route to the drop off/pick up area using information from parking and in vehicle sensors.
AUTOPilot Test-site Vigo. Autonomous Valet Parking

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AUTOPILOT Test-site Vigo.
Connected Urban Autonomous Driving

• GLOSA
  • Traffic lights send status information to the IoT Open Platform
  • In vehicle communication platform receives Traffic light status
  • The AD prototype adapts its speed in order to save fuel and avoid sudden breakings and accelerations; as well as minimize the time stopped

• VRU
  • Traffic sensor or/and in vehicle sensors detects a VRU and send the information to the IoT Open Platform
  • In vehicle communication platform receives VRU position
  • The AD prototype reduces its speed until it is safe to stop suddenly

• Road events
  • TMC sends information about a road event (road works, accident…) to the IoT Open Platform
  • In vehicle communication platform receives position and type of event
  • The AD prototype adapts the speed in order to reach the event with a speed that allows a sudden stop in a safe way.
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Connected Urban Autonomous Driving
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Thank You!

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