IoT*-01-2016: Large Scale Pilots

Pilot 5: Autonomous vehicles in a connected environment

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- Unit A3: Complex Systems & Advanced Computing
- Unit A4: Components

IoT* = Internet of Things
IoT Focus Area Calls

**IoT Direct Focus Area Calls**
IoT-01-2016: Large Scale Pilots (IA)
IoT-02-2016: IoT Horizontal activities (CSA)
IoT-03-2017: R&I on IoT integration and platforms (RIA)
**IoT-01-2016: Large Scale Pilots**

- Deployment of IoT solutions in Europe through integration of advanced IoT technologies across the value chain, as close as possible to operational conditions.

- **Scope:**
  Propose IoT approaches to real-life challenges.
  Pilots are autonomous entities that involve stakeholders from supply side to demand side, and contain all the technological and innovation elements.
IoT – Large Scale Pilots in 2016

IoT LSP: Specific features

- Involve all value-chain actors
- Address business model validation & standardisation
- Address user validation and acceptability
- Pilots encouraged to exploit open platforms like FI-Ware, CRYSTAL, UniversAAL

Key Performance Indicators:

- Ensure the longer-term evolution of the Internet of Things
- Critical Mass, leadership
- Rich portfolio of technologies and tools
- To guarantee the sustainability of the approach
**Expected Impact**

Validation, sustainability and replicability, of architectures, standards, interoperability properties,

New industry and business processes and innovative business models

User acceptance validation addressing privacy, security, vulnerability, liability

Significant contribution to standards or pre-normative activities

Citizens' quality of life, opportunities for entrepreneurs, secure and sustainable European IoT ecosystems and contribution to IoT infrastructures viable beyond the duration of the Pilot.
IoT-02-2016: IoT Horizontal activities

Coherence and exchanges between the various activities of the Focus Area

Issues of horizontal nature and topics of common interest, such as:

- Privacy, security, user acceptance
- Standardisation
- Creativity, societal and ethical aspects
- Legal issues and international cooperation

need to be coordinated and consolidated across the pilots to maximise the output and to prepare the ground for the next stages of deployment including pre-commercial or joint public procurement.
Links between communities of IoT users and providers, other initiatives including:

- contractual Public-Private-Partnerships (e.g. in the area of Big Data, Robotics, Factories of the Future, 5G-infrastructure)
- Joint Technology Initiatives (e.g. ECSEL)
- European Innovation Partnerships (e.g. on Smart Cities)

Scope: Interoperability and standards approaches at technical / semantic levels;
Common methodologies for design, testing and validation;
Federation of pilot activities and transfer
IOT LARGE-SCALE PILOT NUMBER 5:

AUTONOMOUS VEHICLES IN A CONNECTED ENVIRONMENT
The teaming up of automotive and digital sector is hugely important for Europe’s global competitiveness.

The automotive and digital sector is committed

• to work on common roadmaps to speed up the development and deployment of connected automated driving.

• These roadmaps will cover better connectivity, mobile network coverage and reliability, the take-up of connected automated driving and how to address any security and privacy concerns of users.

Vision: Towards Smart Anything Everywhere

Innovation across the full value chain
Objective:
Autonomous vehicles in a connected environment: optimal combination of local & distributed information and intelligence

→ Added value and potential of applying IoT

CRITICAL: strong use case & business case & strong commitment from the pilot host(s) -> Maximise impact
Clarification on the Call text: Level of Autonomy
"It should **test scenarios of deployment** of safe and **highly** and **fully** autonomous vehicles (up to SAE38 international level 5, full automation) in various representative use case scenarios, exploiting local and distributed information and intelligence"

<table>
<thead>
<tr>
<th>SAE Level</th>
<th>SAE name</th>
<th>SAE narrative definition</th>
<th>Execution of steering and acceleration/deceleration</th>
<th>Monitoring of driving environment</th>
<th>Fall-back performance of dynamic driving task</th>
<th>System capability (driving mode)</th>
</tr>
</thead>
</table>
| Automated driving system ("system") monitors the driving environment
| 3         | Conditional Automation
| **3**     | **Conditional Automation**                                                             | System                                      | System                          | **Human driver**                           | Some driving modes            |
|           | **the driving mode**-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene** |                                                                         |                                 |                                               |                               |
| 4         | High Automation                                           | System                                    | System                          | System                          | System                                     | Some driving modes            |
|           | **the driving mode**-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene** |                                                                         |                                 |                                               |                               |
| 5         | Full Automation                                            | System                                    | System                          | System                          | System                                     | All driving modes             |
|           | **the full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver** |                                                                         |                                 |                                               |                               |
IoT for autonomous vehicles in a connected environment

Paving the way to **deployment up to FULL AUTOMATION (driver out of the loop)**

1. **OBTAINED VIA** Optimal combination of **Autonomy & Connectivity**
   - **Local** information & intelligence = **autonomy** (of individual vehicles)
     → **Essential for SAFETY in REAL ENVIRONMENT**: mixed traffic with legacy vehicles, lost connection, pedestrians, etc.
   
   - **Distributed** information & intelligence = **IoT**
     → connectivity for **improved** performance: adding redundancy, prediction & longer term planning, higher level scene understanding, etc.

2. **ALLOWING Innovative IoT services**: driver out of the loop
"Using advanced technology for connectivity seen as an asset": explore the merits of 4G (3GPP LTE-V) and IEEE 802.11p

**Ecosystem of vehicles and infrastructures**
- **Open platform** for a mobility ecosystem to share information and intelligence
- **Full chain** involving sensors, data storage, dynamic processing, format transformation, horizontal platform-to-platform export, open APIs.
Foster deployment in real traffic

Sustainable pilots & Permanent installations

- Requires commitment from the pilot hosts, authorities, etc.

Demonstrate Technical performances in real environment

- Dependability (incl. safety), robustness and resilience, usability

Address non-technical aspects

- Maximise added value to users
  - scenario: urban, highway, dedicated lanes or mixed environment, etc.
- User acceptance and User behaviour
- Economic, legal, regulatory and ethical issues
Scope

• What do we want to achieve with this pilot?

• Direct outcome
  
  Demonstrate the socio-economic benefit of automated connected vehicle deployed in real environment, made possible through addressing the technical and non-technical issues

• Impact (short term, mid-term)
  
  Short term:
  - Standardization (interoperability of platforms, modules, etc.)
  - New business models, open service platforms
  - Punctual deployment of these scenarios in other cities/countries + new value-added services

  Long term:
  - Ubiquitous deployment + new market sectors in IoT services
Core technologies include

- **Reliable and real-time platforms managing mixed criticality vehicle services,**
  - Integration of State of the Art embedded components (advanced sensors, components, actuators)
  - Advanced sensors and Internet information sources

- **Efficient navigation**
  - In vehicle embedded (sub)systems for autonomous navigation, real-time up-dates on road, transport conditions, pattern recognition

- **Improved decision-making algorithms**
  - Beyond advanced driver assistance systems
  - Optimisation of local and distributed information and intelligence

- **Interconnectivity between vehicles, vehicle to infrastructure communication**
  - Communication and network technologies (e.g.: 4G (3GPP LTE-V), IEEE 802.11p)
  - Mobile IoT - Interconnectivity V2V & V2I

- **Supported by an open service platform**
  - Access to in-vehicle embedded information sources
  - Data gathering from vehicle surrounding information
  - In view of providing value-added apps e.g. intelligent maintenance
Structure

• What efforts do we need on the demand side?
• Essential:
  • Pilot driven by strong use and business case -> requires representatives from user side, vehicle industry, expert in ELSE (ethical / legal / socio-economic aspects) representative insurance companies (as appropriate)
  • Innovative Services (in particular pushing the limits of automation)
  • Strong commitment from the pilot host(s) -> local authorities, public bodies, political support
• How would the ideal consortium look like?
  • TECH
  • INDUSTRY: running business around it – economic beneficiaries
  • PILOT HOSTS
  • USERS
  • Experts in non-technical issues (ELSE, perception, trust, etc.)

  → optimize the constellation and balance as required by the pilot
Stakeholders

Who are the stakeholders?

- **TECH:**
  - OEMs: Components and Subsystems
  - Technology providers: Robotics, Comms & Network, platforms for mixed criticalities, software, etc.
  - IoT Services / Applications (APP developers, service providers, ...)
- **INDUSTRY**
  - Car industry (Car manufacturers, integrators, new entrants,...) / other vehicle manufacturing
  - Enablers (e.g. Insurance companies, certification bodies, etc.).
- **PILOT HOSTS**
  - Infrastructure providers & Public Authorities (city, regions, ministries, parking, etc.)
- **USERS**
  - Users and end-users representatives (rental cars, drivers, etc.)
  - Experts in non-technical issues (ELSE, regulation, etc.)
Some relevant organisations / initiatives*

AIOTI
C-ITS
CLEPA
Eposs
ERTICO
ERTRAC
EUCAR
SPARC – Robotics PPP
5GPPP
Etc.

⇒ NO PRIVILEGED TREATMENT IN THE PROJECTS SELECTION

*not exhaustive – alphabetic order
Way forward

Promote to the relevant events – reach existing & new stakeholders

- **Relevant events**
  - ITS World Congress Bordeaux [http://itsworldcongress.com](http://itsworldcongress.com) 5th-9th Oct
  - EpoSS (12th Oct)
  - FIA Conference (20th Oct)
  - Automotive Europe 2nd/3rd Nov
  - ERTRAC (6th Nov)
  - Robotics Brokerage event in Brussels (18th Nov Brussels) - Registration available shortly on [www.eu-robotics.net](http://www.eu-robotics.net) and [www.sparc-robotics.net](http://www.sparc-robotics.net)
  - IoT Pilot5 Infoday – Brussels – December 3rd
  - Mobile World Congress in Barcelona 22-25 Feb.

Useful links and contact

Identifier: IoT-01-2016 – Large Scale Pilots
**Pilot 5: Autonomous vehicles in a connected environment**
Type of actions: IA (Innovation Actions)

**Dates**

**Budget** Proposal requesting EU contribution up to 20M€

**Workprogramme**


**Participant Portal**
ec.europa.eu/research/participants/portal/desktop/en/home.html

**Contacts**
Cecile.Huet@ec.Europa.eu, Eric.Gaudillat@ec.Europa.eu
Pilot 5: Autonomous vehicles in a connected environment
(excerpt from the workprogramme text)

The pilot addresses the added value and the potential of applying IoT for autonomous vehicles in a connected environment. It should test scenarios of deployment of safe and highly and fully autonomous vehicles (up to SAE38 international level 5, full automation) in various representative use case scenarios, exploiting local and distributed information and intelligence. Core technologies include reliable and real-time platforms managing mixed criticality car services, advanced sensors and Internet information sources around which value-added apps may be constructed, efficient navigation and improved decision-making technology, interconnectivity between vehicles, vehicle to infrastructure communication. Using advanced technologies for connectivity is seen as an asset. The selected scenarios will provide proofs of concept showing how such technology provides benefits affecting users on a daily basis, for instance on the highways or in urban congested environment, either on dedicated lanes or mixing autonomous connected vehicles and legacy vehicles. To make a real step towards future large scale deployment and to demonstrate dependability, robustness and resilience of the technology over longer period of time and under a large variety of conditions, priority will be given to permanent installations and sustainable pilots rather than to temporary prototypes or demonstrators.

These evolutions are expected to be supported by an open service platform which may have access to all in vehicle embedded information sources and to car surrounding information, in view of providing value-added apps e.g. intelligent maintenance. Key barriers to the deployment of such vehicles and ecosystems such as robustness of the perception, how to keep users of highly and fully automated vehicles sufficiently engaged and overall user acceptance are in scope, as well as economic, ethical, legal and regulatory issues.
Advices

• Avoid overlap with other parts of the WP (in particular SC Transport – see annex) → Important differentiating factor: higher level of automation and IoT platform

• Maximise the impact: focus the efforts on pushing the limits of automation (driver out of the loop) exploiting the state of the art both from IoT and autonomy

• Goal is not on developing zillions of services -> un-focused. The intention is rather to provide a platform on which services can be developed. Given the objective of this pilot, the services developed within the pilot should preferably contribute to reaching high level of automation, but they should also serve to demonstrate the interoperability of the platform with third-party developers.

• Need to bring the right balance of stakeholders: IoT/connectivity/vehicle industry/robotics + non-tech

• Differentiate wrt. all the demos we have seen so far – this is why we need sustainable pilot installation

• Maximise impact of this relatively low budget (as compared to investment by the car industry) – build and add value to their investment

• To ensure critical mass and maximise the impact – 1 big pilot up to 20 M€ funding
Some possible use case scenarios

Call text: "It should **test scenarios of deployment** of safe and highly and fully autonomous vehicles (up to SAE38 international level 5, full automation) in **various representative use case scenarios**, exploiting local and distributed information and intelligence."

The next slides present some possible use case scenarios:

These are only given as some illustrative examples to show the expected level of ambition. They are not meant to be limitative nor exclusive!"
## Pilot 5 Possible use-case scenarios: morning journey (1/2)

### Start of the day:

<table>
<thead>
<tr>
<th>From home to the highway: country road</th>
<th>On the highway (esp. in traffic jam)</th>
<th>Leaving the highway – to the parking lot in the suburbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver in control</td>
<td>Driver out of the loop</td>
<td>Driver in control</td>
</tr>
<tr>
<td>Hands on the driving wheel</td>
<td>Driver reading, or sleeping</td>
<td>Driver stops reading &amp; takes back the driving wheel</td>
</tr>
</tbody>
</table>
### Pilot 5 Possible use-case scenarios: morning journey (2/2)

<table>
<thead>
<tr>
<th>Driver drops the car at the entrance of the parking lot</th>
<th>Person transfer to either shared autonomous car, or autonomous taxi, or autonomous car-pooling, or autonomous public vehicle</th>
<th>Destination reached!</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Driver out of the loop</strong></td>
<td><strong>Driver out of the loop</strong></td>
<td></td>
</tr>
<tr>
<td>Car parks on its own (no driver in the car)</td>
<td>Either no driving wheel or conventional vehicle but driver hand-off feet-off, in urban environment (segregated or mixed traffic)</td>
<td></td>
</tr>
</tbody>
</table>
Other relevant WP16-17 Topics

Avoid overlap!

Differentiating factors of this Pilot:

1) Highly and Fully autonomous vehicle (up to automation level 5)
2) No specific constraint on the environment (could be a mix of urban, highway, parking, etc.) nor on the type of vehicle (could be a mix of standard cars, fleet of other types of vehicles, etc.). But note that the call text refers to "cars" – therefore is implies passengers vehicles.
3) Technology push: fully exploiting autonomous navigation (local info/intelligence) and IoT (distributed info/intelligence) to push the level of automation
ANNEX: CALL 2016-17 Mobility for Growth

6. INTELLIGENT TRANSPORT SYSTEMS

- Seamless transport for passengers and goods
- Mobility as a Service

→ the focus is on mobility, not on improving the level of automation

MG-6.1-2016: Innovative concepts, systems and services towards 'mobility as a service'

MG-6.2-2016: Large-scale demonstration(s) of cooperative ITS
- focus on cooperative dimension (multimodal)
- focus is NOT on improving the level of automation within the pilot
- focus on cross-modal integration /cross border interoperability

Differences:
Pilot 5 focuses on:
- increasing the level of automation
- technology: optimised combination of local autonomy and IoT
ANNEX: CALL 2016-17 Automated Transport - Complementarity

Focus passenger cars automated driving level 3 and truck platooning in real traffic conditions from 2020 onwards.

ART-01-2017: **IA** - ICT infrastructure to enable the transition towards road transport automation:

- **up to automation level 3 to 4**
- Connectivity + sensors + maps + GNSS + cloud
- Cyber-security

Main differences:
- Pilot 5 focuses on:
  - Test scenarios of higher levels of automation (driver out of the loop)
  - Technology: optimised combination of local autonomy and IoT

ART-02-2016: **IA** - Automation pilots for passenger cars

- Automated cars in mixed traffic on public roads
- **Focus: Automation level 3 (+ test some 4)**
- Field operation test *(at least 3 different countries) – passenger cars*
- Highway(X border) & Urban

ART-03-2017: **IA** - Multi-Brand platooning in real traffic conditions

- **Heavy-duty vehicles – long distance (Xborder)**
ANNEX: CALL 2016-17 Automated Transport - Complementarity

ART-04-2016: **RIA** - Safety and end-user acceptance aspects of road automation in the transition period
- **RIA** – user-centric & driver-car interaction for **level 3 automation** – safety in mixed traffic/legacy

ART-05-2016: **RIA** - Road **infrastructure** to support the transition to automation and the coexistence of conventional and automated vehicles on the same network

ART-06-2016: Coordination of activities in support of road automation

Main differences:
- Pilot 5 is an **IA** not **RIA** and focuses on:
- No focus on infrastructure (but some adaptation to existing infrastructure could be part of the pilot)
ANNEX: CALL 2016-17 Automated Transport - Complementarity

ART-07-2017: IA - Full-scale demonstration of urban road transport automation (IA – 10-15M€)

full-scale demonstrations to prove the reliability, safety and robustness of fully automated road transport systems in complex scenarios in urban areas

+ user acceptance and legal framework
+ develop business cases -> economically viable

Scope: fleet of automated road transport vehicles (e.g. light weight vehicles, cyber cars, small buses) at pan-European level in urban and/or sub-urban areas.

IMPACT: new public transport - Innovative mobility services

Main differences:
Pilot 5 focuses on:
- Level 4 or 5 (not restricted to fully automated)
- Technology: optimised combination of local autonomy and IoT
- No restriction on urban nor type of vehicle nor public transport nor pan-European (not excluded but not limited to such cases)
Thank you