

Autonomous Driving Progressed by oneM2M

The Experience of the AUTOPILOT Project

Giovanna Larini, Giovanni Romano
TIM S.p.A. – Torino, Italy

Mariano Falcitelli, Sandro Noto, Paolo Pagano
PNTLab - CNIT – Pisa, Italy

Miodrag Djurica
TNO – The Hague, Netherlands

Georgios Karagiannis
Huawei Technologies Düsseldorf GmbH, – Germany

Gürkan Solmaz
NEC Laboratories Europe – Heidelberg, Germany



Mariano Falcitelli – CNIT

19 June 2019



AUTOPILOT project has received funding from the European Union's H2020 research and innovation programme under Grant Agreement No 731993



Table of Content

- 1 The AUTOPILOT Project
- 2 Challenge: IoT interoperability for AD services
- 3 Federated IoT platforms
- 4 AUTOPILOT oneM2M Interoperability Platform
- 5 User Applications from Livorno PS (clips)





IN A NUTSHELL

Use IoT technologies to move Automated Driving towards a new dimension

- ✓ Enhance driving environment perception with “IoT enabled” sensors
- ✓ Integrate IoT platforms in the vehicles
- ✓ Use IoT Platforms on the Cloud to
 - ✓ «Store & Share» IoT sensor data
 - ✓ Create new Mobility Services for fully automated vehicles



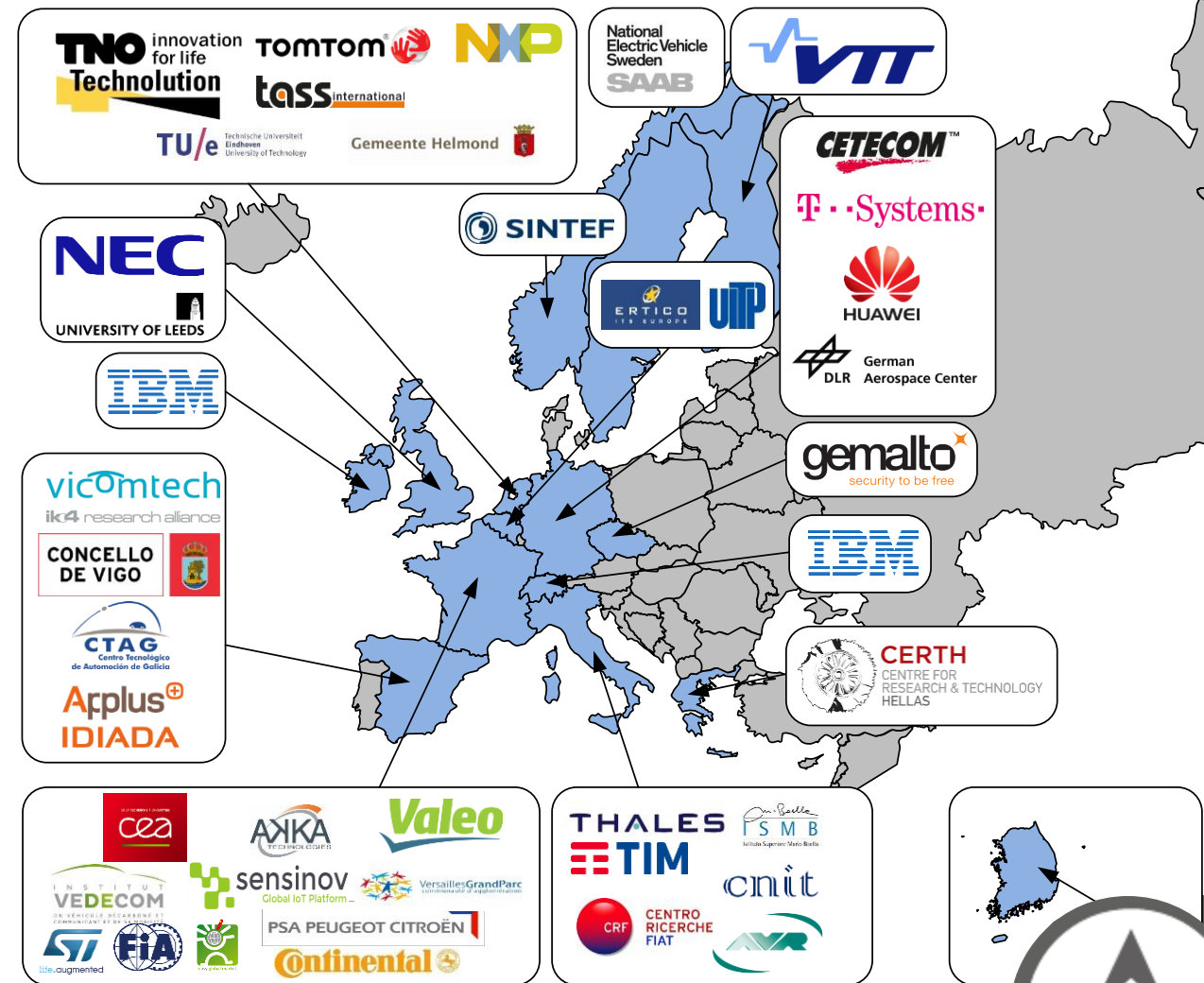
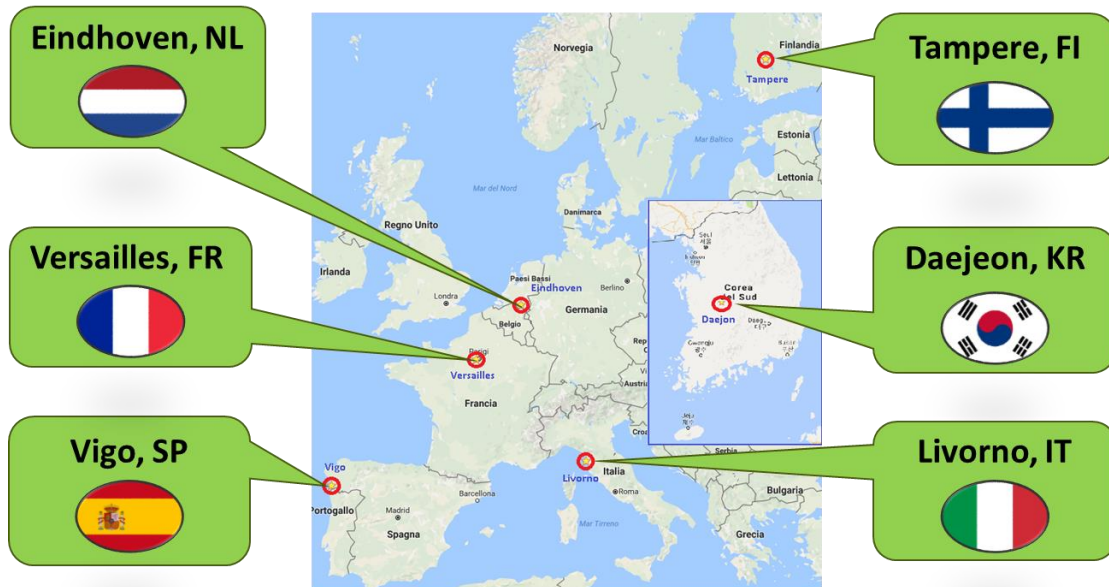
Large Scale Pilot Sites and Partner Consortium

One of the 5 Large Scale Pilots on IoT funded by DG CONNECT unit -- > Autonomous Vehicles in a Connected Environment

3 Years Innovation Action: 01/01/2017 – 31/12/2019

44 beneficiaries – coordinator: **François Fischer, ERTICO**

Project costs: 25 m€ - EU contribution: 20 m€



Overall concept



4



DRIVING SERVICES

Real time car sharing

Sixth sense driving

Automated driving route optimisation

HOW DOES IT WORK?

2 **IoT PLATFORM**

INTEROPERABLE | STANDARDISED | SECURE | OPEN-ACCESS

3 **APPLICATIONS**

AUTOMATED VALET PARKING

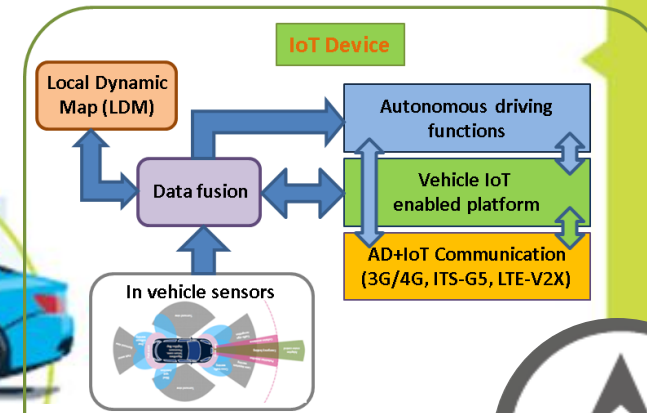
HIGHWAY PILOT

PLATOONING

URBAN DRIVING

1 **IoT eco-system**

Vehicle IoT integration



Pilot Sites, Applications and Services

IoT enabled Services



Automated driving route optimisation



City Chauffeur services for tourists



Driverless car rebalancing



Dynamic eHorizon



Electronic driving license



HD maps for automated driving vehicles



Real time car sharing

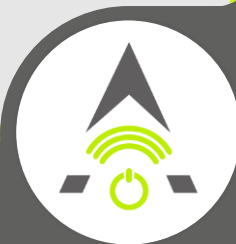


Sixth sense driving

					
Country	City/Region	Valet Parking	Highway Use	Platooning	Urban Driving
	Tampere	✓			✓
	Versailles	✓		✓	✓
	Livorno-Florence		✓		✓
	Daejeon				✓
	Eindhoven	✓	✓	✓	✓
	Vigo	✓			✓

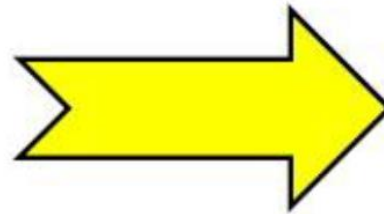
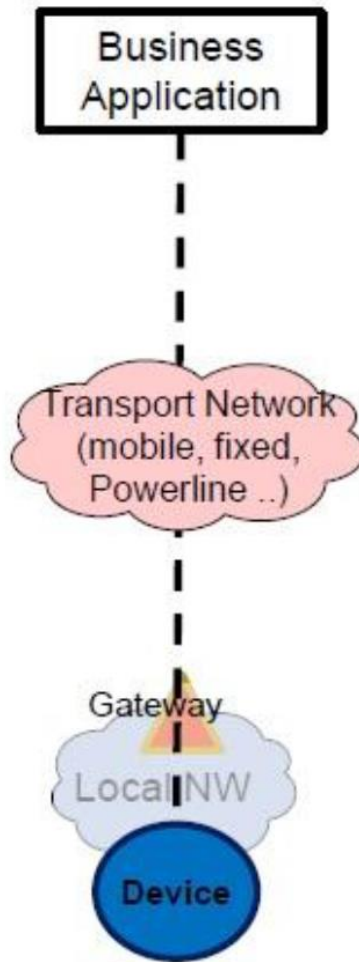


Challenge: IoT interoperability

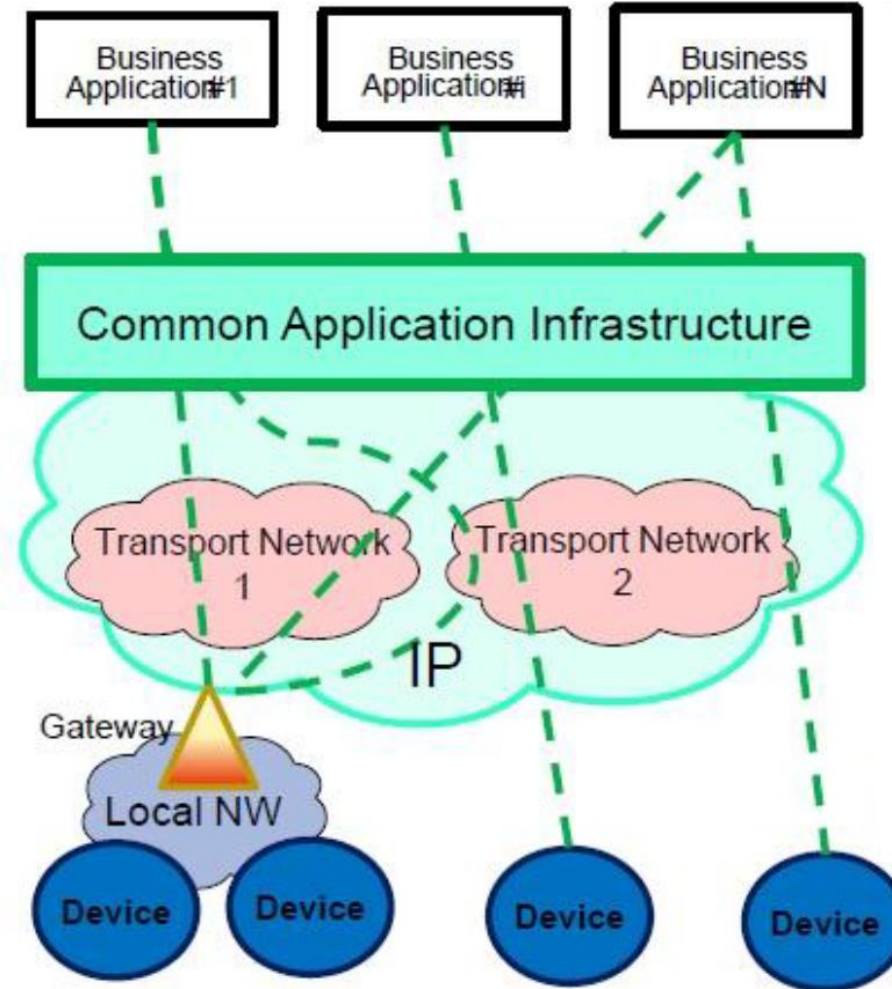


The Challenge

Vertical pipe:
1 Application
1 Platform
1 Network
1 Device



Horizontal pipe: Applications shares common infrastructures, platforms and networks



Designing the Architecture



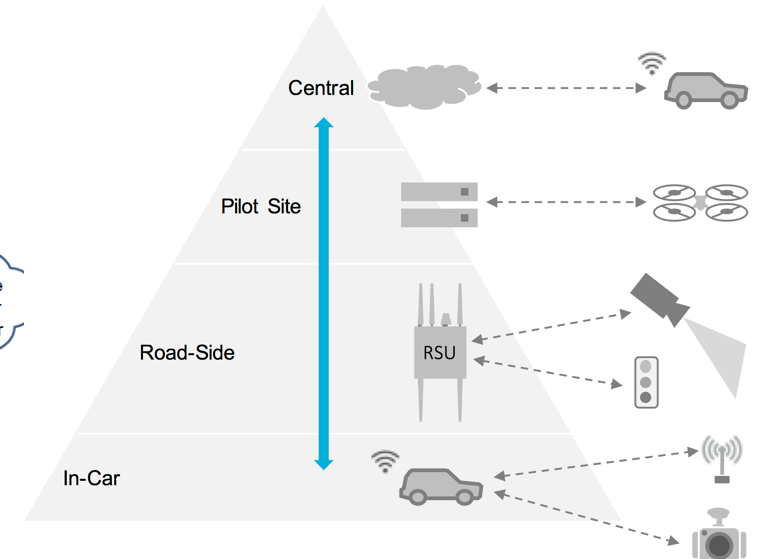
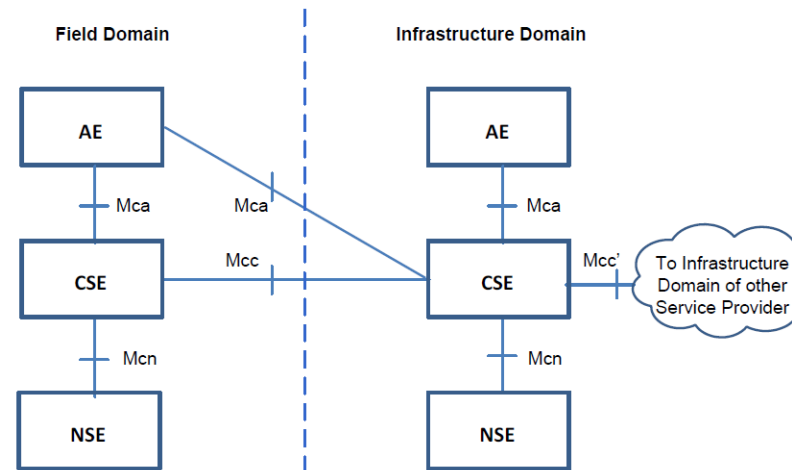
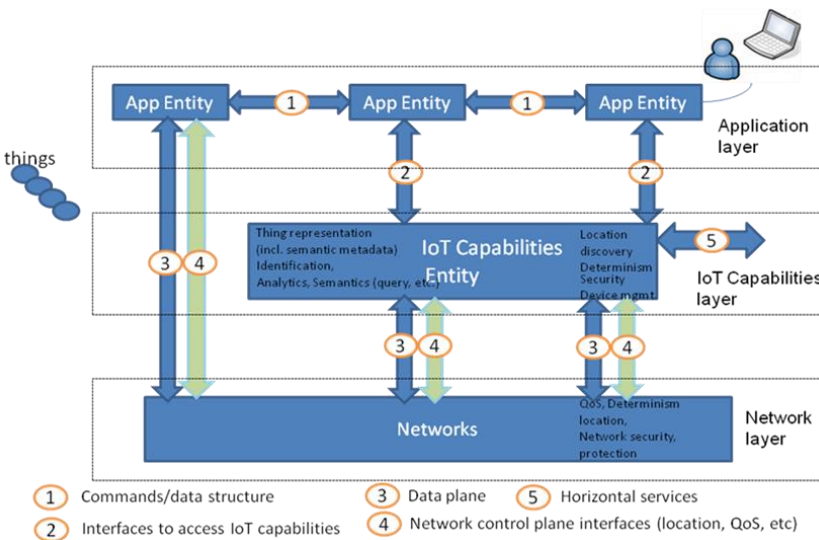
Brainport

Livorno

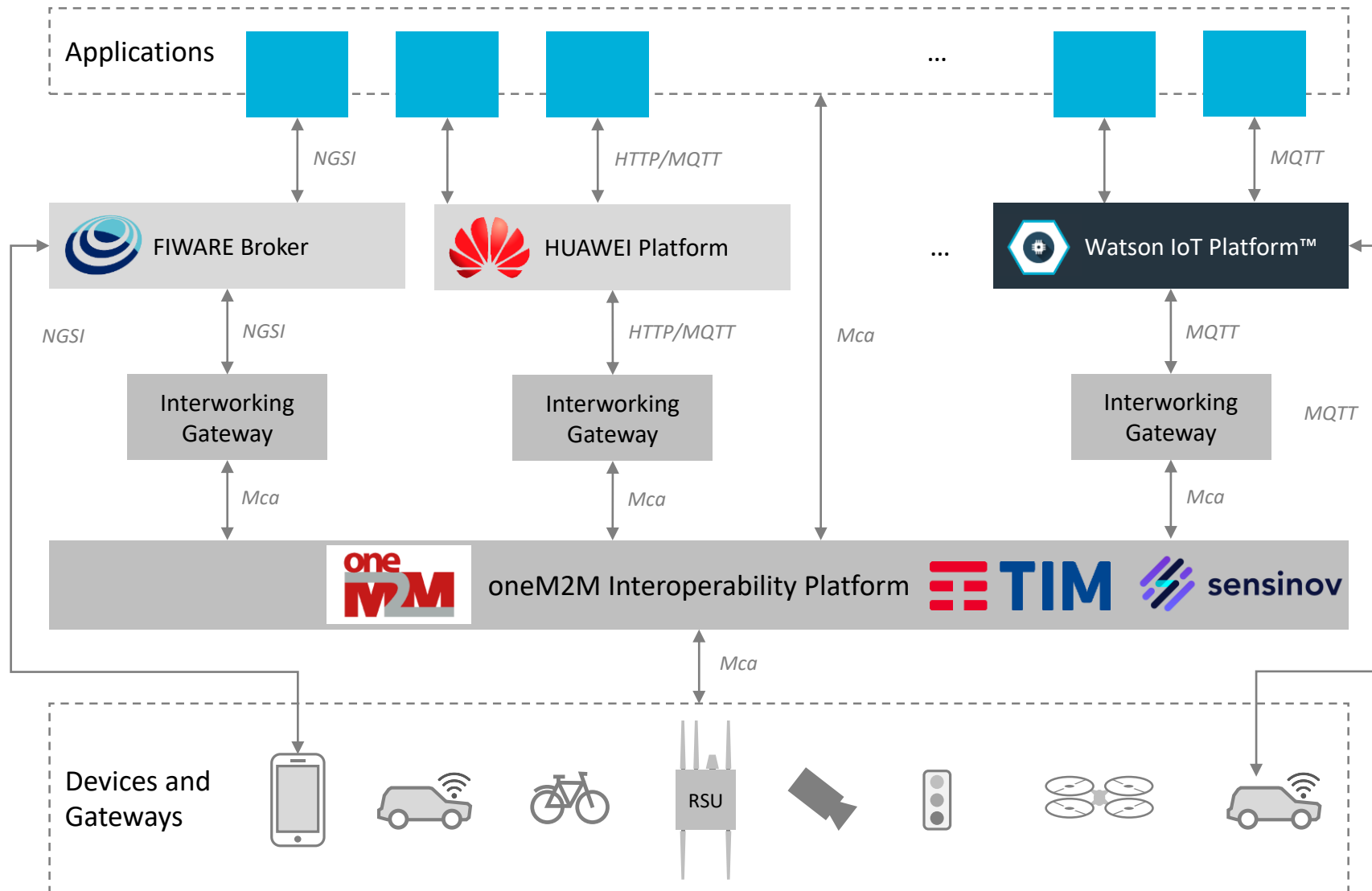
Tampere

Versailles

Vigo



Federated IoT platforms



AUTOPILOT oneM2M Interoperability Platform

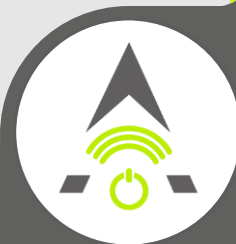
Interoperability in AUTOPILOT is achieved based on the following three principles:

- oneM2M Interoperability Platform and Interworking Gateways.
- Standardized IoT Data Models.
- Standardized Ontologies.

Goal: allow the automatic creation of a oneM2M resource structure for the use cases and enable tool-support for the partially automated creation of the required interworking proxy.



User Applications from Livorno PS (clips)





About Livorno Pilot Site

• Specific features:

- ✓ The testbed encompasses the area of the **Port of Livorno** and the **Florence - Livorno highway**.
- ✓ IoT devices are deployed in the car and along the roads in both the **Highway** and the **Urban Area**.
- ✓ **7 JEEP Renegade prototype** vehicles are used: 2 connected and AD cars, 5 connected cars.
- ✓ A **connected bicycle prototype** is also used in the urban tests.
- ✓ The **MONI.C.A.TM Port Monitoring Centre, Traffic Control Centre** with **DATEX-II** node are integrated into the PS ICT infrastructure.

• Use cases:



- **Highway Pilot:** road hazard events announced by IoT devices enable speed adaptation and lane change functions on the AD cars.

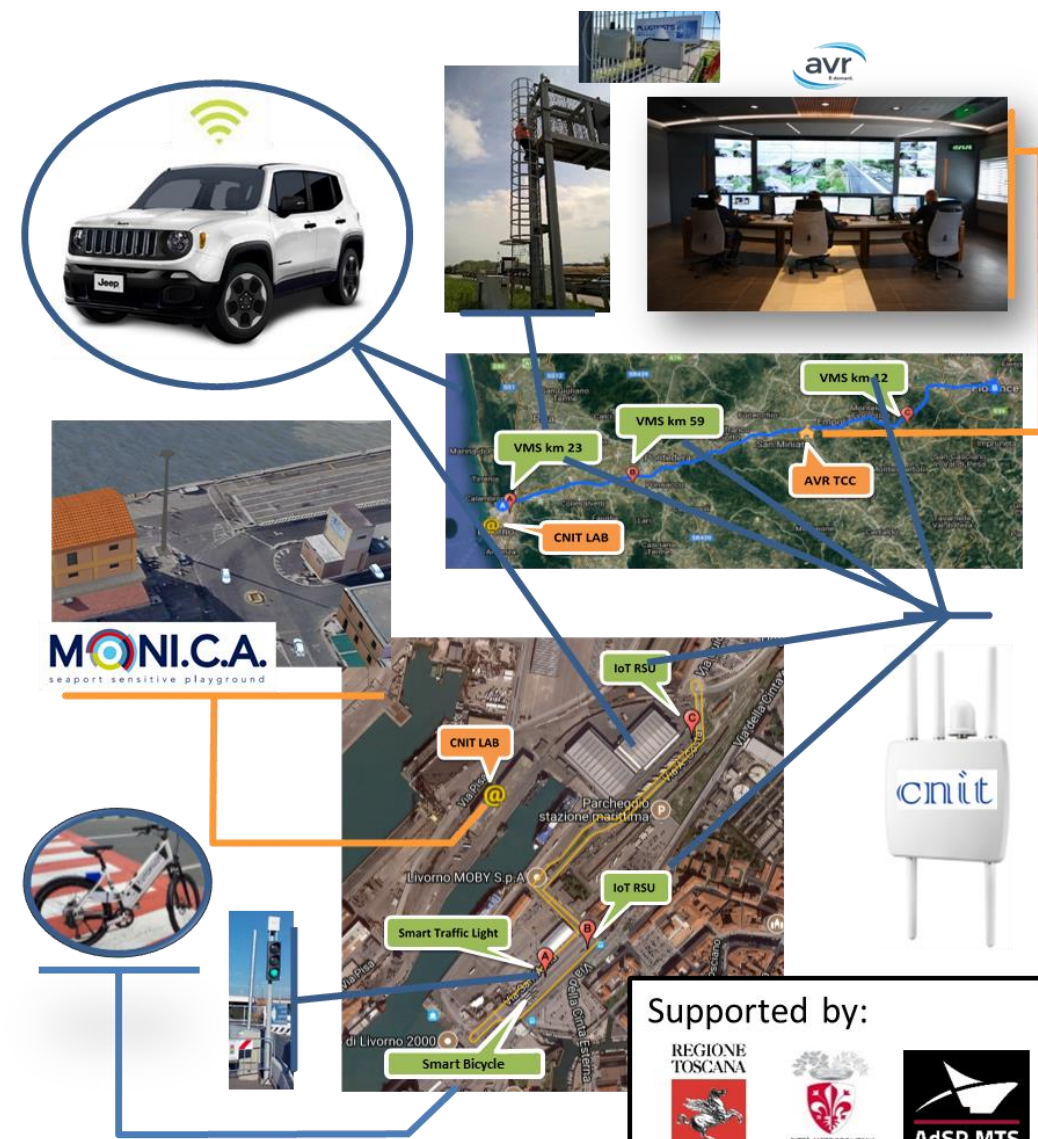


- **Urban driving:** vulnerable road user are detected at traffic light intersection and trigger brakes on the AD cars.

• Partners involved:



Supported by:



IoT components of the Livorno PS



• Devices

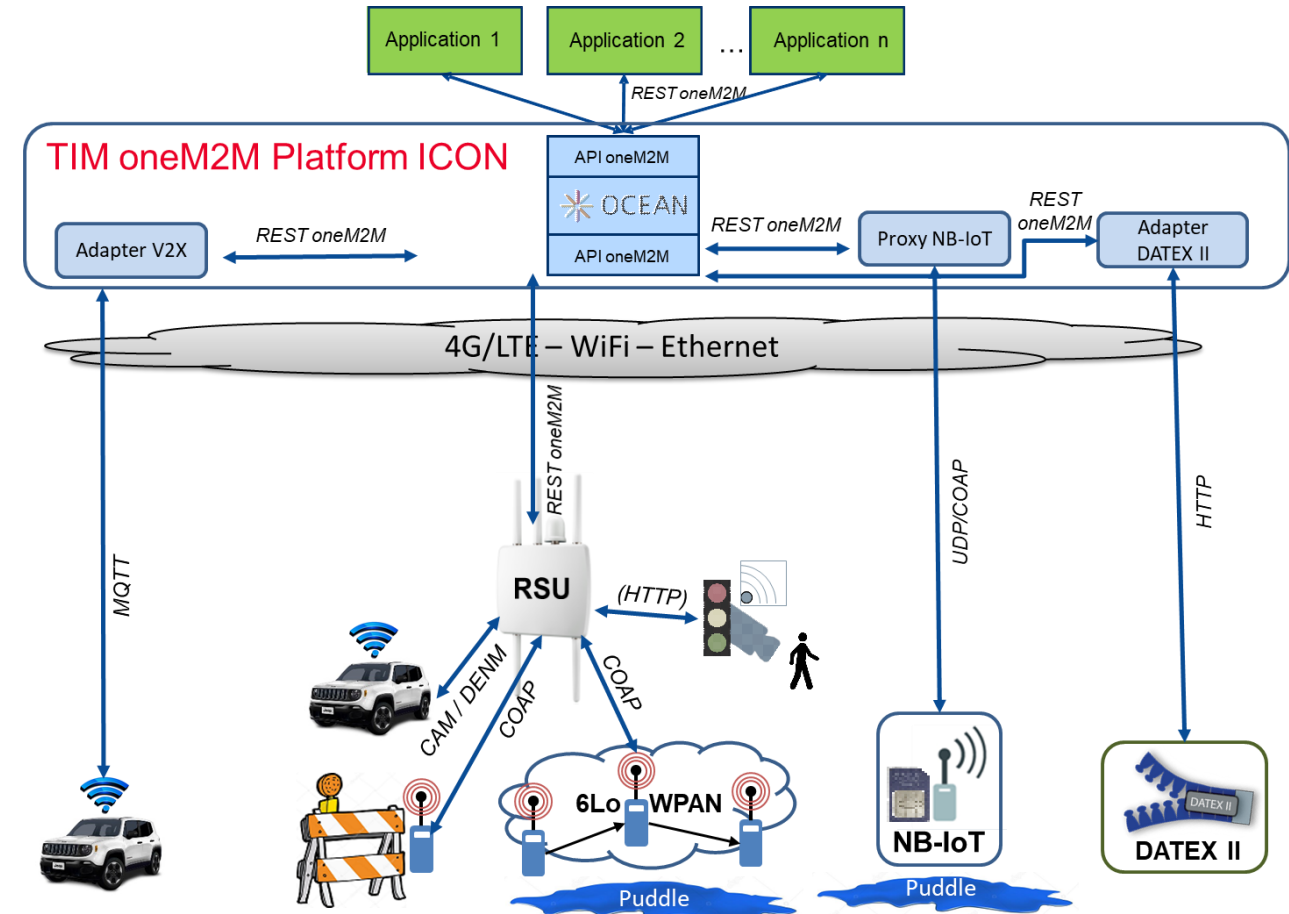
- Puddle IoT sensors (based on 6LoWPAN and NB-IoT technologies),
- Pothole detector,
- Smart Trailer (announcing roadway works),
- Road Side Units,
- On Board Units (cars and bicycle),
- Smart traffic light,
- Smart camera.

• Networks

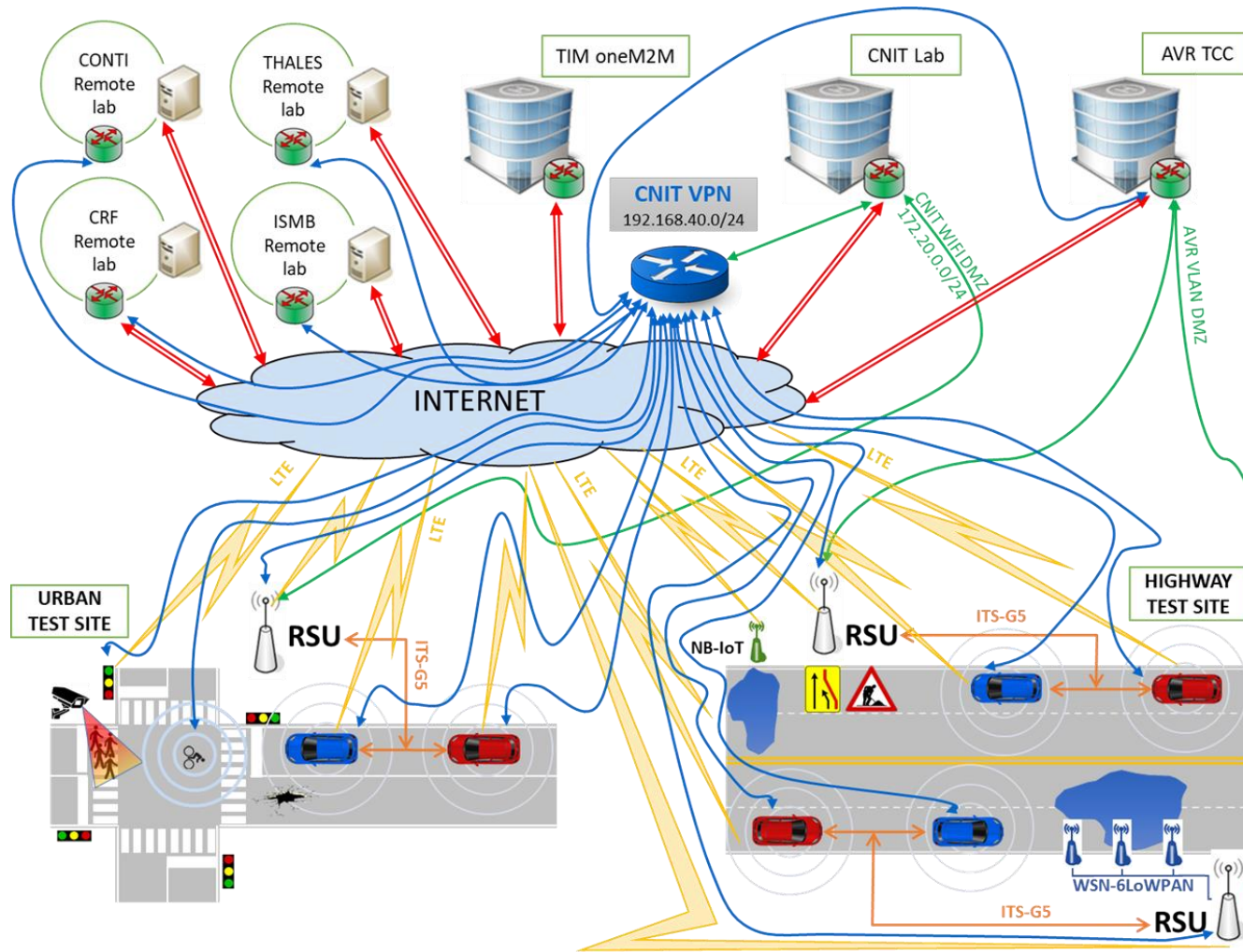
- 4G cellular network,
- Port Wireless Backbone,
- Highway Backbone (Tuscan Institutional Cabled Network),
- ETSI ITS-G5,
- NB-IoT/6LoWPAN,

• Platforms

- ICON OneM2M platform,
- In-vehicle IoT platform.



Network Map of Livorno PS



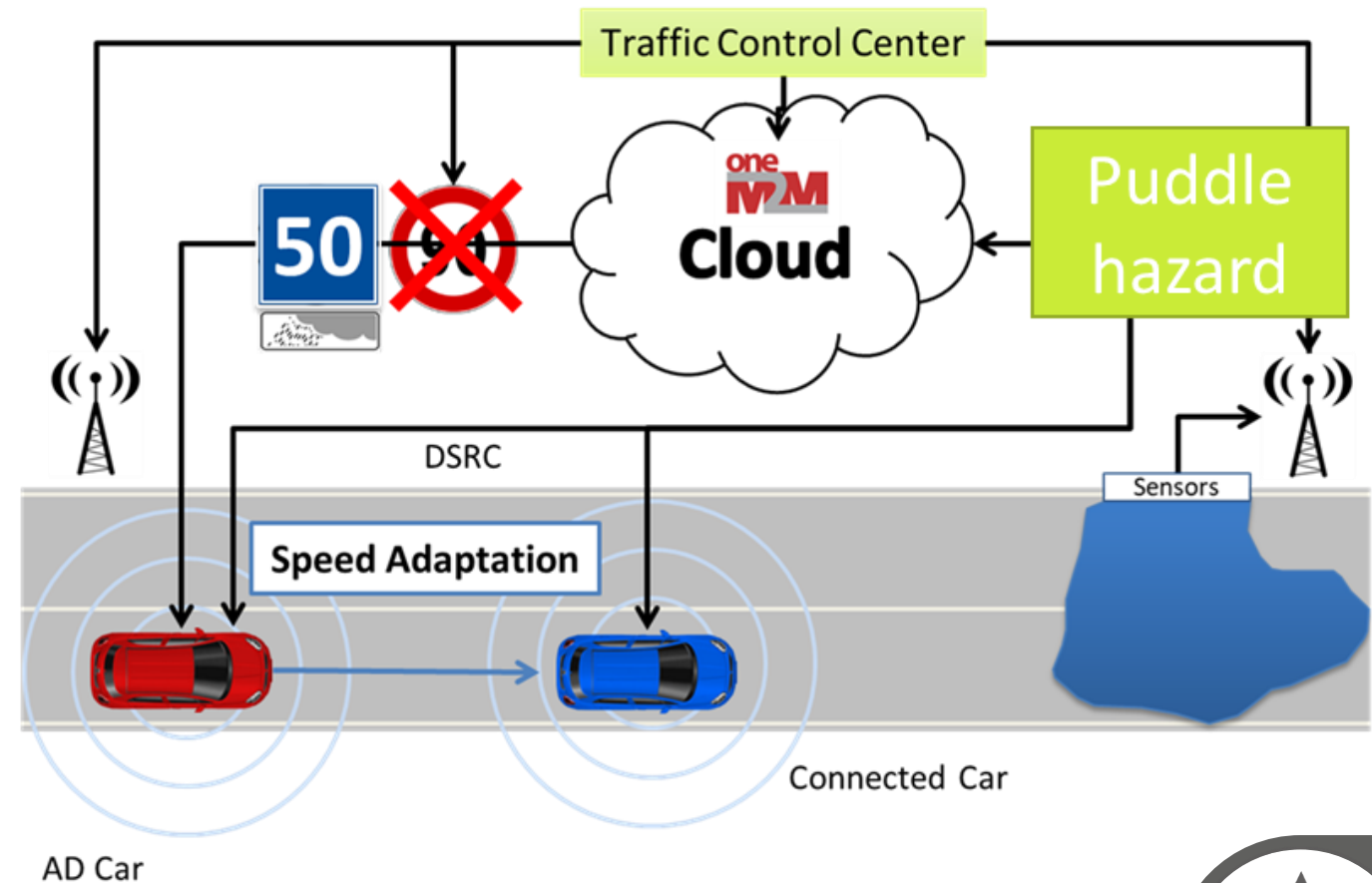
• Large Scale Heterogeneous Network Infrastructure:

- Tier 0:
 - Urban and Highway test sites.
- Tier-1 service providers:
 - CNIT lab (Livorno);
 - AVR TCC (Empoli);
 - TIM IoT OpenLab (Turin).
- Tier-2 remote labs:
 - Continental (Toulouse);
 - Thales (Florence);
 - FCA-CRF (Trento);
 - ISMB (Turin).
- **VPN for remote access to devices during piloting.**

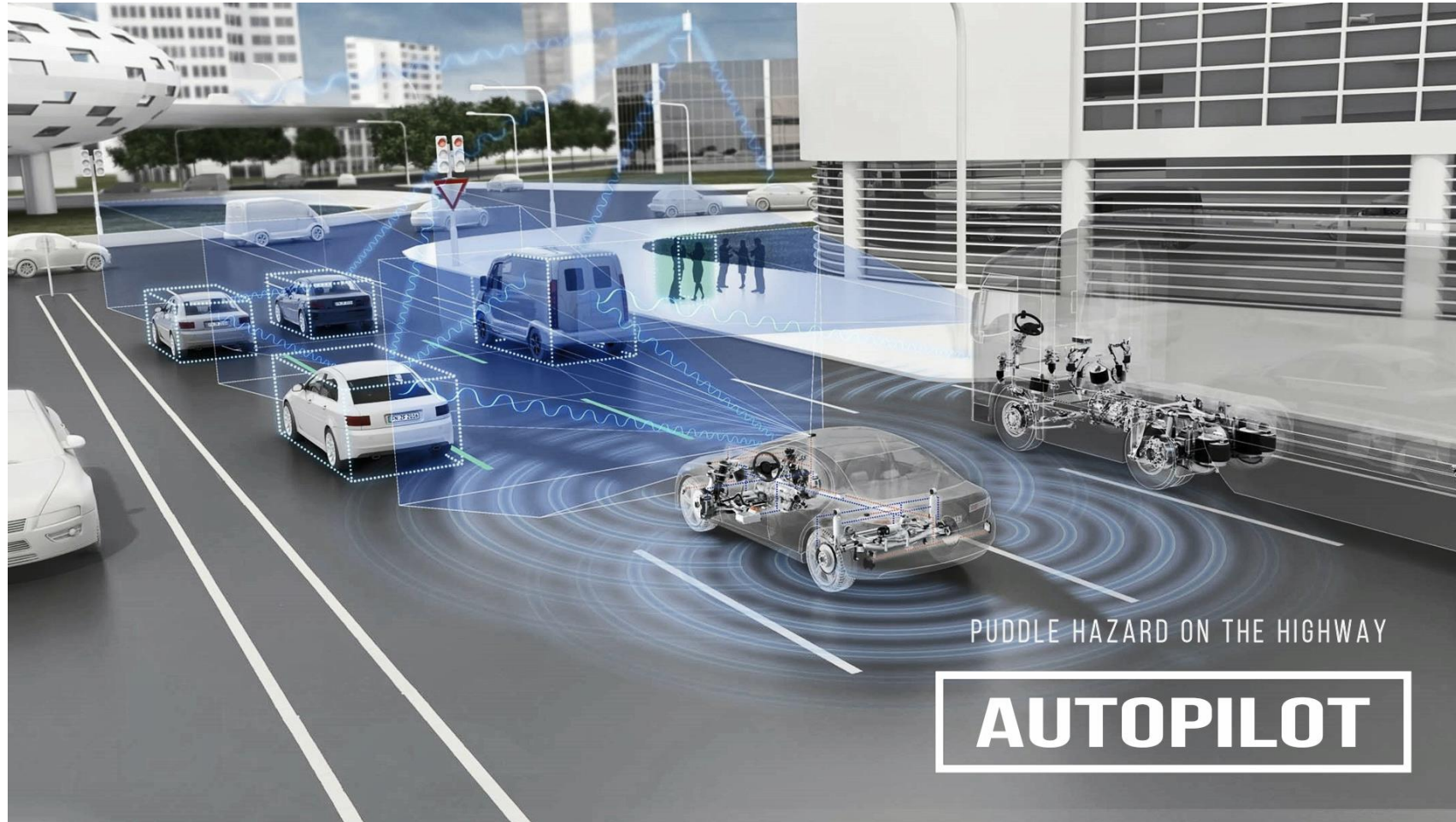


Example of highway application: IoT assisted Speed Adaptation at Road Hazard

- In case of puddles an alert triggered by IoT sensors is published to the oneM2M platform
- RSU broadcasts this information to vehicles (DENM) and to the oneM2M platform.
- TCC consumes the info validates the alert and set the advisory speed on the oneM2M.
- RSUs updates the DENMs with highest information quality
- C-eHorizon is subscribed to the oneM2M, it updates the maps with alert signals and advisory speed
- AD car **adapts speed** using information obtained from both oneM2M and DENM.

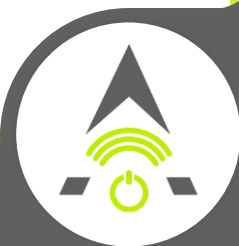


VIDEO: Puddle hazard on the highway



Conclusions

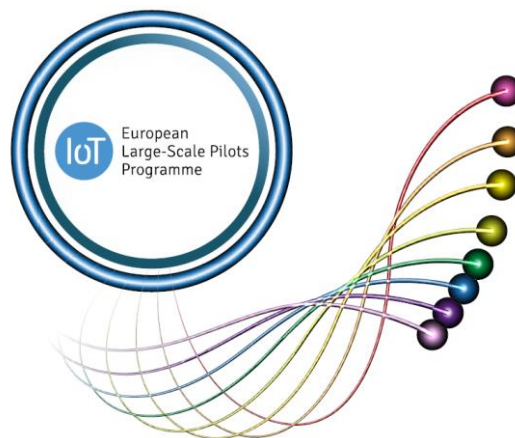
- AUTOPILOT project shows that oneM2M compliant platforms and devices are valuable bricks of the digital infrastructure for accommodating the usage of AD cars in EU roads.
- A set of contributions based on results obtained in AUTOPILOT were agreed and introduced in oneM2M-TR-0026-V-4.2.0.
- oneM2M interoperability platforms have been developed allowing different proprietary platforms to interwork successfully.
- The interoperability of the different solutions developed within each Pilot Site will be demonstrated by a test fest planned in November 2019.
- Further work is needed to achieve a seamless federation with the IoT infrastructure emerging from related project areas (created by the European H2020 Large-Scale Pilots Programme: IoT FA, LSPs and IoT-02-2016 CSA).



Thank you for your attention

Mariano Falcitelli, CNIT | 19/06/2019

 www.autopilot-project.eu
 info@autopilot-project.eu
 [@autopilot_eu](https://twitter.com/autopilot_eu)



mariano.falcitelli@cnit.it
<http://www.cnit.it>

