



## SARWS

Project ID: C2016/3-5

Start Date: 1 November 2018

Closure date: 30 April 2022

### Partners:

Be-Mobile, Belgium  
 Belgian Postal Services, Belgium  
 CBT, Communication & Multimedia, S.L, Spain  
 Commissariat à l'Energie Atomique et aux énergies alternatives (CEA-LETI), France  
 Dtonic Corporation, Korea  
 eLichens SA, France  
 ENEO TECNOLOGIA S.L., Spain  
 Ericsson Arastirma Gelistirme ve Bilisim Hiz. A.S., Turkey  
 Eurico Ferreira S.A., Portugal  
 Idemia, France  
 IMEC - Interuniversitair Micro-Electron, Belgium  
 Innovalia Association, Spain  
 Instituto de Telecomunicações, Portugal  
 Inuits, Belgium  
 MICROIO - SERVIÇOS DE ELECTRÓNICA, LDA., Portugal  
 Otokar, Turkey  
 Royal Meteorological Institute, Belgium  
 Turkcell, Turkey  
 Turkgen Yazilim Sanayi Ticaret Limited Sikreti, Turkey  
 University Paris Est Creteil (UPEC), France  
 Verhaert New Products & Services NV, Belgium  
 YoGoKo, France

### Co-ordinator:

Joaquim Ferreira

Instituto de Telecomunicações

E-mail: [jjcf@ua.pt](mailto:jjcf@ua.pt)

### Project Website

[www.celticnext.eu/project-sarws](http://www.celticnext.eu/project-sarws)

## Real-time location-aware road weather services composed from multi-modal data

Adverse road weather conditions and air pollution are challenging for human drivers, urban population and for automated vehicles. To reach the safety, comfort, and efficiency benefits of Cooperative, Connected and Automated Mobility, vehicles need to sense road conditions and see beyond the fog and/or rain wall.

### Main focus

The recent development of C-ITS standards based on a common ITS station communication architecture is an opportunity to break-up the historical separation in non-interoperable silos. In particular, the definition of a generic messaging system and a data publication/subscription service allow ITS stations run cooperative applications with the potential to improve ITS safety, sustainability, efficiency and comfort beyond what can be achievable by stand-alone systems. Therefore, exploiting and further extending C-ITS standards, has the potential to expand the local data collection mechanisms from traditional road weather and pollution data sources to completely innovative ones. A new generation of solutions is now possible, taking advantage of the integration of roadside units and road weather/pollution stations, vehicle' data, road weather sensors and ultimately the mobile device data from each handheld device from the road' users.

A system allowing to warn any driver, the urban population, and automated cars, with practically any kind of on-board instrumentation would be interesting to many national road authorities and could contribute to the overall road safety, efficiency and comfort. Dedicated sensors embedded in vehicles can also report pollution level to build high-resolution dynamic maps accounting both weather and pollution, besides all other data already available in such maps.

### Approach

- ◆ Pervasive, fine grain, sensing using probe vehicles and road weather/pollution stations, integrated in the Cooperative Intelligent Transportation Systems (C-ITS) architecture.
- ◆ Leverage on C-ITS technologies to take the most benefits from a real-time analysis of the data gathered from weather and pollution sensing technologies and provide an on-time appropriate reaction to the drivers/automated vehicles.
- ◆ The recent development of C-ITS standards based on a common ITS station communication architecture is an opportunity to break-up the historical separation in non-interoperable silos.
- ◆ Build real-time, high-resolution, location-aware road weather/pollution services composed from multi-modal data

### Achieved results

The SARWS project succeed to build end-to-end architecture for road safety, localized weather forecast, and air quality monitoring based on V2X communications.



Figure 1: eLichens air quality unit and dashboards



Figure 2: Cross-border interoperability for road weather (1) and air quality (2) applications.

- ◆ Definition of a common architecture, both to integrate weather and pollution data in the C-ITS and to aggregate different use cases.
- ◆ Use of NGSI-LD, standardized by ETSI Industry Specification Group CIM (cross-cutting Context Information Management), in the central broker to support cross-border interoperability.
- ◆ Proposal of SARWS message format, an extension of ETSI Local Dynamic Map (LDM), to be submitted to standardization within ISO/ETSI.
- ◆ Design and implementation of novel sensing hardware
- ◆ High-definition road-weather forecast and air quality maps
- ◆ Implementation of three end-to-end pilots, with interoperability based on ETSI-CIM API and extended LDM messages.

- ◆ Organization of two workshops integrated in IEEE flagship conferences: the International workshops on Next Generation Road Weather Services (NG-ROWS)
- ◆ The special issue "The Weather and Pollution Sensing for Intelligent Transport Systems", in the MDPI Sensors journal (ISSN 1424-8220)
- ◆ A total of 18 papers were published in journals and conferences, and some more are in the pipeline to be published.

## Impact

The project has filed 7 international patents, has deployed over 15 prototypes and field trials, and over 40 new products have been developed based on the project results. In average, industrial partners expect a tenfold return of investment, within the next three years. More optimistic estimates, of a large company, envision a

100x return of investment in their IoT market segment from the technology developed in SARWS. 40+ new permanent employees were hired by the partner organizations.

## About Celtic-Plus

Celtic-Plus is an industry-driven European research initiative to define, perform and finance through public and private funding common research projects in the area of telecommunications, new media, future Internet, and applications & services focusing on a new „Smart Connected World“ paradigm. Celtic-Plus is a EUREKA ICT cluster and belongs to the inter-governmental EUREKA network. Celtic-Plus is open to any type of company covering the Celtic-Plus research areas, large industry as well as small companies

or universities and research organisations. Even companies outside the EUREKA countries may get some possibilities to join a Celtic-Plus project under certain conditions.

## Celtic Office

c/o Eurescom, Wieblingen Weg 19/4  
69123 Heidelberg, Germany  
Phone: +49 6221 989 138  
E-mail: office@celticnext.eu  
www.celticnext.eu

