



Project Results

# APPSTACLE

Vehicle connectivity for novel applications

## EXECUTIVE SUMMARY

Through a consortium of major players such as Ericsson, Bosch, NXP and The Eclipse Foundation, the ITEA project APPSTACLE has created an open-source platform which connects cars to one another and to the cloud. This allows the secure development of new applications and services which could revolutionise the automotive domain.

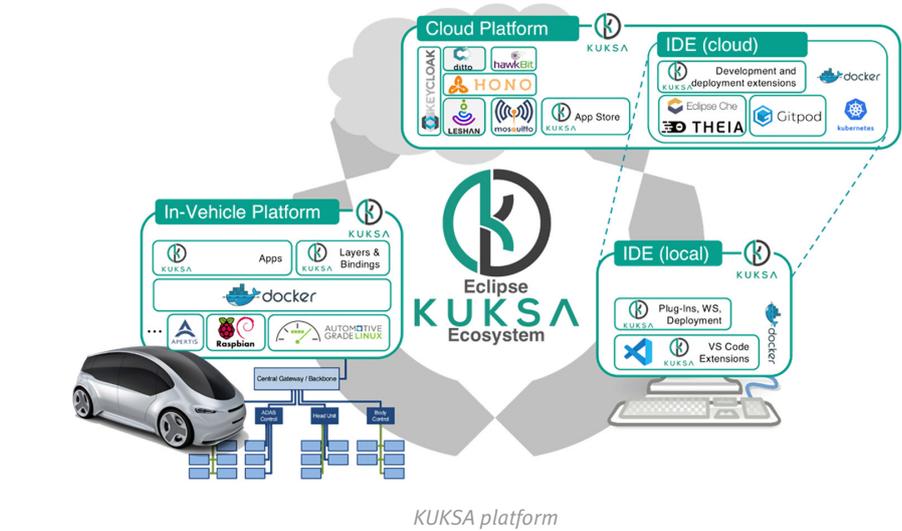
## PROJECT ORIGINS

In the automotive domain, there is an increasing demand for software related to services like location, media and driving assistance. Although high-end cars now contain hundreds of millions of lines of code, development takes place in silos belonging to each manufacturer or OEM. To meet consumer needs at this high level of complexity while avoiding 'walled' proprietary solutions from a few monopoly players, a secure, open car-to-cloud and cloud-to-car platform is needed.

The APPSTACLE (open standard Application Platform for carS and TrAnsportation vehICLES) project has created such a platform, connecting cars and transportation vehicles to the cloud using hybrid communication technologies (4G, 5G, LTE-V and ITS-G5) for V2X communication. Eclipse facilities have been used to build an open ecosystem in which the security, privacy and identity requirements can be met, allowing the platform to be used in a wide range of vehicles. Standard interfaces use Internet of Things (IoT) connectors to link in-car data to the cloud, allowing for software updates and the upgrading of application systems, software solutions and services.

## TECHNOLOGY APPLIED

As a car-to-cloud ecosystem, APPSTACLE can potentially connect to the vehicle's infrastructure (e.g. OBD-II, CAN, automotive ethernet) and add functionalities in order to connect to an open-source environment for developing,



KUKSA platform

deploying, maintaining and monitoring in-vehicle applications. For cars without in-built connectivity, an open-source dongle can be used to access the vehicle data over the OBD-II interface. Data on aspects such as speed, temperature and driver behaviour can be fed to the outside world, allowing existing connectivity to be applied in new market sectors. Additionally, the consortium has used and implemented the information path W3C-VISS (Vehicle Information Service Specification, <https://www.w3.org/TR/vehicle-information-service/>). This ontology standard allows the implementation of multiple big manufacturers as sources for application development.

The in-vehicle platform consists of three layers: the Linux-based Operating System (which reuses the original equipment's existing services, layers, hardware abstractions, etc.), middleware (which uses APIs to abstract vehicle E/E architecture and communication services to manage network access and provide data from the vehicle) and application (which runs third-party applications and contains a sandbox environment and additional services). Extra security is guaranteed by driver authentication for in-coverage/out-of-coverage scenarios, two-factor authentication and asymmetric and symmetric authentication for short-range communication. The same security standards are used for telecommunication

network connectivity (4G, 5G), ensuring that all data is encrypted.

Ten use-cases have been implemented and verified with end-to-end functionalities. Driver authentication, for instance, can be used by municipalities to manage public transport drivers, who must provide fingerprint scans to open the engine control system. Roadside assistance, meanwhile, is based on the car's Electronic Controller Units (ECUs) and uses algorithms to automatically analyse these ECUs when a problem is detected. If a software patch is already available, this can be downloaded to pre-emptively correct the issue. 15 demonstrators are currently available on the basis of these use-cases.

## MAKING THE DIFFERENCE

For the time being, APPSTACLE is focused on dissemination amongst developers, with the open-source platform Eclipse KUKSA having already attracted 38 contributors to increase the platform's development through libraries, components and coding. This has led to a number of external collaborations, including a connectivity gateway proof-of-concept with industry partners and traffic simulation with Eclipse SUMO. Additionally, Eclipse KUKSA is targeting the industry sector and offering non-manufacturing companies in the automotive domain the opportunity to access new markets and business models, such as allowing rental

companies to track the status of their vehicles and optimise their turnaround management. As an alternative to OEM proprietary solutions, this is also a means for SMEs to enter the field of vehicle connectivity (currently worth USD 14.5 billion).

Academic dissemination is another key result of the project, with APPSTACLE having so far played a role in ten MScs and 14 PhDs across Europe. The consortium has also organised three Eclipse KUKSA-related courses and summer schools which were attended by around 150 students in total. KUKSA should therefore become an asset in teaching and research for automotive IoT end-to-end frameworks. Standardisation is ongoing and includes a generic, extensible data model currently specified by the W3C. In the long term, Eclipse KUKSA will make disruptive changes to the automotive value chain. One aspect is the emergence of new forms of connectivity: street infrastructure (e.g. streetlamps, traffic lights) hold the potential to become information base stations to enable data processing near to the car rather than in the cloud. Most importantly, however, is that Eclipse KUKSA shows large companies that there is more to be gained from sharing data rather than protecting it within proprietary solutions. As more vehicles become connected, more applications and services will emerge. Companies can therefore enhance the business domain as a whole while increasing the size of their own share.

## MAJOR PROJECT OUTCOMES

### Dissemination

- 10 publications in journals and magazines, +20 conference articles and presentations
- Several summer schools and courses in 4 European Universities, consisting of +150 students

### Exploitation (so far)

- KUKSA – open source application platform, containing:
  - In-vehicle platform
  - Cloud platform
  - Application development environment
  - Application marketplace
- IoT gateway by taskit:
  - A multifunctional gateway for automotive and other IoT related connectivity development projects
- KUKSA OBD dongle by Bosch:
  - An open source hardware dongle for automotive development projects

ITEA is a transnational and industry-driven R&D&I programme in the domain of software innovation. ITEA is a EUREKA Cluster programme, enabling a global and knowledgeable community of large industry, SMEs, start-ups, academia and customer organisations, to collaborate in funded projects that turn innovative ideas into new businesses, jobs, economic growth and benefits for society.

## APPSTACLE 15017

### Partners

#### *Finland*

Ericsson

Haltian

University of Oulu

#### *Germany*

BHTC

Bosch.IO

FH Dortmund

Eclipse Foundation Europe

Expleo

Fraunhofer IEM

Robert Bosch

taskit

University of Paderborn

#### *Netherlands*

Eindhoven University of Technology

Forescout Technologies

NXP Semiconductors

Technolution

#### *Turkey*

KoçSistem

Netas Telekomunikasyon

Otokar Otomotiv

### Project start

October 2016

### Project end

December 2019

### Project leader

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### Project website

<https://www.eclipse.org/kuksa/>