

Moreover, standardization efforts performed within SCOOP initiative is a global challenge and IDnomic, Renault and Telecom Paris Tech, are working with international standardization bodies such as ETSI (European Telecommunications Standards Institute) and the European Commission in order to achieve worldwide interoperability and harmonized deployment in accordance with the European Certificate Policy.

Efficient testing procedures

All SCOOP equipments have to pass through a set of testing procedures including laboratory, test tracks and open road tests. When all these steps are approved, the equipment is considered ready for deployment.

These procedures are described as follows :

- **ETSI conformance testing:** These tests are the ones provided by the ETSI. They consider mainly the conformance of communications protocols at the facilities and the networking layers.
- **SCOOP conformance testing:** This validation part focuses on SCOOP use cases and their specific parameters. It is checked that the communication profiles, defined in the specifications, are correctly implemented.
- **Technical log (tlog) generation verification:** Each tlog generation needs to be verified on each equipment. For this purpose, all possible events are run on each station. The derived tlog file is then checked.
- **Tlog upload verification:** The upload of the files through RSUs are verified for all tlog files in various situations (heavy files, numerous files, ...).
- **Secure message testing:** Secure messages are sent by equipments by combining the concrete message with the message signature using an appropriate certificate (mainly a pseudonyme certificate). The provided messages are also checked in order to ensure the correctness of the secure message.
- **PKI access verification:** The access to the PKI to change certificates is checked using adapted scenarios.
- **Scalability check:** It is checked whether the ITS station can behave properly when it receives a high number of messages from its neighbourhood.
- **DATEX translation into DENM:** The SCOOP Platform sends DATEX messages to RSUs which translate them into DENM messages. Also RSUs translate their DENM into DATEX when they need to send them to the SCOOP Platform. Both translations are verified for different scenarios.

In order to achieve these procedures, we have developed our own tools which are :

- Extension of ETSI TTCN testing cases
- Software able to communicate with the equipments (OBU or RSU) and check their responses.
- Software able to analyse automatically log files given by sniffers equipped with an ITS G5 device. These steps could be run on-line within a test period or off-line.

Our expertise has been used as one of the inputs for the compliance assessment Working Group of C-ITS platform. This work has been mainly achieved by the Université de Reims Champagne-Ardenne and IFSTTAR.



SCOOP's key achievements

Vehicles ready for driving !

SCOOP focuses on innovation and as such embeds a range of specificities related to its implementation in an already existing serial car. Transferring research and developments into pre-industrial activities was challenging and complex and had to respect the whole quality requirements as for industrial developments. The challenge was even much more complicated as expected as parts of the frame, especially the tests beds, were completely to be created. As **common specifications**¹ for the different communication levels (access technology, geonetworking, message protocols, applications for 23 use cases) have been defined in parallel to the technical detailed specifications that a car manufacturer usually share with suppliers, beneficiaries and sub-contractors were confronted to new issues on a daily basis. Therefore, a range of validation procedures has been set up and enforced: structured feedbacks, advanced validation procedures, enhanced dialogue and consultation phases, specifications' freezing – on a supplier level, on an OEM internal level and together with the stakeholders of the SCOOP Consortium.



Car Manufacturers faced mainly 4 big activities:

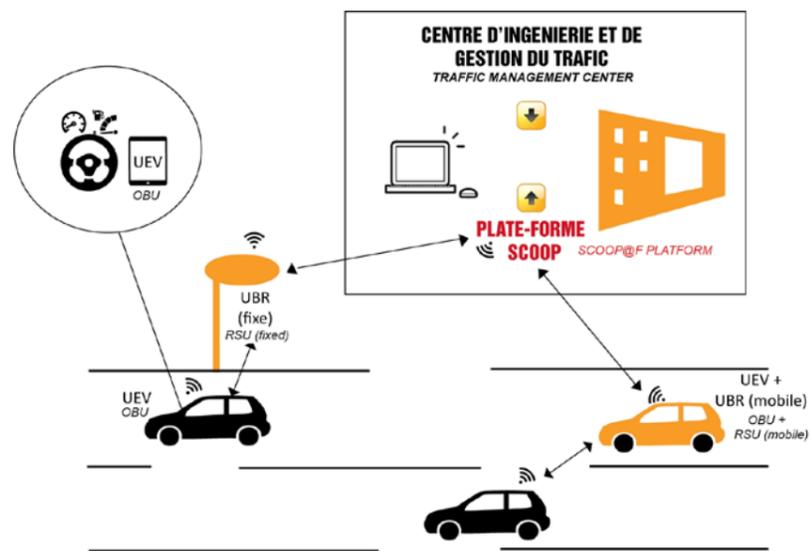
- **Specification and development of the C-ITS hardware:** stand-alone ITS G5 telecommunication unit, ITS G5 antenna, electric wiring.
- **Specification and development of the C-ITS software:** within the stand-alone ITS G5 telecommunication but also within the Human-Machine-Interface to display the SCOOP alerts or to allow manual declaration of an event. Main emphasis has been given on a completely integrated solution

¹ - The specifications developed by the Consortium are open and available on the project's website: <http://www.SCOOP.developpement-durable.gouv.fr/en/technical-specifications-a22.html>
The current release #2 includes all updates based on the many feedbacks from the developers.

of SCOOP within the serial HMI to facilitate and optimize the usage for the customer. But such SW activities included not only the realization of SCOOP use cases but also the request of security pseudonyms in link with the Public Key Infrastructure (PKI) and additional adaptations to grant technical and usage logs downloads for scientific partners for impacts studies.

- **Compliance assessment of these developments** following the validation criteria on desk, on track and on open roads. Specification, development and validation tasks are deeply interconnected and interdependent, notably due to the loop processes enforced.
- **Preparation of the mounting processes** – in the plant for Renault and in the dealer network for PSA – of the sales and after-sales processes to make them as much convenient for customers as possible. The production of SCOOP vehicles is yet scheduled, the pipeline for commercial contracts opened. So, potential customers might refer to conventional car manufacturer vendors or address their request to: <http://www.SCOOP.developpement-durable.gouv.fr/en/and-you-a4.html>

A robust back-end architecture



SCOOP involves both fixed Road Side Units (RSUs) and On Board Units installed in the road operator's vehicles (OBU-ro), which can act as mobile RSUs. The SCOOP central ITS station, named SCOOP Platform, links these together. It can be deployed at any Traffic Management Center (TMC) of any road operator. It is used by the 5 pilot sites involved in SCOOP, in various environments.

From the TMC to the vehicles, the SCOOP Platform is designed to:

- receive event data in Datex II v2.3 from the TMC (in real time or forecast events, especially road works) ;
- check the contents: date and time, identifier, unicity, etc. and drop them if wrong ;
- process data, for example calculating GPS coordinates, decomposing into simple messages, adding road characteristics, generating traces ;
- store and update data ;
- send them to the involved RSU(s) and/or OBU-ro around the dissemination area for dissemination to the vehicles ;
- check the acknowledgement of RSU and/or OBU-ro.

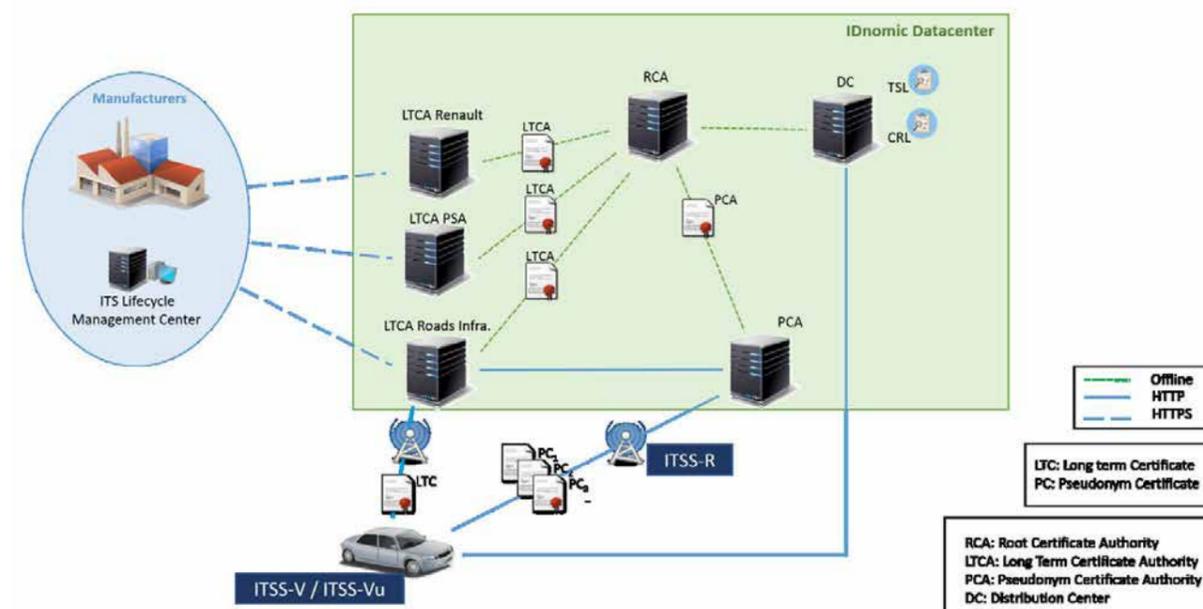
From the vehicles to the TMC, the SCOOP Platform is designed to:

- receive event data and road traffic data in Datex II v2.3 from the vehicles via RSU and OBU-ro ;
- check the contents: date and time, identifier, unicity, etc. and drop them if wrong ;

- process data, for example aggregating same events from several messages / users, aggregating road traffic data, translating GPS coordinates into road operator's geographical references (road and kilometer point) ;
- check whether or not the event is related to the road operator's network (if not, it is dropped) ;
- store and update data ;
- send them to the TMC if the triggering conditions are reached (event type, length, geographical area, quality).

A fully operational PKI

A key component for providing secure communications at a large scale is a Public Key Infrastructure (PKI) provided by a relying Trust Services Provider as IDnomic, the Europe's leading trusted identity technology provider. The IDnomic PKI enables all ITS stations to verify the integrity and the authenticity of the received messages, prevents any malicious modification during transmission and enforces the right to control the access and use of any personal data. SCOOP PKI is hosted within **IDnomic high-security datacenter** that meets the ongoing two-fold objectives of ensuring robustness and safety. Private keys of Certificate Authorities (CA) are issued, stored and operated under the best security conditions, while guaranteeing very high performance levels. **The Key Ceremony of SCOOP Root CA** has been successfully held on September 2016. Each secure communication depends on the strength of this infrastructure. Preproduction PKI, which is already online, allows SCOOP project partners to perform their ongoing security tests.



The SCOOP PKI provides a complete certificate management service including:

- **Registration of ITS stations**
- **Provision of long term certificates (LTC) and pseudonym certificates (PC)**
- **Revocation of ITS stations when needed**

Combination of both separation between Certification Authorities (LTCA and PCA) and usage of pseudonym certificates ensures anonymity of ITS stations and preserves users' privacy.

To contribute to the deployment of ITS security system, SCOOP has a tight collaboration with IRT SystemX through the ISE (ITS Security) project.