ON-ROAD CHARGING OF ELECTRIC VEHICLES : THE FABRIC PROJECT

Jérôme Perrin*, Institut VeDeCoM, France
Angelos Admitis, ICCS (Inst. Communication Computer Syst.), Greece
Vittorio Ravello, CRF (Centro Ricerche Fiat), Italy
Jean-Charles Pandazis, ERTICO, Belgium
Denis Naberezhnykh, TRL (Transport Research Laboratory), UK
Sebastiaan Meijer, KTH (Kungliga Tekniska Hoegskolan), Sweden

** jerome.perrin@vedecom.fr*

Introduction

A key to the future success and public acceptance of electric vehicles (EV) relates to commercial solutions to increase their range, given the constraints of low specific energy and high cost of batteries.
A first category of options consists of increasing the vehicle range by adding a fuel-powered electricity generator on-board, be it a gasoline or gas -fuelled combustion engine in a plug-in hybrid or range extender configuration, or an hydrogen fuel cell.
A second category of options consists in offering the most convenient service and infrastructure for battery recharging from the grid. This goes from providing fast charging to switching from cable plug-in to wireless charging as the vehicle is idle. But the ultimate service would be continuous or quasi-continuous on-road charging while driving.
The latter solution is in the agenda of transport electrification roadmaps, but its technical performance, economical viability, and socio-environmental impacts needs to be assessed. The European project FABRIC (*FeAsiBility analysis and development of on-Road chargIng solutions for future electric vehiCles*), gathering 24 partners from 9 countries (Belgium, Italy, France, Germany, Greece, Netherlands, Spain, Sweden, UK), from Jan. 2014 to Dec. 2017, aims at providing relevant answers to these questions.

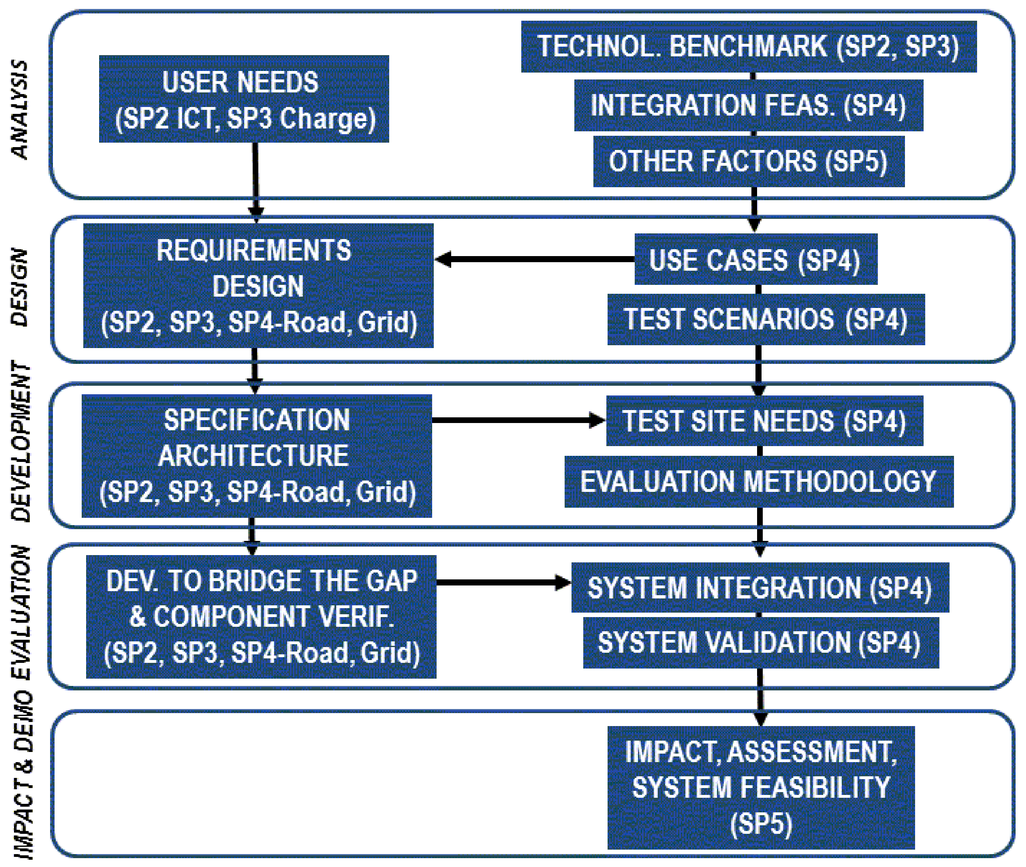
Objectives

FABRIC is focusing on wireless inductive charging with two sub-systems : the power emitter off-board and the receiver on-board ; however conductive charging with a sliding contact is also studied for comparison. FABRIC will provide a step forward in the progress of state-of-the-art static and dynamic wireless charging by analysing all factors influencing its development and implementation, and assessing the extent to which progress in technologies might solve challenges and provide benefits when compared to conventional plug-in charging.
Several technical, economical, environmental and societal challenges have to be addressed :

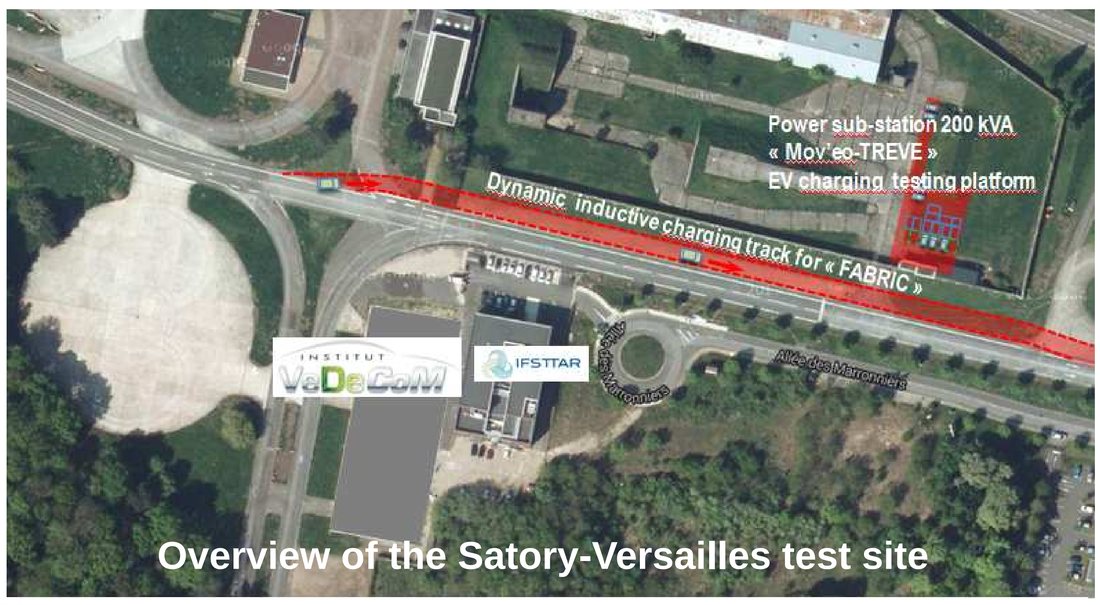
- design of inductive power transfer coupling coils, and cost and materials resources needed for large scale deployment
- power electronics to trigger the emitter when the car is facing it,
- dynamic vehicle alignment with respect to emitter coils,
- ICT solutions for long distance and short distance vehicle to infrastructure (V2I) and vehicle-to-vehicle (V2V) traffic control
- relation between power sub-station and grid energy supplier
- impact on the grid and global green-house-gas emission depending on how electricity is supplied
- resistance of off-board emitter systems when implemented in a road and submitted to vehicle rolling and various weather conditions
- safety with respect electromagnetic radiation exposure of human beings and animals, or any foreign object

Methodology & planned work

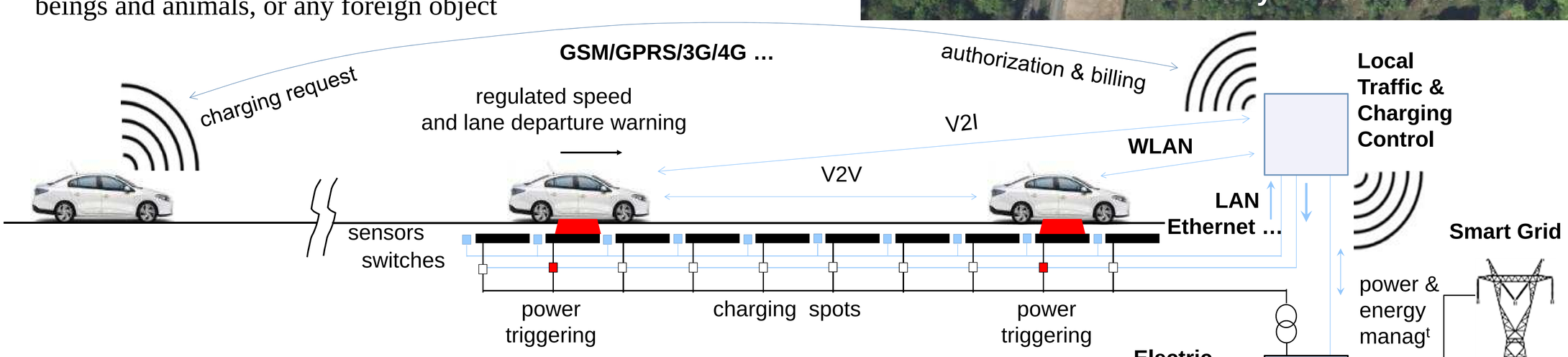
FABRIC is structured in sub-projects : SP1-Management (leader: ICCS), SP2-ICT solutions (ERTICO), SP3-Charging Solutions (TRL), SP4-Integration, Infrastructure & Testing (ICCS), SP5 Assessment (KTH), following a step-wise approach.



Year 2014 is dedicated to the analysis of user needs, specifications and technical benchmarking. Year 2015 will consist of design and technical developments, use cases and test scenarios and evaluation methodology. Years 2016-2017 will be dedicated to system integration and validation in three test sites : i) Satory-Versailles, France, operated by VeDeCoM, and ii) Torino-Bardonecchia, Italy, operated by CRF, both for inductive charging, and iii) Hällered, Sweden, operated by Volvo, for conductive charging, and assessment of economical, environmental and societal impacts and feasibility of large scale deployment of such systems.



Overview of the Satory-Versailles test site



Schematic principle of the electrical infrastructure and ICT solutions related to the operation of an on-road dynamic inductive charging station