

Technology Improvements for Large Scale Smart Cities Deployment



TILAS

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The Celtic-Plus project TILAS (Technology improvements for large-scale Smart City deployments) exploits the initial outcomes of different Smart City related projects with an associated large-scale IoT test-bed deployment. The proposed innovations overcome the problems caused by moving from typical experimental laboratory tests to integrated large-scale implementations. This project aims at addressing some of these key challenges and aligning them to the particularities of the Internet of Things (IoT) paradigm.

Main focus

For the definition of the main TILAS topics, the project has taken the Santander City Deployment as a reference. It can be considered a relevant case, as Santander has 180,000 inhabitants, about 12,000 IoT devices, deployed in the SmartSantander project, and more than 25,000 downloads of the Smart City smartphone application. Based on the analysis of the existing infrastructure, two kinds of problems were detected:

- ◆ Problems derived from technical challenges – such as node testing, multihop networking, security, housing solutions for outdoors and node reprogramming.

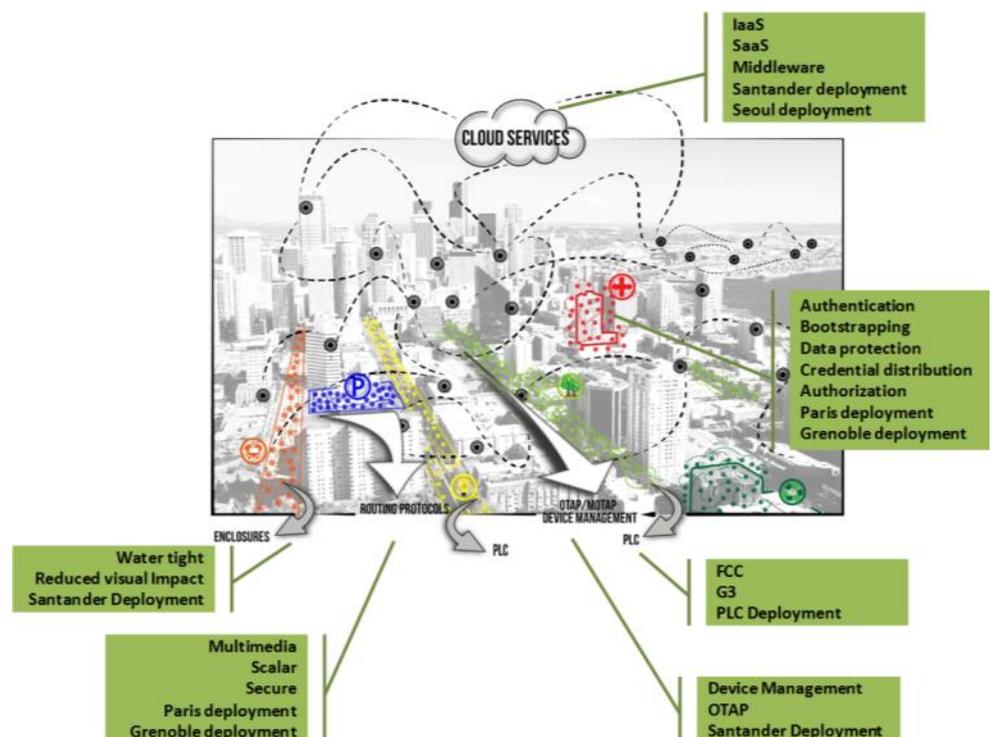
- ◆ Challenges derived from societal aspects – such as visual impact of devices, pertinence of services created and lack of engagement

TILAS focuses on the aforementioned technical problems and additionally on solving visual impacts of devices deployed in the street. The scope of the project is to facilitate and boost the development of novel solutions based on the exploitation of the IoT paradigm in cities. The provision of reliable and efficient communication capabilities demands the improvement of current solutions on device level and network level.

The figure below illustrates all these main TILAS lines of investigation, namely Cloud Services/Middleware, Over The Air Programming (OTAP), Security, Routing protocols, Enclosures and PLC. Together with these items, a short comment is given mapping these lines of investigation with current TILAS proposals and TILAS deployments where they are demonstrated.

Approach

The work in TILAS started with the aforementioned feedback obtained from already deployed smart city deployments, where results were discouraging in some topics. From that starting point, and



through an exhaustive state of the art study, TILAS proposed the project scenarios, use cases, business models and first requirements.

On top of that input, all technical activities were started, following two main lines of investigation: network functional enhancements and device level enhancements. In this step, all TILAS technical concepts were developed and tested in simulations. The feedback of those contributions was then used to build up the system concept, in which all TILAS innovations must be covered and aligned with already existing IoT/M2M standards as ETSI.

Finally, key innovations were selected and deployed on demonstrators. This task also covers the inherent work of grouping innovations so as to be tested into a single test bed and the administrative work needed to integrate solutions among partners and discussing with local city authorities about the best place to deploy the devices so as to take advantage of them for real life applications.

These deployments, together with all TILAS dissemination and standardization activities, can be considered as main TILAS outcomes.

Achieved results

The consortium has produced a wide number of innovative solutions, working on different use cases, research, development and demonstration on real city deployments:

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

- ◆ Internal antennas and customized enclosures have been designed to cope with visual impact problems (building them to look like luminaries) and assuring waterproofness. They are already a product ready for the market.

- ◆ Pursuing an optimum and cost-effective network operation, TILAS partners have developed a large-scale-IoT oriented, remote and over the air programming procedure (OTAP and DM (Device Management)), solving the multi-hop and low power issues of conventional OTAP procedures. The protocol is currently embedded on commercial nodes available to purchase. In addition, a novel density aware MAC protocol has been studied and proposed to enhance the behavior of nodes. This last proposal is just on its technical approach and disseminated through a paper.

- ◆ Security is a big threat on the IoT world. TILAS has defined a comprehensive and secure architecture able to handle in a secure way large amount of nodes. All TILAS security proposals are demonstrated in a field trial, and its outcome is pushed forward for standardization inside OneM2M consortium. In addition, TILAS proposes a novel hardware and software architecture for IoT devices able to cope with interoperability (in terms of number of interfaces supported) and modularity (seamless workability with similar nodes) problems inherent to the IoT world.

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

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- ◆ Routing mechanisms for IoT devices have been designed and showcased, dealing with scenarios such as multimedia (photo and video, in different approaches) routing, secure routing, scalar routing.... All these proposals have been tested on demonstrators and disseminated through paper publications.

- ◆ TILAS has developed a middleware able to provide access from devices based on different technologies to the servers where applications are running. Cloud based services have been also proposed (IaaS and SaaS) bringing to the project the exploitation of large amount of data. These concepts are also demonstrated in proof of concept demos inside the project and being pushed forward for adoption in big companies such as Turk Telecom.

Impact

TILAS main impact consists on the fact that five different deployments have been produced. Key TILAS results have been implemented on these deployments, both in real cities (in coordination with municipalities), such as in Santander (Spain) and Seoul (South Korea), and in lab-based sites such as in Paris (IoT-Lab, France) and Grenoble (France).

- ◆ An urban traffic pattern monitoring platform based on NO2 and O3 sensors has been deployed in Santander, demonstrating device management, remote configuration, low impact enclosures and middleware features.

- ◆ A water management and monitoring system has been implemented in Seoul including TILAS proposals on cloud services for real time data monitoring.

- ◆ Image/video surveillance with security advanced features was setup in Paris (on the IoT lab premises) to demonstrate routing protocols and quality of service.

- ◆ PLC (Power Line Communication) platform is also implemented in Paris to validate IPv6 end to end protocol.

- ◆ Temperature monitoring system has been set up in Grenoble to demonstrate security and routing protocols.

As a result, both the objectives and the technical proposals are demonstrated. In addition, in case of real city deployments, the technology is already on the streets, and local municipalities are aware and interested on following the initial TILAS deployments with extra node installation.

