Apollo

The project developed a platform that supports new services in the area of machine-to-machine (M2M) communications. It is a transversal technological platform that supports management, control and monitoring of a network of sensors and actuators. And that exports a service layer to third parties willing to develop NGM2M applications in areas such as Utilities, Transports, Agriculture.

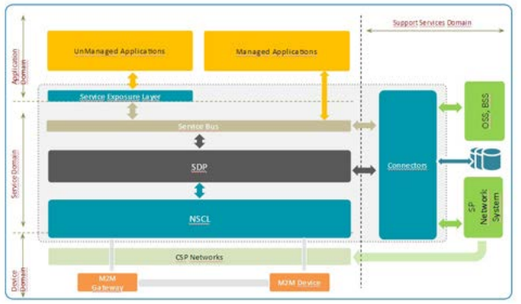

Fig. 1 Apollo solution arquitecture.

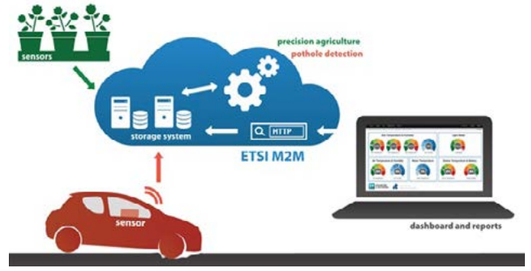

Fig. 2 Project Concept

Main Project Team

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Funding Agencies

QREN	**200,985€**
Start Date	01/10/2011
Ending Date	01/01/2014

Indicators

Journal Papers	2
Conference Papers	10
Concluded MSc	4

Two Main Publications

M. Antunes, J. P. B. Barraca, D. G. Gomes, P. O. Oliveira, R. Aguiar, **Unified platform for M2M Telco Providers, International Conf. on Ubiquitous Computing and Ambiente Intelligence, Belfast**, United Kingdom, Vol. 0, pp. 0 - 0, December, 2014.

F. Cabral Pinto, P. Chainho, N. Pássaro, F. Santiago, D. Corujo, D. Gomes, **The business of things architecture** , Transactions on Emerging Telecommunications Technologies, Vol. 24, No. 4, pp. 441.

PROJECT WEBPAGE URL
https://atnog.av.it.pt/projects/apollo

GENERAL MOTIVATION AND OBJECTIVES

The APOLLO project, delivers an enhanced M2M platform encompassing sensors, management and applications platform for a major Telco provider. APOLLO builds on top of ETSI M2M specifications and rich service execution environments providing easy orchestration of services to end-users.

The project objective was to leverage existing telecommunication networks and systems with new capacities and features to address a new business area in which a very large number of machines communicate with each other in articulated orchestration environments.

CHALLENGE

The project platform was set to support a vast set of M2M Smart Services & Applications such as Smart Metering, Smart Grids, m-Health (remote monitoring of patients), Smart Cities, Smart Home and Smart Buildings according to a Portuguese Government set policy for the deployment of next generation networks.

WORK DESCRIPTION AND ACHIEVEMENTS

The project developed a novel IoT/IoS architecture that covers aspects related to network, device management, services and applications overcoming the shortcomings of existing solutions.

APOLLO takes advantage of the ETSI M2M specifications to support seamless integration between heterogeneous sensors and the services present in the upper domains, and supported by a Telco OSS platform.

As part of an enhanced M2M platform, components of the network domain are also responsible for the management and auditing of devices, providing programmatic interfaces that facilitate device provisioning and debugging.

The platform allows for tenants to develop and deploy services (User Services) directly into it, benefiting from being closer to the data (lower latency). Tenants may deploy two kinds of services: developed on their own following basic web services guidelines and API's, or orchestrated through the supplied graphical user interface. Both service kinds are deployed in the Service Execution Environment (SEE) and made available to all other services through Web Services.

Two use-case scenarios were presented: Road Monitoring and Smart Agriculture.

In the Smart Agriculture scenario we equipped a local agriculture school (ESAC in Coimbra) greenhouse with APOLLO smart sensors and actuators. Sensors were based on low power µC, battery/solar powered, capable of monitoring parameters from soil, water, air and radiation. Sensor operation relied on a variable duty cycle, adapted to the power left in their Li-Ion batteries, in order to maintain the network operational in days with reduced solar intensity. Communication between sensors and gateway used ZigBee radios with mesh capabilities and the CoAP protocol. The flow based service creation interface allowed the definition and analysis of workflows controlling several aspects of the greenhouses, such as leaks and frostbites. The platform handled about 1 million of events per month, all handled in real time as actuation could be required.

For the road monitoring scenario, we worked a pothole detection service for municipalities, recurring to crowd sourcing, massive data collection, using off-the-shelf mobile devices and machine learning techniques. An Android App was created and made available to citizens who would place their monitoring phones in their cars. The information generated by app in the vehicles was filtered in order to detect high peaks in acceleration. After we leveraged our cluster based storage for detecting anomalies based on high Z peaks events, and a machine learning approach for determining anomalies based on a reference road segment. As a result, we obtained 82% success ratio in determining potholes under realistic conditions. We processed 10 Million reports per month for the duration of the pilot, which enabled us to build a detailed map covering the entire Aveiro region, and even part of the Center region of Portugal.