

Ph.D. dissertation abstract: Design, Specification, Validation, and Application of a modular WSN architecture

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Abstract. This document proposes the abstract of my Ph.D. dissertation (original title in Spanish: *Diseño, Especificación, Validación y Aplicación de una Arquitectura modular de gestión de Redes Inalámbricas de Sensores*[1]) that has been successfully defended (*Cum Laude*) in 2011 at the Department of Communications of the Universidad Politecnica de Valencia (Spain).

1 Summary

During last years, Wireless Sensor Network has been object of an intense research activity as consequence of an increasing commercial interest. This activity has determined relevant advances for both the base technology and the final architectures. Wireless Sensor Network (WSN) is based on the concept of low cost autonomous node that provides limited resource in terms of data processing and storage, low-power transmission and advanced sensors. This class of sensor device is featured by reduced sizes and by an engineering oriented to the power optimization. Even if advanced, efficient and flexible solutions are currently available, the massive commercialization of WSN, normally considered as next to be a fact, is not happening. The reasons are related, directly or indirectly, to two main factors: high overall cost and inadequate level of reliability/robustness. One of the most relevant consequences of the ad-hoc approach, that at the moment characterizes the development of WSNs, is the definition of several local optimums for the problems but, at the same time, a fundamental lack of standardization and generalization of the solutions. In this sense, innovative exploitation models for WSN are object of interest for the scientific community.

2 Goals

This work was planned according to the last research lines that propose innovative and advanced solutions able to work in the real world in a context of scalability, flexibility and economic sustainability. In order to assure a certain competitiveness, the proposed architecture is designed without any dependence

or relation with concrete applications or technologies. This approach determines a flexibility of the reference architecture that can be particularized as the function of concrete applications and of related functional/non functional requirements. The proposed architecture is also independent of the nodes behaviour that can be static, nomadic or mobile.

3 Results

By a methodological point of view, it is important to design a reference model for the different aspects of the network (connectivity model, dynamic clustering, mobile behaviour). The model can assure a solid theoretical ground, independent from any concrete application domain or technology, that can be useful through the different development phases of concrete architectures (design, simulation, preliminary evaluation, refinement). At the same time, the implementation and the experimentation of the platform within real environments provide a vital feedback for the refinement of the models and of the framework.

4 Methodology

The methodology adopted is summarized by the following points:

- Horizontal approach as contradistinction of the traditional vertical approach that characterizes the great part of similar works.
- Overall approach oriented to the cost reduction using multi-domain flexible solutions.
- Elaboration of theoretical models refined using the information provided by the experimental evaluation in several application domains.
- Support for static, nomadic and mobile nodes and actors.
- Development of a reference architecture able to work within several logic environments according to different interaction and interoperability models, as well as different scale and complexity.

5 Structure of the Work

The work is structured in three interdependent logic sections:

- The first one describes the design of the reference architecture. By a functional perspective, three different layers can be identified: the sensor network, the middleware infrastructure and the information system. By a conceptual point of view, the architecture is designed and defined according to four progressive concepts: Physical Resource, Virtual Resource, Sensor Web and Semantic Sensor Web.

- The second logic section is entirely focused on WSN and it has a theoretical focus. Several related models are proposed in order to provide an analytic tool that should support the designer during the different phases of the deployment (design, simulation, implementation, preliminary evaluation).
- The last logic section describes the implementation of the reference architecture and its particularization and experimentation in several application domains.

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