SYSTEM-SIM : System-Level Simulations In Wireless Sensor Networks: Hardware, Software, Energy

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I. INTRODUCTION

Design of communicating circuits, for example Wireless Sensor Networks or Radiofrequency Identification (RFID) systems, is a difficult task because of many criteria to take into account. For example, the optimal choice between circuits, protocols, data management and energy usage is not a trivial task. Moreover, measurement validated models are required in order to propose an accurate simulator.

Because these systems have to be deployed and they are mainly energy-constrained, early stage of design have to take all the aspects into account, from application level downto hardware-level. Many simulators exist, often focussing on low-level aspects (CPU cycles) or high-level aspects (application, protocol) such as the well -known NS-3.

This special session also proposes new research papers focussing on Electronic System-Level simulators.

II. PAPER 1

"System-level simulation for the dependability improvement of Ultra High Frequency (UHF) RFID Systems", from V. Beroulle, O. E. K Aktouf, D.Hely, details a system-level simulator and emulator that permits to evaluate robustness in RFID systems. Indeed, the aim is to validate and evaluate methods for detecting and diagnosing defects within RFID systems, and to develop new middleware services to improve the performances of RFID systems in presence of defects, then to develop robust RFID tag architectures. This paper sums up all these complementary solutions, which have been validated thanks to system level simulation or emulation and which have been integrated in a global dependable UHF RFID system.

III. PAPER 2

"Energy Management of a set of sensor nodes at application level using the LINC Middleware", from O. Mokrenko, S. Lesecq, M. I. Vergara-Gallego, details the optimisation of the energy consumption of sensor networks taking from application-level downto node hardware level. Early stage of this implementation was done with MATLAB simulations. This paper also summarizes control strategies to minimize the energy consumption, that were implemented on a real testbed composed of heterogeneous sensor nodes, and using the LINC middleware.

IV. PAPER 3

"Validating a Wireless Protocol Implementation at Binary Level through Simulation Using High Level Description of Protocol Properties in Light Esterel", from C. Barnes, F. Verdier, A. Pegatoquet, D. Gaffe, J.M. Cottin, details a co-simulation framework that is capable of verifying and validating a protocol stack at low (binary) level in a Wireless Sensor Network. This simulation framework is based on the co-simulation of QEMU and SystemC, which are interfaced through TLMu. It permits to check the OCARI protocol by analysing exchanged data frames; while this protocol is simulated at instruction level on an electronic architecture.

V. PAPER 4

"CLS: ContactLess Simulator", from D. Navarro and G. Migliato-Marega, details a new simulator, considering contactless-powered smart systems, such as a Near Field Communication circuit coupled to a microcontroller unit. More precisely, the study focuses on battery-less electronic systems: all circuits are supplied by the contact-less emitter. To permit such a system to function, energy budget has to be explored; this is the aim of this simulator. This paper describes the considered electronic system, models that were written, simulator architecture and a simulation example.

VI. CONCLUSION

Design of communicating circuits, for example Wireless Sensor Networks or RFID systems, is a difficult task because of their complexity. Meanwhile, simulators have to be accurate and to consider all the key aspects. It means they have to be measurement validated in order to prove their models are accurate. Metrics are both low-level (time, power, energy etc.) and high level (Packet Delivery Rate, Packet Latency, Quality of Service, etc.) Also, they have to respect an acceptable simulation time even if models are accurate.