Rapid prototyping suite of IEEE 802.15.4-compliant Sensor Networks

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A toolsuite for rapid prototyping and implementation of real-time applications on Wireless Sensor Networks (WSN). The work is motivated by the need to use WSNs in industrial control contexts, where the sampling rate and the workload are much higher than in typical current applications of WSNs, and the real-time constraints are much tighter. We present a simulator for early evaluation of the real-time behavior of a WSN application, and a real-time Operating System that implements appropriate real-time scheduling policies to allow timing analysis and guarantee timing constraints.

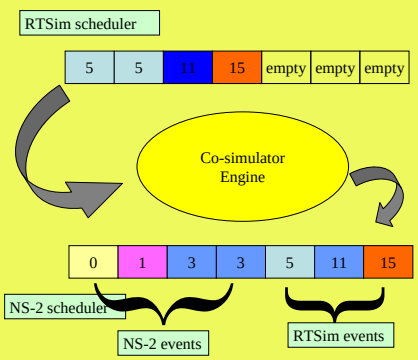
http://rtns.sssup.it

RTNS is a simulation package built by integrating the popular NS-2 (Network Simulator) and RTSim (Real Time Operating System SIMulator). It permits to simulate network and CPU levels for distributed networked applications.

Exploiting the NS-2 native support for Wireless Personal Area Networks, RTNS simulates WSNs operations compliant to the IEEE 802.15.4 standard.

The integration of the two packages:

- allows to consume time for the "intra-node" activities not related to telecommunications and ignored by the standalone NS-2 package;
- makes RTNS be seen by the end users as an extension of the NS-2 platform, allowing full compatibility with existing functionalities.



- NS-2 event scheduler is the main engine; the RTSim engine is "synchronized" to it;
- NS-2 processes all events of RTSim that happen at a single point in time.

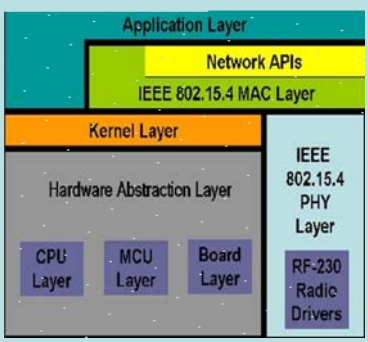
http://evidence.eu.com

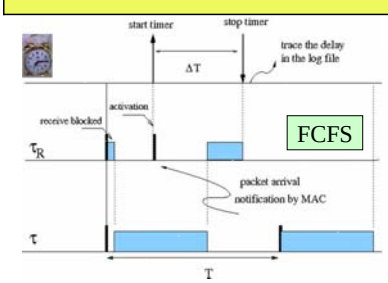
ERIKA Enterprise is an innovative RTOS for small microcontrollers:

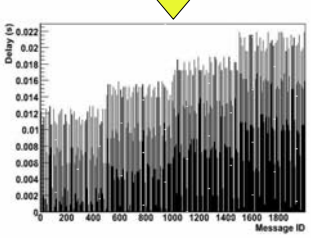
- available in double licensing, GPL and commercial;
- implementing APIs similar to OSEK/VDX;
- very small RAM footprint (~3 Kbytes);
- innovative scheduling algorithms (Fixed Priority, Stack Resource Policy, and Earliest Deadline First), which can be used to schedule tasks with real-time requirements.

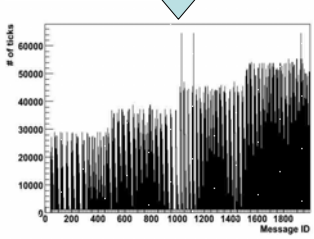
ERIKA runs on several platforms (e.g. Microchip dsPic, Altera NIOS II, and ARM 7). Recently it has been ported to ATMega 128 (AVR-5 family chipset) and to STK 500/501 development board.

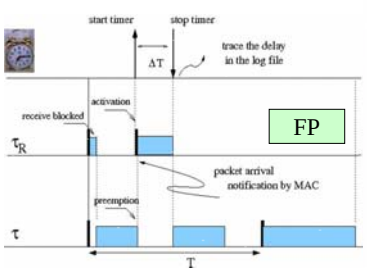
- The AVR network stack implementing IEEE 802.15.4 standard has been integrated into the ERIKA structure.

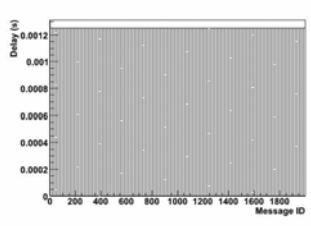


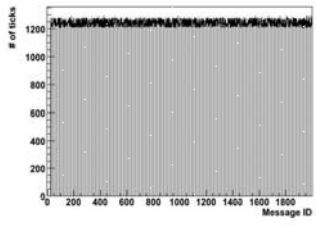




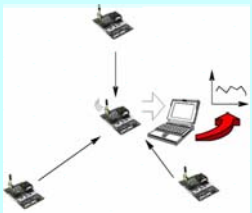








- Both in simulation and in Real Hardware two tasks are scheduled following either the FCFS or the FP policies at the sink:
  - Load Task Period = 65 ms
  - Packet Transmission Period = 70 ms
- Load Task Execution Time is varied to tune the CPU Utilization factor of the sink;
- Using a flat FCFS scheduling policy, the load at the sink affects the Quality of Service (QoS) reachable by the network introducing an overhead in message elaboration;
- Adopting a FP-based scheduling policy and assigning to Networking higher priority with respect to the Load Task, the same QoS is guaranteed independently of the load.



Acknowledgements - This work has been developed within the **RI-MACS** EU project and the **ART DECO** Italian MUR project