TOS-NS3: a framework for emulating wireless sensor networks in the ns3 network simulator.

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I. Extended Abstract

The growing integration of Wireless Sensor Networks (WSN) in industries and critical infrastructures requires capabilities beyond the limits of the existing development tools. The performance of WSN needs to be evaluated before deployment, either by on-site experiments or simulation. The on-site performance evaluation is time and cost consuming, cannot easily cover the full range of expected operational conditions, and is not repetable with real sensor nodes. Simulations, therefore, are the only efficient means to evaluate the performance of wireless networks. A major problem associated with most current network simulators is that the implementation of network protocols is different from the one in real devices. Therefore, in many cases it is difficult to conclude whether a certain performance characteristics is due to specific protocol functionality or is just a feature of a particular implementation in a network simulator.

With rapidly growing research in the WSN domain many operating systems (OS) where developed during the last few years. TinyOS [1], [2] is dé facto standard operating system in the WSN research community. Other operating systems for WSN are Contiki [3], MANTIS OS [4] just to name a few (for a full list see [5] and references therein). Some of the OS's come with simulators and/or emulators. TOSSIM [6] and Cooja [7] are simulation environments for TinyOS and Contiki, respectively.

A notable drawback of TOSSIM is a simulator-specific and simplified implementation of the MAC layer. As for Cooja it implements a rather simplified model of the physical layer. A common drawback of both simulators is the inability to conduct complex simulations with heterogeneous network technologies. Most importantly, the existing WSN simulation tools lack the ability to conduct combined experiments with both real and simulated devices.

The new version of network simulator ns, ns3, allows conducting experiments with the above mentioned features. In this poster we will describe preliminary results and work in progress on the integration of TinyOS wireless sensor networks into ns3.

In particular we develop a new node platform for TinyOS where the Hardware Layer (HL) is implemented in Linux, and the application and the full network stack is implemented in TinyOS. We also move the implementation of the MAC layer to nesC, abstracting away from the hardware specific implementation dependency.

The role of ns3 is to configure and run the experiments. In our case, however, instead of reimplementing the functionality of the sensor nodes ns3 will span multiple instances of TinyOS objects.

When integrating TinyOS into ns3 a number of challenges have to be addressed. Among the most difficult ones are correctly replicating radio devices available for sensor nodes; reusing tracing functionality from ns3 in the TinyOS; and simulating hardware clocks of the notes.

Most difficult challenge is to keep TinyOS timers in sync with ns3, or Linux, timer.

The poster will present our solution to the above stated challenges and demonstrate results from conducting heterogeneous simulations.

[1] By heterogeneous networks we mean mixed Internet, WiFi, IEEE 802.15.4 and Mesh network environments.

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