

An Outlook of Open-ZB: an open-source implementation of the IEEE 802.15.4/ZigBee protocol stack on TinyOS

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The IEEE 802.15.4/ZigBee protocols are very appealing for both research and industrial communities as candidate technologies for Wireless Sensor Network (WSN) applications.

Although this standard protocol was not specifically developed for Wireless Sensor Networks (WSNs), it provides enough flexibility for fitting different requirements of WSN applications by adequately tuning its parameters. In fact, low-rate, low-power consumption and low-cost wireless networking are the key features of the IEEE 802.15.4 protocol, which typically fit the requirements of WSNs. Therefore, these protocols have attracted several recent research works. Most of those research studies have typically focused on the evaluation/improvement of some characteristics of the standard protocols either analytically or by simulation. However, no experimental work has argued many of those research works due to the lack of a real open-source implementation of the IEEE 802.15.4/Zigbee protocol stack. This lack prevents from experimentally demonstrating the feasibility of the proposed approaches and from the accurate validation of the theoretical results of those studies, since simulation tools are usually not sufficient to evaluate the real behaviour of the protocols due to many abstractions in the simulation models. Hence, there was a tremendous motivation for developing an open-source implementation of IEEE 802.15.4/Zigbee for different sensor network platforms to (1) foster the development of research works focusing on the IEEE 802.15.4/Zigbee protocol stack, (2) provide a means to validate, demonstrate and evaluate the real deployment of IEEE 802.15.4/Zigbee WPANs.

In this line, we present Open-ZB [1], an open-source implementation of the IEEE 802.15.4/Zigbee protocol stack under the TinyOS operating system for the MICAz and TelosB motes, filling a gap between some newly released complex C implementations and black-box implementations from different manufacturers. The Open-ZB [2] was developed in the context of the ART-WiSe Framework [3], which consists in providing real-time and reliable communication for WSNs using COTS (Commercial Off The Shelf) technologies.

In addition, for the sake of a comparative evaluation between simulation and experimentation of the IEEE 802.15.4/ZigBee protocol stack, we have also developed a simulation model using the OPNET simulator. This simulation tool implements the Physical and the MAC Layers of the IEEE 802.15.4 protocol standard supporting the physical layer characteristics, the beacon enabled mode, the slotted CSMA/CA, the protocol frame formats and a battery module that computes the consumed and remaining energy levels for the MICAz motes.

This Poster overviews the most important aspects of the software implementation in TinyOS, as well as a number of research work that build on its use. We also share our experience on the challenging problem that we have faced during the implementation of the protocol stack.

The Open-ZB framework site already witnessed over 60 000 visits and 4 000 downloads in 2 years.

[1] Open-ZB - Open Source Toolset for IEEE 802.15.4 and ZigBee. <http://www.open-zb.net>

[2] Andre Cunha, Anis Koubaa, Ricardo Severino, Mario Alves, "Open-ZB: an open-source implementation of the IEEE 802.15.4/ZigBee protocol stack on TinyOS", 4th IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS'07), Pisa, Italy, October 2007, pp.1-12.

[3] The ART-WiSe Framework, www.hurray.isep.ipp.pt/art-wise/