Radiocommunication Testbed for Wireless Sensor Networks

Krisztián Veress

In wireless sensor networks there is a huge need for a test environment or framework where multiple network topologies [1], [2], [3] along with their parameters and applied communication protocols can be easily described and tested under different circumstances. Such a testbed could reveal the effectiveness or the bottleneck of built-up networks and protocols.

Given the problem described above, our purpose was to implement a testbed being capable of performing different types of unit tests focusing on the wireless communication by collecting specially designed statistical indices on it. The framework is written in NesC language under the TinyOS operating system which are the de facto standards for writing embedded applications for wireless sensor networking hardware [4], [5].

Because of the lack of dynamic memory allocation in current TinyOS distributions, we had to overcome the problem of dynamically assigning network topologies and communication schemes to the sensor nodes building up the network. This is done by predefining statically the supported network types and applying configuration procedures realtime.

Our model represents the general networks as a directed graph having sensor nodes as vertices and communication lines as edges. For each edge, the communication scheme can be separately set up. The frameworks supports every message transmission modes (broadcasting, direct addressing and acknowledgements) provided by the TinyOS system along with the Low-Power-Listening [6] feature used mainly in resource-limited applications.

Since WSNs are heavily event-driven, the message transmissions are tied to specific events such as timer triggering, message sending ans reception, or special control messages. During the test runs, simple messages are transmitted having unique payloads that let us to collect statistics about the communication in progress. These are among others: *the count of message sending requests*, *total sent messages*, *resend count*, *sent messages for which acknowledgement has not been received*, *receive count*, *missed message count*, etc. We have established a few equations that must hold between these indices in order to have a method to verify them.

Since statistics are collected per edge, the user has the possibility to evaluate and analyze either a certain communication line (part of a network) or the network in whole.

References

[1] J. Polastre, J. Hill, D. Culler *Versatile Low Power Media Access for Wireless Sensor Networks*, SenSys'04, November 3–5, 2004, Baltimore, Maryland, USA.

[2] A. Arora, P. Dutta, S. Bapat, V. Kulathumani *Wireless Sensor Networks for Habitat Monitoring* WSNA'02, 2002, Atlanta, Georgia, USA

[3] A. Arora, P. Dutta, S. Bapat, V. Kulathumani *A Line in The Sand: A Wireless Sensor Network for target Detection, Classification, and Tracking* Computer Networks Elsevier, (2004), 46, 605–634

[4] S. Madden, et al., *TAG: A Tiny AGgregation Service for Ad-Hoc Sensor Networks* OSDI, 2002

[5] J. Mclurkin, *Algorithms for distributed sensor networks* Masters Thesis for Electrical Engineering at the University of California, Berkeley, 1999.

[6] R. Jurdak, P. Baldi, C.V. Lopes, *Adaptive Low Power Listening for Wireless Sensor Networks*, IEEE Transactions on Mobile Computing, 6(8), (August 2007) 988–1004.