Chapter 24

Reducing Simulation Runtime in Wireless Sensor Networks:

A Simulation Framework to Reduce WSN Simulation Runtime by Using Multiple Simultaneous Instances

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ABSTRACT

Wireless Sensor Networks (WSNs) can be deployed using available hardware and software. The Contiki is an operative system compatible with a wide range of WSN hardware. A Contiki development environment named InstantContiki is also available and includes the Cooja simulator, useful to test WSN simulation scenarios prior to their deployment. Cooja can provide realistic results since it uses the full Contiki's source code and some motes can be emulated at the hardware level. However this implies extending the simulation runtime, which is heightened since the Cooja is single threaded, i.e, it makes use of a single core per instant of time, not taking advantage of the current multi-core processors. This chapter presents a framework to automate the configuration and execution of Cooja simulations. When a multi-core processor is available, this framework runs multiple simultaneous Cooja instances to reduce simulations runtime in exchange of higher CPU load and RAM usage.

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INTRODUCTION

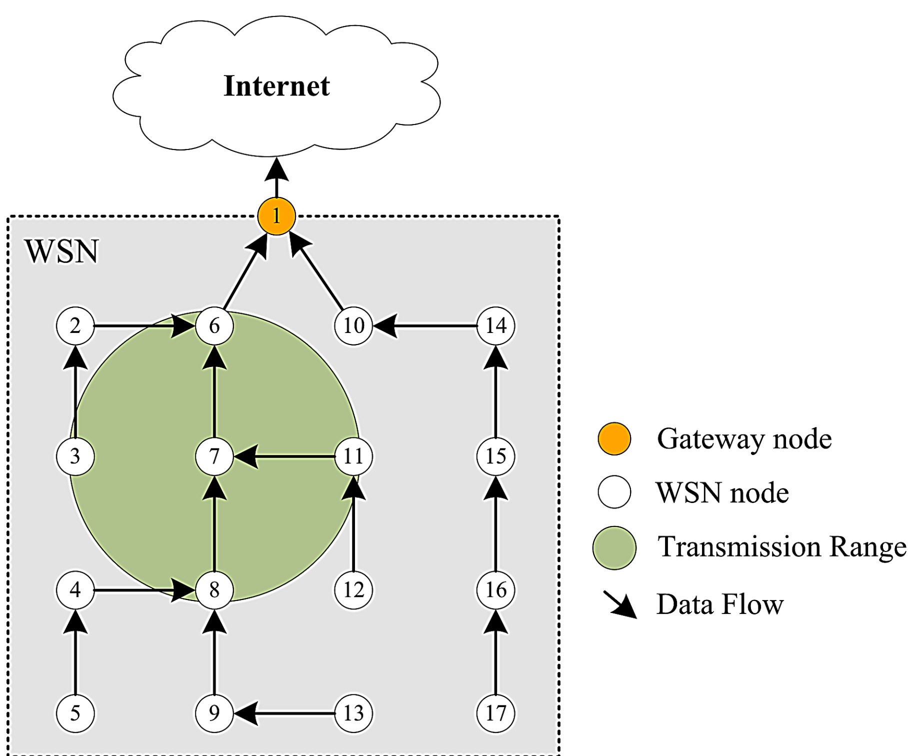
A Wireless Sensor Network (WSN) consists of a large number of sensor nodes communicating with each other, where each node has limited energy and processing resources. Usually, these nodes generate and transport sensed data towards a gateway node, which, in turn, connects these networks to the Internet, as shown in Figure 1.

The WSNs can be deployed in real scenarios using hardware products such as the Z1 (“Z1 mote,” n.d.), the SeedEye (“SeedEye,” n.d.), the MICAz (“MICAz,” n.d.), or the Tmote Sky (“Tmote Sky Project,” n.d.). In terms of software, specifically regarding the Operative System (OS), multiple options are available, examples being the Tiny OS (“TinyOS,” n.d.), the RIOT OS (“RIOT Operative System,” n.d.), and the Contiki (“Contiki OS,” n.d.).

To design and test WSN, namely in scenarios using Contiki, the developers may rely on a development environment named InstantContiki which consists of an Ubuntu Linux in a VMware virtual machine with a set of developer tools. Up to date, the latest version of Contiki is 2.7 and it includes the Cooja simulator (Osterlind, Dunkels, Eriksson, Finne, & Voigt, 2006).

The Cooja simulator is a WSN simulator that uses the full Contiki’s source code in a set of emulated hardware nodes. While other simulators, such as NS-2 (“NS-2,” n.d.) or NS-3 (“NS-3,” n.d.), assume that motes are simplified versions of the real hardware, the usage of full Contiki’s source code and real hardware emulation allows Cooja to obtain close-to-real results and enables the fast deployment of the simulated experiments directly onto the real motes. However, it also increases simulation complexity

Figure 1. Typical WSN



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