Demo Abstract: Viptos: A Graphical Development and Simulation Environment for TinyOS-based Wireless Sensor Networks

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Categories and Subject Descriptors

D.2.6 [**Software Engineering**]: Programming Environments – *Graphical environments, Integrated environments, Interactive environments.*

General Terms

Design, Experimentation, Languages.

Keywords

simulation, modeling, wireless sensor networks, TinyOS, nesC, Ptolemy II, TOSSIM, VisualSense.

1. ABSTRACT

We are announcing the first release of Viptos (Visual Ptolemy and TinyOS), an integrated graphical development and simulation environment for TinyOS-based wireless sensor networks. Viptos allows developers to create block and arrow diagrams to construct TinyOS programs from any standard library of nesC/TinyOS components. The tool automatically transforms the diagram into a nesC program that can be compiled and downloaded from within the graphical environment onto any TinyOS-supported target hardware. In particular, Viptos includes the full capabilities of VisualSense [1], which can model communication channels, networks, and non-TinyOS nodes. This release of Viptos is compatible with nesC 1.2 and includes tools to harvest existing TinyOS components and applications and convert them into a format that can be displayed as block (and arrow) diagrams and simulated.

Viptos is based on TOSSIM and Ptolemy II. TOSSIM is an interrupt-level simulator for TinyOS programs. It runs actual TinyOS code but provides software replacements for the simulated hardware and models network interaction at the bit or packet level. Ptolemy II is a graphical software system for modeling, simulation, and design of concurrent, real-time, embedded systems. Ptolemy II focuses on assembly of concurrent components with well-defined models of computation that govern the interaction between components. VisualSense is a Ptolemy II environment for modeling and simulation of wireless sensor networks at the network level.

Viptos provides a bridge between VisualSense and TOSSIM by providing interrupt-level simulation of actual TinyOS programs, with packet-level simulation of the network, while allowing the developer to use other models of computation available in Ptolemy II for modeling various parts of the system. While TOSSIM only allows simulation of homogeneous networks where each node runs the same program, Viptos supports simulation of heterogeneous networks where each node may run a different program. Viptos simulations may also include non-TinyOS-based wireless nodes. The developer can easily switch to different channel models and change other parts of the simulated environment, such as creating models to generate simulated traffic on the wireless network.

Viptos inherits the actor-oriented modeling environment of Ptolemy II, which allows the developer to use different models of computation at each level of simulation. At the lowest level, Viptos uses the discrete-event scheduler of TOSSIM to model the interaction between the CPU and TinyOS code that runs on it. At the next highest level, Viptos uses the discrete-event scheduler of Ptolemy II to model interaction with mote hardware, such as the radio and sensors. This level is then embedded within VisualSense to allow modeling of the wireless channels to simulate packet loss, corruption, delay, etc. The user can also model and simulate other aspects of the physical environment including those detected by the sensors (e.g., light, temperature, etc.), terrain, etc.

At IPSN in April 2005, we demonstrated a pre-release developmental version of Viptos with two simple applications. The first was a single node sensing application that displayed the value of the light sensor on the LEDs. The second was a two node send and receive application that transmitted the value of the light sensor on the first node to the second node. This release version of Viptos supports more sophisticated applications, such as multi-node routing, and demonstrates some of the more advanced features described in this abstract.

SenSys'05, November 2–4, 2005, San Diego, California, USA.
ACM 1-59593-054-X/05/0011.

2. REFERENCES

[1] Baldwin, P., et al. "Modeling of Sensor Nets in Ptolemy II", in *Proc. of Information Processing in Sensor Networks* (IPSN'04), April 26-27, 2004, Berkeley, CA, USA.