TOSSIM: Visualizing the Real World

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The Problem

- Your TinyOS application doesn’t work
  - Is the network so messy that routing fails?
  - Is there a bug in your routing algorithm?
  - How do you tell the difference?
- Test TinyOS code
- Reproducible, controlled experiments
- Interaction with network
- Experiment visualization

Solution: TOSSIM and TinyViz

- TOSSIM, TinyOS mote simulator
- Add more realistic radio models to TOSSIM
  - Based on empirical data (Alec Woo)
  - Incorporate tools to generate loss rates
- TinyViz: visualization and actuation tool
  - Customizable for specific applications
Outline

- TOSSIM briefly revisited (Phil)
- Empirical radio models (Phil)
- TinyViz architecture (Nelson)
- Demo (Nelson + Phil)

TOSSIM

- TinyOS mote simulator
- Scales to thousands of nodes
- Compiles directly from TinyOS source
- Simulates network at bit level
- Since last retreat
  - Ported to nesC
  - Radio stack acknowledgements
    - Empirical radio models

Empirical Radio Models

- Based on Alec’s data set
- Extrapolate bit error from packet loss rates
  - Independent bit errors
  - Generate loss graph from physical topologies
- TOSSIM simulates per-link bit errors
Model Strengths and Limits

- Many loss topologies for a physical topology
- Repeatable loss rates
- Asymmetric links
- Signal strength not considered

TinyViz Goals

- Visualization
  - Sensor readings, leds, radio links
- Actuation: affecting a run of Tossim
  - Changing underlying radio model, sensor readings
- Extensibility
  - Application specific visualization

TinyViz Components

- Communication subsystem
- Event bus
  - Synchronization, information passing
- Plug-ins
  - Drawing, mote options
  - Subscribe to events
  - Send commands
  - Maintain state
- GUI
  - Drawing, user interaction
Surge application Demo
  - Uses ad-hoc routing to send sensor readings back to base station
Surge Demo consists of
  - TinyOS application
  - SerialForwarder
  - Java application

Surge and TOSSIM
  - Compile application for TOSSIM
  - Start TOSSIM
  - Connect TinyViz to TOSSIM
  - Connect SerialForwarder to TOSSIM
  - Connect Surge to SerialForwarder
Future Directions

- Surge implemented in TinyViz (plug-ins)
- Actuation and models (sensor and radio)
- Running TOSSIM entirely through TinyViz