TOSSIM: Visualizing the Real World

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NEST Retreat, January 2003
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
TinyViz Architecture

GUI

SerialForwarder

Communication

Event Bus

TOSSIM

Plug-ins

Events

Drawing

Commands
Visualizing Simulation

GUI

Communication

SerialForwarder

TOSSIM

Event Bus

Plug-ins
Actuating Simulation

GUI

SerialForwarder

TOSSIM

Communication

Event Bus

Plug-ins
Visualizing Real World

GUI

Communication

SerialForwarder

Event Bus

Plug-ins
Demo

• 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