

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

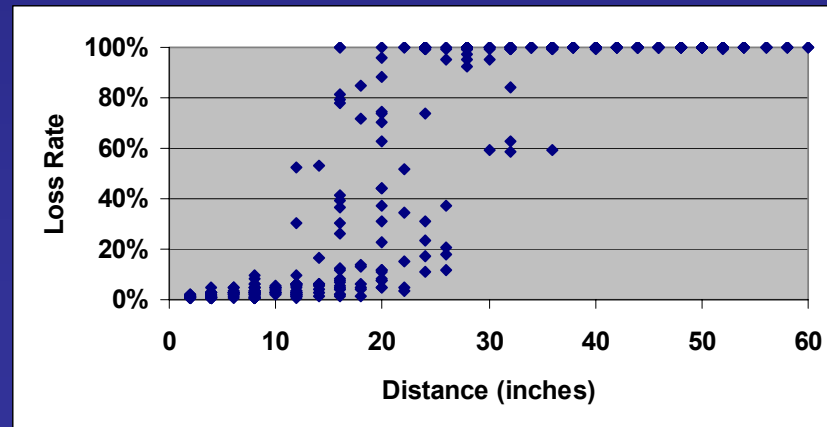
- **TOSSIM briefly revisited (Phil)**
- **Empirical radio models (Phil)**
- **TinyViz architecture (Nelson)**
- **Demo (Nelson + Phil)**

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**

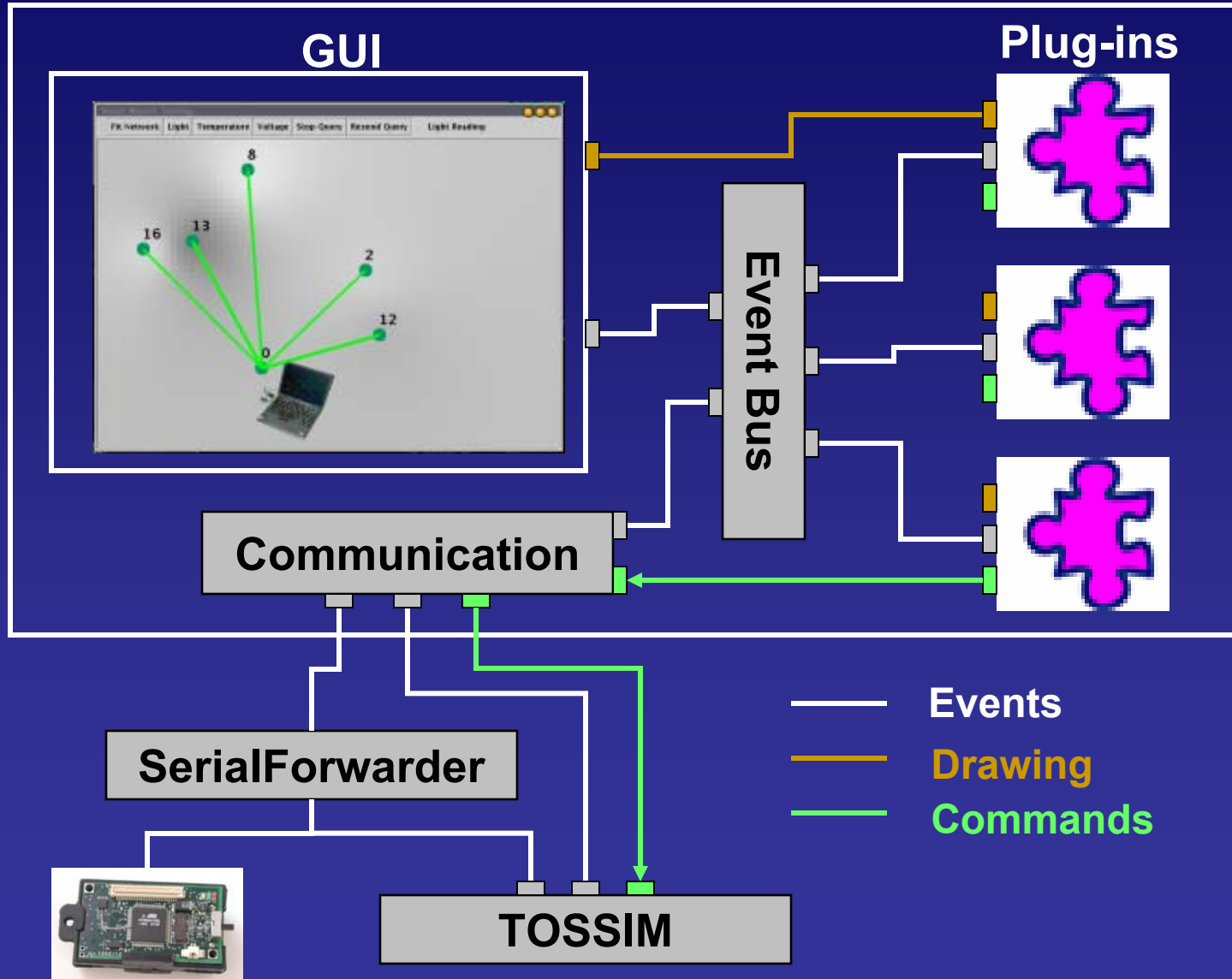
TinyViz Goals

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

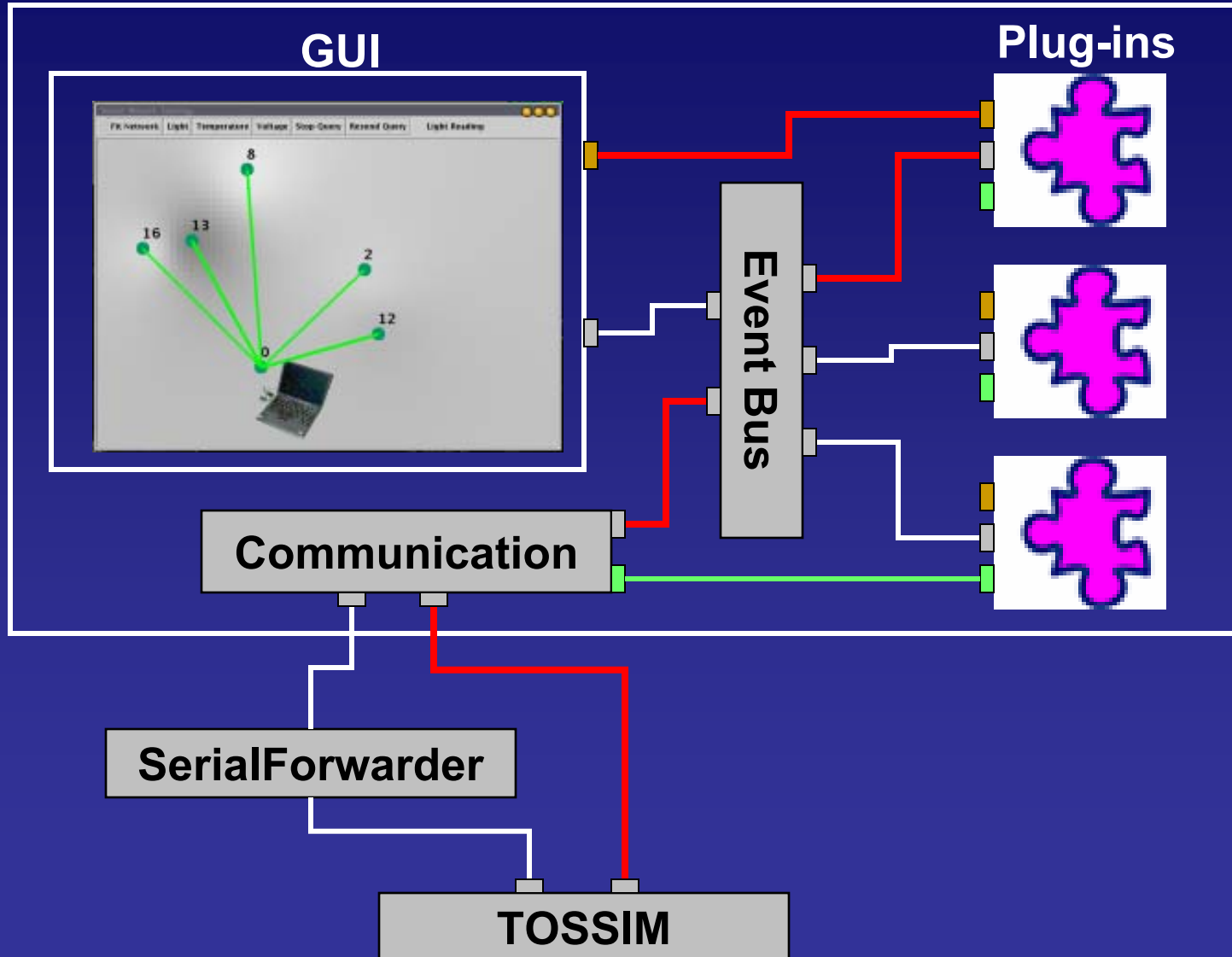
TinyViz Components

- **Communication subsystem**
- **Event bus**
 - Synchronization, information passing
- **Plug-ins**
 - Drawing, mote options
 - Subscribe to events
 - Send commands
 - Maintain state
- **GUI**
 - Drawing, user interaction

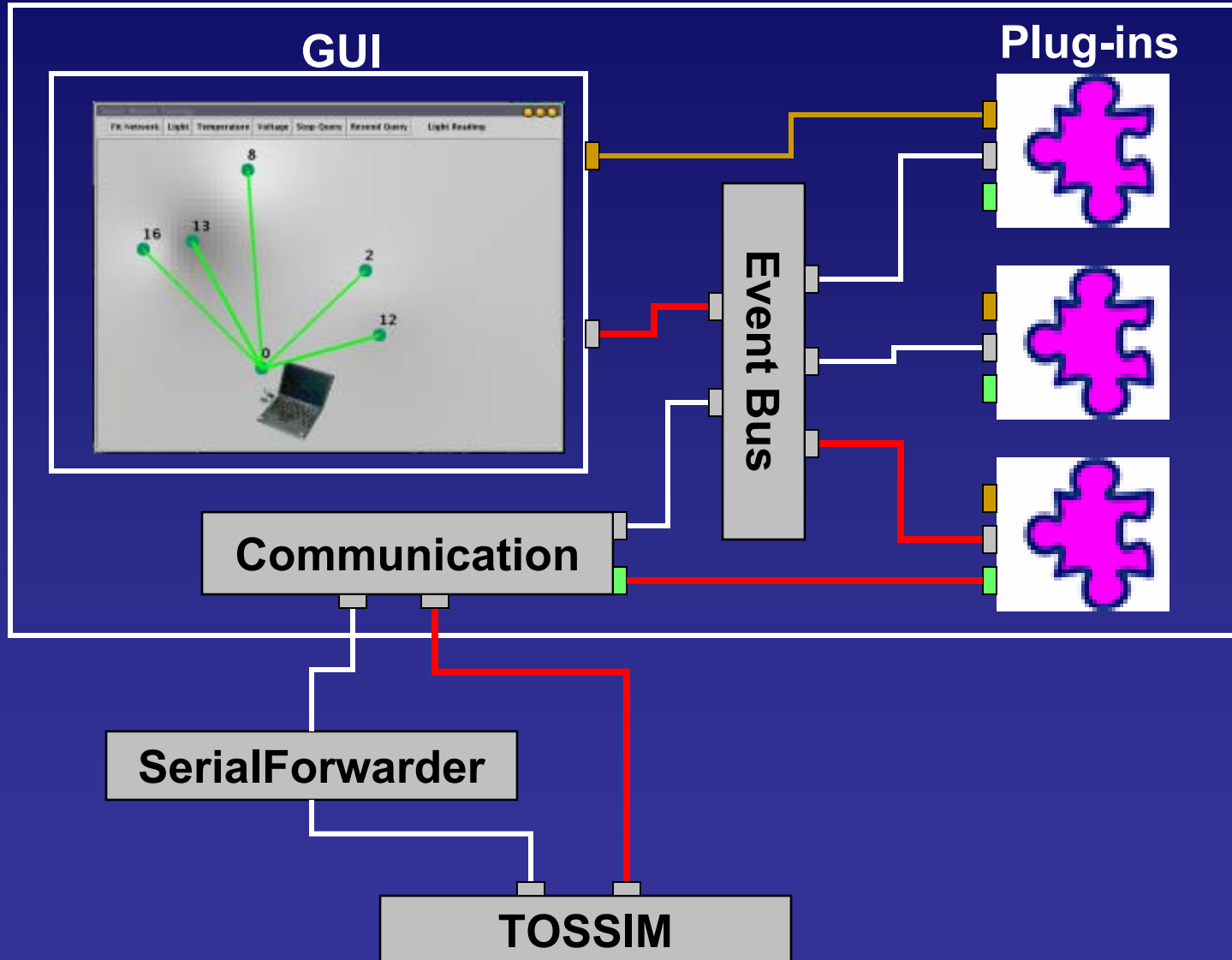
TinyViz Architecture



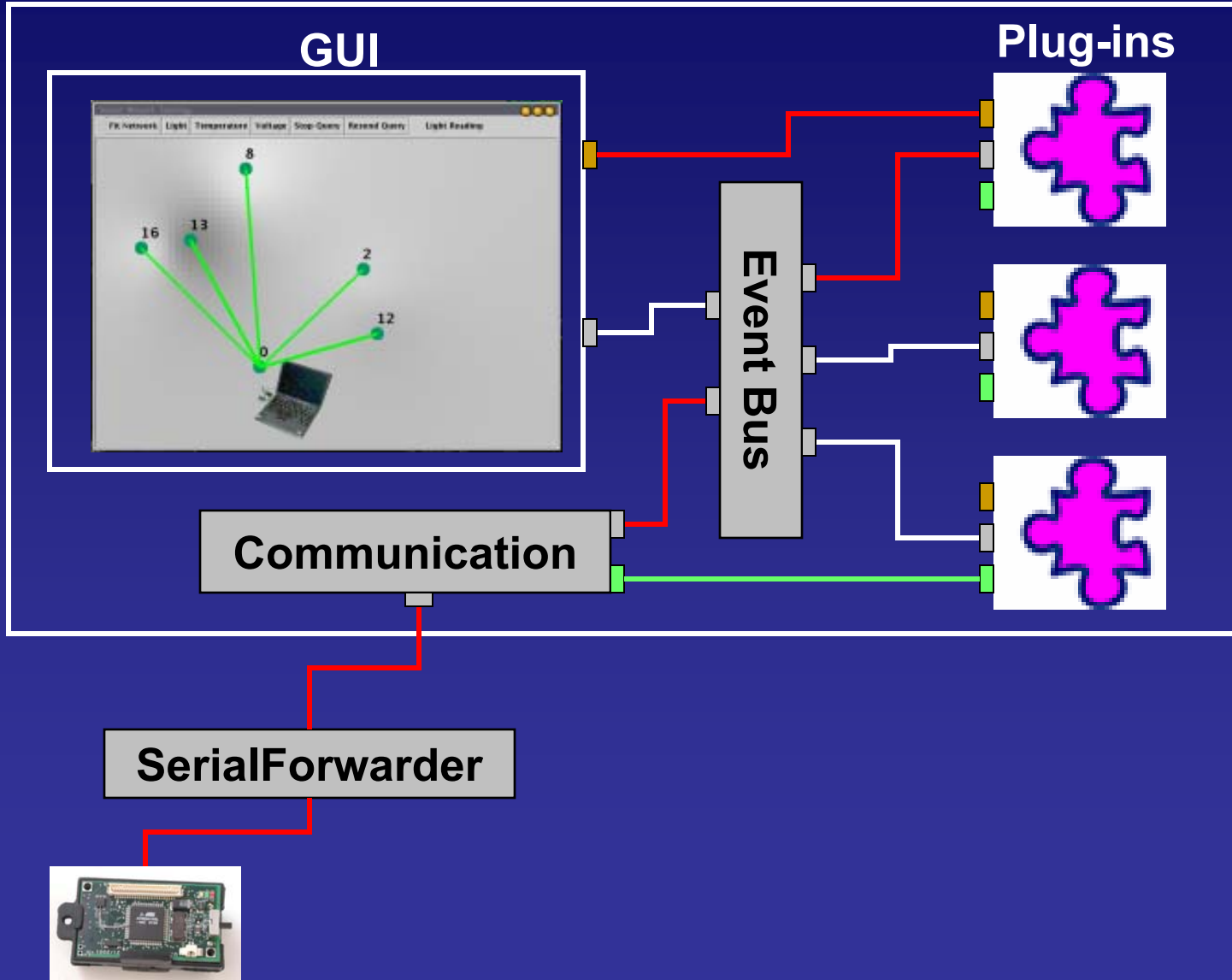
Visualizing Simulation



Actuating Simulation



Visualizing Real World



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**