Rupeas: A language for analyzing Wireless Sensor Network test logs

Motivation

Testing is important to arrive at a running system

- WSNs are deployed in remote locations ➞ long-term unattended operation
- Assurance of correct functioning is of utmost importance
- Challenges:
  - Strongly concurrent system with vast state space
  - Embedded system with severe resource limitations
  - Unreliable wireless communication
- Development of WSNs requires specialized tool for testing
- Comprehensive testing framework is important to arrive at a running system

Analysis of tests on testbeds and simulators

- Common abstraction: Traces captured during execution
- Wealth of unstructured data in traces
- Traces depend on logging policy
- A language for analysis and testing:
  - Extract behavioral information ➞ Assert expected behavior

Idea

Event abstraction: Logs as event sets

Operators for event analysis

Operators for event analysis

Implementation

Rupeas is a DSL for event analysis

- Testing is more than writing simple analysis scripts
- Embedding the analysis in a powerful dynamic language allows for integration of a comprehensive tool
- Event analysis can be integrated into a comprehensive testing framework

In action

Multihop Routing Case Study

- TinyOS 2.x Collection Tree Protocol (CTP) in simulation with TOSSIM
- Grid topology featuring two central sinks and 70 nodes ➞ 2 million events.
- Declare send and receive events
- Determine all routes through transformation

Results

- Rupeas allows for easy formulation of analyses
- Allows for relating events e.g. transmission relation
- Extracts behavioral information from unstructured traces
- Helped to uncover routing path problems hidden by an acceptable yield

References: