JAWS Deployment-Support Network
Principle – Status – Current Work

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Today's WSN Design and Development

Simulation
- TOSSIM [Levis2003]
- PowerTOSSIM [Shnayder2004]
- Avrora [Titzer2005]

Virtualization and Emulation
- EmStar [Ganesan2004]
- BEE [Chang2003, Kuusilinna2003]

Test Grids
- moteLab [Werner-Allen2005]
- Emstar arrays [Cerpa03/04]
- Kansei [Dutta2005]

Specialized simulation tools for WSN applications
Fast-prototyping in a controlled environment
Closing in on the “real” experience

Figure abridged from D. Estrin/J. Elson
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From Proof-of-concept to Real-world WSNs

Traditional test grid
- Wired
- Immobile
- Not scalable

In-network tools
- Unreliable

Self-organizing backbone network with deployment-support services
Next-Generation Deployment-Support

Deployment-Support Network
- Temporary, minimal invasive
- Virtual connections to nodes
- Reliable, wireless, scalable

Target Sensor Network

Developer Workstation
JAWS – Application Partitioning

**JAWS Application**
- Topology Control
- Connection Management
- Data Transport
- Caching
- Node Management

**Codesize 100 kB**

**Target Adapter 4 kB**
- Target Control
- Programming
- Logging

**WSN Target Application**

**Monitor 2 kB**
- Threads/IRQs
- High level context
SNMT – Sensor Network Monitoring Toolkit

A suite of services based on the JAWS deployment-support network

- Remote logging and event detection
- BTnut OS tracing facility
- Long-term logging and analysis
- Remote programming
- Generic DSN access
- Power and status monitoring
- Coordinated fault injection
JAWS – Application Example

Test Setup: 20+ nodes

Distributed Event Tracing
- Time-synchronized
- Context switches
- Interrupts
JAWS – Field Experiments

Deployment using 70+ nodes on an office floor

Largest connected Bluetooth Scatternet
Deployment-Support – Closing the Loop…

Full life-cycle support for Sensor Networks

Feedback to concept, design and development under real-life, production conditions
JAWS – Operational Prerequisites

Network Control Interface

- Get events (within a given time interval)
- Send immediate single command
- Topology request
- Status requests
- Schedule recursive commands
- Schedule commands at DSN node

All information is run through a server with an attached database that takes care of fetching data from the DSN.
Logical Target Interface

- Target programming
- Power control/monitoring (power on/off, battery status)
- Hardware control (toggle pins, similar like led patterns)
- ASCII control (send string/command/action over UART)
- Target hardware logging
- Target ASCII logging

Actions are scheduled for execution in a queue at each DSN node. Data is time-stamped and logged locally.
JAWS – Application Overview

DSN - Server

DSN - Node

DSN - Layer

GUI
AT
... GUI

GUIs & Analysis Tools

Target Network - Layer

Target - Node

Infra structure

Device Under Test
JAWS – Target Interface

**Target Programming**

**Buffered Action Queue**
- Scalability
- Distributed actuation
- Flexibility

**Local Data Logging**
- Time synchronized
- Custom log filters
- Retrieval on demand
- Notification on demand
JAWS – DSN Server Details
JAWS – Development

Demonstrated Scalability (EWSN 2006)

☑️ 40+ node demo on three floors
☑️ SNMT services operational

Major BTnut/JAWS Structural Rollover

☑️ Code roll-over working
☑️ Two Connection manager variants (tree and XTC mesh)
☒ Testing under way

MSP430 Target Adapter

☑️ Interface definition
☒ Implementation started
JAWS – Current Workpackages @ ETHZ

**DSN – Server**
- Server
- Polling engine, Database
- Trend/Status monitor
- People: JB, MD, TK

**DSN – Node**
- JAWS connection manager
- Event detection/logging
- Time synchronization
- Target adapter
- People: KM, MD, JB

**User Interface**
- Test Case Generator
- Trend Analyzer
- People: PO, JB, TK, MD

**FSN Prototype**
- Tmote Sky based
- People: AM, RL
JAWS – Current Status

**DSN – Server**
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41% completion
90% completion
25% completion
12% completion
To probe further...

http://www.btnode.ethz.ch