Worldsens: Development and Prototyping Tools for Application Specific Wireless Sensors Networks

Guillaume Chelius  Éric Fleury  Antoine Fraboulet

CITI Laboratory
INSA Lyon
INRIA ARES Project

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Worldsens : Application Specific Design Flow

- Application Specifications and Constraints
- High Level Design
- Distributed application protocols

- High Level Design of Distributed Application

- Implementation Choices
- Hardware Platform
- Software Specification
  - Application
  - Network protocol
  - Operating System
- Software Implementation
- Cross-compiler tools

- Design Implementation Choices

- Performance Evaluation and System Validation
  - Target binary ready for deployment

- Distributed Simulation
  - WSim + WSNet
**Worldsens : Design Tools**

**WSim : hardware platform simulation**
- Temporal simulation
- Complete hardware platform simulator
- Peripheral management
- Handles target application binary code

**WSNet : wireless network simulation**
- Classical event-driven simulator
- Physical layer & radio medium consideration
- UDP/IP frontend

**WSNet + WSim : complete distributed system simulation**
WSim platform simulator

Software oriented simulator

Models characteristics

- Instruction precise (asm)
- Models the complete platform (CPU + peripherals)
- Has a reduced complexity for simpler construction and faster usage.

Features

- Can interact with external tools and simulators.
- Fully instrumented for
  - Debug
  - Performance estimation
  - Energy consumption analysis
WSim Simulation/Execution Loop

- Instruction Execution
- Internal Peripherals Configuration and I/O
- Clock system
- Time evaluation
- Internal Peripherals Update
- libSelect()
- MCU > Dev
- MCU < Dev
- Dev update
- Platform
- Write
- Read
- Update
- GUI
- IRQ Evaluation

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- GUI
- IRQ Evaluation
- yes
- no
- LPM
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- GUI
- IRQ Evaluation
- LPM
- WSNet external events

Yes
- no

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Instruction Precise Simulation

Precise reports
- Interrupts
- Power Modes
- Communications

Node activity
- Simultaneous events
- Off-line analysis

Performance Evaluation
- Code performance
- Memory footprint
- Power consumption
Frequency Scaling

Clock modules simulation
- Variable Frequencies
- Nodes clock skew and drift
- Energy estimation

Clocking System Simulation

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Target Code Debug
Performance Evaluation : Source Code Annotation
Hybrid simulation

Node simulator  \( \text{WSim} \)  Radio simulator  \( \text{WSNet} \)

UDP/IP

network packets events
Hybrid simulation

Node simulator

Radio simulator

UDP/IP

network packets events

Node simulator

Node simulator

Node simulator
Hybrid simulation

- **Intro State Worldsens WSim**
- **WSim+WSNet**

- **Hybrid simulation**
- **base station serial link**
- **Serial comm software**
- **Database storage**

- **GDB**
  - **local/remote debugging**

- **GCC**
  - **cross compiler toolchain**

- **Application binary file**
  - **TCP/IP GDB remote protocol**

- **Node simulator**

- **Radio simulator**

- **WSim**
  - **Node simulator**
  - **Node simulator**
  - **Node simulator**

- **WSim+WSNet**

- **Clock Flash RAM SPI**

- **CC1100 Radio Module**

- **1MB Flash Memory**

- **MSP430 16 bits CPU**

- **Peripheral**

- **1wire**

- **External Serial interface**

- **Serial comm**

- **UDP/IP network packets events**

- **Node simulator**

- **Radio simulator**

- **WSim**

- **WSNet**

- **Compiler toolchain**

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Tutorial website

http://wsim.gforge.inria.fr/tutorials/wasp/