Simplified Development of Wireless Sensor and Actuator Applications Using Java™ Technology

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http://www.sunspotworld.com/

LAB-7160

Agenda

Wireless Sensor Networks

Sun SPOT – Platform & Tools

Hands-on Lab

Wireless Sensor Networks (WSNs) – The "State of the Art"

- Ideas of "Smart Dust"
  - Berkeley, Kris Pister, 1998-2001
- Berkeley motes, TinyOS
  - Mica2, Mica2Dot: 8-bit microcontroller, 7.37/4.0 Mhz clock, 128 KB flash, 4 KB SRAM, CC1000, 512 KB external flash, ...

- Intel Mote
  - Zeevo module (ARM7 core, SRAM and flash memory, Bluetooth wireless), runs TinyOS
  - Mote 2: 32-bit Xscale PXA 271 CPU, large RAM and flash memories, runs Linux

Today's WSN Applications

- Structural monitoring
- Cane toad distribution
  - University of NSW, Australia
- Environmental monitoring
  - Redwoods
  - Endangered species

Today's WSN Applications: Chicken and Egg Problem

- Hard to develop applications using current technologies
- Low-level C-like languages
- Unproductive development tools
  - Hardly any debugging support
- Too many low-level concerns in current systems
  - Most high-level software developers do not know how hardware works, or even have an appreciation any more
- Not accessible to majority of software developers

Future WSAN Applications – The New Ecology of Things

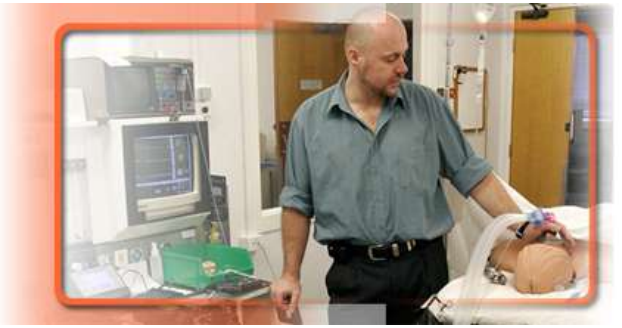
Sponsored by Sun Labs at the Art Center College of Design, USA

- Autonomous light air vehicles
- Retail-smart shoe
- Social interaction icebreakers

Source:
http://people.artcenter.edu/~vanallen/ecology/

Future WSAN Applications – Vibrotactile Alarm System

Patient Monitoring
The University of Queensland, Australia



- Breathing mask on patient
- Intubation of the patient
  - Potential reactions to drugs, gases, etc.
  - BUT... monitor out of sight, noise can mask sounds
- Vibrotactile actuators wirelessly alert anaesthetist

Source: J. Ng et al, Anesthesia and Analgesia, vol. 101, 2005.

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Hands-on Lab

Our Solution – Developer-friendly Tools

- Bring Java technology to wireless sensor and actuator devices
- Use standard Java IDEs and debugger tools
  - NetBeans projects
  - ant tasks
  - JDWP-compliant debugger support
- SpotWorld

Our Solution – More Powerful Hardware Platform

- Mid-level device that can be battery powered
- Enough memory to allow exploratory programming
- More processing closer to the device to reduce network traffic
- Enable over-the-air reprogramming

The Sun SPOT SDK

- Java ME CLDC 1.1
- Requires no OS on-device
- Minimal C code to
  - Capture interrupts and notify VM
  - Access to low-level hardware
- Device drivers and interrupt servicing written in the Java programming language
  - SPI, AIC, TC, PIO drivers
- Sub/super-set of JSR121: Application isolation API specification
- Libraries
  - Demo sensor board, radio, network (802.15.4 MAC layer), desktop

Agenda

Wireless Sensor Networks

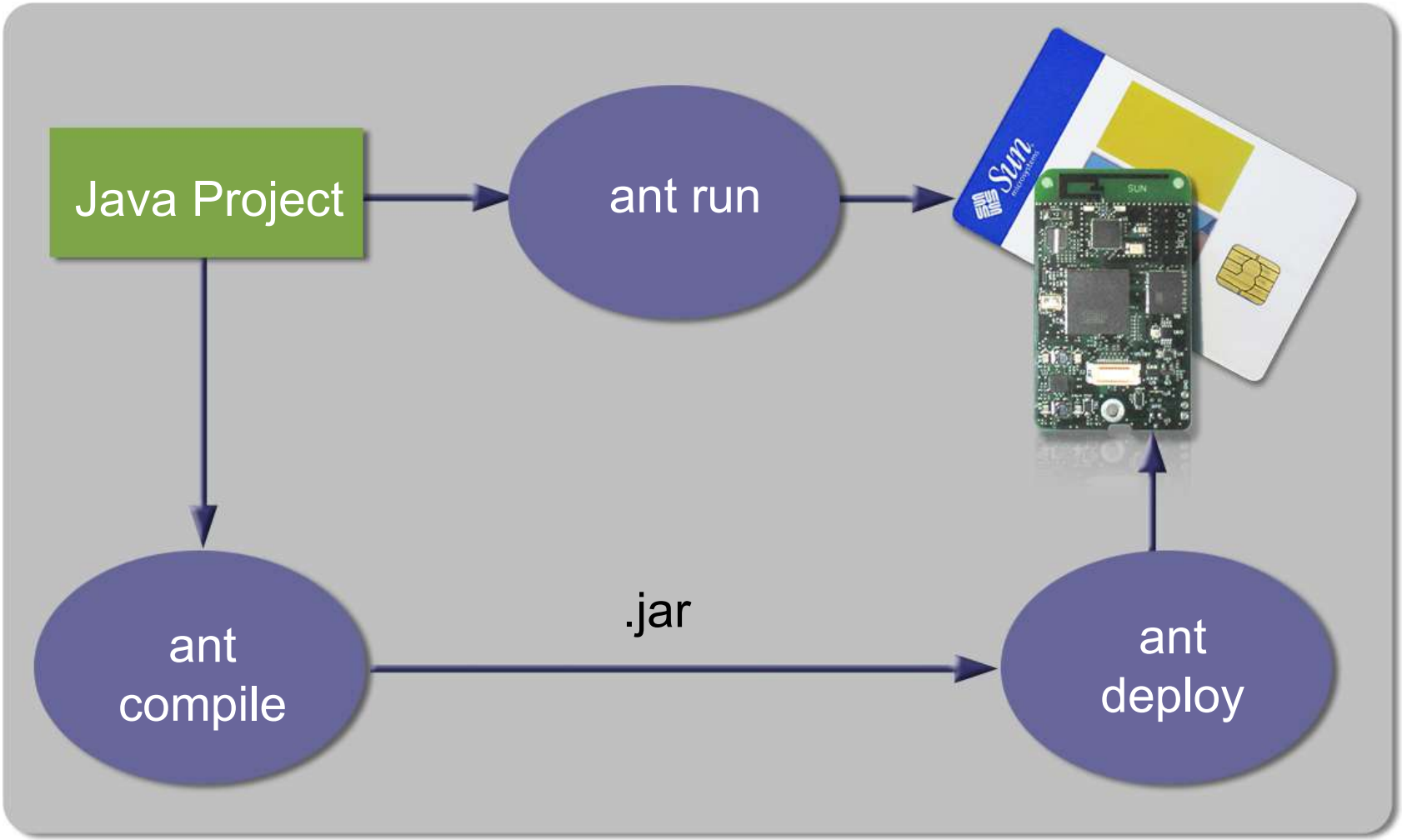
Sun SPOT – Platform & Tools

Hands-on Lab

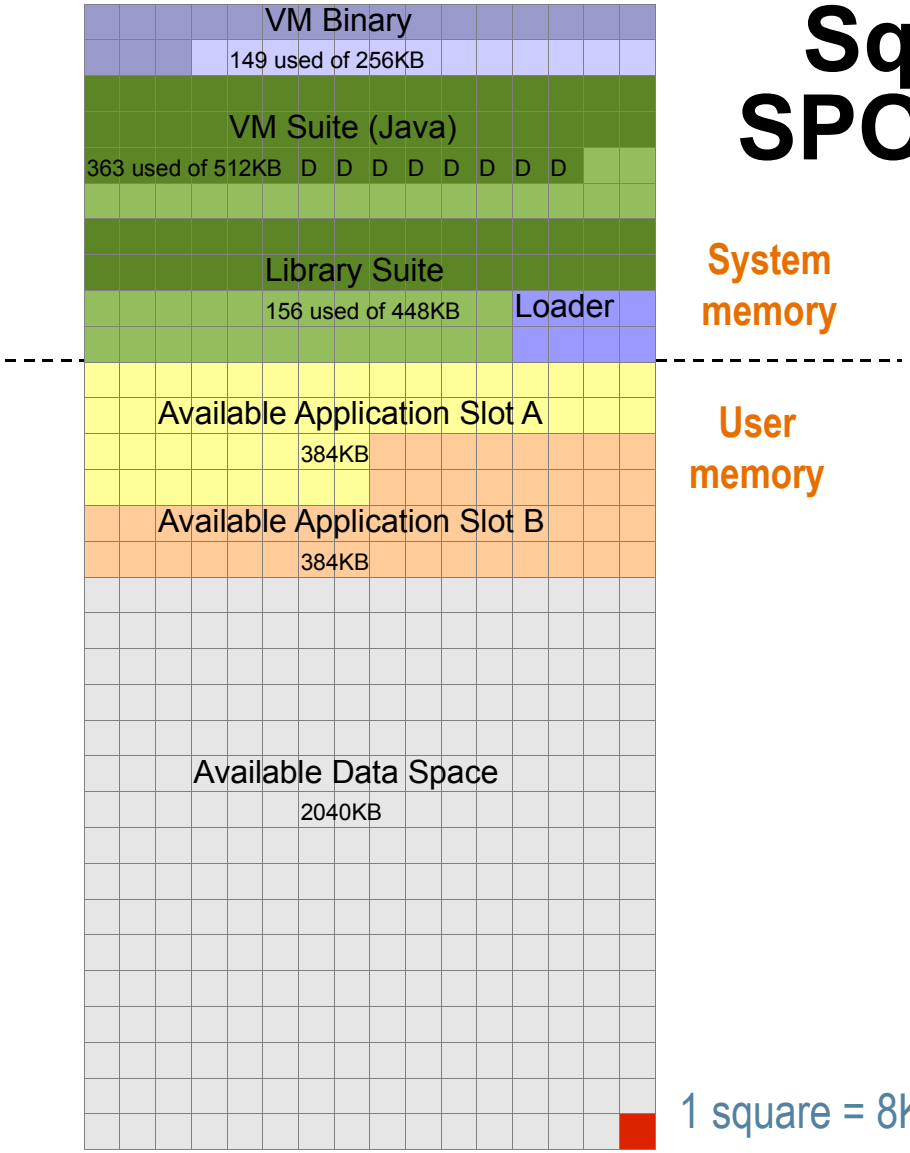
Hands-on Lab Agenda

- Exercise 1 (10 mins) – Getting Familiar with the Sun SPOT device
- Exercise 2 (20 mins) – Using the accelerometer and LEDs
- Exercise 3 (15 mins) – Using the radio
- Exercise 4 (15 mins) – Integrating with desktop applications
- Exercise 5 (20 mins) – Accelerometer visualization and trajectory

Build and Deploy Process



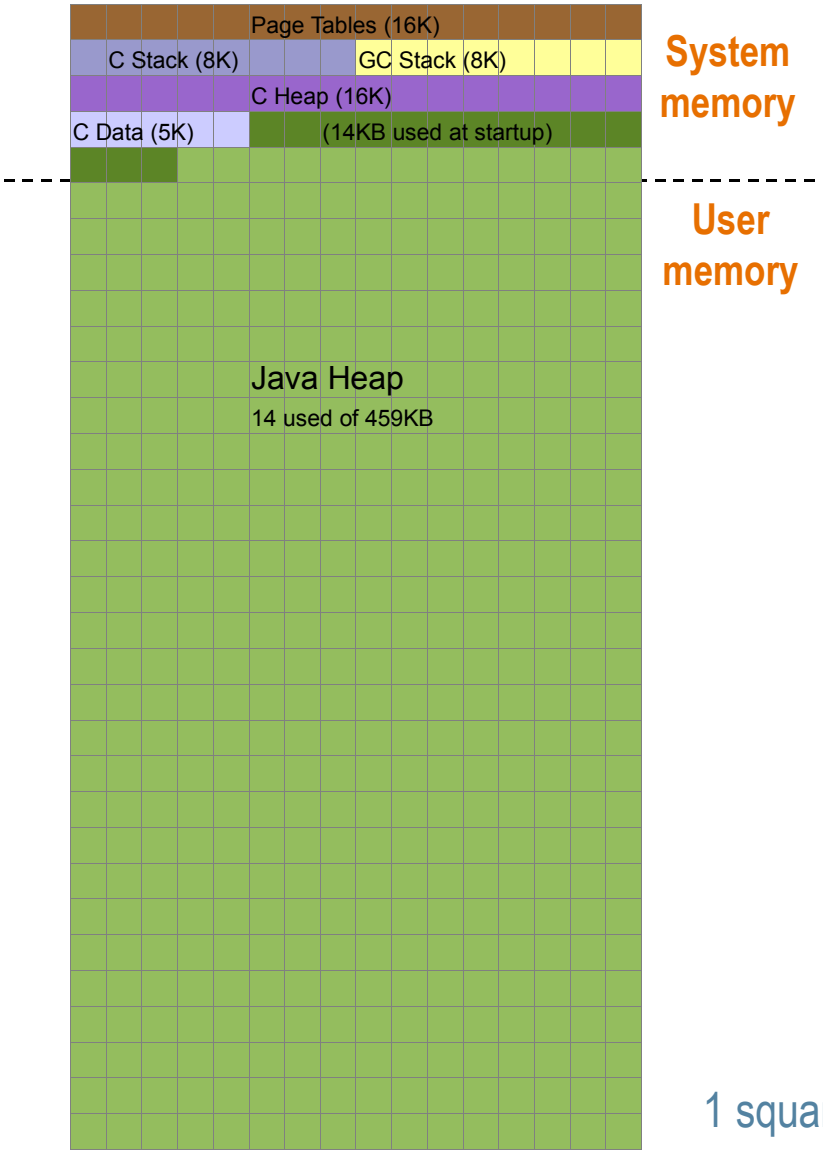
Squawk on the Sun SPOT: Flash Memory



- 4 MB flash
  - very low power
  - 1 million cycles/sector endurance
- 1/3 reserved for System
  - not all in use
- 2/3 reserved for applications and data

1 square = 8KB

subject to change



Squawk on the Sun SPOT: RAM

- 512 KB pSRAM
  - Active current ≈ low mAs
  - Inactive current ≈ low µAs
- >80% available for application objects

1 square = 1KB

subject to change

Hands-on Lab

Do not forget to come up and sign up to find out when they will be available

http://www.sunspotworld.com/contact

For More Information

- Project Sun SPOT
  - http://www.sunspotworld.com
- Sign up on the Sun SPOT mailing list or forum
  - http://www.sunspotworld.com/contact/
  - http://www.sunspotworld.com/forums/
  - You can come up to the podium to sign up throughout the hands-on lab portion
- Squawk
  - http://research.sun.com/projects/squawk
- JavaOne 2006 Pod “Project Sun SPOT: Java technology-based platform for ubiquitous computing”

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