

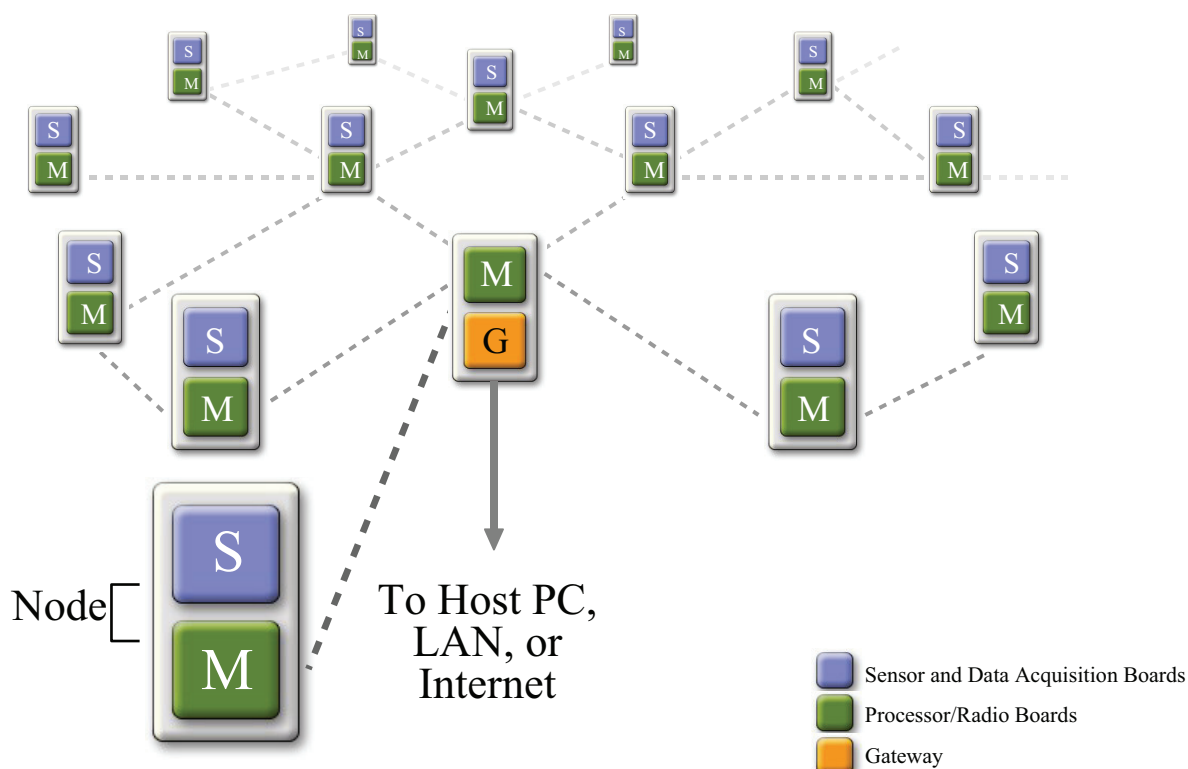
Introducing the Project Sun SPOTs

Small Programmable Object Technology

- Project from Sun Laboratories
- Platform for intelligent wireless sensors network
- Live-laboratory for implementing new computing scenarios:
 - > The (Inter)net of Things
 - > Program the world



Wireless Sensor Networks



SPOTs Hardware

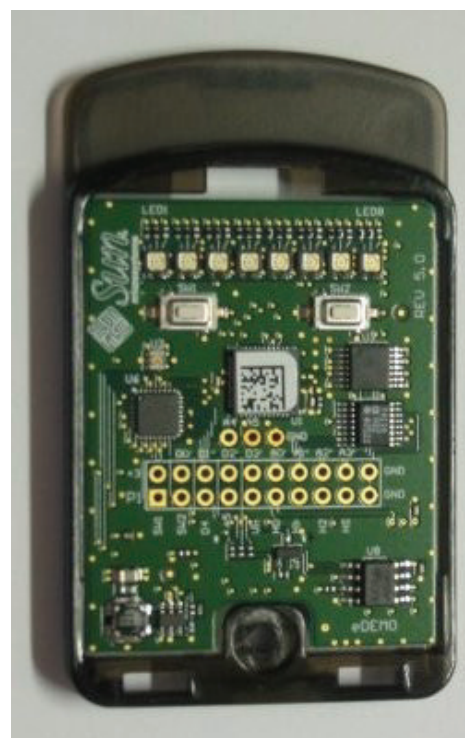
- Processor Board
 - > 180 MHz 32 bit ARM920T core
512K RAM/4M Flash
 - > 2.4 GHz IEEE 802.15.4 radio
with integrated antenna
 - > USB interface
 - > 3.7V rechargeable 720 mAh
lithium-ion battery
 - > 32 uA deep sleep mode



9

SPOTs Hardware

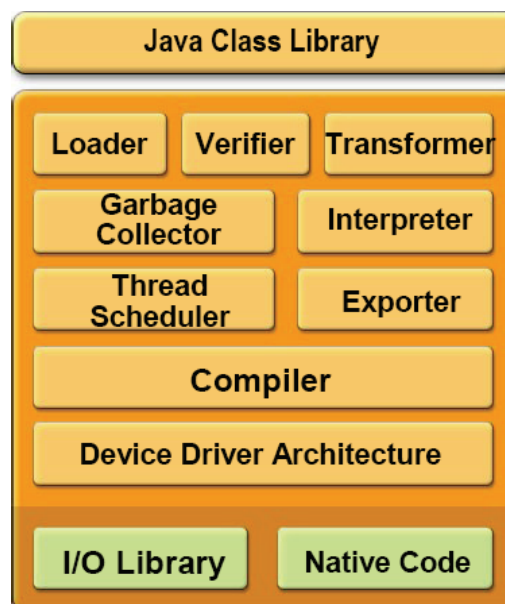
- Demo Sensor Board
 - > 2G/6G 3-axis accelerometer
 - > Temperature sensor
 - > Light sensor
 - > 8 tri-color LEDs
 - > 6 analog inputs, 2 switches
 - > 5 general purpose I/O pins
 - > 4 high current output pins



10

SPOTs Software

- Squawk Virtual Machine
 - > Fully capable J2ME CLDC 1.1 Java VM with OS functionality
 - > VM executes directly out of flash memory
 - > Device drivers written in Java
 - > Automatic battery management



11

The Squawk Java VM

- Java VM mainly written in the Java programming language
 - > Interpreter written in C
 - > Garbage collector translated from the Java to the C programming language
- Java ME CLDC 1.1
- Extra features
 - > Runs on the bare ARM without an underlying OS
 - > Interrupts and device drivers written in the Java programming language
 - > Supports isolate application model

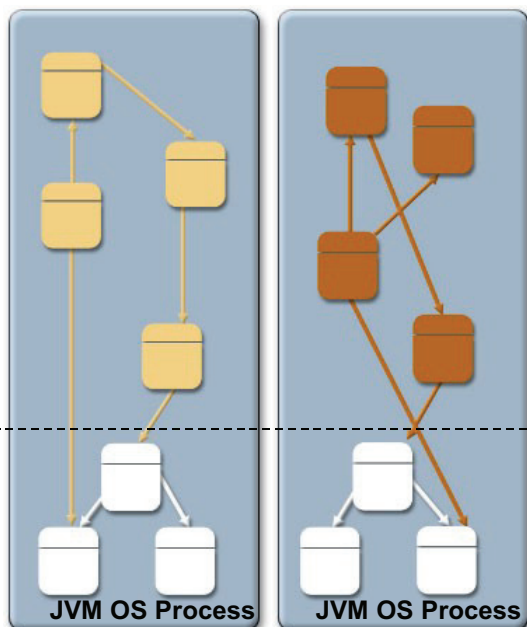


Isolate Application Model

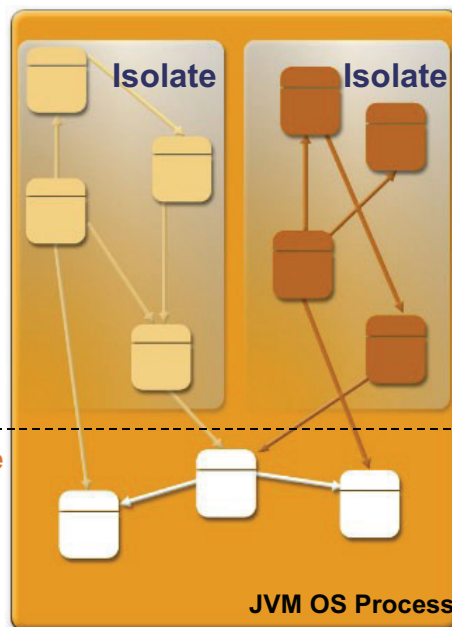
- JSR 121: Application Isolation API Specification
- Application state is an object `Isolate`
 - > `start` `-exit` `-moveTo`
 - > `resume` `-pause`
- Every isolate has its own state for all static variables
- Allows for running multiple applications in one VM
- Inter-isolate communication
 - > Provides lower-level asynchronous message delivery
- Can migrate from one device to another

Multiple Isolates (Applications) on the One Java VM

Standard Java VM



Squawk Java VM

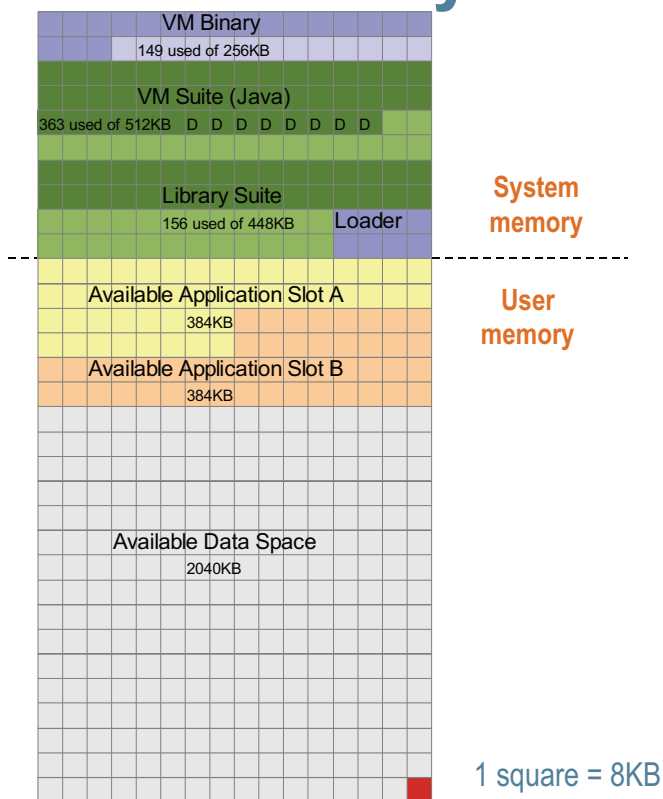


Non-shareable object memory

Shareable object memory

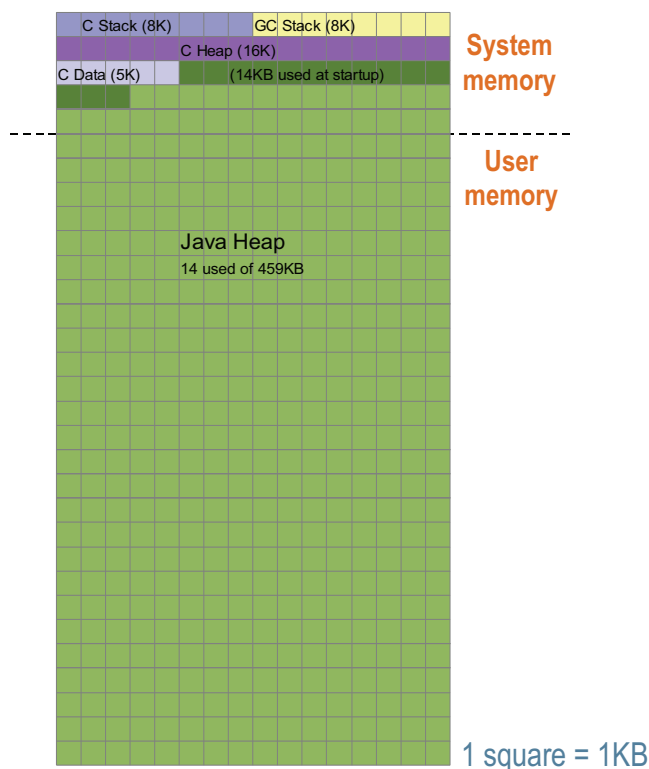
JVM OS Process

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

Squawk on the Sun SPOT: RAM



- 512 KB pSRAM
 - > Active current \approx low mAs
 - > Inactive current \approx low μ As
- >80% available for application objects

subject to change

Sun SPOT Java Development Kit



12

Free-Range and Basestation

- Sun SPOT Development Kit provides:
 - > Two free-range SPOTs, equipped with Processor Board, radio interface, Demo Sensor and battery
 - > One basestation SPOT, with Processor Board and radio interface
 - > SDK for Windows, Mac OS X, Linux
 - > USB cable

13

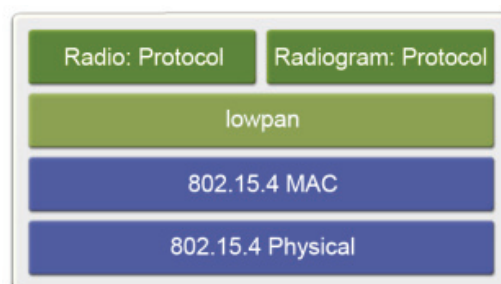
Applications

- Sun SPOT Applications
 - > Run on free-range SPOTs
 - > CLDC 1.1 and IMP 1.0 application model
 - > Full access to peripherals and demo board
- Sun SPOT Host Applications
 - > Run on a SPOT configured as basestation
 - > Stand-alone application model
 - > Simultaneous access to SPOT and JSE libraries

15

Radio Communication

- Sun SPOTs come with low-range IEEE 802.15.4 radio module
- Communication API is based on Generic Connection Framework and provides:
 - > RadioConnection (radio://) from stream-based communication
 - > RadiogramConnection (radiogram://) for datagram based communication
 - > basestation may act as proxy for HTTP connections



17