JCP IoT Inspiration Cocktail: Java, Embedded, D.I.Y., JSR's and Fun!

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- SouJava member since 2001
- Participated at 13 JavaOnes
- Oracle and Sun instructor in 2001-2002
- Founder of Globalcode
- Founder of The Developer’s Conference
- Creator of jHome Project and Things API
- Duke’s Choice Award 2011
- JavaOne Rock Star Speaker 2012
- Presenting talks related IoT since 2011
- Crazy for surfing and loves to cook
Yara Senger (@yarasenger)

- SouJava's president and member since 2001
- Participated at 11 JavaOnes
- Java Champion
- Founder of Globalcode
- Founder of The Developer’s Conference
- Dozens of articles written for JavaMagazine Brasil and InfoQ Brasil
- Collaborated on ScrumToys project for JSF 1.2 RI and Glassfish
- JavaOne Rock Star Speaker 2012
Agenda

- Introduce some IoT Projects & Scenarios
- Architecture Basis, Computer and Boards
- Share our IoT Experience
- Some Demos and Gadgets
Our special thanks to JCP.org...
Internet of Things
Internet of Things
Internet of Things

**Problem**
Parents are constantly concerned about their babies. First time mums don’t know what to do. Overly attached parents can’t to sleep. Modern parents get worried. Babies of couples break outs.

**Idea**
Now parents know when it’s time to change their babies. Using Huggies TweetPee they can be alerted if the nappy or cloth is being changed. We can save money, prevent unnecessary changes.
Our Past Experiences with Things....
Horse Telemetry
Sailboat Automation
Robots
Home Automation

**jHome Automation Overview**

- **jHome Web Server**
- **jHome Device**

Using Web Browser you can control lamps, RGB leds, gates, monitor sensors, etc.

Using Android phone or tablets you can have your house in your preferred mobile device!

You can plug different types of sensors to monitor your house like temperature, light, ...

You can connect different types of slave boards and sensors to control wall jackets, lamps, color LEDs, motors, etc.
Student Satellite
Smart Helmet
End-to-end Java

- **Java ME**: low-end / edge devices
  - Gemalto ehs6, Freescale FRDM-K64F, ...

- **Java SE Embedded**: making every Java developer an embedded developer
  - ARM: Raspberry, Beagle, UDDO
  - Intel: Galileo, Edison, Minow

- **Java EE**: regular Java EE can perform in many different types of boards (or Java EE cloud)
Low-level development

- **Hard real-time**: keeping drone direction, air-bags
- **Creating your own sensor**: making a regular analog sensor an I2C sensor
- **Fixing / adapting Linux**: implementing API for GPIO access
IoT Project Scenarios

- **Legacy device / gadget:** connecting old machines or devices to Internet
- **Startup project:** innovative projects that starts small but might need to scale fast
- **D.I.Y.:** solving your own problem
- **Industry:** production projects like gateways, health sensors, wearables, smart cities, automation, etc.
IoT Architecture Basis

1. **Computers**: SoC / microcontroller / hybrid single board computers
2. **Sensors**: using I2C, UART, SPI, transistor, logic-level converter, RS-425
3. **Actuators** like sound, leds, motors, relays
4. **Energy & power consumption**
5. **Communication & Security**: 3g, wifi, cable, MQTT, Websockets, etc.
6. **Software**: platform, language, cloud, big data,
Energy Project Profiles

- Full power A/C (houses, building, offices)
- Battery High Profile (cars, boats)
- Battery medium (LIPO, lithium-ion)
- Battery low (coin)
- Recharging: solar panel / wind / dynamo
- Measuring:
  - Current: ACS712
  - Voltage: voltage dividers circuit
# Small Computers

<table>
<thead>
<tr>
<th>Computer / Controller</th>
<th>Platform / Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmega / Arduino</td>
<td>C / C++ / AVR GCC</td>
</tr>
<tr>
<td>PIC</td>
<td>C / C++</td>
</tr>
<tr>
<td>Electric Imp</td>
<td>Squirrel</td>
</tr>
<tr>
<td>Freescale FRDM-K64F</td>
<td>Java ME 8.1</td>
</tr>
<tr>
<td>Gemalto Concept Board</td>
<td>ME 3.2 / 3.3</td>
</tr>
<tr>
<td>Keil Board</td>
<td>ME 3.3</td>
</tr>
<tr>
<td>Dragon Board Qualcomm</td>
<td>Java ME 8</td>
</tr>
</tbody>
</table>
Freescale Freedom

- First Java ME Board Arduino Compatible
- Arduino Capabilities + Java + Ethernet + SD Card
- Same price, KUDOS Freescale!
Gemalto Concept Board

- EHS6 module
- Low-power consumption
- 2g / 3g connection
- Arduino compatible
- Updates over the air
- Affordable price

*Subject to change*
## Medium Size

<table>
<thead>
<tr>
<th>Single-board</th>
<th>SoC</th>
<th>Processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspberry Pi</td>
<td>BCM2835</td>
<td>ARM1176JZFS</td>
</tr>
<tr>
<td>UDDO Board</td>
<td>Freescale iMX6</td>
<td>ARM Cortex-A9</td>
</tr>
<tr>
<td>pcDuino</td>
<td>AllWinner A10</td>
<td>ARM Cortex-A8</td>
</tr>
<tr>
<td>Beagle Bone Black</td>
<td>Sitara AM335</td>
<td>ARM Cortex-A8</td>
</tr>
<tr>
<td>Intel Galileo</td>
<td>Intel Quark x1000</td>
<td>Pentium 32 bits</td>
</tr>
<tr>
<td>Intel Edison</td>
<td>Intel 22nM</td>
<td>ATOM 500mhz + Quark 100mhz</td>
</tr>
</tbody>
</table>
Sensors

- I2C Sensors is always the best choice
- SPI used for high-volume data sensor
- UART legacy and serial communication like GPS, Bluetooth, RS-232, RS-485
- Sometimes a dedicated microcontroller is required!
- Avoid UART 115200 BPS communication
Device I/O API

- [http://openjdk.java.net/projects/dio/](http://openjdk.java.net/projects/dio/)

- Standard API for peripheral
  - General Purpose Input/Output (GPIO)
  - Inter-Integrated Circuit Bus (I2C)
  - Universal Asynchronous Receiver/Transmitter (UART)
  - Serial Peripheral Interface

- It's being developed!!!
# Internet Connection

## Solution

<table>
<thead>
<tr>
<th>RICH</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet cable</td>
<td>Generic RF gateway</td>
</tr>
<tr>
<td>FullWifi</td>
<td></td>
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<tr>
<td>Wifi w/ Tethering</td>
<td></td>
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<tr>
<td>Wifi w/ GPRS modem</td>
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<tr>
<td>GPRS Module</td>
<td></td>
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<tr>
<td>GPRS Board</td>
<td></td>
</tr>
<tr>
<td>Bluetooth bridge</td>
<td></td>
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<tr>
<td>Zigbee gateway</td>
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</tbody>
</table>
Transportation

- REST = user-friendly, good for humans
- WebSockets = good for fluid communication in browser
- MQTT = message-oriented
- COAP = Light REST?
Practical Examples
Combike: Smart Helmet

- Medium battery
- Raspberry Pi B+
- Camera
- Wifi + 3g tethering
- GPS + Leds
- Audio
- Java SE Embedded

https://github.com/vsenger/things-api/tree/master/raspberry/Samples/PiPicture

This code is a sample code to create a generic Raspberry Pi Java camera. Combike software / code is not available!
IoT Sandbox Gateway

- A/C Power
- Raspberry Pi
- Arduino + Any sensor
- Ethernet cable
- Java SE Embedded
- Apache Camel + MQTT

Thanks Tomas @tomkriech!

https://github.com/thomas-kriechbaum/iot-sandbox/tree/master/mqtt-my-raspi
Tiziu: Smart Sailboat

- Big Battery + Solar Panel
- Raspberry Pi B+
- Arduino
- Gemalto Concept Board
- Camera, Wifi, Audio
- GPS + Leds + Gas + Presence + Reed + Current
- 3g tethering
- Java SE Embedded + Tomcat + MQTT
- Pi4J and Things API
Tiziu Smart Sailboat

- Sensors
- Wifi + 3g router
- Camera Audio
- Raspberry Pi
- Arduino (can reboot Gemalto)
- Sensors
- Realy
- GEMALTO Concept Board
- Turn on Gemalto module :

MQTT + Camera + Video + Over the Air Update

SMS Data
Tiziu: Smart Sailboat

- All sources available now: https://github.com/vsenger/boat-gateway
- Using Arduino MK to remote update firmware
- Continuous deployment in a sailboat!
IoT Hacking Panel

- Raspberry Pi
  - Camera
  - Relays
  - Wifi
- Arduino Nano
  - Temperature
  - Humidity
  - Distance
  - Presence
  - Light
DEMO
IoT Surf Board

- Temperature
- Humidity
- Light
- Alcohol
- 4 Transistors
- RTC
- Relay + current
- RGB LED
- IR Emitter Receiver
- ZigBee or Wifi or Bluetooth
IoT Surf Board

- Controlled by Arduino Nano;
- Easy integration with any single board computer:
  - Voltage level converter for I2C, SPI, Serial
  - Can integrate with Raspberry Pi, Galileo, Beagle, UDOO, etc.
- Educational proposal;
- High-level prototyping;
- Designed by Globalcode Brazil;
- Made in California!
- May change Arduino to FRDM-K64F
THANKS!

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