Scatterweb platform

Markus Waelchli
Universität Bern
Overview

> Scatterweb (http://www.scatterweb.de)
  — Hardware (ESB nodes, gateways)
  — Applications
  — Scatter OS
> Contiki OS (SICS Sweden)
ESB nodes

parallel interface for programming and debugging
button for hardware reset
Texas Instruments MSP430 system on a chip with 8 MHz RISC CPU, 64kB memory, AD/DA converter
microphone
piezoelectric buzzer
antenna

vibration sensor
infrared receiver
serial interface for data in- and output
user mode button
infrared sender diode
light, temperature and movement sensor
external power source
red/yellow/green LEDs

TR1001 low-power radio transceiver operation at 868.35 Mhz at max. 115.2k baud data rate
battery box for 3 AA batteries - other version of the ESB are powered only by a solar cell
on/off switch for battery power (has no influence on external power)

Successor with Chipcon-Chip is in preparation
Gateways

- Full access to the ESB nodes (in connection with ScatterStudio / ScatterViewer)
- Over-the-air flashing
- Windows and Linux drivers
- PoE
- Built-in Web server
Applications

> ScatterStudio (modular software to access nodes)
> ScatterViewer
  — Data logging, node management, OTA flashing, routing
> TinyOS with some applications
> Contiki OS
> Ns-2: userapp-code can be compiled and run in ns-2
ScatterOS

> Software architecture
  — System (handles interrupts, hardware access, sending / receiving)
    – Infinite loop where sensor events are periodically checked
    – Sleep if nothing has to be done
  — Application code

  — Threads (simple cooperative scheduler)
    – Minimal memory requirements
    – No memory, only static allocated space for task tables, etc.
    – Task functions shouldn’t allocate stack space
    – All state must be held in vars defined globally -> restrictions
## ScatterOS vs. TinyOS

<table>
<thead>
<tr>
<th>Feature</th>
<th>ScatterOS</th>
<th>TinyOS</th>
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<tbody>
<tr>
<td>Hardware / Software Watchdog</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Error handling</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>System time</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Global Time / Date</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>DCO (digital clock, precise) Checker</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Threading</td>
<td>Threads</td>
<td>Task queue</td>
</tr>
<tr>
<td>OTA flashing</td>
<td>√</td>
<td>√</td>
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<tr>
<td>Terminal Interfaces</td>
<td>Scatter Studio Scatter Viewer</td>
<td>C – Serial Forwarder</td>
</tr>
<tr>
<td>Security</td>
<td>AES, RSA, MD5</td>
<td>Tiny Sec</td>
</tr>
<tr>
<td></td>
<td>ScatterOS</td>
<td>TinyOS</td>
</tr>
<tr>
<td>------------------------</td>
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<tr>
<td>Database</td>
<td>ScatterDB</td>
<td>TinyDB</td>
</tr>
<tr>
<td>MAC</td>
<td>SMAC, TMAC, LMAC (soon)</td>
<td>SMAC, TMAC, BMAC, SMACS</td>
</tr>
<tr>
<td>NS2</td>
<td>√</td>
<td>(full?) √</td>
</tr>
<tr>
<td>TinyOS</td>
<td>√</td>
<td>Obvious</td>
</tr>
<tr>
<td>ScatterOS</td>
<td>Obvious</td>
<td>X</td>
</tr>
</tbody>
</table>
The Contiki Operating System

- Developed at the Swedish Institute of Computer Science (SICS)
- Runs on typical sensor nodes:
  - main platforms ESB (FU Berlin), Tmote Sky, but also Linux, C64 etc.
  (Contiki is easy to port, Contiki runs on > 20 platforms)
- Event-driven kernel
- Small memory footprint (< 1 KB RAM, < 10 KB ROM)
- Current users include SICS, KTH, Uppsala Univ., UCC Cork, UCL, Lancaster Univ., Univ. of Coimbra, Swedish SME Emwitech
- Well documented, network simulator available
- BSD-style license

http://www.sics.se/~adam/contiki
Contiki features not found in e.g. TinyOS

- Multitasking:
  - Threads inherently require extra memory (stack)
  - Contiki supports threads for applications that require it e.g. long-running computations
- Support for dynamic loading and unloading of modules during runtime
- Protothreads:
  - Lightweight threads that enable sequential programming on top of an event-driven system
  - Overhead 2 Bytes RAM per protothread

- Main drawback: Almost no protocols/applications are supported yet

http://www.sics.se/~adam/contiki