Prototyping Wireless Sensornet Applications with BTnodes

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**BTnodes**

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Basic Communication Features</th>
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<tr>
<td>• 8-bit microcontroller, 8 MHz/ 8 MIPS</td>
<td>• Spontaneous networking</td>
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<td>• 64 Kb RAM, 4 Kb EEPROM, 128 Kb Flash</td>
<td>• High bandwidth (~1Mbps)</td>
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<td>• Bluetooth radio</td>
<td>• High-level communication interface</td>
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<td>• Generic sensor and I/O interfaces</td>
<td>• Error detection and correction</td>
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<td>• Power management</td>
<td>• Device &amp; service discovery</td>
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<td>• Clock-frequency scaling</td>
<td>• Over-the-air &quot;serial-port&quot; (RFCOMM)</td>
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<td>• Unit cost (200 devices): 170 CHF/ 110 €</td>
<td>• Voice channels</td>
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**Application Building Blocks**

**Integration into Computing Environment**

- Make use of off-the-shelf devices without modification
  - mobile phones
  - GPS receivers, surveying systems
  - printers, cameras (video and still)
  - PDAs, laptops
  - network access points
- typically using over-the-air "serial port" and AT commands

**Input and Actuation**

- Gateways connect sensor patches to applications and support infrastructure

**Direct User Interaction**

- Specifying new sensing task/ parameters
- On-site debugging
- User notification
  - set off phone alarm
  - send SMS
  - wake up PDA

**Dissemination and Use**

**Programming**

- Lightweight BTnode software
  - standard C language
  - event-based programming model
  - portable (runs on Linux, Windows/Cygwin, x86 and iPaq, Mac OS X)
- Easy to learn (½-day Hackfests)
- Over-the-air programming

**Projects**

- 200 BTnodes deployed in 16 research groups in CH, DE, DK, SE, FI, GB, USA,…
- External projects with BTnode platform
  - Tiny OS ported to BTnode
  - BTnode software ported to other microcontrollers (ST10 and ARM7)
  - BTnode hardware used as reference implementation

**Prototypical Application Scenario**

- Clustered or self-organized patches of sensors
- Sensornet front end (e.g., data browsing)
  - directly through laptops and PDAs or
  - through Internet gateway