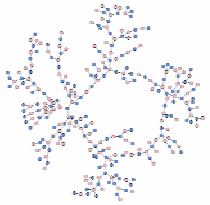
Wireless Sensor Networks
Shockfish SA

February 2006 – Roger Meier



Agenda

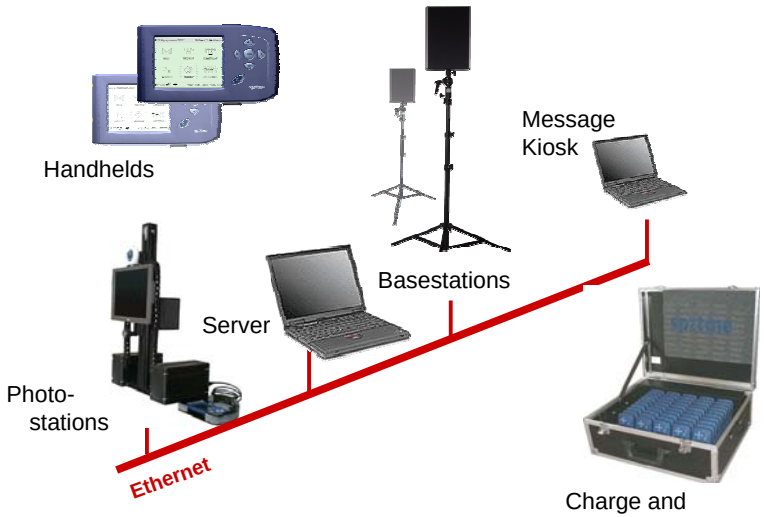
- Shockfish SA and Spotme™
- Wireless Sensor Networks Today and Tomorrow
- TinyNode Hardware

Shockfish SA

- Founded in **1998**
  by Rémy Blank, Roger Meier and Bänz Ledin
- Spin-off of the Swiss Federal Institute of Technology
- **10 Employees**
- Products & Services:
  - **Spotme (since 2001)**
  - **Wireless Sensor Networks (since 2004)**

Instant Knowledge in Your Hand

Spotme System Overview

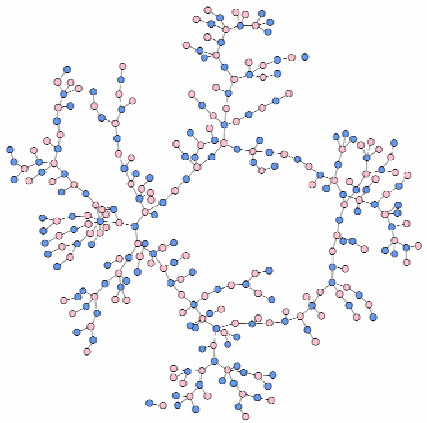


Over 100 Satisfied Customers

Next Generation - Spotme II

- State-of-the-Art hardware
- Multiple Radios
  - Proprietary radio with 2MBit/s and ranging
  - WLAN with VoIP support
  - NFC for logistics and access control
  - GSM/GPRS module
- Color screen and keyboard
- CPU for video and audio applications

Wireless Sensor Networks



Wireless Sensor Networks Today

... today, WSN **deployment is limited to only extremely experienced integrators** and developers. Ninety percent of the adopting WSN market place **cannot afford** to spend the time and expense necessary **to create a working WSN** system. There has to be a simpler, cheaper way to go about deploying these networks,"

Chris Onan, Appian Venture Partners

Today, we have...

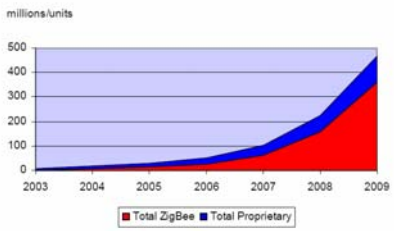
- ...custom made systems
- ...manual insertion of nodes in the Network
- ...6 month pilot projects

Wireless Sensor Networks in 2010

- Customizable systems
- Automated, location aware insertion
- 3 week pilot projects

Proprietary will grow together with ZigBee

Figure 13: Global RF Modules, ZigBee vrs Proprietary 2004-2010



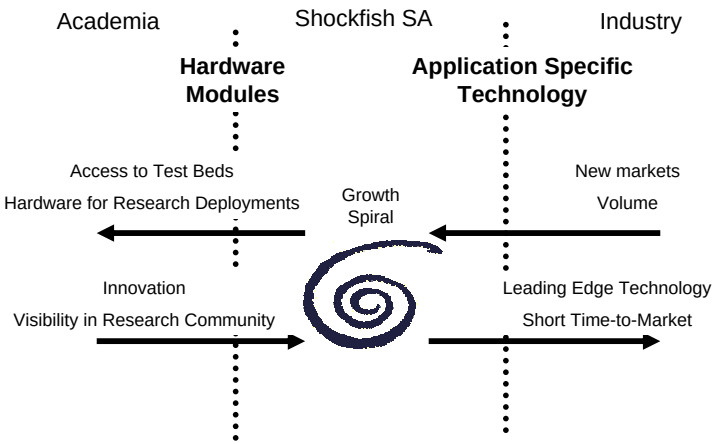
	ZigBee	Proprietary
Range	~30m	~300m
Multi-Hop	Only through FFD	Through battery operated nodes
Customization	System-on-Chip (SoC)	Software

Table 6: Global RF Modules, ZigBee vrs Proprietary 2004-2010

	2004	2005	2006	2007	2008	2009	2010
ZigBee	0.30	7.16	13.12	27.30	62.76	157.00	362.08
Proprietary	5.89	10.07	15.74	25.30	40.79	67.00	103.50
Total	6.19	17.23	28.86	52.60	103.55	224.00	465.58

Source: OnWorld 2004

Strategy: Interfacing Academia and Industry



TinyNode Design Criterias

- Modular and flexible design to allow multiple applications
  - Group components used in all applications
  - Separate application specific board (sensors, actuators)
  - Radio with configurable data rates and bandwidth
  - Full access to MAC layer for innovative protocols
- Highest autonomy for battery operation
  - Low sleep current and fast wake-up cycles
  - Very low duty cycle operation
- Highest possible range in license free frequency bands
- TinyOS compatible

TinyNode Hardware Modules

TinyNode 584

MSP430 µC

XE1205 Transceiver

4Mbit Extra Flash

Power Management

40 x 30 mm

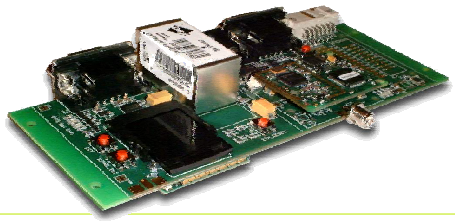
Extension Board

RS-232

JTAG

Some Basic Sensors

Can be AC powered



Mama Board

Extension Board + ..

..Ethernet module

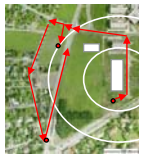
..GPRS module

..SD memory card

Range vs. Data Rate

Data Rate (kbit/s)	152,3	**76,2**	9,6	1,2
Receiver Sensitivity (dBm)	-101	**-104**	-110	-122
Line of Sight *) (m)	150	**200**	400	1600
Indoor *) (m)	30	**40**	60	150

*) Typical Range with ¼ Wave Antenna, Transmission Power = +10 dBm,



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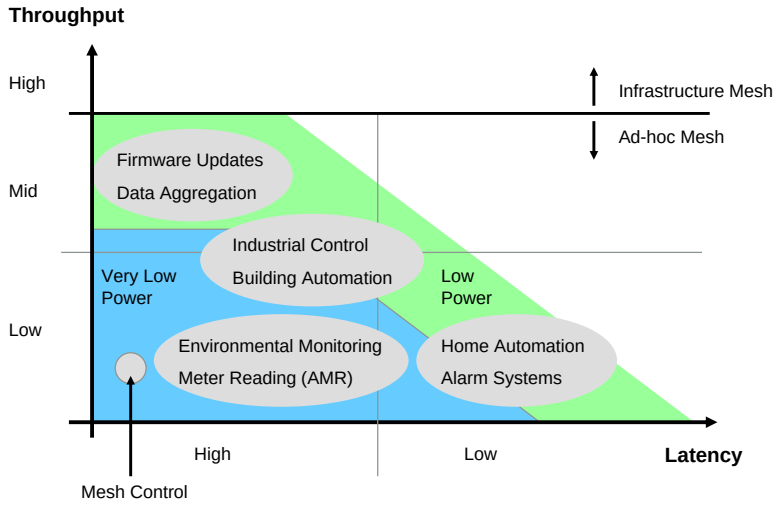
Power Consumption

State	mA
Sleep, Timer off	0.004
Sleep, Timer on	**0.007**
µC only	2
Receive (inc. µC)	**16**
Transmit 0dBm/1mW	25
Transmit 10dBm/10mW	45
Transmit 12dBm/16mW	62

Different Applications in a Quasi-Static Ad-hoc Mesh Network



Proposition: Seperate Mesh Control from Data

- Mesh Control is needed in all WSN applications and manages:
  - Installation behavior (bootstrapping)
  - Insertion and removal of nodes (discovery, self-healing)
  - Overlapping networks (multiple sink problem)
  - Firmware updates
  - Health and Traffic Monitoring
  - Parameters for underlying MAC layer
  - Routing table and bandwidth allocations for data packets
- It should run on a separate (synchronized) low bandwidth channel with a reasonable latency
- MAC parameters and bandwidth allocations for data are adaptive and application specific