

# Why are real WSNs so hard for us to achieve?

Jan Beutel, ETH Zurich



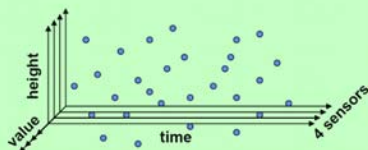
# "Proof-of-Concept" Deployment Experience

We got **820,700** Data Overview

49% yield

33 nodes  
44 days  
288 samples/day  
4 sensors  
1,672,704 points

Still more than we knew how to handle!



[Gilmann Tolle, UC Berkeley]

## Counter-Example: Non-Sustainable, Non-Scalable



17 Feb 2006

ETH Zürich

[Prabal Dutta, UC Berkeley]

## Murphy's law: everything that can go wrong will go wrong

March 16<sup>th</sup> [Field test 1]

- Gateway casing does not fit
- melted DC/DC converter
- TNodes antennas fall off
- incorrect wiring of Sensirion sensor



May 4<sup>th</sup> [Field test 2]

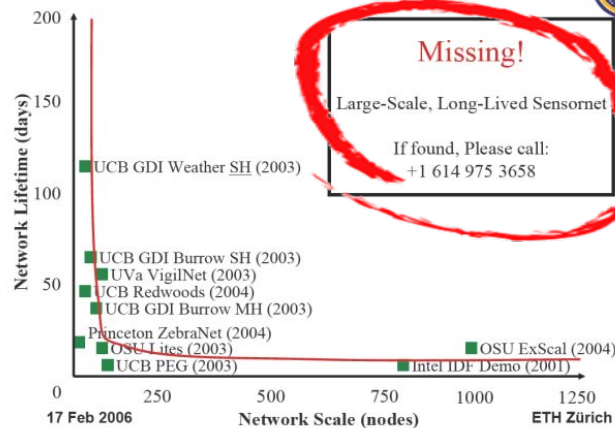
- untested T-MAC version (no development tree!)
- T-MAC loses synch (never use unsigned!)
- debugging nightmare (LEDs off, low data rate)

Summer School, Dagstuhl, September 1st, 2005



[Koen Langendoen, TU Delft]

## Size vs. Lifetime for Untethered, Outdoor Sensornets



[Prabal Dutta, UC Berkeley]

# Sensornets Are Hard

- Sensor networks often fail/operate poorly
  - Great Duck Island network: median yield 58% [SenSys 2004]
  - Redwood network: median yield 40% [SenSys 2005]
  - Volcano network: median yield:68% [OSDI 2006]
- Survey of causes
  - Protocol conflicts/interference
  - Collisions and congestion induced loss
  - Neighbor management (with layer 2 scheduling, e.g. TMAC)
  - Don't know!
- Low-power, limited resources make complete logging prohibitively expensive...

[Phil Levis, Stanford]

# Is it just generally painful?



# Are we doing things the wrong way?



# Were we promising too much?



## My Contribution – WSN Deployment Survey

- A survey on the **success, failure** and generally **experience** in wireless sensor network deployments.
- **Online at**
  - <http://www.btnode.ethz.ch/Projects/WSNDeploymentSurvey>
- **Contact**
  - Jan Beutel, ETH Zurich – [j.beutel@ieee.org](mailto:j.beutel@ieee.org)
- **Prize – Win a Free Ski Weekend in the Alps**
  - Drawing is closing on December 15, 2007.

- Why are ...
  - we not applying the same rigor and methods we teach to students in WSN design/deployment practice?
    - Code reviews, calibration, comparable/repetitive experiments ...
  - we cramming more and more into tiny microcontrollers, operating them beyond limits, wondering why last minute quick-fixes fail?
    - The embedded industry designs and scales architecture exactly for the required performance/complexity!
  - so many computer scientists building (lower layer) MAC protocols and not the radio designers/manufacturers?