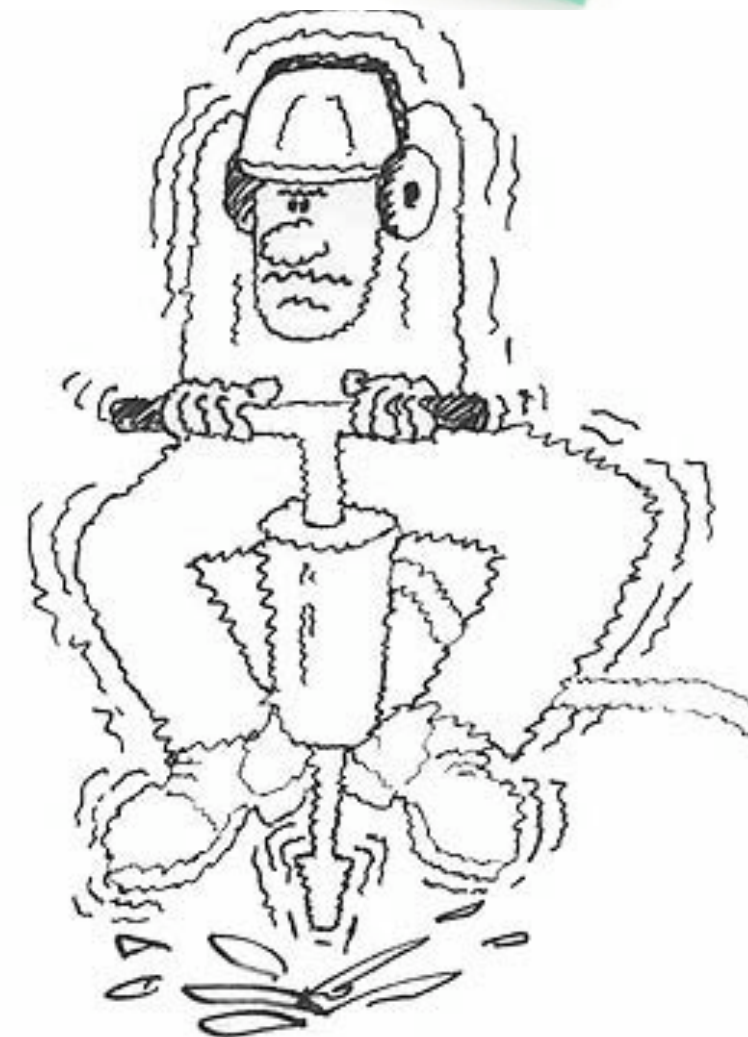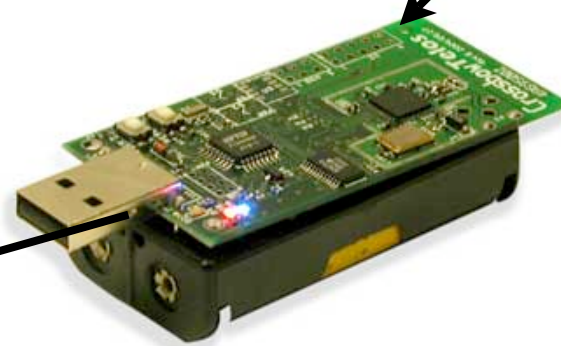UPPSALA
UNIVERSITET

WISENET

Wireless Sensor Networks
VINN Excellence Center

Wireless Sensor Networks, WSNs

VINN Excellence Center WISENET 2009
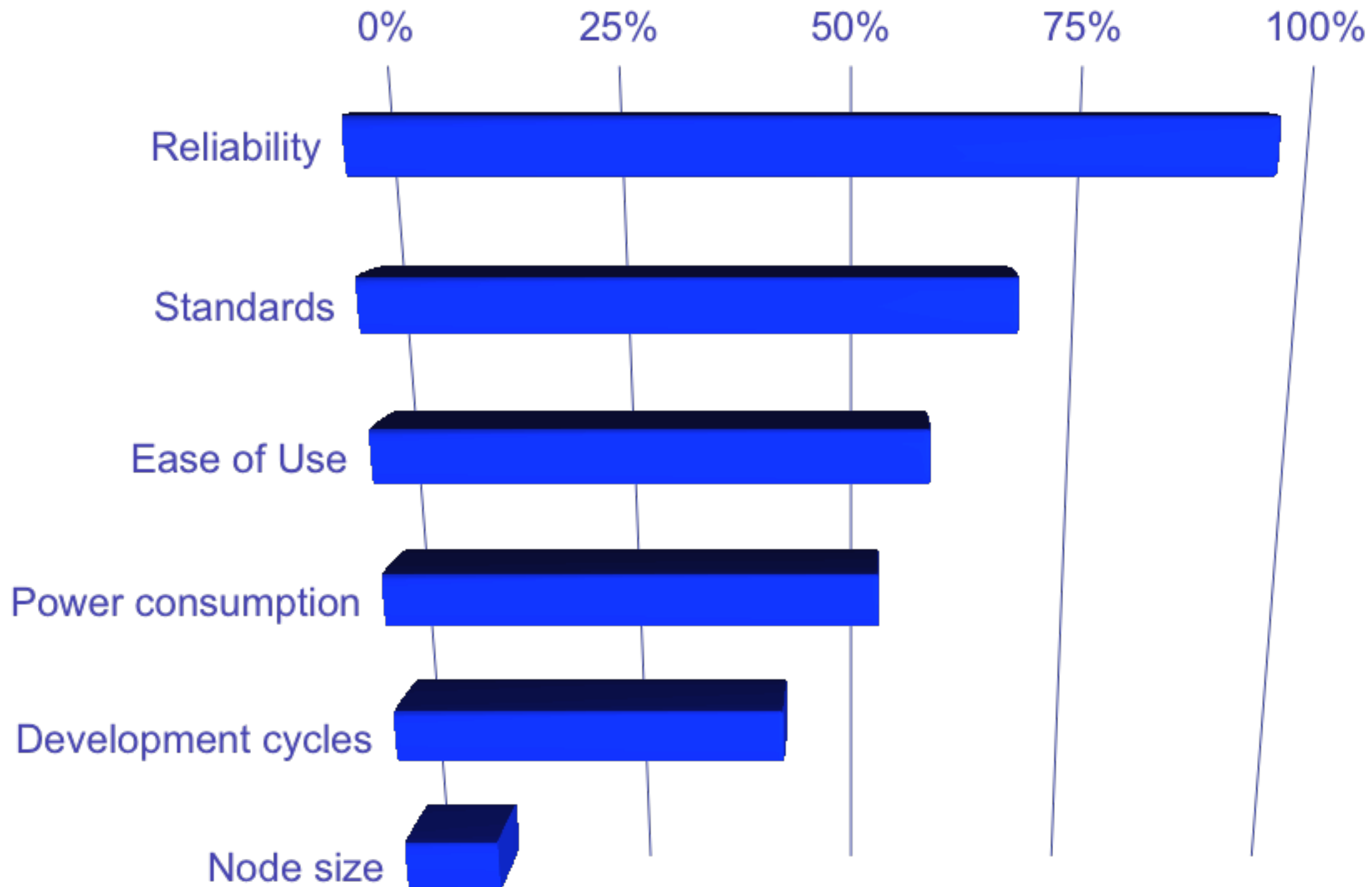
Enthusiasm for WSN

- Smart nodes - a sensor with a computer

- Inexpensive

- No wires, fast deployment

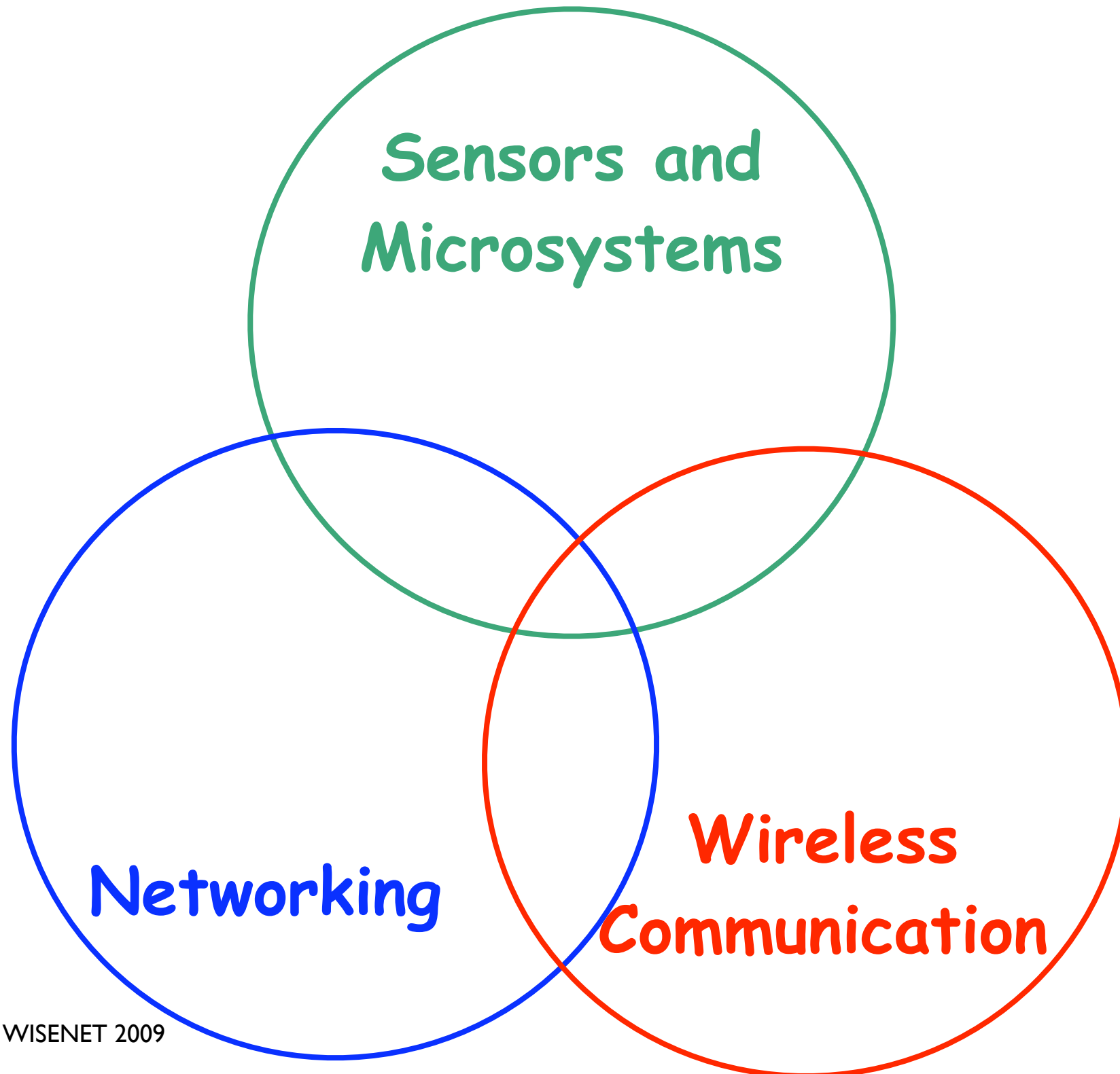- Feasible to launch thousands of sensors

- Mobile

Barrier to adoption

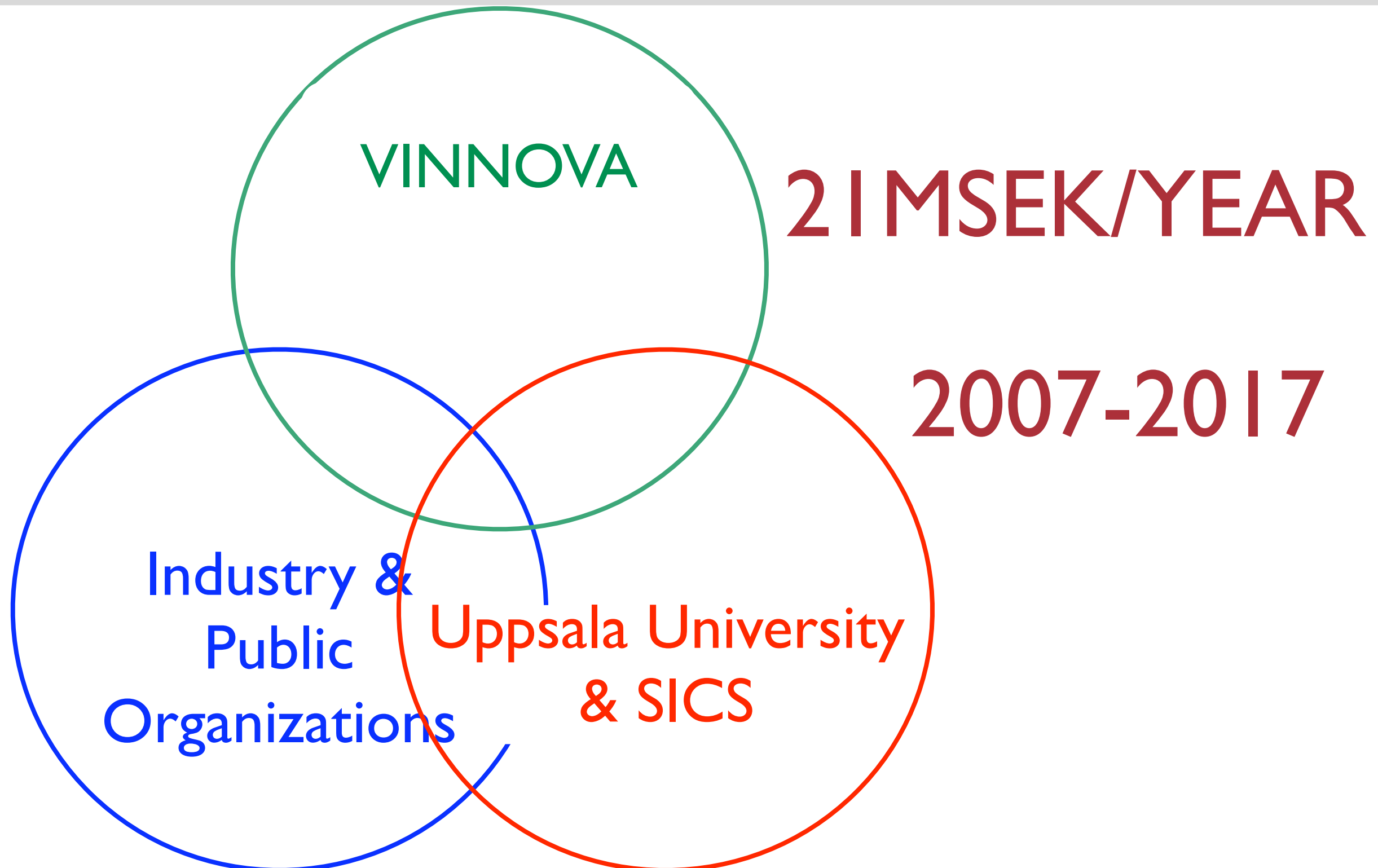VINN Excellence Center WISENET 2009

Next Generation WSN?

- Reliable, robust, secure and maintenance-free

- Ease of programming

- Integration into cost-effective units

- Web access and searching

- "Useful and commercial" applications

Multidisciplinary Approach

VINN Excellence Center WISENET 2009

Collaboration & financing

VINNOVA

21MSEK/YEAR

2007-2017

Industry &
Public
Organizations

Uppsala University
& SICS

VINN Excellence Center WISENET 2009

WISENET Partners

HECTRONIC

TNT ELEKTRONIK
www.TNT.CC

SenseAir®
Maintenance-free Gas Sensors

BANVERKET
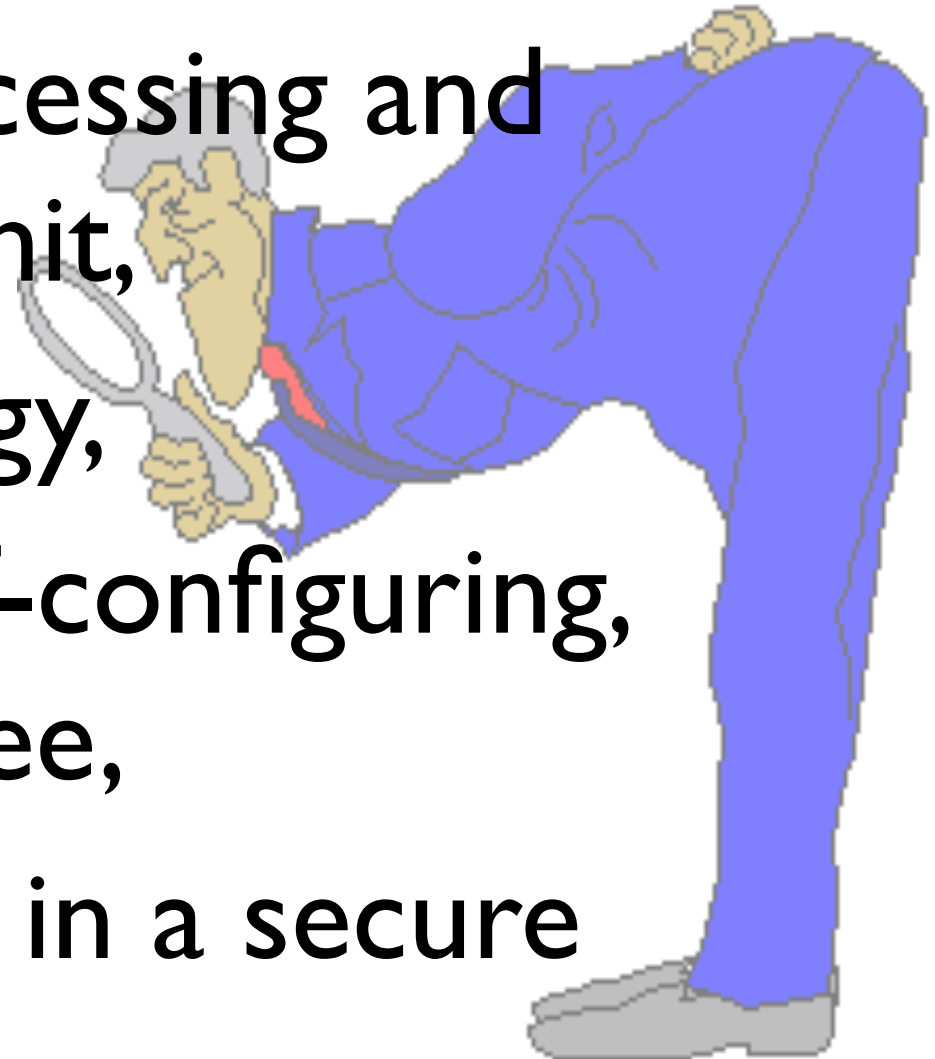
silex
MICROSYSTEMS

SICS

UPPSALA
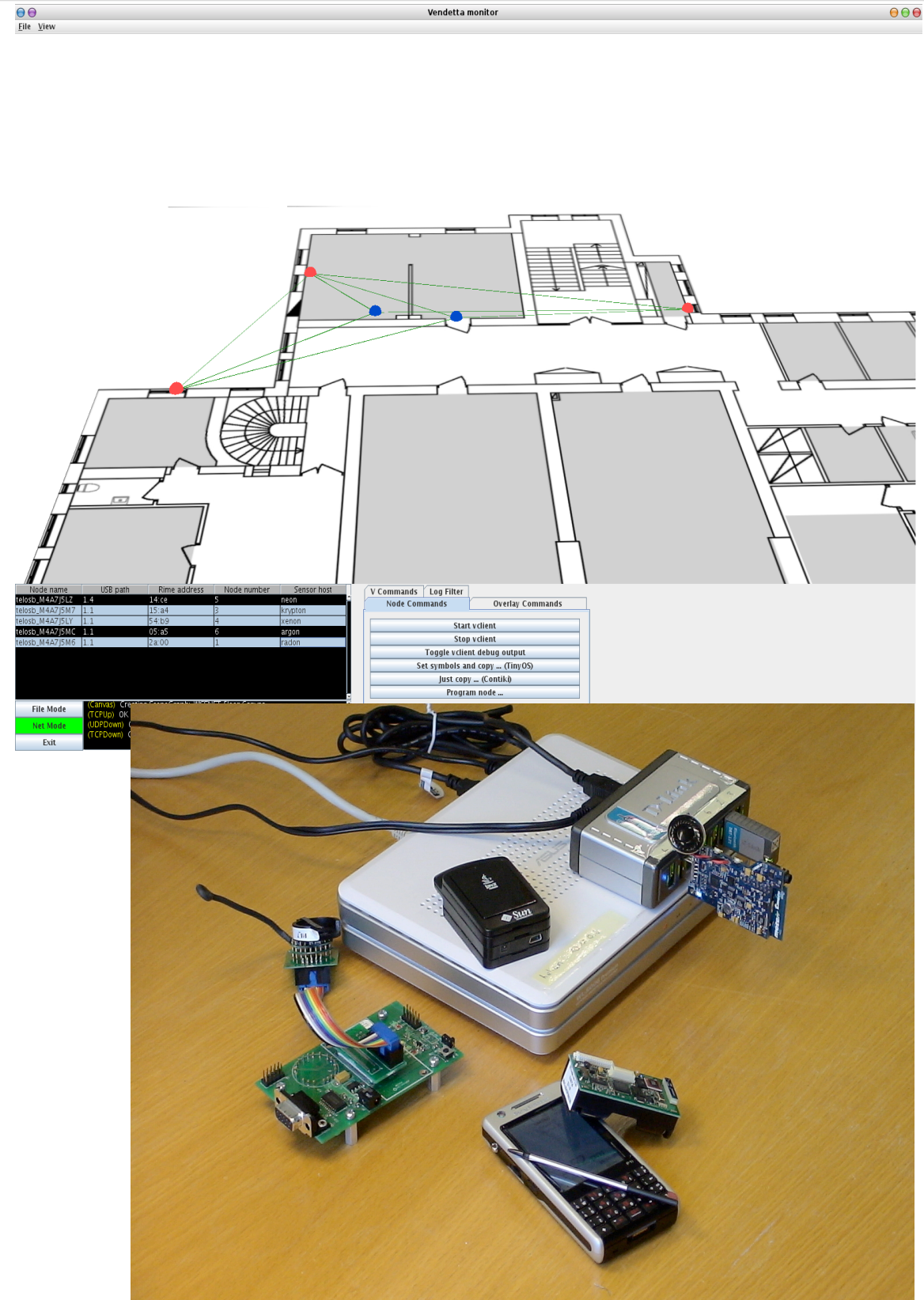UNIVERSITET

VINNOVA

FOI

TRIONA

Research Focus

- Integrate sensing, data processing and communication into one unit,

- Manage and generate energy,

- Make sensor networks self-configuring, robust and maintenance-free,

- Attach sensors to Internet in a secure way.

Application: Railway Systems

- Simulation of antenna beam patters
- Measurements and verification

WISENET Demo and testbed

- Researchers

- Testbed federation

- Companies launching WSNs

- Students

Application: Body in Motion

Sensors for Biomechanics
Wireless sensors measuring strain, position and motion

- eye tremor
- depth of corneal implant
- orientation sensor for improved tooth crown prep
- shoulder ligament strains
- spinal ligament strains
- wireless vertebral bone strains
- elbow ligament strains
- wireless emg and ekg
- 3DM-G measures orientation and motion
- wrist ligament strains
- hip replacement - sensors for measuring micromotion
- smart wireless sensor measures implant subsidence
- knee ligament strains
- smart total knee replacement
- ankle ligament strains
- achilles tendon strains
- wireless smart insoles measure force
- arch support strains

MicroStrain
800.449.3878
www.microstrain.com

Accelerometer, gyro, EM

Connector to EMG

EMG sensor

Application: Urban Sensing

Universal sensing device

CO$_2$: 3,0%

Issue: Sensor and Web

Google™ Sverige
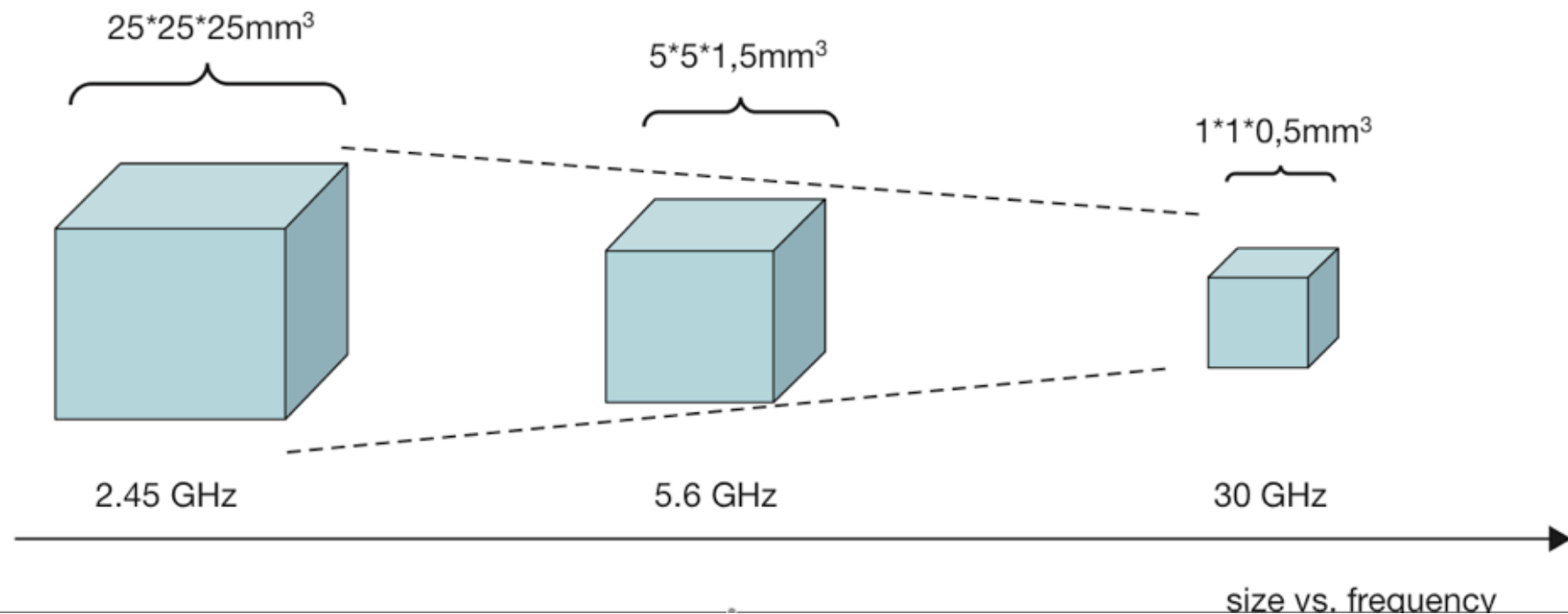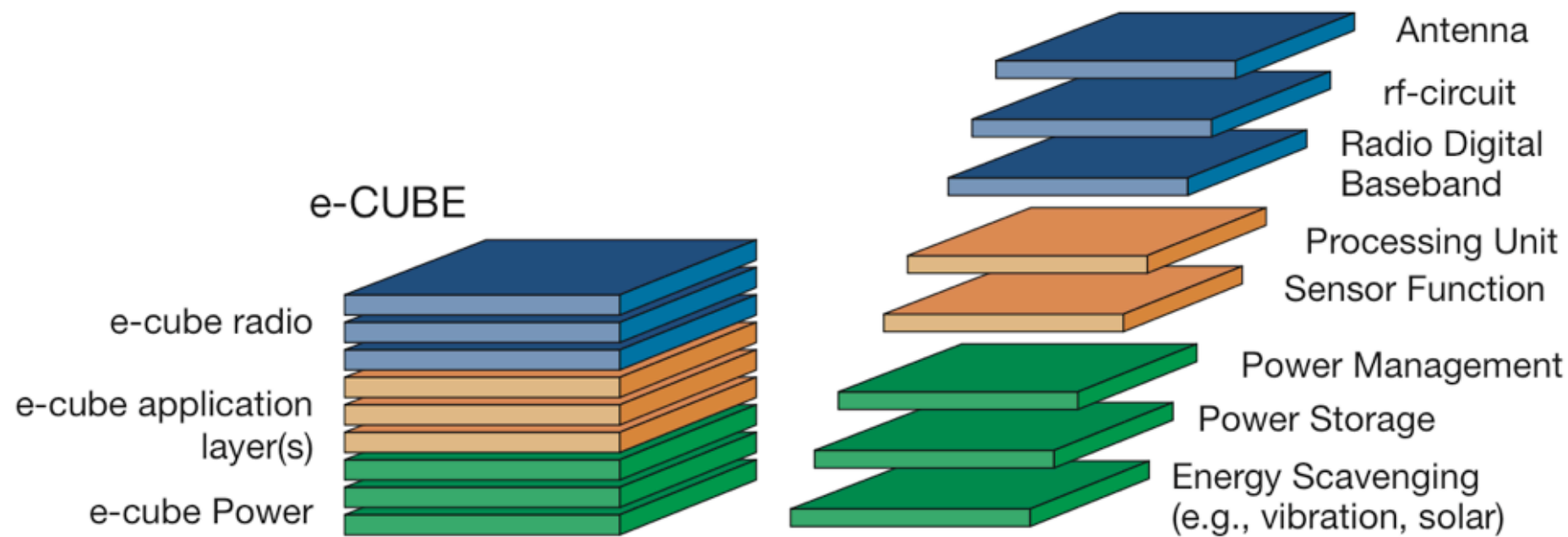
Sensors Web   Images   Groups   News   Scholar   more »

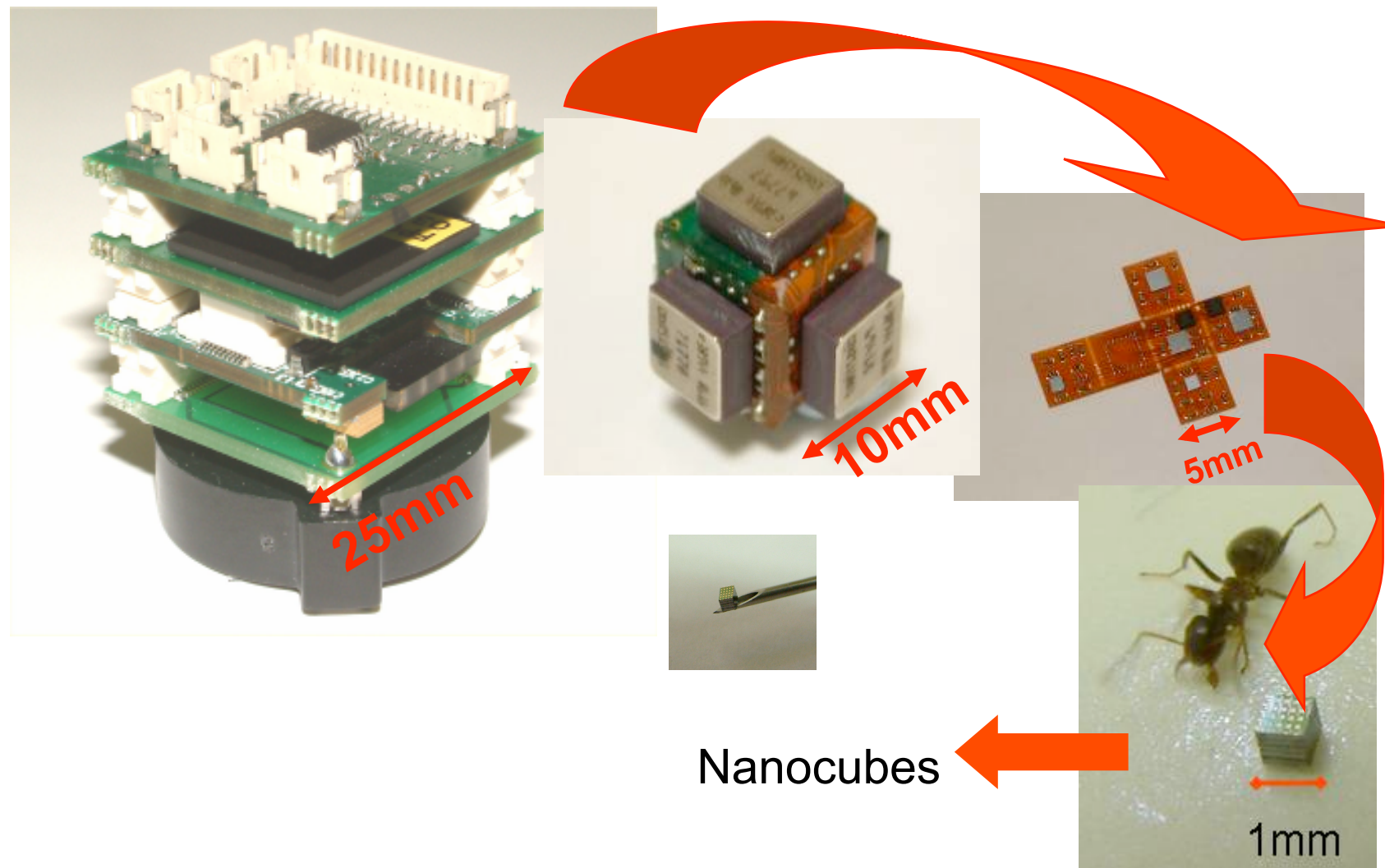algae blooming AND temperature week 30 2004 AND 2005 Baltic Sea

Google Search   I'm Feeling Lucky

Advanced Search
Preferences
Language Tools

Issue: Sensor node integration

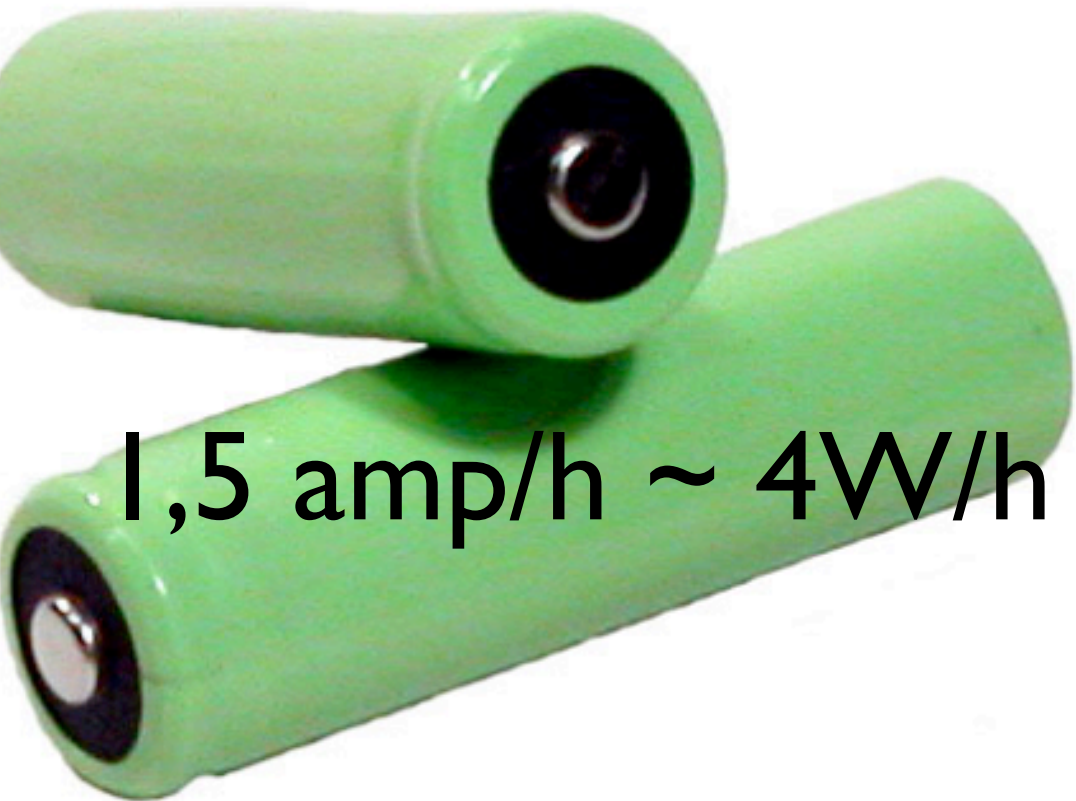# Issue: Sensor Scaling

25mm

10mm

5mm

1mm

Nanocubes

Issue: Energy Scheduling

AA Batteries

1,5 amp/h ~ 4W/h

Mobile phone - few hours (active)
WiFi - several hours
GPS - couple days
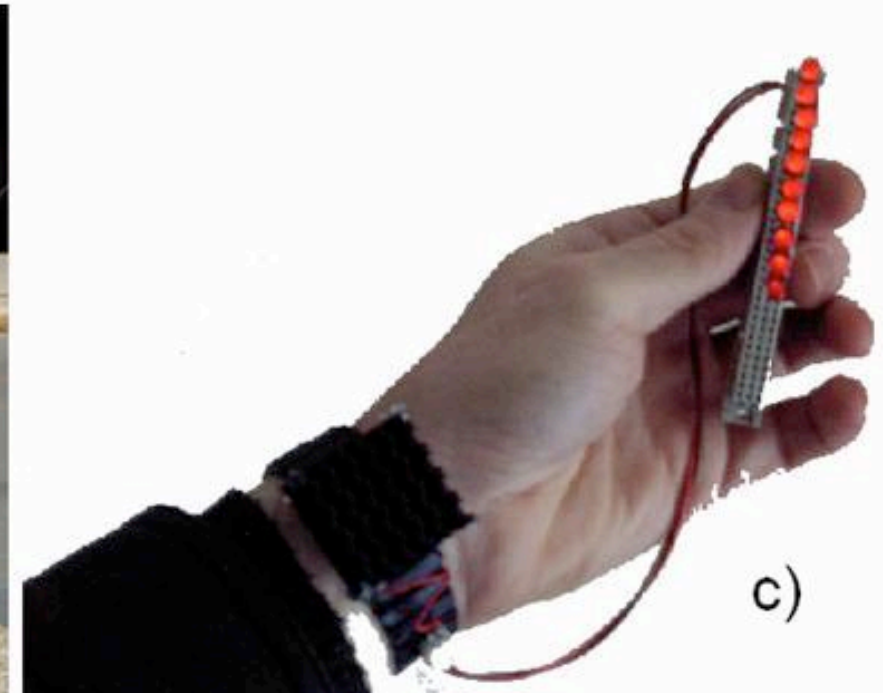
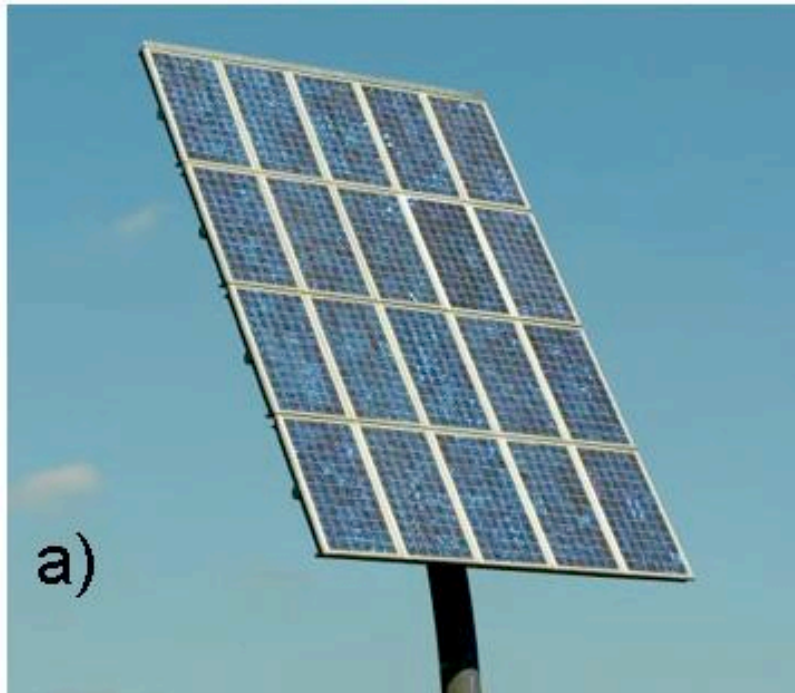*Sensor node*

50 mW active, 20 uW passive
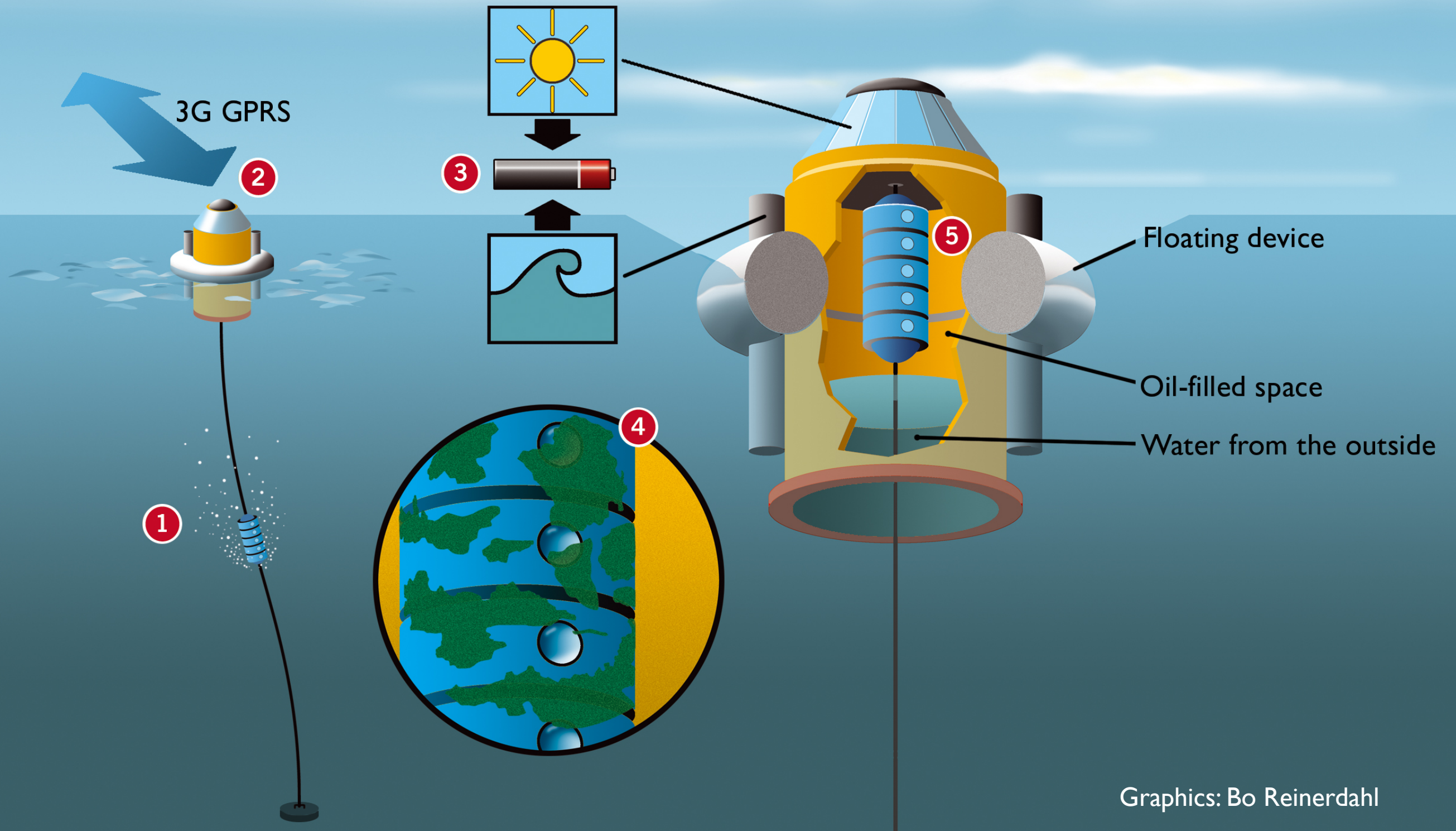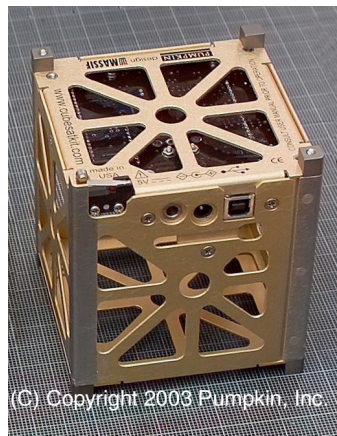
450 uW: one year
45 uW: ~10 years
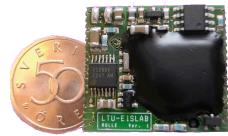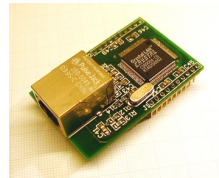
Issue: Stored Energy

Issue: Energy Harvesting

Wave Power Harvester

3G GPRS

Floating device

Oil-filled space

Water from the outside

Graphics: Bo Reinerdahl
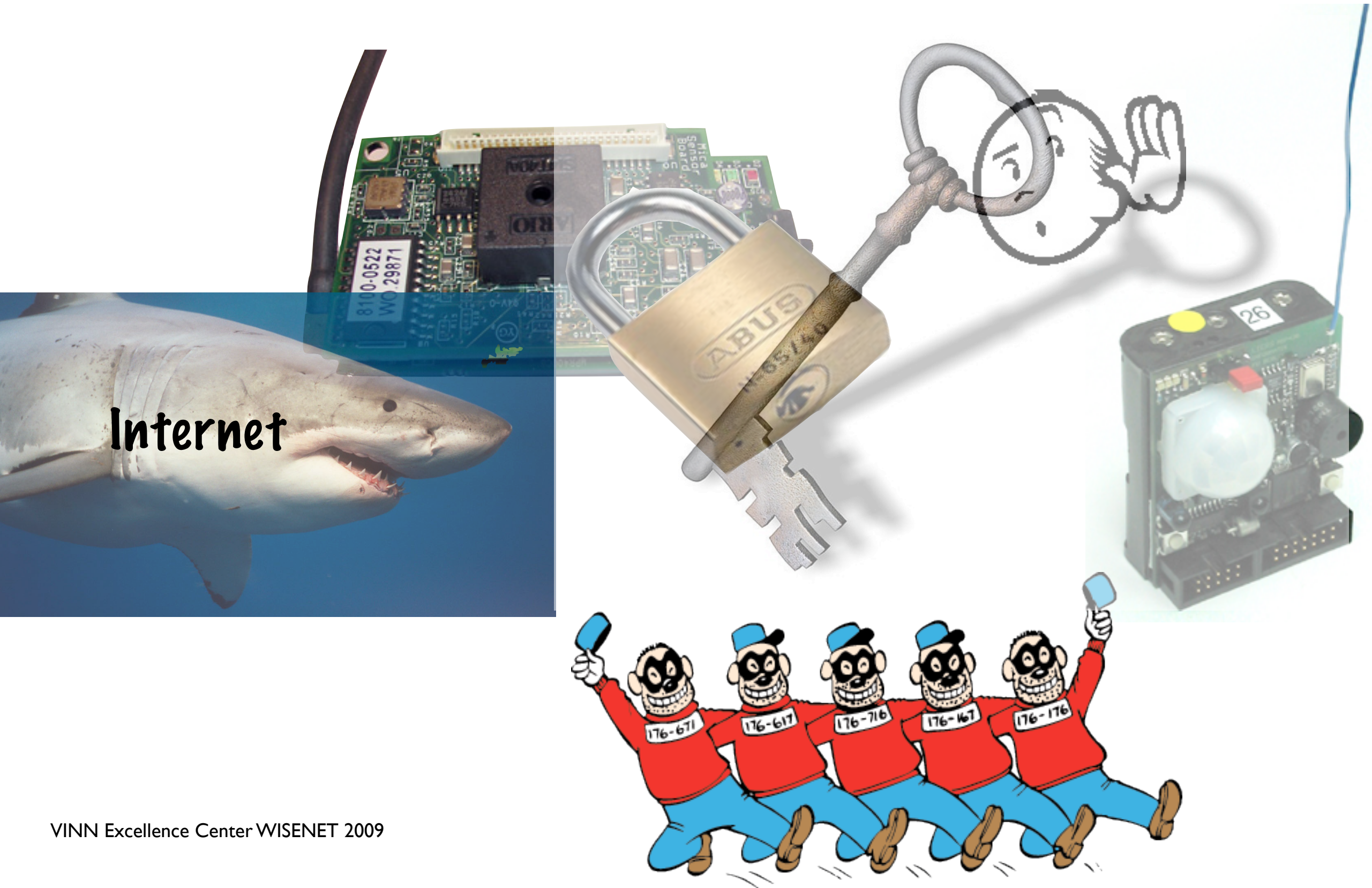
Contiki OS & *u*IP

Realtime operating systems

- Multi-threaded, realtime properties, implemented in C

TinyOS (Berkeley 2000-)

- Event-driven, non-realtime, implemented in nesC

Contiki (SICS 2003-)

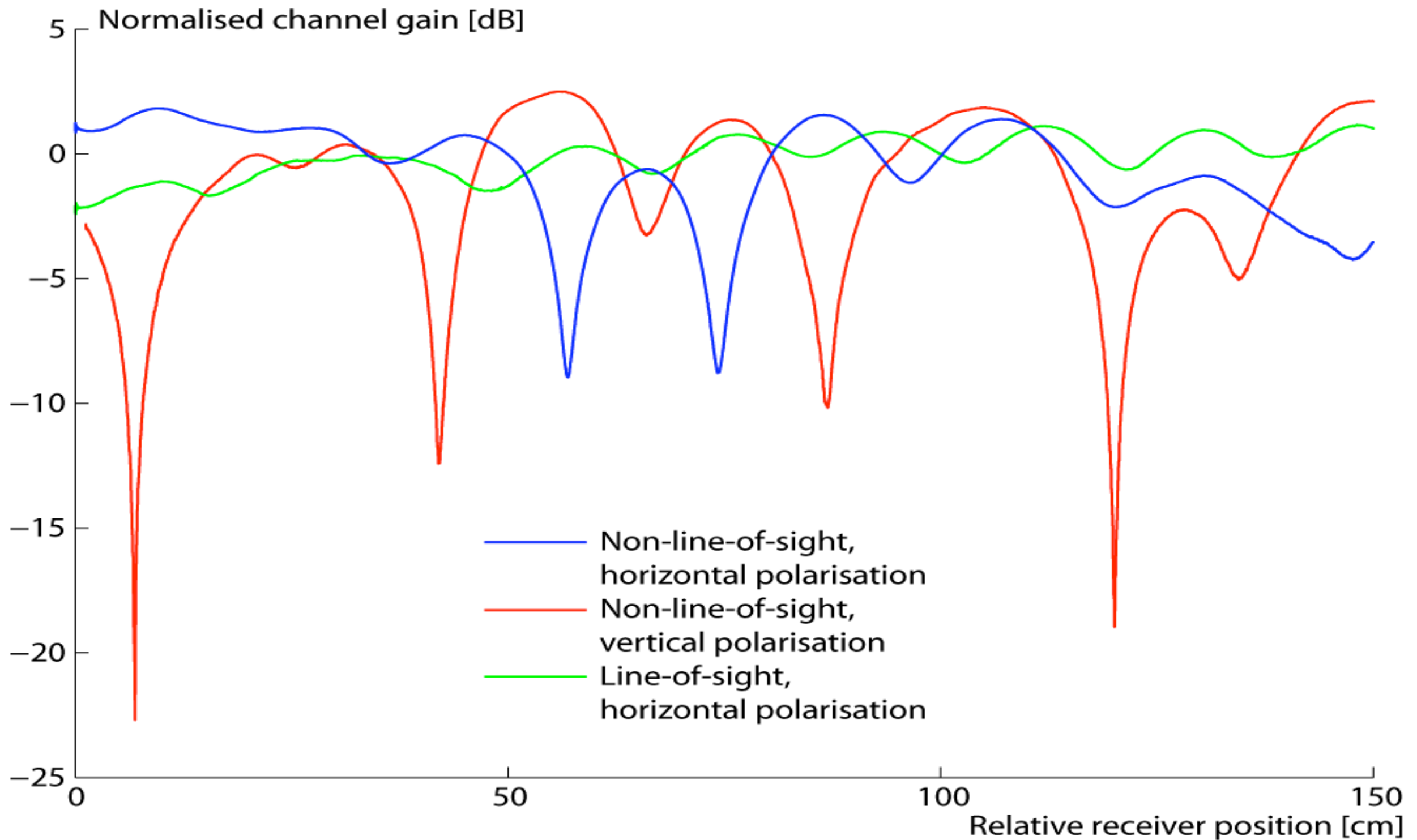- Event-driven + multi-threaded + protothreads, realtim
non-realtime, implemented in C

October 2008:
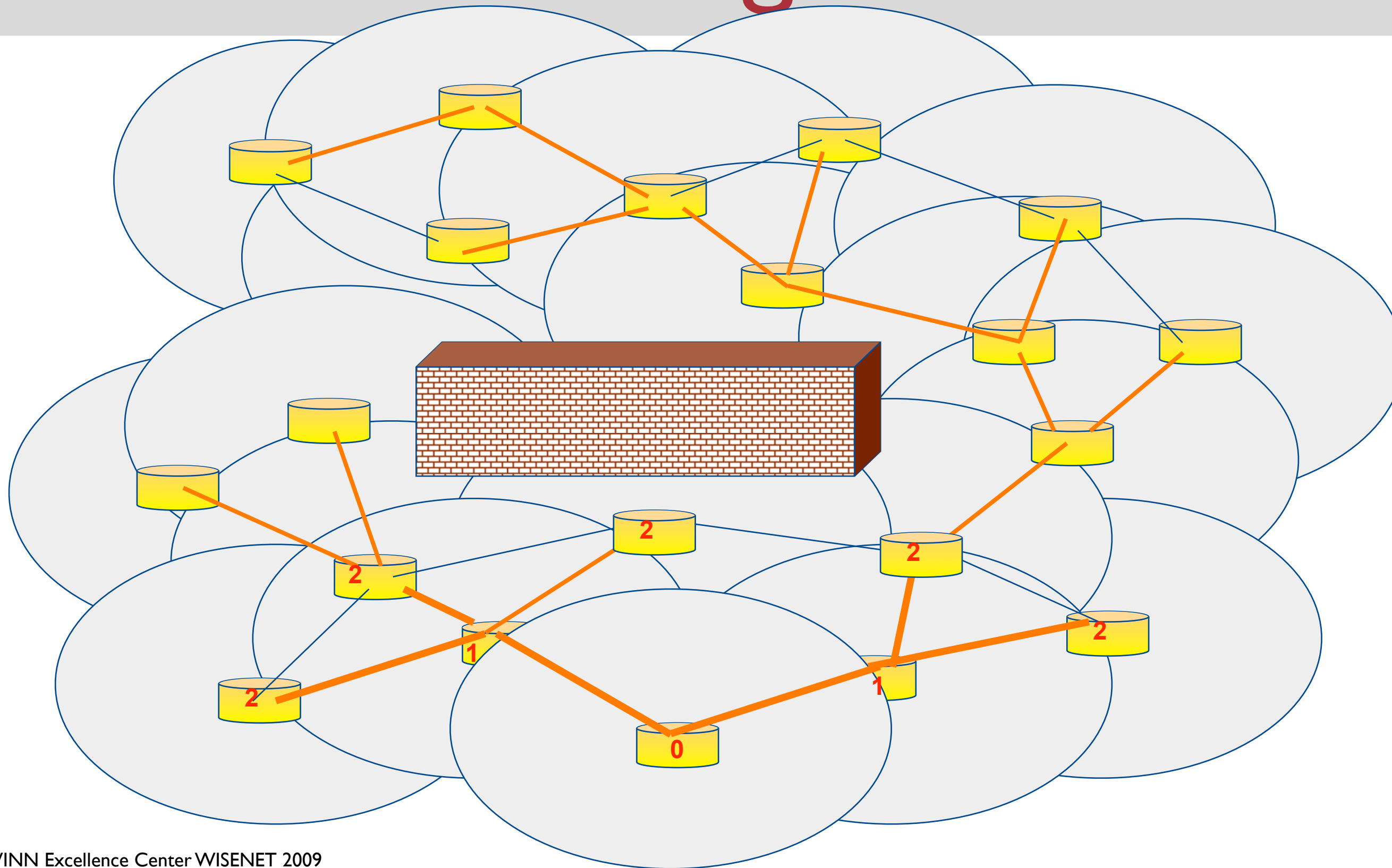*uIPv6, the world's smallest IPv6 stack*

Issue: Security

Internet

Issue: Radio Quality

VINN Excellence Center WISENET 2009
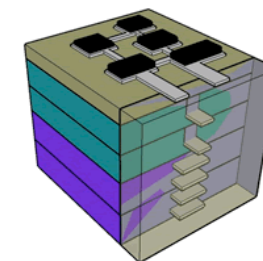
Issue: Self Organization

Issue: Ensemble programming

- Too costly and complicated to program sensor nodes individually

- Must deal with:

  - Energy constraints

  - Self management

  - Distribution of codes

  - Adaptation

  - Synchronization

WISENET = 4 * 10

- 10 years (315,633,637 seconds) operational time

- 10 SEK for a sensor

- 10 times smaller

- 10 years of funding

http://www.wisenet.uu.se/