Application of Sensor Networks

Hans-Joachim Hof

Institute of Telematics
Universität Karlsruhe

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Scenarios

- Habitat Monitoring
- Environment Monitoring
- Health Care
- Military Applications
- Industrial Applications
- Home Automation and Smart Interactive Places

Scenarios

- Habitat Monitoring
  - Great Duck Island
  - ZebraNet
- Environment Monitoring
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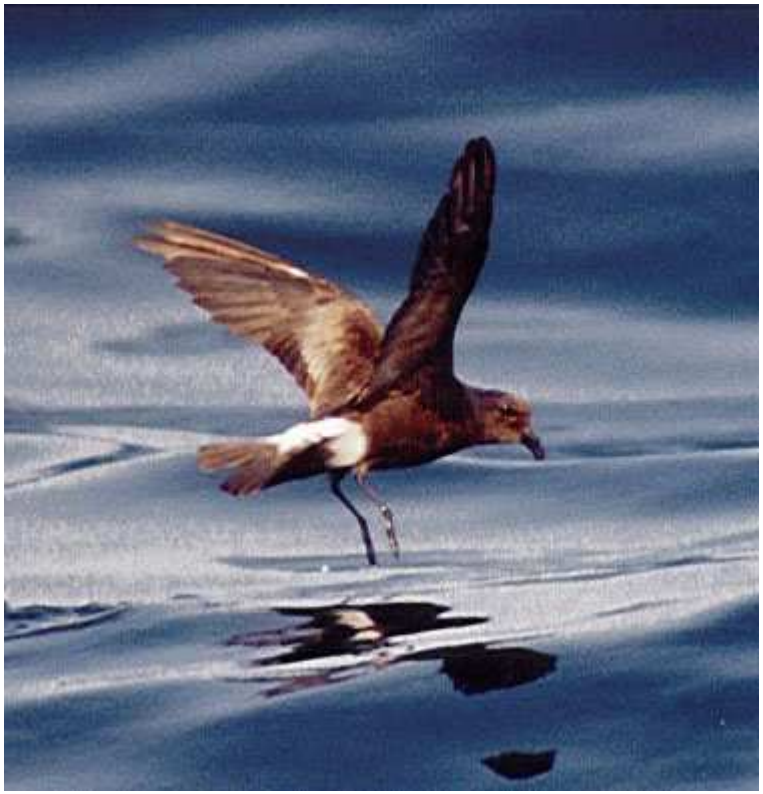
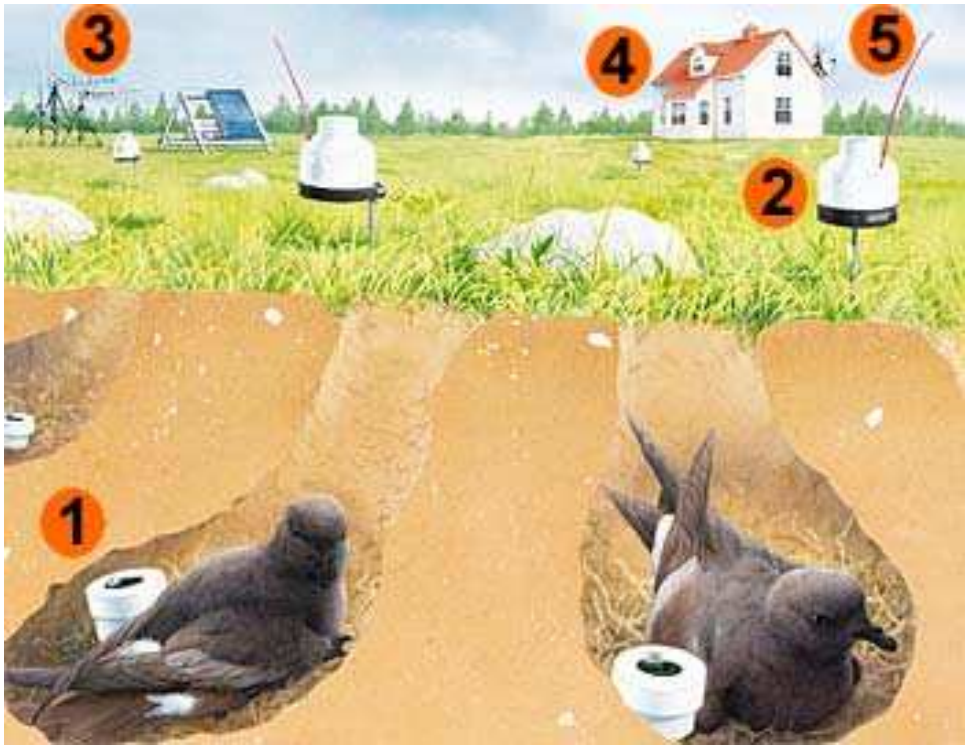
Great Duck Island: Problem

- Monitoring micro-climat of nesting burrows of Storm Petrel
- Large number of burrows
- Long-term observation
- Current techniques intrusive



(Quelle: http://reports.eea.eu.int/report_2002_0524_154909/en/page121.html)

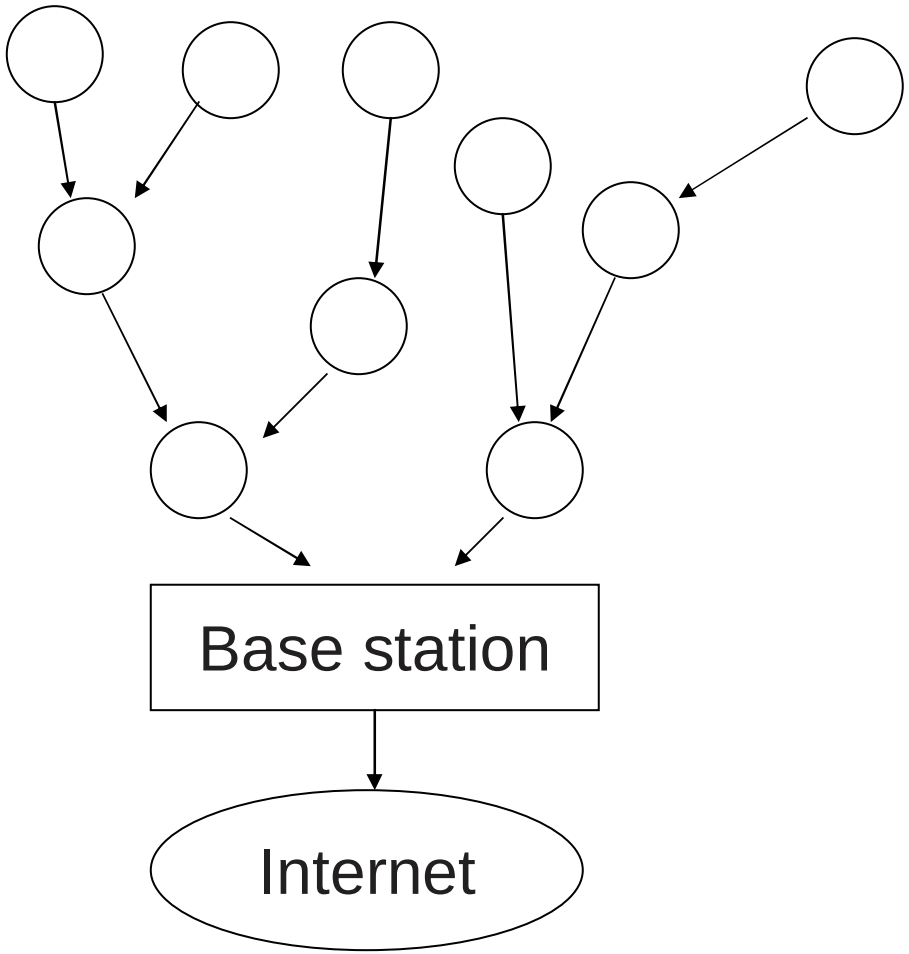
Great Duck Island: Node Placement



(Quelle: www.wired.com/wired/archive/11.12/network.html)

- Over 100 sensor nodes (Mica)
- Pre-configured
- Long term observation

Great Duck Island: Communication Issues



- Multi-hop network
- Base station

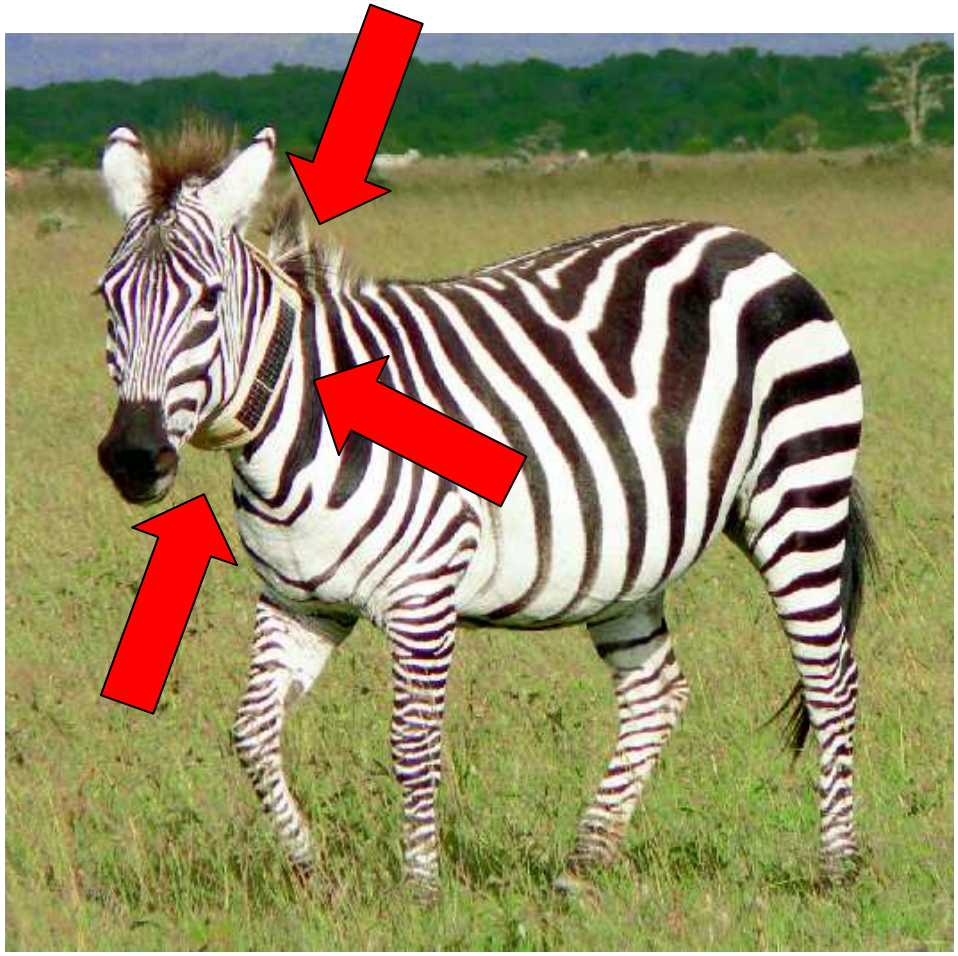
ZebraNet: Problem

- Migration patterns of zebras unknown
- Zebras move in wide area
- Long-term observation

(Quelle: http://www.princeton.edu/~mrm/zebranet.html)

ZebraNet: Hardware

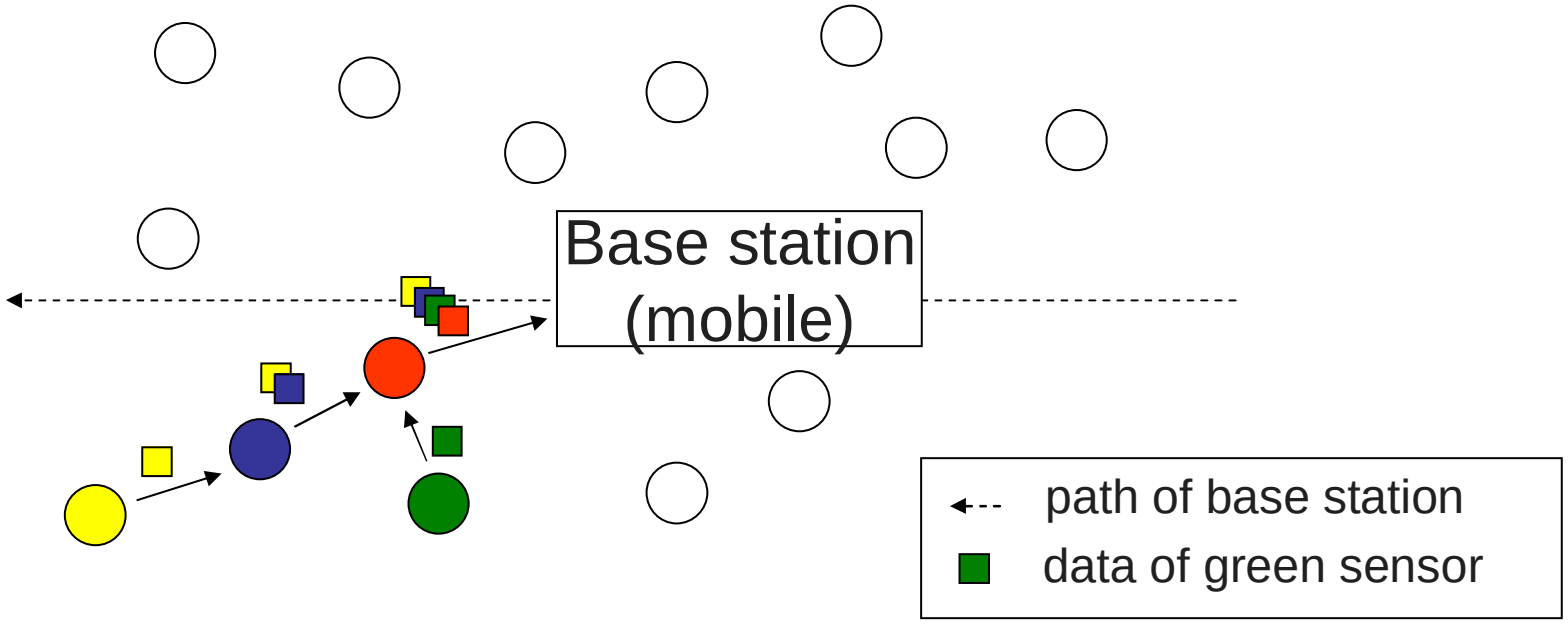
- Limited Weight
- Recharging battery
  - Designed for recharge after 5 days
- Two radios
  - long-range (base station)
  - short range (neighbors)
- Integrated into collar
- Sensors:
  - heart rate
  - body temperature
  - frequency of feeding
  - GPS



(Quelle: http://www.princeton.edu/~csadler/)

ZebraNet: Network Model

- Store and Forward model
  - Mobile base station
  - Priorization of data



ZebraNet: Schedule

- Complex Schedule:
  - 30 GPS position samples / 24 hours
  - Activity log for 3 minutes / 1 hour
  - 6 hours searching for neighbor nodes and communication / 24 hours
  - 3 hours searching for base station / 24 hours

  } overlapping
- 640 kilobytes of data / 5 days

Scenarios

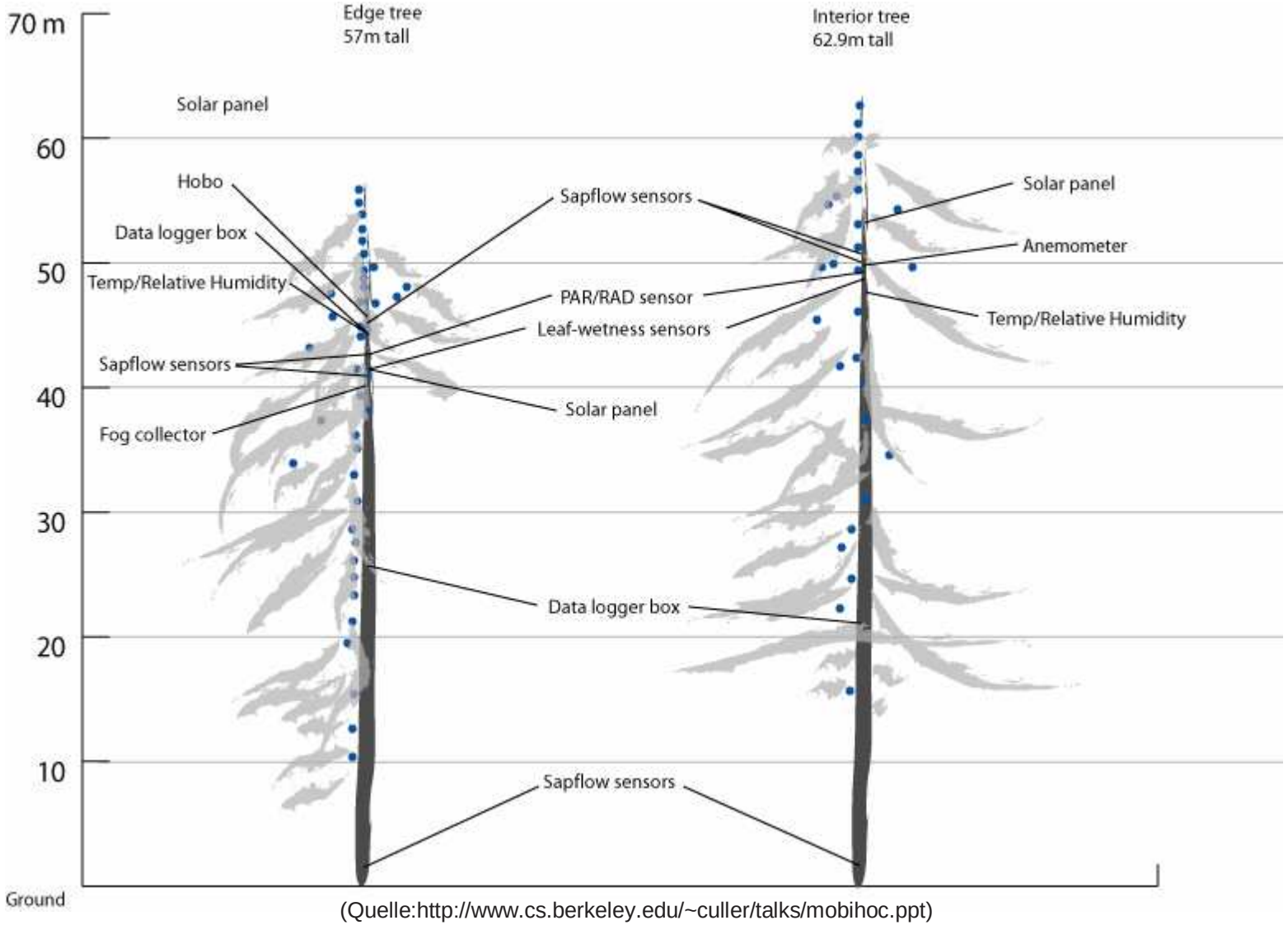
- Habitat Monitoring
- Environment Monitoring
  - Redwood Ecophysiology
  - Meterology and Hydology in Yosemite National Park
- Health Care
- Military Applications
- Industrial Applications
- Home Automation and Smart Interactive Places

Redwood Ecophysiology: Problem

Today:

- Leaf physiology of trees good understood
- Extension to the entire tree canopy is open problem
- Data acquisition:
  - Satellite observations: wide coverage, low resolution, canopy surface
  - Single weather stations: single point in space
  - Instrument elevator: haul data logger along vertical transect
- Dense monitoring throughout canopy of sampling of trees throughout forest

Node Placement



(Quelle:http://www.cs.berkeley.edu/~culler/talks/mobihoc.ppt)

Experiment Setup

- Interior and Exterior Trees
- 40-50 nodes per tree
  - At different elevations
  - Multiple nodes per level, center and periphery
- 25 day duration
- Simple schedule: Sampling every 5 minutes
- Ground level weather station and fog sensors
- Data Loggers
- Sap Flow sensors
  - Internal indicator of level of photosynthetic activity

Meteorology and Hydology in Yosemite National Park

Monitoring of water system in Sierra Nevada

Properties:

- Inaccessible terrain
- Communication problems due to high relief of park
- No solar panels for wildlife protection

System design:

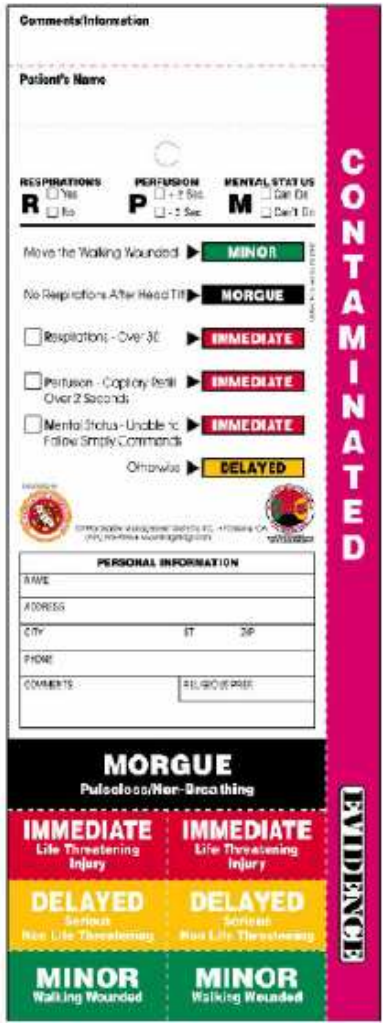
- Different communication technologies
  - radio
  - cell-phone
  - land-line
  - satellite
- Data loggers

Scenarios

- Habitat Monitoring
- Environment Monitoring
- Health Care
  - Code Blue
- Military Applications
- Industrial Applications
- Home Automation and Smart Interactive Places

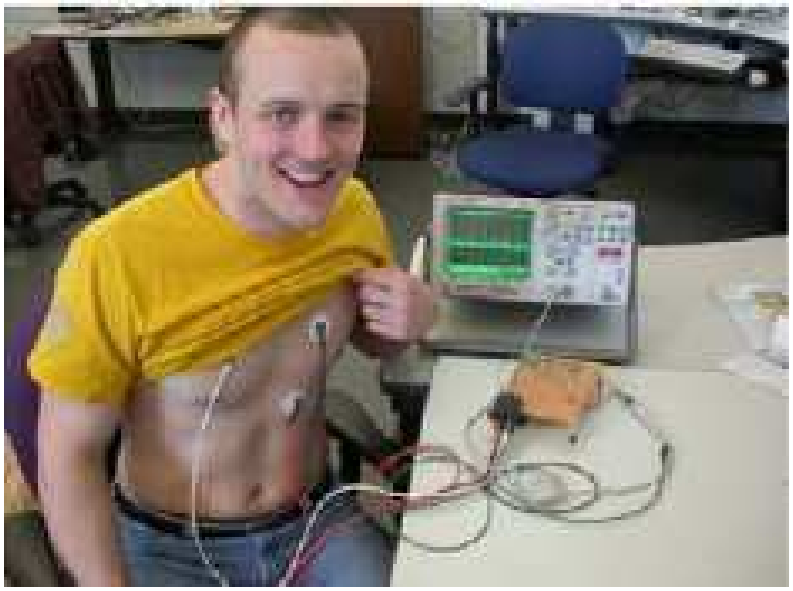
Code Blue: Goals

- Enhance emergency medical care
  - management in disaster area
  - seamless patient transfer



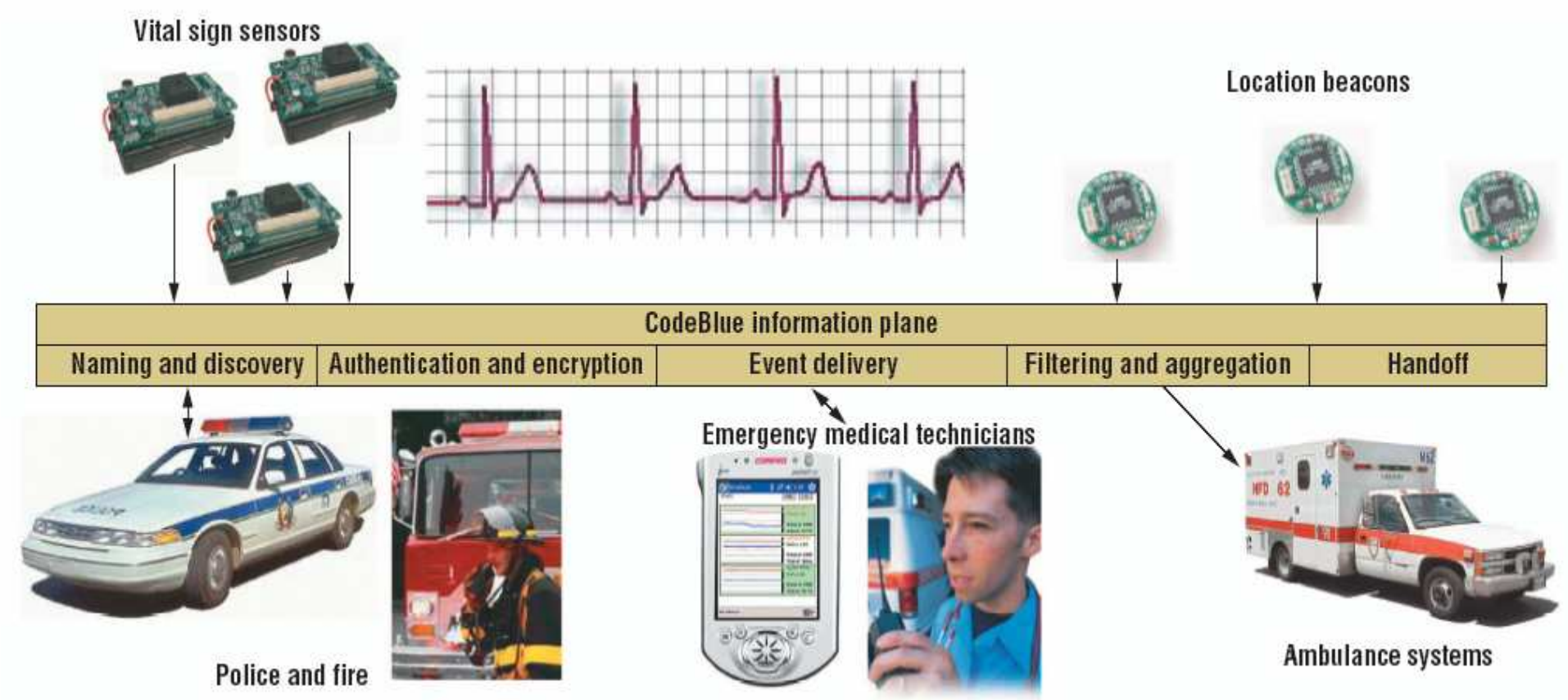
CodeBlue: Sensor nodes

- Heart rate
- Oxygen saturation
- Endtidal CO_2
- Serum chemistries measurements



(Quelle: http://www.eecs.harvard.edu/~mdw/proj/codeblue/)

CodeBlue: Architecture



(Quelle: IEEE Pervasive Computing, Oktober-Dezember 2004)

Scenarios

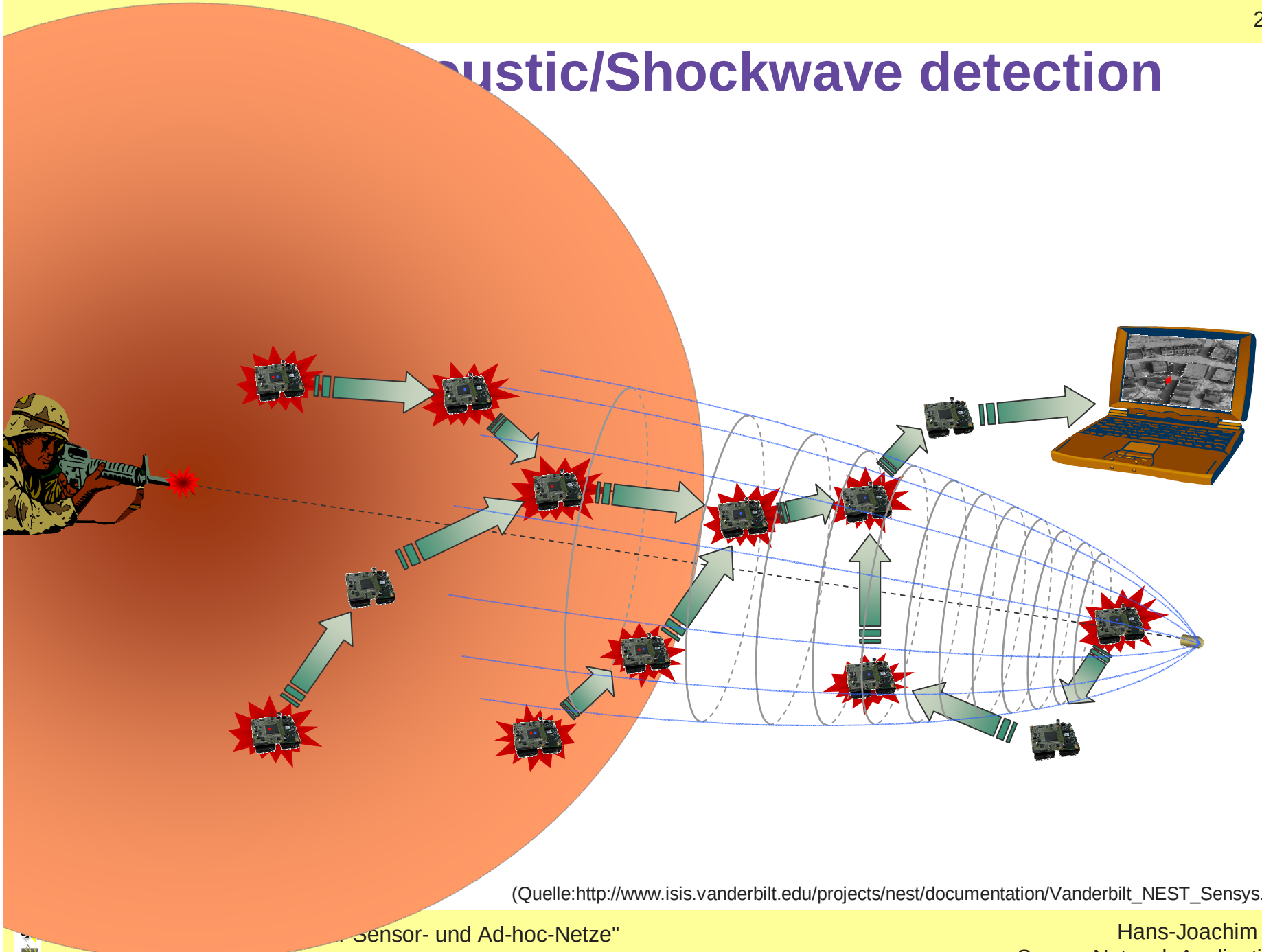
- Habitat Monitoring
- Environment Monitoring
- Health Care
- Military Applications
  - Counter Sniper System
- Industrial Applications
- Home Automation and Smart Interactive Places

Counter Sniper System PinPtr

- Sniper = danger to military operation
- Location preferable
- Only short time for location
- Sniper optical difficult to spot

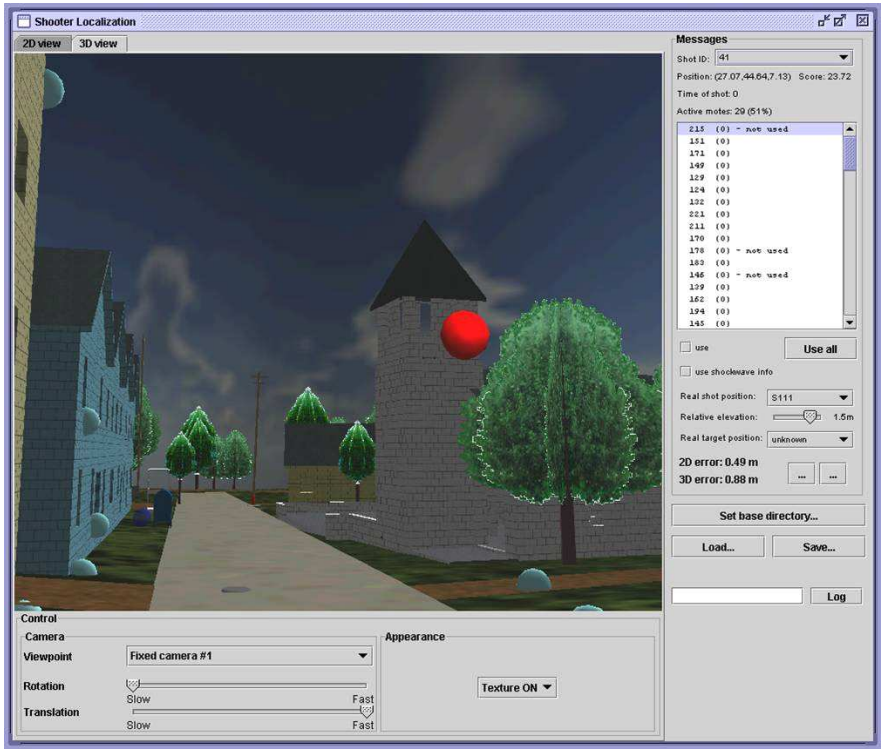


ustic/Shockwave detection



(Quelle:http://www.isis.vanderbilt.edu/projects/nest/documentation/Vanderbilt_NEST_Sensys.ppt)

PinPtr: User Interface



(Quelle:http://www.isis.vanderbilt.edu/projects/nest/applications.html)

Scenarios

- Habitat Monitoring
- Environment Monitoring
- Health Care
- Military Applications
- Industrial Applications
  - Condition based Monitoring
- Home Automation and Smart Interactive Places

Industrial Application: Condition Based Monitoring

- Maintenance regarding condition of a machine
  - Continuous monitoring of machine
- Autonomous data collection
- Autonomous analysis

Scenarios

- Habitat Monitoring
- Environment Monitoring
- Health Care
- Military Applications
- Industrial Applications
- Home Automation and Smart Interactive Places
  - Smart Kindergarten

Smart Kindergarten

Goal:

- Learn about behaviour patterns of children in group settings
- Design interactive classroom

(Quelle:http://nesl.ee.ucla.edu/projects/smartkg/photos.htm)

Sensors:

- Tags
  - record voice
- Intelligent objects
  - Table
  - Textbook

Network:

- Report to central database

Summary

- Sensor networks are used to monitor complex phenomenon
- Sensor networks are used to monitor large areas. Inaccessible areas can be monitored.