1 places left!
Contact seminar organization directly!

Information Session for the Master-Seminar

Sensor Nodes: Operation Modes, Networks and Applications

SS 2012

Prof. Baumgarten, Prof. Carle,
Corinna Schmitt, Alexander Klein, Christoph Söllner

- **Administration**
  - Responsibilities
  - Appointments and Deadlines
  - Grading
- **Introduction to offered topics**
  - Sensor Nodes
  - Network Topologies
  - Operating Systems
  - Middleware Concepts
  - Applications
  - Much more …
- **Topic selection**

- **Administration**
  - **Responsibilities**
  - **Appointments and Deadlines**
  - **Grading**
- **Introduction to offered topics**
- **Topic selection**

Responsibilities and Appointments

- **Organization:** Prof. Baumgarten, Prof. Carle, Schmitt, Klein, Söllner

- **Appointment:** Block Seminar – 23.-24.07.2012 (9 a.m. - 6 p.m.)
- **Requirements:** Pre-knowledge in Network Architectures (Module IN0010)

- **Formality:**
  - Diplom Students: 2 SWS
  - Credits (B.Sc./ M.Sc): 4 ECTS
  - Attendance list exists
  - Each participant will be session chair for one talk
    (moderation, discussion leader, min. 1 question concerning the talk)
  - Successfully attendance (Talk, Paper, Review)
  - Using department templates on our homepage
  - Language: English or German

- **Registration via Seminar homepage**

  http://www.net.in.tum.de/de/lehre/ss12/seminare/

Appointments and Deadlines

	Appointments
Topic selection (1.Chance)	31.01.2012
Meeting with advisor until (MUST)	18.02.2012
Topic selection (2.Chance)	t.b.a.
Upload of paper (1st Version) and talk slides *	01.07.2012
Talks Invited Guest Talk: t.b.a.	23./24.07.2012 9:00-18:00 Uhr
Uploads of reviews	19.07.2012
Upload of paper (2nd Version)	06.08.2012
Publication of Proceedings	t.b.a.

* Slides must be presentable otherwise -0.3 degree in grading.

Slides can be modified after upload after consultation with advisor.

Additional Support

- See homepage: http://www.net.in.tum.de/de/lehre/ss12/seminare/
- Slides:
  - Talk: How to write a scientific Paper?
  - Talk: How to write a Review?
  - Talk: How to give feedback?
- Example:
  Paper version 1 → Review → Paper version 2
- Questions send to schmitt@net.in.tum.de
- Advisors offer the opportunity of test talks!

Grading

Grading parts:

- Personal meetings with advisors
- Paper submissions (6-8 pages in ACM format)
  - 1st Version → Peer-Review process and 2nd Version (final) for publication
- Talk (20min, following discussion and feedback)
  - *Content* counts; personal presentation style is *not* counted
- Review about papers from other seminar participants

Special things:

- Attendance at all appointments
- Observance of deadlines (upload form on homepage)
- Write paper yourself !!! → Plagiarism check takes part every upload
- Session chair for 1 talk

Plagiarism or failure to meet with advisor until t.b.a. result in DISQUALIFICATION.
Other violations result in degrading.

- Administration
- **Introduction to offered topics**
  - **Sensor Nodes**
  - **Network Topologies**
  - **Operating Systems**
  - **Middleware Concepts**
  - **Applications**
  - **Much more …**
- Topic selection

What‘s going on now?

For each topic

- An intoduction,
- A motivation,
- A little more detailed view into topic,
- And a detailed assignment of tasks

is given.

Introduction to Sensor Networks I
- Comparison of node hardware platforms

Platforms:

- Smart-Its
- TinyOS nodes offered by Crossbow (Mica, TelosB)
- Scatterweb

Questions:

- What is a Wireless Sensor Network (WSN)?
- Characterization of different technologies?
- Short characterization of an operating system (e.g. Contiki, TinyOS, Btnut, …)
- Compare the different technologies:
  - Hardware equipment
  - Wired and Wireless Communication
  - Limited factors (energy, space, environment)
  - Possibilities for optimization
  - Areas of application

Iris Mote


Mica 2 Dot


Berliner Motte

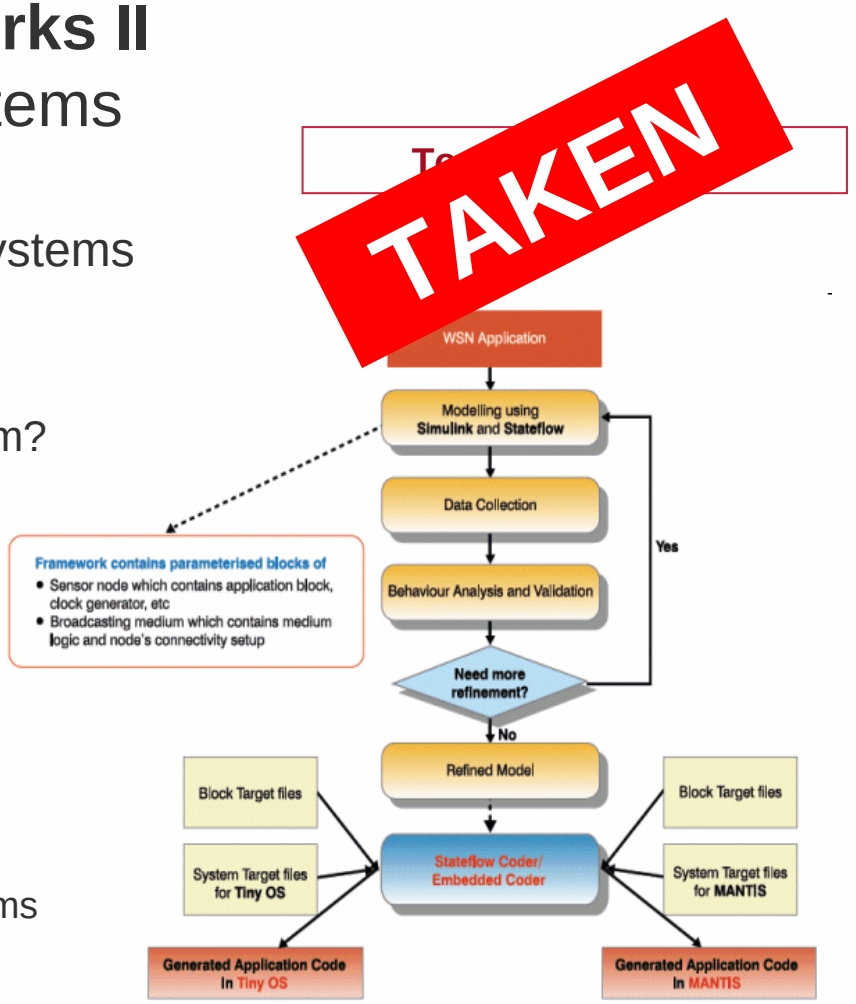

TelosB

Introduction to Sensor Networks II
- Comparison of Operating Systems

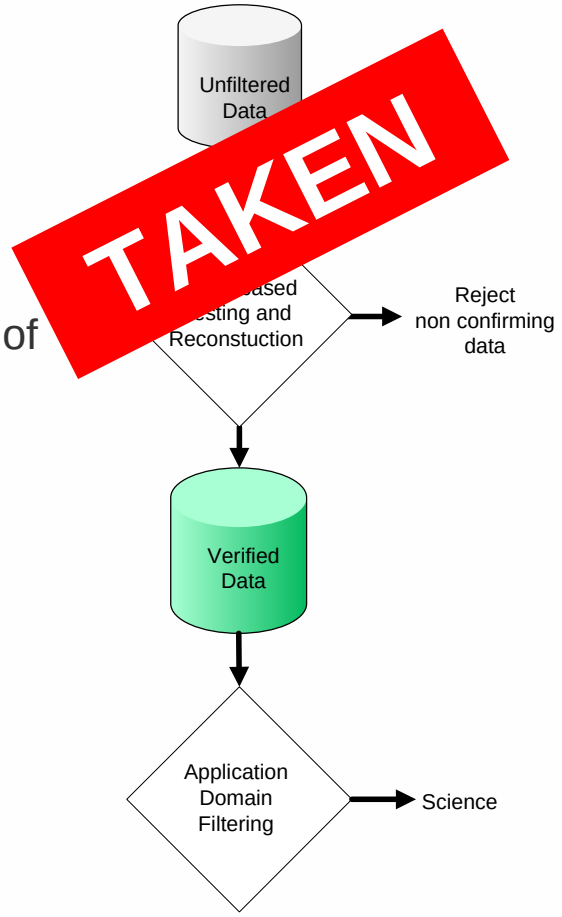
Goal: Introduction of different operating systems

Questions:

- What is a sensor node operating system?
- What are its different characteristics?
- Candidates:
  - TinyOS
  - Contiki
  - MANTIS OS
  - …
- Which goals are important?
  - Energy Consumption
  - Adaptation to different hardware platforms
  - IT security
  - Documentation available
  - API / Programming Language / Compiler / Tool-Chain



Data processing techniques



General:

- Huch data amount is collected.
- Sensor data samples and especially their integrity are of
  - significance and
  - once acquired must not be lost.
- Challenges:
  - data must arrive ordered
  - sensors are often calibrated,
  - sensor network deployments and their maintenance are labor-intensive and expensive.

Questions:

- Which techniques exist to face the challenges?
  - Reconstruction of the Correct Temporal Order of Sensor Network Data (IPSN 2011)
  - PermaDAQ: A scientific instrument for precision sensing and data recovery in environmental extremes (IPSN 2009)
- What development exist?

Security in WSNs I - Key Distribution and Management

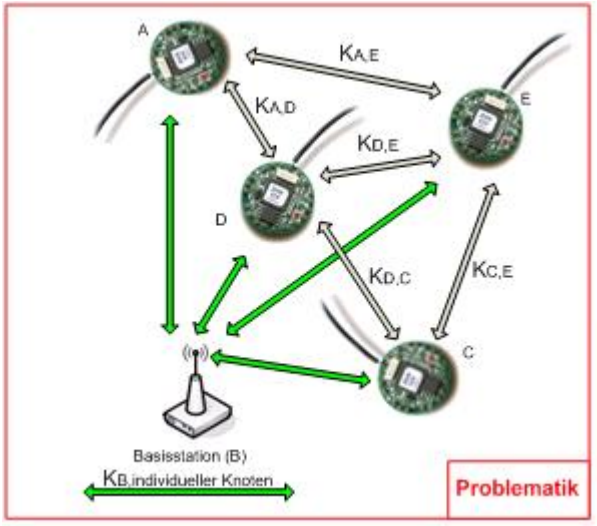
2 Topic of 4 TAKEN

General:

- Security levels within a WSN depend on
  - Network size
  - Application
- Key Distribution and management schemes can be devided into groups:
  - Centralized Key Schemes (LKHW…)
  - Distributed Key Schemes (LEAP, BROSK, PIKE…)
  - Probalistic Key Schemes (LBKP…)

Questions:

- Characterization and comparison of special techniques
- Attack possibilities
- Defence strategies



Security in WSNs II – Denial Of Service attacks

General:

- Depending on the application:
  - Hugh network size with hundreds of nodes
  - Exploiting without manual observation
- Different attacks on different layers

Questions:

- What attacks are possible on a special layer?
- Which consequences occur?
- How can the attack be detected?
- Which defense mechanisms exist?

1 Topic of 4 TAKEN

Network layer	Attacks	Defenses
Physical	Jamming	Spread-spectrum, priority messages, lower duty cycle, region mapping, mode change
	Tampering	Tamper-proofing, hiding
Link	Collision	Error-correcting code
	Exhaustion	Rate limitation
	Unfairness	Small frames
Network and routing	Neglect and greed	Redundancy, probing
	Homing	Encryption
	Misdirection	Egress filtering, authorization, monitoring
	Black holes	Authorization, monitoring, redundancy
Transport	Flooding	Client puzzles
	Desynchronization	Authentication

Watermarking in Sensor Data Sets

1 Topic of 2 TAKEN

General:

- Sensor Data must be analysed in context focus
- Solution is watermarking techniques
  - Known from trade market such as bank notes
  - Different techniques exist
  - Techniques offer among others perceptibility, robustness and capacity

Questions:

- Characterize and analyse the following approaches
  - Self-identifying sensor data (IPSN 20110)
  - Multiple watermarking method for privacy data protection in WSN (2011)
  - Selective Forwarding Attack Detection using Watermark in WSNs (ISECS 2009)
  - An Authentication Method for Self Nodes Based on Watermarking in Wireless Sensor Networks (2009)
- Compare the approach to traditional watermarking strategies

Topic can be split!

Aggregation in WSNs

General:

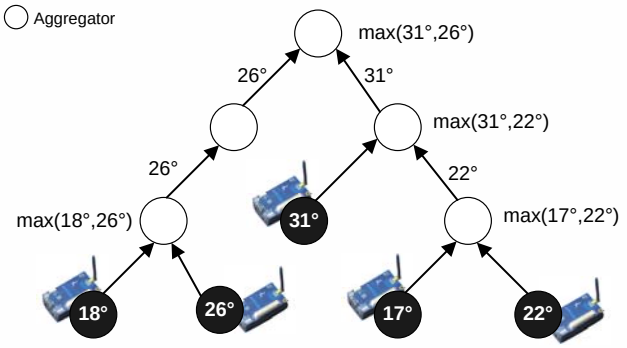
- Resources must be saved
- Most energy is consumed during data transmission

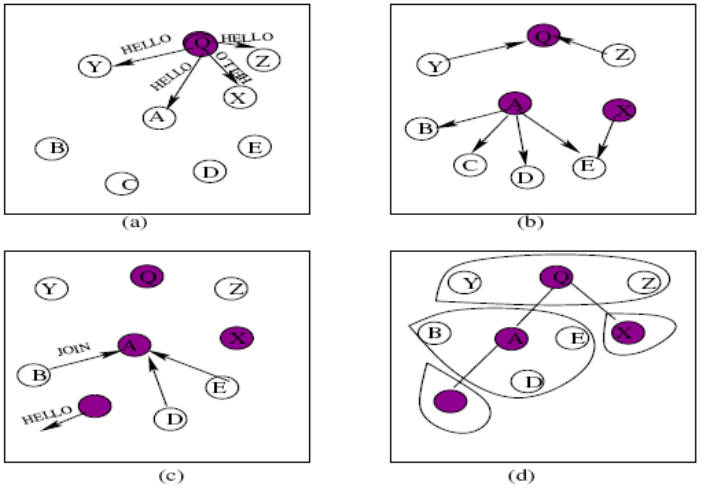
→ Data Aggregation

- Different approaches:
  - Cluster-based Aggregation
  - Tree-based (hierarchical) Aggregation
  - Single Aggregator Algorithms

Questions:

- Why is data aggregation a solution for the problem?
- Which challenges occur?
- Characterization and comparison of different approaches





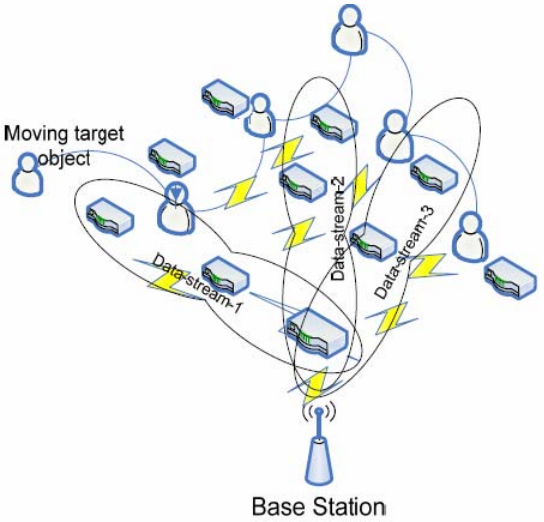
Resource-Management-Tools for WSNs

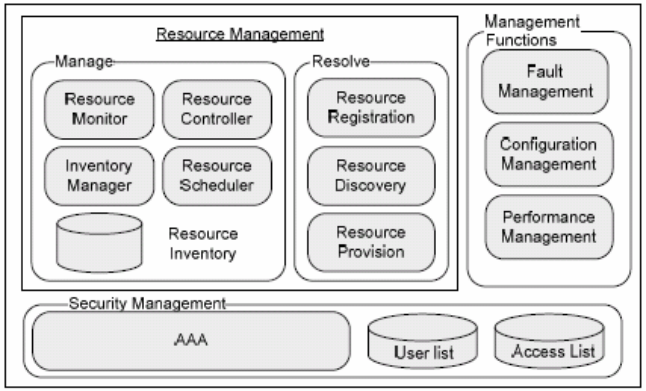
General:

- Resources must be saved
- Most energy is consumed during data transmission

→ Management-Tool

- Different approaches:
  - Tiny Network Manager(TNM) (2010)
  - Peloton (2009)
  - Collective Intelligence (2009)

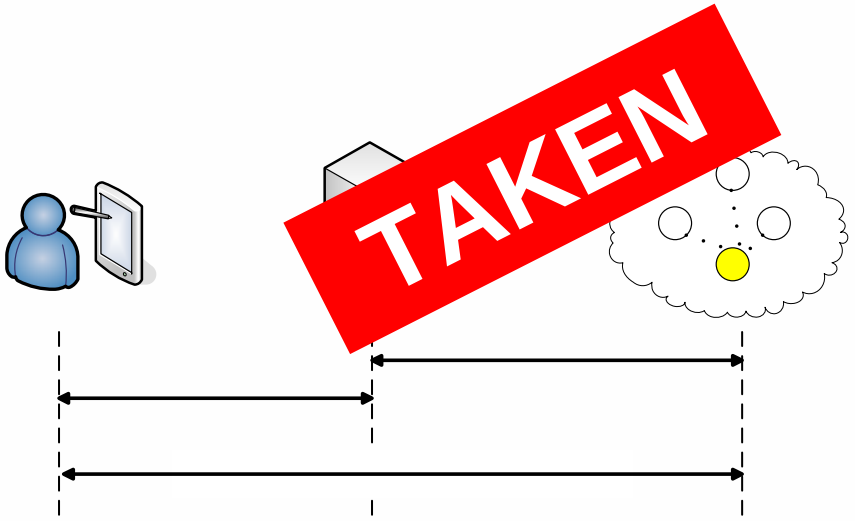




Questions:

- What are the challenges during the development of a management-tool that must be faced?
- Characterization and comparision of different tools

TLS solutions for WSNs



General:

- Security is very important
- Common solution is TLS in “normal P2P networks”
- Is it a solution for WSN?

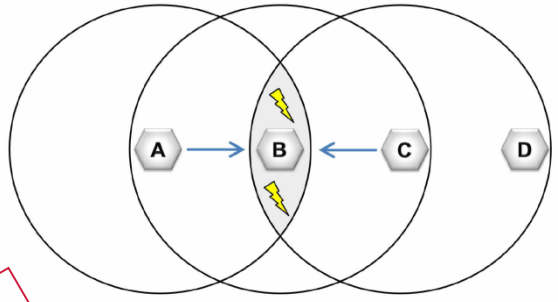
Questions:

- Why is a TLS solution interesting for WSNs?
- Introduce, analyse and compare the following approaches
  - Securing Communications between Multiple Entities Using a Single TLS Session (NTMS 2011)
  - Adapting TLS Handshake Protocol for Heterogenous IP-Based WSN using Identity Based Cryptography (ICWUS 2010)
  - Tiny 3-TLS: A Trust Delegation Protocol for Wireless Sensor Networks (ESAS 2006)
- What are the challanges and what must be faced in the future?

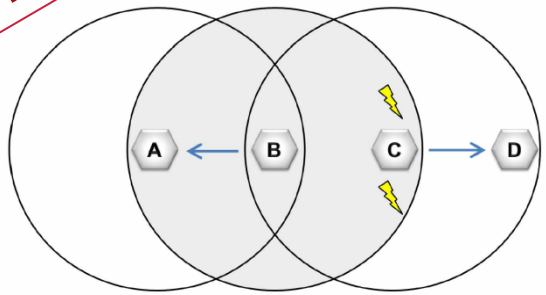
Aspects of Communication in Wireless Sensor Networks

General Issues:

- Low-power components are very limited
- High node density
- Event-correlated traffic
- Unreliable communication links
- Asymmetric data links
- Multi-hop communication
- Over-emitting, idle listening, collisions, traffic fluctuation



Hidden node problem



Exposed node problem

Topic can be split !
Student thesis is offered !

Tasks:

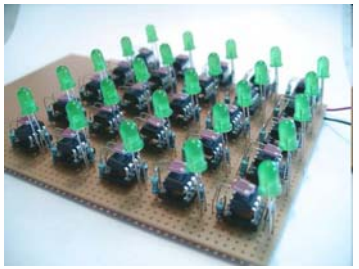
- Describe the communication challenges on **network and data link layer**
- Introduce one or two solutions to each of the issues described above

Energy-efficient communication

Its not a bug!

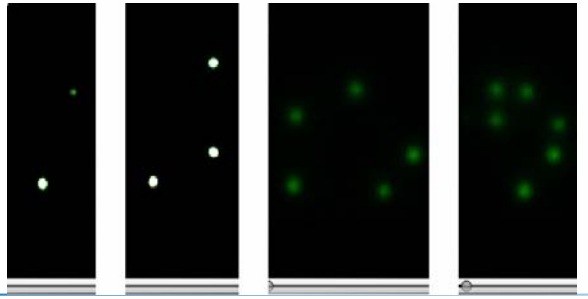
General:

- Most energy is consumed by the transceiver
- Low data rate is sufficient for most sensor applications
- Different solutions (e.g. bio inspired ones as used by fireflies) can be applied to support sleep scheduling



Tasks:

- Give an overview of different strategies to conserve energy (clustering, synchronization, aggregation, scheduling)
- Compare the different approaches in terms of delay, throughput, overhead, complexity, and expected energy savings in different scenarios
- Discuss their use cases
- Which approach suits which target application?



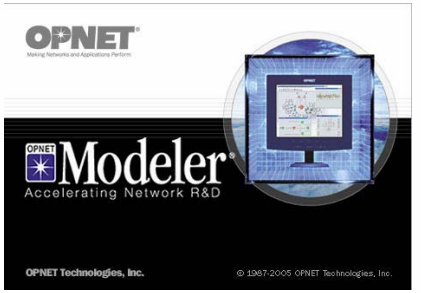
Simulation Tools

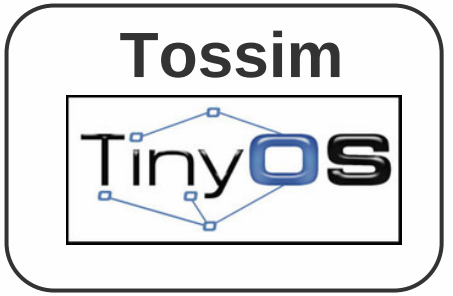
Evaluation:

- Packet Loss
- End-to-End Delay
- Jitter
- Energy Consumption
- Network Lifetime
- Application
- Signal Propagation
- Mobility

Network Performance

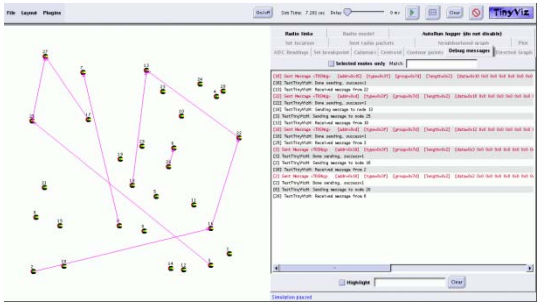
Power Consumption





Topic:

- Introduction and comparison of OPNET, Avrora and Tossim



Reprogramming Techniques for WSNs

1 Topic of 3 TAKEN

General:

- Depending on the application field the manual human input is not possible (e.g. agricultural, building monitoring) → Reprogramming “on the fly”
- Changing values (e.g. measurement intervals) according to the requirements

Questions:

- What challanges can occur by reprogramming sensor nodes? (e.g. node is lost)
- What techniques exist? Characterize and compare them
  - Selective Reprogramming in Sensor Networks (NTMS 2011)
  - Trickle (NSDI 2004)
  - Melete (SenSys 2006)
  - Deluge (SenSys 2004)
  - Zephyr (USENIX 2009)
  - Using Compression of Executable Modules (SECON 2008)
  - MOAP (2003)
  - MNP (2005)

Environmental Monitoring

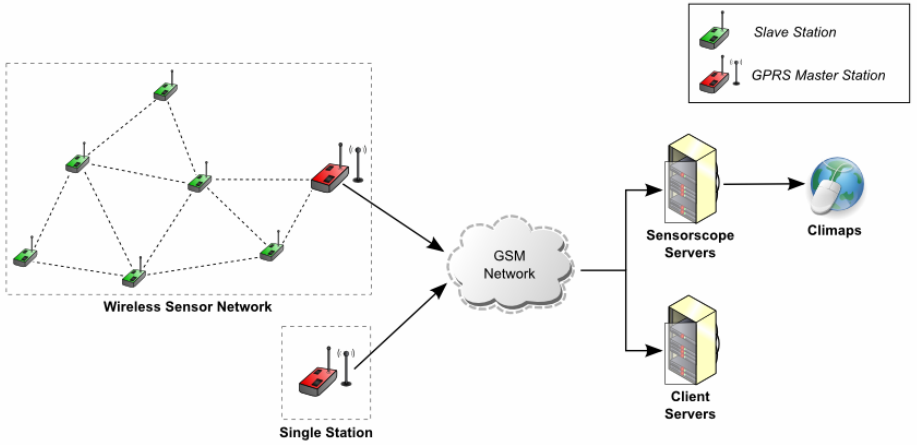
Source: http://www.sensorscope.ch/

General:

- Application field focusing different values measurable in environment
- Gas concentration, light influences, pressure
- Unfriendly exploration area (e.g. extrem wet, cold or dry)
- Project: SensorScope (2007), Switzerland

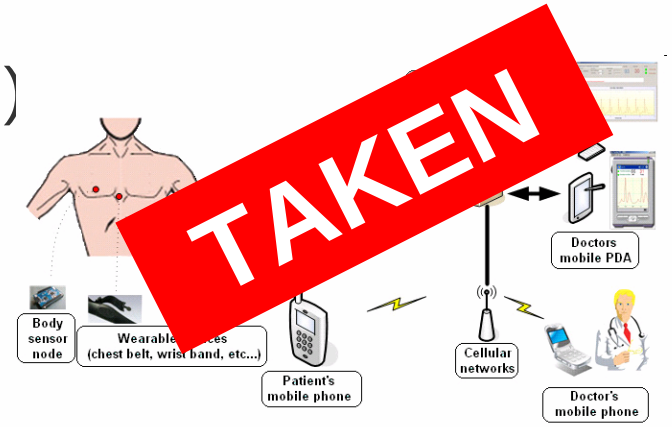
Questions:

- What does environmental monitoring mean?
- What is the project about?
  - Hardware requirements
  - Software requirements
  - Deployment and Localization
  - Challenges and results



Source: http://www.sensorscope.ch/

Wireless Body Area Networks (WBAN)



General:

- Human functions observed by sensors
- Direct data transmission to analysis facilities
- Two main areas:
  - Medical Applications (Project CodeBlue)
  - Private/Commercial Applications

Questions:

- What are WBANs? What are the challenges and requirements?
- Hardware and Software characterization
  - Wireless Body Area Network (WBAN) for medical Applications (survey)
- Introduce, analyse a detailed example application:
  - A Patient-Specific Algorithm for the Detection of Seizure Onset in Long-Term EEG Monitoring: Possible Use as a Warning Device (1997)
  - Nike+ vs Samsung/Adidas „micoach“ vs Nintendo Wii

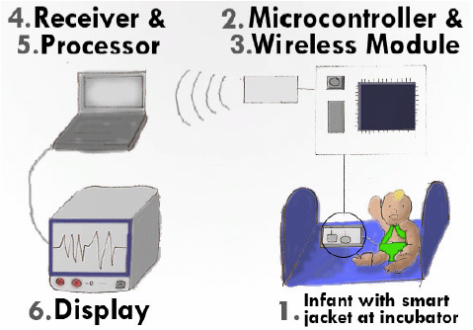
Neonatal Monitoring

General:

- Upcoming application area is health monitoring
- Important: Hippocratic Oath → Save Life
- “Small” WSN technology is interesting for “small” bodys → Neonatal Medicine
- Important: correct data transmission, detection and display

Questions:

- Why are WSNs so interesting for neonatal medicine?
- Introduce, analyse and compare the following approaches
  - Design of Wireless Sensor System for Neonatal Monitoring (NTMS 2011)
  - Wireless Transmission Design for Health Monitoring at Neonatal Intensive Care Units (ISABEL 2009)
- What are the challanges and what must be faced in the future?



Elderly Assistance Systems (EAL), Home Automatic

TAKEN

General:

- Goal: Elderly and disabled People may remain at home f periods
- Ease daily and common tasks by automating electronic equipment and providing a variety of input methods (voice, gestures, etc.)
- Monitor medical condition and alert emergency or ambulance automatically
- Improve felt safety / security and fight loneliness by connecting patients to other people via Internet and social networks

Questions:

- What kind of systems and solutions are currently under developement?
- Are any of them ready for use already?
- Which parts of a typical home are affected?
- How is wireless sensor technology used in those systems, particulary with health monitoring and emergency alerting?
- What future uses are thinkable?

- Administration
- Intoduction to offered topics
- **Topic selection**

Topic Selection (I)

Bold written topics can be split !

Author	Title	Advisor(s)
Schmidpeter	Introduction to Sensor Networks I - Comparison of node hardware platforms	Söllner
Reusing Weber	**Introduction to Sensor Networks II** -**Comparison of Operating Systems** - Topic I - Topic II	Söllner
	Aggregation Techniques	Schmitt
Waltl	Data processing techniques	Schmitt
Norouzian	**Security in WSNs II – Denial of Service** Attacks -Transport Layer -Physical Layer -Link Layer -Network and Routing Layer	Schmitt

Topic Selection (II)

Bold written topics can be split !

Author	Title	Advisor(s)
Lowack	TLS solutions for WSNs	Schmitt
	Neighbor Discovery Strategies in WSNs	Schmitt
	Simulation Tools	Klein
Sternecker	**Reprogramming Techniques for WSNs**	Söllner
Stöckl	Environmental Monitoring	Schmitt
Ederer	Wireless Body Area Networks (WBAN)	Schmitt, Söllner
	Neonatal Monitoring	Schmitt
Kanzler	Elderly Assistance Systems (EAL), Home Automation	Söllner, Schmitt
Enzinger	Energy-efficient communication	Klein
	Aspects of Communication in Wireless Sensor Networks	Klein

Topic Selection (III) Bold written topics can be split !

Author	Title	Advisor(s)
Khanibeik Ilyushkin	**Security in WSNs I – Key Distribution and Management** -Centralized Key Schemes -Distributed Key Schemes -Probalistic Key Schemes	Schmitt
Vadasz	Watermarking	Schmitt
	Resource-management Tools for WSNs	Schmitt