Lehre/Teaching
Winter 2007/2008

University of Freiburg
Computer Networks and Telematics
Prof. Christian Schindelhauer

Christian Schindelhauer
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Repetitorium Informatik III

University of Freiburg
Institute of Computer Science
Computer Networks and Telematics
Prof. Christian Schindelhauer

- **Vorbereitungskurs zur Nachklausur Informatik III**
  - Klausur am 20.09.2007
- **Dozent: PD Dr. Andreas Jakoby (Uni Lübeck)**
- **Jeden Tag (Mo-Fr) von 27.08.-14.09.**
  - 9-11 Uhr Vorlesung zu einem angekündeten Thema
  - 11-13 Uhr Übung mit studentischen Tutor
  - 14-16 Uhr Sprechstunde/Training
- **Zusätzlich Sprechstunden in der letzten Woche vor der Klausur**
  - Mo-Mi

Informatik III

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- **Inhalt**
  - Automaten
  - Formale Sprachen
  - Komplexitätstheorie
  - Berechenbarkeitstheorie
- **Veranstaltungsform**
  - Vorlesung (4)
  - Übung (2)
- **Prüfungsrevelant**
  - Übung
  - 3 Miniklausuren
  - Abschlussklausur
- **Material**
  - Buch: Micheal Sipser, Introduction to the Theory of Computation, MIT Press, 1996
  - Webseiten:
    `http://cone.informatik.uni-freiburg.de/teaching/vorlesung/informatik-III-w07/index.html`
  - Folien, Audioaufzeichnung

Bachelor-Arbeit in der Informatik

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- **12 ECTS-Punkte für Arbeit**
  - 4/5 der Note
  - Umfang 3 Monate
- **3 ECTS-Punkte für Präsentation**
  - 1/5 der Note
  - hochschulöffentlich
  - vor zwei Prüfern (mit Beisitzer)

Master-Arbeit in der Informatik

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- **Arbeit**
  - 27 ECTS-Punkte
  - 6 Monate
  - englischer oder deutscher Sprache
- **Präsentation**
  - 3 ECTS-Punkte

- **Siehe auch**
  - http://www.informatik.uni-freiburg.de/studienberatung/master/index.htm

Lab Course, Projekt, Teamprojekt

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- **Projekt im Bachelor of Computer Science**
  - Plan im 5. Semester
  - 6 ECTS-Punkte
- **Lab Course im Master of Computer Science oder Applied Computer Science**
  - Plan im 2. Semester
  - 6 ECTS-Punkte
- **Teamprojekt im Master of Computer Science oder Applied Computer Science**
  - Plan im 3. Semester
  - 14 ECTS-Punkte
  - englischer oder deutscher Sprache
- **Siehe auch**
  - http://www.informatik.uni-freiburg.de/studienberatung/bachelor/index.htm
  - http://www.informatik.uni-freiburg.de/studienberatung/master/index.htm

Topics

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- **Wireless Sensor Networks**
  - Medium Access Protocol
  - Routing
  - Lifetime
  - Mobility and Scalability
- **Mobile Ad-Hoc-Networks**
  - 3-MANET
- **Peer-to-Peer-Networks**
  - TooFree
  - 3-Nuts
- **Storage-Area-Networks**
  - Insane (File Area Network over the Internet)
- **Telematics**
  - Integrated Simulations for Self-organizing Networked Robots
  - Swarmbats: Localization using environmental sound events

Lab Course/Projekt/Teamprojekt
Ad hoc Network

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- **Two parts:**
  - Mobile Ad hoc Network (MANET)
  - Wireless Sensor Network (WSN)
- **Depending on the project scope, the number of each project member is up to three.**
- **Lectures will be given based on the requirements of the proposed projects.**
- **Project output may include:**
  - Specifications
  - Codes
  - Demonstration
  - Final presentation
- **Objectives**
  - To attain practical expertise with Hardware, Software and Design

Part A:
Mobile Ad Hoc Networks

Lab Course/Projekt/Teamprojekt
MANET Projects

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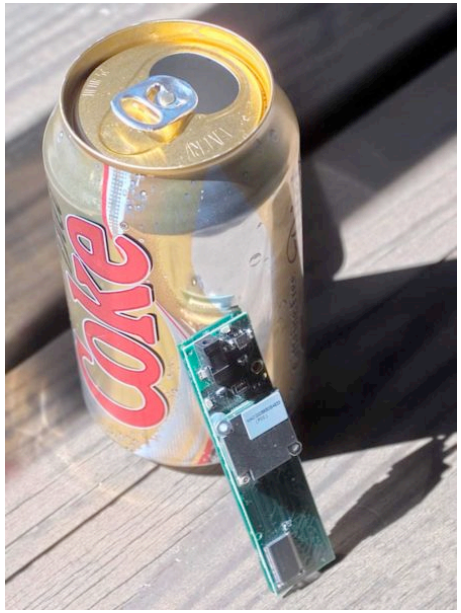
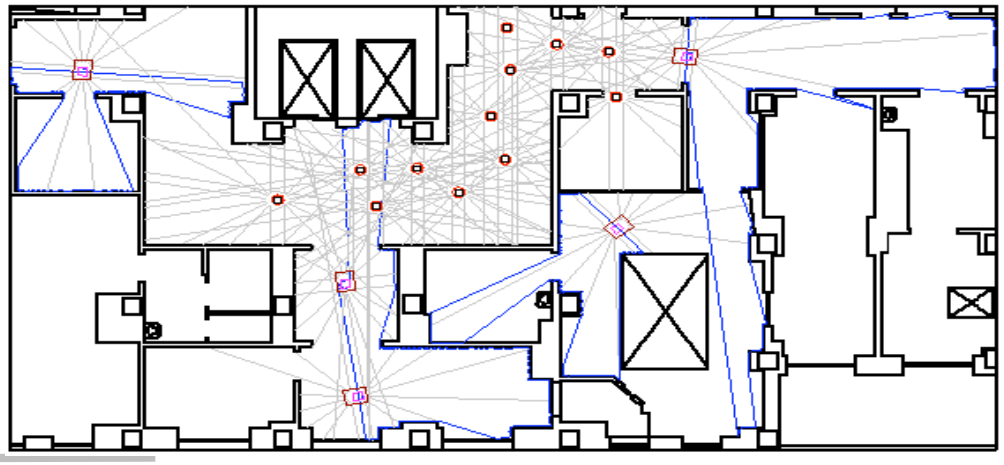
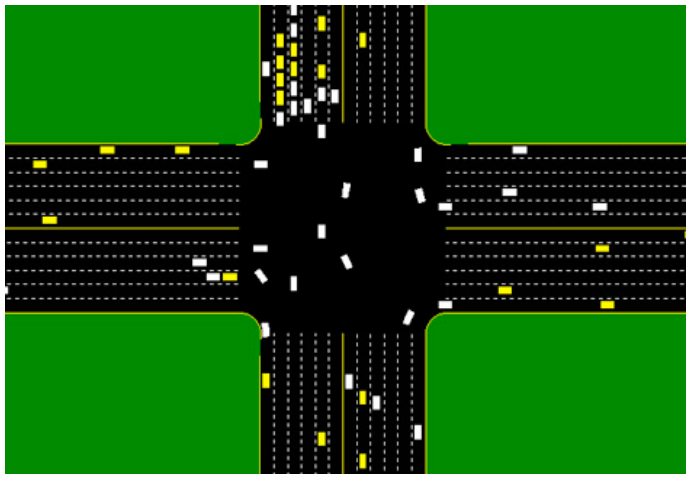
- **Simulation-based:**
  - Network simulators: Omnet++, NS-2
  - Robot simulators: MissionLab, Player/Stage
  - Traffic simulators: SUMO
  - Combination of the above
  - Create your own simulator
- **Implementation-based:**
  - Construct MANET test bed using Gumstix with Wi-Fi-stix (and optionally GPS-stix, robo-stix), moving toys, laptops, you, bikes, etc.







MANET Application I: Vehicular Ad-hoc NETwork (VANET)

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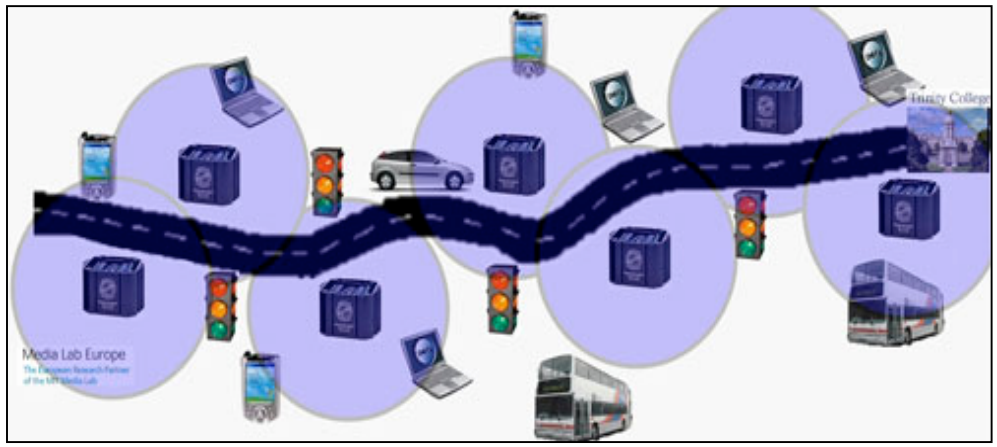
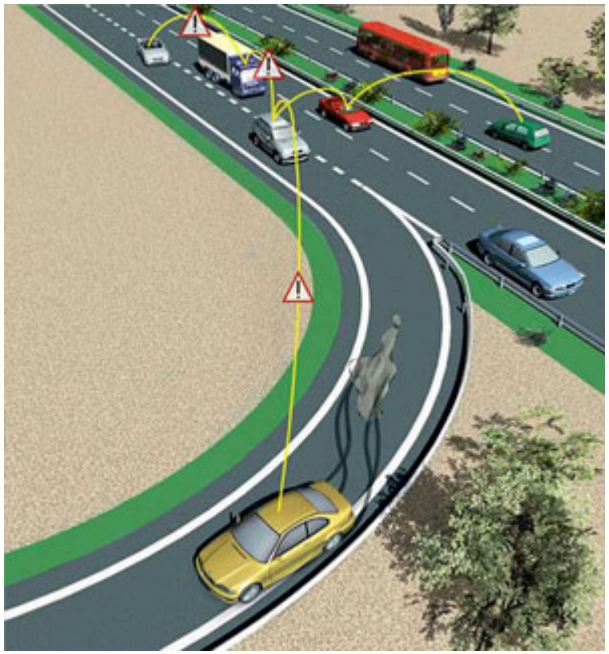
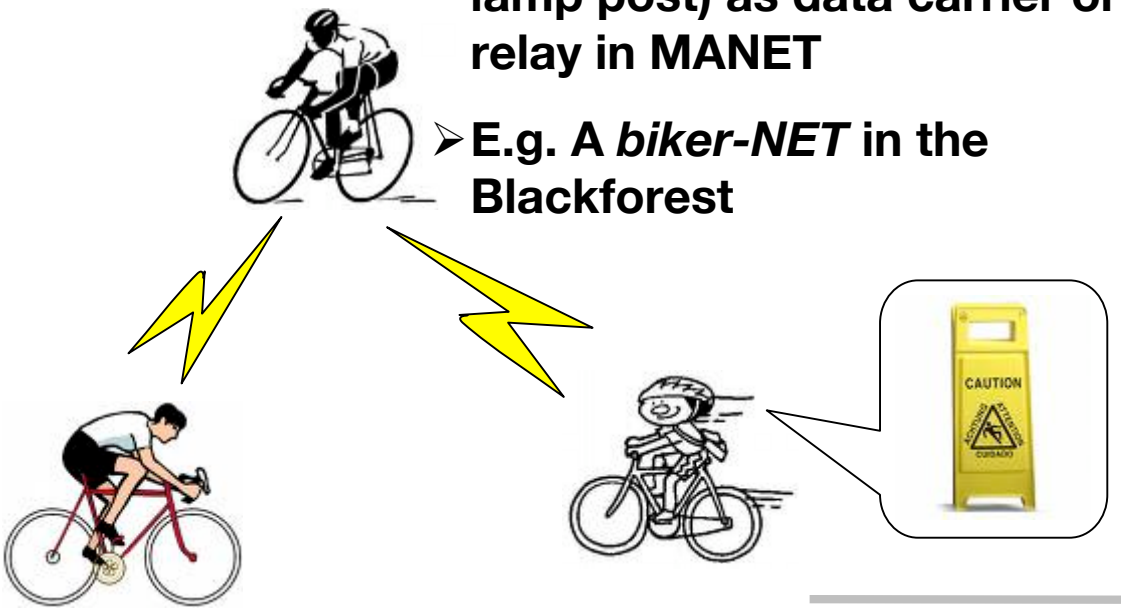




- **Integrated traffic simulator with network simulator**
- **Vehicle mobility-based routing strategy**
- **Make use of public transport (e.g. trams, trains, buses) or traffic facilities (traffic light, lamp post) as data carrier or relay in MANET**
- **E.g. A *biker-NET* in the Blackforest**



MANET Application II: Robot (-assisted) Ad hoc Network

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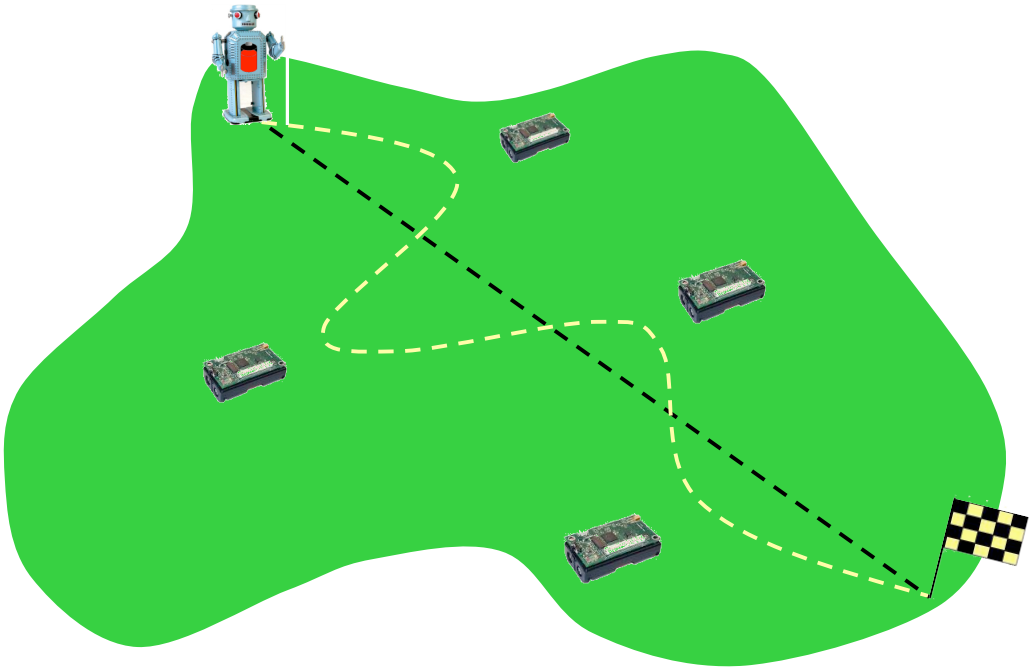

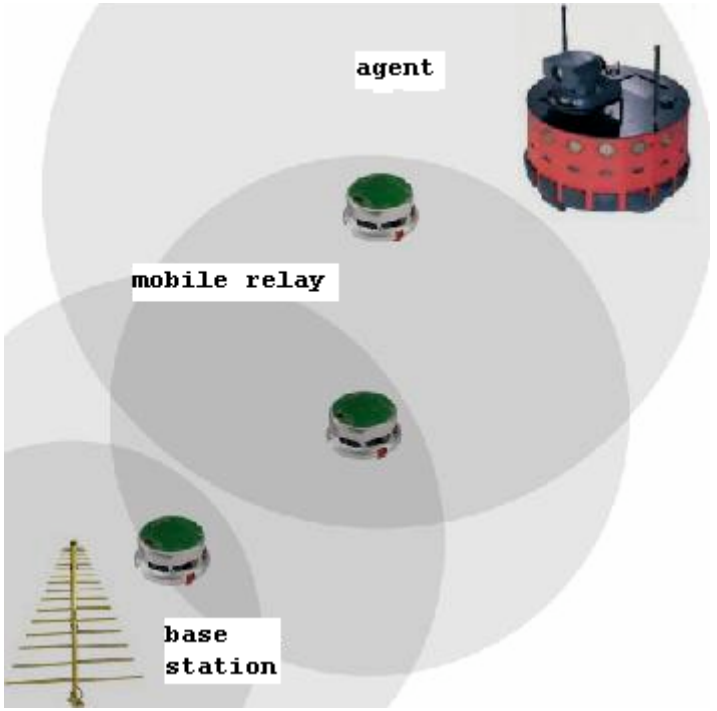

- **Mobile robots moving around wireless sensor network**
  - to collect/send data from/to sensors
  - to aid in localization
- **Mobile robots serve as relay in MANET**
  - How to guarantee connectivity?
  - How to conserve energy?

MANET Application III: Others

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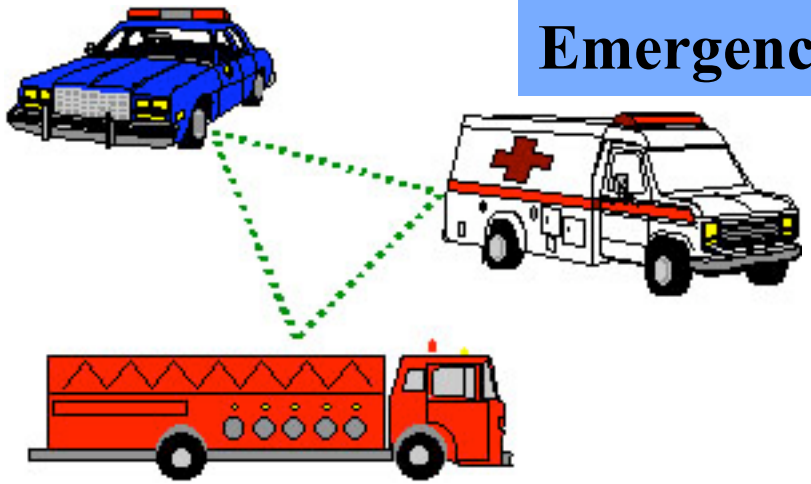
Search & Rescue / Emergency Services



MANET Project Ideas (I)

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Followings are some project ideas based on the example MANET applications above:

- **Realistic mobility analysis**
  - Collect traces of human-beings' movement. Analyze the data and propose a mobility prediction algorithm to improve current MANET protocols.
- **Modeling radio propagation**
  - For indoor or outdoor environment. Examine its impact to data communications in MANET.
- **Energy consumption analysis**
  - Analyze power usage of different components of computing devices, e.g. radio, CPU, sensors, of Gumstix/laptops/sensors. Propose and evaluate the techniques to reduce the cost.

MANET Project Ideas (II)

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- **Route selection algorithm**
  - Develop a route selection algorithm for MANET protocols to determine the best strategy for different network conditions. Evaluate the performance of the proposed algorithm.
- **QoS in MANET routing protocol**
  - Improve any MANET routing protocol to maintain route and guarantee data delivery.
- **Real-time multimedia streaming in MANET**
  - Identify limitation of wireless link and problem in MANET for multimedia streaming. Enhance routing protocol to be robust to network dynamics.
- **Application development**
  - Develop an application for Gumstix, considering the hardware constraints. E.g. Gumstix phone.

Part B:
Wireless Sensor Network

Wireless Sensor Network: Lecture

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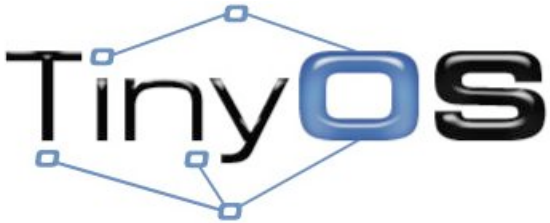
- **There will be introductory lectures about following.**
  - TinyOS
  - B-MAC
  - Mica-2 and ScatterWeb hardware
  - C crash-course *if required*!

MICAz 2.4GHz



Project-1: Architecture

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- **Design and implement software architecture of Sensor Network**

- **Skill Needed:**
  - Software design, Object oriented design, Design Patterns, C, TinyOS

- **Details:**
  - Numerous MAC layer and energy management protocols are designed, with no inter-operatability.
  - They have different assumptions and provide different interfaces.
  - Aim of this project is to develop a software architecture that provide common interfaces for different protocols, facilitating independent development and selecting process of protocols.

Project 2: Energy Conservation using HICA

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- **Implement Hardware Independent Connectivity Algorithm (HICA) to increase network lifetime.**

- **Skills Needed**
  - TinyOS, C and introduction to B-MAC-interface

- **Details**
  - HICA increases network lifetime by putting sleep redundant nodes
  - Nodes are carefully elected to be part of *connected dominating set*.
    - These node assure network connectivity.
  - Rest of the nodes are put to sleep mode for a *fix period of time*
    - After that fix period new set of nodes are re-election to be part of connected dominating set.
  - Aim of this project is to implement HICA on mica-2 and possibly improve its design.

Project 3: Localization using HILA

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- **Implementation of Hardware Independent Localization Algorithm (HILA)**

- **Skills Needed**
  - TinyOS, C, and introduction to B-MAC interface

- **Details**
  - Localization algorithm usually required special hardware:
    - Example: GPS, light omitting/reflecting devices, special transceiver etc
  - HILA required no hardware support
  - It uses two-hop neighbors information to estimate relative nodes locations
  - This project aim is to implement HICA on real sensor networks and improve its design.

Project 4: Sensing Robots

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- **Build sensing robots using off the shelf hardware**

- **Skills Needed**
  - Hardware architecture, TinyOS, C

- **Details**
  - Mobility increase sensors coverage and connectivity. Sensor network available in market have two disadvantage
    - Too expensive
      - ≈150$ per sensor mote
    - Usually no built-in mobility mechanism
  - Aim of this project is to design sensing robots using either solar energy or very energy efficient.
    - Robots should be able to software programmable and support TinyOS

Project 5: SOA Application (Open Project)

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- **Suggest, design and implement a state of art application**

- **Skills**
  - TinyOS, C and others

- **Details**
  - Application should be useful in real life.
    - May be some commercial value!

  - Rest of details you decide.

Auf Wiedersehen!
Good bye!

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20.07.2007