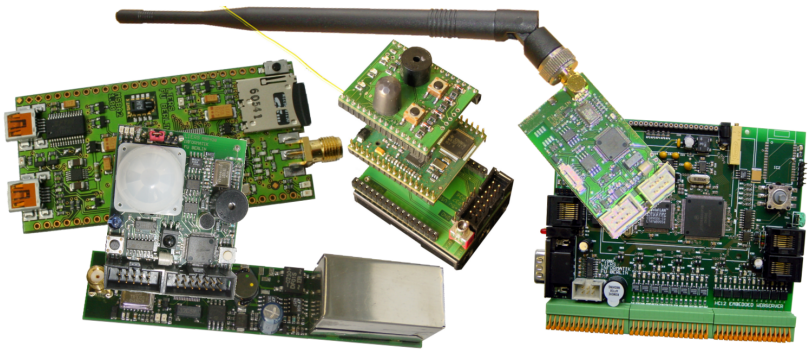


Seminar Technische Informatik WS0910

Mobile Ad-hoc Networks

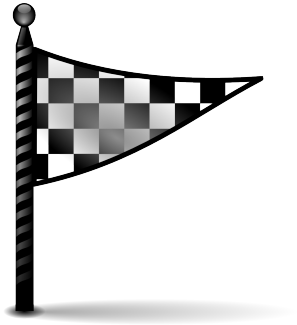
Bastian Blywis

Department of Mathematics and Computer Science
Institute of Computer Science
October 16, 2009

Outline

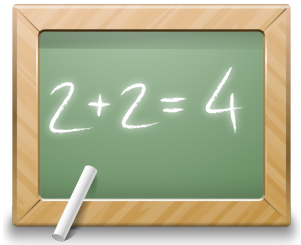
Seminar Goals

- Seminar for Diploma and Master students
- Introduction of advanced topics based on telematics and mobile communications
- Literature research, related work
- Technical writing
- Critical review and discussion of publications
- Learning and practicing giving a talk
- “Schein” with 4 ECTS-Credits
- Please send notification when not attending seminar



Teaching Methods

- Seminar with weekly meetings (instead of a “block-seminar”)
- 1 to 2 talks per event, 25-30min, see website for schedule
- Discussion after talks
  - Active participation of all students
  - Selected students get task to prepare questions
- 85% attendance mandatory, including first two meetings
- Report submission in the end of lecture period, 7-8 pages, IEEE Transactions layout
- Talk weights 1/3 of final grade and report 2/3



Teaching Methods

Seminar Manager

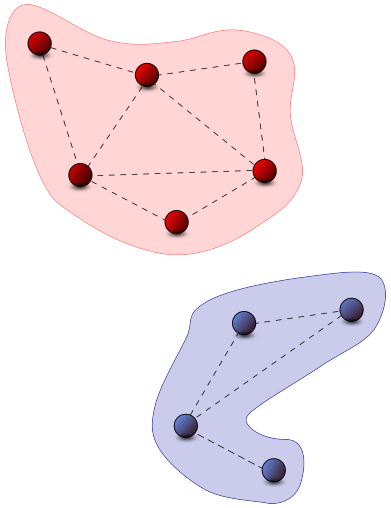
- Hosts meetings
- Reviews slides and reports: template, formatting, readability
- Enforces deadlines
- Can exclude students from seminar
- Mediates between students and supervisors
- Does not care about report and talk content

Supervisors

- Hand out topics
- Provide primary literature
- Supervise content of talk and report
- Grade students
  - Weight 2/3 in grading their own topics
  - Weight 1/3 together in grading other topics
- Can not extend deadlines or modify general seminar rules

Mobile Ad-hoc Networks

- Usage of wireless technologies to achieve mobility
- Roaming hosts
- Shared medium, half-duplex communication
- Links can be unidirectional and asymmetric
- Lower bandwidth
- Higher delays
- Have to consider routing to mobile hosts
- Often time node positions are desired
- Differ from wireless mesh networks (WMNs) and wireless sensor networks (WSNs)



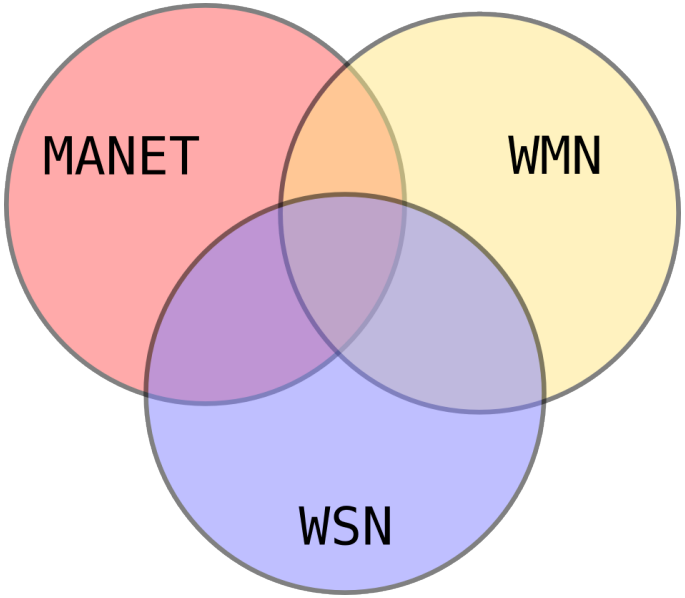


Figure: Wireless Networks

Bastian Blywis

- Teaching assistent / research staff
- DES-Testbed maintainer
- Focus on routing (and localization) in WMNs

An Introduction to Mobile Ad-hoc Networks

Mobile Ad-Hoc Networks (MANETs) are the topic of this term. It is the task of this topic to give an introduction to MANETs. Every student shall get an understanding of the basic properties of these kind of networks. The common problems have to be discussed and the differences to “traditional” network architectures elaborated. Particular topics of interest are routing, media access, and localization. The Neighborhood Discovery Protocol (NHDP) is one attempt to standardize the task of discovering all nodes in the neighborhood in a mobile ad hoc network. The protocol uses a local exchange of HELLO messages in order that each router can determine the presence of, and connectivity to, its 1-hop and symmetric 2-hop neighbors. Messages are defined and sent in packets according to the specification in RFC 5444. You have highlight the differences to wireless mesh and wireless sensor networks and their application scenarios. Give an overview of the standardization concepts. This will be the opening talk of the seminar.

Bastian Blywis

Anchor-Free Distributed Localization

Anchor-Free Distributed Localization (AFL) is an algorithm to embed mobile nodes in a coordinate system. The localization procedure is divided in two phases: First of all, an initial coordinate system is constructed in which all nodes are embedded. In the second phase every node measures the distance to its neighbors and propagates its current position in the coordinate system. The nodes are assumed to be connected by springs that push and pull them in position. The force of a spring is determined by the difference between measured distance and distance of the nodes regarding the coordinate system. In the end the whole system shall end in a global force minimum. As interesting the idea of AFL is, it has some shortcomings for the application in MANETs. It is the task of this topic to research and discuss the issues and proposed solutions.

Bastian Blywis

Quality of Service in Mixed Wireless Local Area Networks
IEEE 802.11 supports two modes of operation. The infrastructure mode with access points and mobile stations and the ad-hoc mode where every node functions as router. Providing Quality of Service (QoS) in infrastructure networks has been introduced by the IEEE 802.11e standard yet providing QoS for nodes out of reach of access point is a challenging issue. These node use multi-hop communication to reach an access point in a MANET-like fashion. Identifying idle nodes to use as relays is only one of the challenges. It is the task of this topic to research and discuss the approaches to provide QoS in scenarios where IEEE 802.11 infrastructure networks have to be extended by MANET-like means.

Bastian Blywis

Media Independent Handover

Mobility if one of the essential features of future networking. Due to the property of limited radio ranges the mobile devices have to associate with different access points over time. This handover can be done between access points of the same kind or even using different technologies. The *Media-Independent-Handover* (MIH) standard has been published by the IEEE 802.21 working group in January 2009. Give an overview to the standard and its applicability in MANETs and discuss the "always-best-connected" (ABC) concept.

Felix Juraschek

- Research staff member in OPNEX project
- DES-Testbed maintainer
- Focus on testbed management, experimentation, and channel assignment

Distributed Channel Assignment

Wireless mesh networks based on IEEE 802.11 recently gain more attention, because of an increase of commercial deployments that provide Internet access for city areas. This wireless technology features several non-overlapping channels. The usage of these channels promise a better network performance with higher throughput and less packet retransmission because of collisions or network congestion. This seminar topic will focus on distributed channel assignment, in which nodes measure local channel statistics and exchange these data with near-by nodes to calculate the channel assignment. In contrast to centralized approaches, in which usually a designated node (gateway) calculates the network-wide channel assignment, the calculation takes place on every node. Therefore, typical challenges such as the ripple effect and channel oscillation must be taken into account and solved.

Norman Dziengel

- Research staff member in project FeuerWhere
- Soon member in AVS-Extreme project
- Focus on distributed Eventdetection in WSNs

Data Quality Rating while Sensor Fusion in Wireless Sensor Networks
Wireless Sensor Networks (WSNs) need to rate the quality of collected data within the network. To fuse sensor data we know different approaches like statistics, Bayesian inference, Fuzzy Logic, neuronal networks and the Dempster-Shafer theory. But which of these approaches is best for Wireless Sensor Networks? To answer the main question try to answer the following questions first: Are these approaches in real systems useful as a sensornode is strictly limited in its computational power and energy resources? Which of these approaches rates the quality of data and is able to give us a real improvement of our simple data stream, cluster based data or event based data. Classify the given fusion ideas and finally evaluate the systems while thinking of the applicability in WSNs.

Norman Dziengel

Improvement of IMU by ZUPT

In order to track a person in an infrastructureless areas we need an intertial measurement unit (IMU) on a sensornode. The components of an are an 3D accelerometer and 3D gyroscopes, sometimes an additional compass is available. Especially during measuring acceleration values and integration these values to gain velocity and further to gain a position by combining all measurements, some problems arise: The positioning information is not trustworthy over time. To solve this problem it is possible to correct this positioning error of the calculated speed directly when the person is not moving with an Zero Velocity Update (ZUPT). Understand and investigate this approach and find out how applicable this approach is in reality. Find papers making use of ZUPT and compare them in order evaluate the ZUPT. Find a concluding message. Are there other approaches like ZUPT around?

Marcel Kyas

- Junior-Professor Embedded Systems
- Former research assistant and Phd at Christian-Albrechts-Universität zu Kiel
- Focus on formal modelling and analysis of embedded and distributed systems

Modeling Radio Networks

Most modeling frameworks for the study of probabilistic distributed algorithms in synchronous radio networks are based on discrete event simulation. These rely on informal descriptions of the channel behaviour and comparing results is difficult because of definition subtleties. They also lack generality, because simulation runs are random walks that are cut of after some time. Here, a framework has been developed, that attempts to rectify these issues by providing: (1) a method to precisely describe a radio channel as a probabilistic automaton; (2) a mathematical notion of implementing one channel using antoher channel; (3) a mathematical definition of a problem and solving a problem; (4) a pair of composition results that simplify the tasks of proving properties about channel implementations. The goal of the authors is to produce a model streamlined for the needs of the radio network algorithms community. But is the described method a good step into the right direction?

Marcel Kyas

Does Clock Precision Influence ZigBee's Energy Consumptions?

Wireless embedded sensor networks are predicted to provide attractive application possibilities in industry as well as at home. IEEE 802.15.4 and ZigBee are proposed as standards for such networks with a particular focus on pairing reliability with energy efficiency, while sacrificing high data rates. IEEE 802.15.4 is configurable in many aspects, including the synchronicity of the communication, and the periodicity in which battery-powered sensors need to wake up to communicate. The formal implications of these options are not well understood yet. A formal behavioral model for the energy implications of these options has been developed. The model is modularly specified using the language MODEST, which has an operational semantics mapping on stochastic timed automata. The latter are simulated using a variant of discrete-event simulation implemented in the tool MÖBIUS. Estimated energy consumptions of a number of possible communication scenarios are obtained, in accordance with the standards, and conclusions about the energy-optimal configuration of such networks have been derived. As a specific fine point, the effects of drifting clocks on the energy behavior of various application scenarios are investigated.

Georg Wittenburg

- Teaching assistent / research staff
- Pushed Fence Monitoring / AVS-Extreme project
- Focus on service placement in WSNs

Current Approaches to Service Placement in Ad hoc Networks
The goal of service placement is to select which node in a network is most suitable for hosting a service that responds to queries from other nodes. Optimally placing services reduces network traffic and improves connectivity between clients and servers. Practical approaches to service placement commonly employ heuristics based on information gathered from nodes in the neighborhood of the current host. Some heuristics are tailored to the specific application, e.g. coverage, topology or group mobility, and are thus not applicable to general-purpose service placement. The goal of this project is to summarize recent approaches to service placement in MANETs, and to evaluate in detail their strengths and weaknesses.

Matthias Wählisch

- Research staff member
- Co-founder of link-lab
- Focus on design & analysis of Internet protocols, mobile Internet, multicast, IPv6, P2P

Structured Autonomous Address Assignment
MANETs are infrastructure-less networks that should be deployed without any pre-existing configuration. Nevertheless, nodes require an address to implement selected data distribution. The simplest mechanism is to generate a random address at each node, e.g., by hashing. A purely randomized address creation at each node may not only introduce address collisions, but may cause routing overhead as addresses cannot be aggregated. The aim of this talk is to present the problem of structured autonomous address assignment and current classes of solutions.

Matthias Wählisch

Connecting MANETs: Inter-domain Routing
The objective of inter-domain routing is the interconnection of heterogeneous networks. Neighboring MANETs (a) may use different (intra-domain) routing protocols for distributing path information, and (b) may represent separate administrative domains. The data exchange between such different 'islands' is of great interest to extend the scope of each single domain. In contrast to the Internet, MANETs possess a highly volatile network topology. Additionally, they introduce a much higher diversity of intra-domain protocols. The aim of this talk is to exploit the inter-domain routing problem for MANETs and to present current solutions.

Matthias Wählisch

Multicast Communication in MANETs

Multicast enables nodes to efficiently distribute data to a group of receivers. This group communication scheme is quite interesting for MANETs. It promises the reduction of (energy consuming) packet transmissions on the one hand, and it is self-configuring on the other hand. Traditional Multicast approaches within the Internet are tree-based. Tree-based protocols are not obviously appropriate for volatile topologies as inner vertices that disappear may partition the delivery structure. The aim of this talk is to present the problem of multicast routing in MANETs and current classes of solutions.

Katinka Wolter

- Research staff member, research assistant
- Recently changed from Humboldt University of Berlin
- Focus on dependability and fault-tolerance of service-based systems, Internet performance and dependability, stochastic models, . . .

Fault models for communication infrastructures

When analysing the performance, dependability or connectivity of MANETs in an abstract way a realistic fault model is necessary. The commonly applied fault models for communication networks, the Gilbert-Elliot models, are rather simple, but still quite general and powerful in their flexible choice of parameters. Starting from the paper by Hohlfedt et al fault models shall be presented and their appropriateness for MANETs should be addressed.

Katinka Wolter

Modelling cellular networks using PEPA

Stochastic models of cellular networks are valuable tools to derive and study properties of such systems. PEPA is a tool that allows for the specification and analysis of stochastic process algebra models. The papers by Fourneau, Kloul and Valois as well as by Razafindralambo and Valois present such models and their analysis and their analysis to study performance problems in MANETs.

Katinka Wolter

Quality of Service in IEEE 802.11

To guarantee, manage or optimise QoS in wireless networks is challenging as the transmission quality in these networks is determined by many factors. Several proposals for improving QoS in wireless networks have been published during the last decade. Among those still known are blackburst, distributed fair scheduling and the standard 802.11e. Many publications exist that investigate their potential.

Schedule

Week	Date	Slot	Name	Supervisor	Topic
1	16.10.09	1+2	Blywis	none	Introduction + Topics
2	23.10.09	1+2	Blywis	none	Related work research, plagiarism, writing a seminar report, creating a presentation, giving a talk
3	30.10.09	1 2	??? ???	??? ???	??? ???
4	06.11.09	1 2	??? ???	??? ???	??? ???
...					

Schedule

1. Choose three topics in declining order until 19.10.2008; send email to seminar manager
2. You will receive your topic via email until 21.10.2008 including the date of the talk
3. Meet with the topic supervisor immediately to get primary literatur and discuss content of talk
4. Show slides to supervisor
5. Send slides as PDF to seminar manager per email Thursday prior to talk
6. Discuss content of report with supervisor
7. Meet several times with your supervisor and show current state of report
8. Submit report as PDF to seminar manager until 12.02.2009
9. You will additionally receive paper(-s) to read and prepare questions one week before the particular talk.