

IWWAN 2005

International Workshop on Wireless Ad Hoc Networks

London

23-26 May 2005

Centre for Telecommunications Research
King's College London

Proceedings

Tutorial Schedule

Workshop Schedule

Paper Abstracts



Welcome to IWWAN 2005!

On behalf of the organising committee of the International Workshop on Wireless Ad-hoc Networks (IWWAN) 2005, we would like to welcome you to London.

IWWAN2005 is the second in the annual series of workshops on wireless ad-hoc networks. IWWAN 2005 will highlight the growing applications and power of ad-hoc networks in achieving ubiquitous, pervasive communications in future systems. The workshop will focus on the increasing importance of ad-hoc architectures in next generation networks including interoperation with fixed and cellular networks. The range of topics presented at IWWAN is diverse within this field, covering existing and future networks, information theoretic analysis and field trials. The range of topics shows the growing importance of this area of research.

Last year, IWWAN has drawn submissions from countries across Europe, the USA, Japan, China, the Middle East and Australia, making it a truly international event. The plenary speakers for IWWAN include experts from industry, academia and EU and will present future visions of ad-hoc networks and the practical market realities driving these visions.

Given the more intimate nature of a workshop, there will be ample opportunity to meet and discuss with the Plenary and other speakers in more detail. We encourage you to do this, to take advantage of the networking opportunities, and enjoy the beautiful long, late evenings of London's emerging summer.

We wish you an enjoyable and stimulating workshop!

Prof. Hamid Aghvami

IWWAN General Chairman
Director, Centre for Telecommunications Research

Dr. Ian Oppermann

IWWAN Technical Co-Chair
Director, Centre for Wireless Communications

Dr. Mischa Dohler

IWWAN Technical Co-Chair
Lecturer, Centre for Telecommunications Research

In Short

Monday 23 May 2005

09:00-12:30 Tutorial I: Ad Hoc Capacity Limits (Rohit Nabar & Helmut Bolcskei)
13:30-18:00 Tutorial II: Sensor & Actor Networks (Ian F Akyildiz)

Tuesday 24 May 2005

08:50-09:00 Welcome & Workshop Opening (Hamid Aghvami)
09:00-09:30 Key Note Speech I (Petri Mähönen)
09:30-10:00 Key Note Speech II (Adam Wolisz)
10:30-18:00 Technical Presentations (abstracts below)
20:00-23:00 Social Program (see separate leaflet)

Wednesday 25 May 2005

08:50-09:00 Wiley-Best Paper Award (Mischa Dohler)
09:00-09:30 Key Note Speech I (Kimmo Raatikainen)
09:30-10:00 Key Note Speech II (Sverrir Olafsson)
10:30-18:00 Technical Presentations (abstracts below)

Thursday 26 May 2005

09:00-12:30 EU Cluster Presentations (schedule below)
13:30-16:50 Technical Presentations (abstracts below)
16:50-17:00 Workshop Closure (Hamid Aghvami)

Note

Rooms: The tutorials, half of the technical sessions take place in the auditorium B.5 (except for the Tuesday 4-6pm session, which will take place in G.79); the other half of the technical sessions and the EU cluster day take place in the lecture theatre G.73.

Coffee & Lunch: Tea/coffee/biscuits are served in the 1st floor restaurant during the 30min breaks in the morning and afternoon; lunch is also served there.

Wireless LAN: A WLAN network is available but will be switched off during the technical sessions. The access point is called IWWAN05; the access key is: 8F94D39328; the laptops need to be configured to use DHCP; and it's open key.

Tutorials Monday, 23 May 2005	Workshop Day 1 Tuesday, 24 May 2005	Workshop Day 2 Wednesday, 25 May 2005	Workshop Day 3 Thursday, 26 May 2005
09:00 B.5 Tutorial I	09:00 B.5 Opening: Hamid A. Key-Note #1: Petri M. Key-Note #2: Adam W.	09:00 B.5 Best Paper: Mischa D. Key-Note #1: Kimmo R. Key-Note #2: Sverrir O.	09:00 G.73 Session I EU Cluster Day 105, 99, 100
10:30 Fundamental Capacity Limits of Ad Hoc Networks	10:00 B.5 Sensor Networks	10:00 B.5 Session I-a MAC Part II	10:30 G.73 Session II EU Cluster Day 101, 106, 107
11:00 Rohit Nabar, Imperial Helmut Bolcskei, ETH	10:30 B.5 Session I-a Routing Part I	10:30 B.5 Session I-b Security & Service	
12:30 B.5 Tutorial II	12:30 B.5 Session I-b Network Capacity	12:30 B.5 Session I-a Mobile VCE	
13:30 Research Challenges in Wireless Sensor and Actor Networks	13:30 G.73 Session II-b Routing Part II	13:30 G.73 Session II-b Routing Part III	13:30 G.73 Session III Hardware + Other 4, 22, 32, 25, 38
15:30 Ilan F. Akyildiz, Georgia Tech	15:30 G.79 Session III-a MAC Part I	15:30 B.5 Session III-a Location Positioning	
16:00	16:00 G.73 Session III-b Ad Hoc Networks	16:00 G.73 Session III-b Ad Hoc & Sensor	16:00 G.73 Session IV Other + Closing 72, 63
18:00	18:00	18:00	18:00

Workshop Presentations

Tuesday 24 May 2005 – Overview

Opening + Key Note Speeches Auditorium B.5						
Time	Presenter					
08:50-09:00	IWWAN Opening, Prof Hamid Aghvami, KCL					
09:00-09:30	Key Note Speech, Dr Petri Mähönen, RWTH Aachen					
09:30-10:00	Key Note Speech, Prof Adam Wolisz, TU Berlin					
Sensor Networks Auditorium B.5				Routing – Part I Lecture Theatre G.73		
Time	ID	Title (abstracts p.7)	Presenter	ID	Title (abstracts p.11)	Presenter
10:30-10:54	48	On the Probability Distribution of the Minimal Number of Hops Between any Pair of ...	Sayandev Mukherjee	29	A Novel Bus Lane Scheme for QoS Routing in Mobile Ad Hoc Networks	Lin Xiao
10:54-11:18	21	On the Probability Bound for Uncovered Areas in Sensor Networks	Wei Yen	49	The capacity and packets delivery of MANET On Road: MANETOR	Jiang Hao
11:18-11:42	30	A Hierarchical Model for a Sensor Network	John Orriss	69	Physical Layer-Constrained Routing in Ad-hoc Wireless Networks: A Modified ...	Gianluigi Ferrari
11:42-12:06	90	Self-organizing sensor networks with information propagation based on mutual coupling ... *	Sergio Barbarossa	67	Multivariate Analysis of the Cross-Layer Interaction in Wireless Networks ...	Jean-Michel Dricot
12:06-12:30	83	Power and Energy Consumption for Multi-Hop Protocols: A Sensor ... *	Katja Schwiager	78	A Cross-Layer Stability-based On-Demand Routing Protocol for Mobile ...	Lamia Romdhani
Network Capacity, Coding & Detection Auditorium B.5				Routing – Part II Lecture Theatre G.73		
Time	ID	Title (abstracts p.8)	Presenter	ID	Title (abstracts p.13)	Presenter
13:30-13:54	81	Network Coding for Wireless Applications: A Brief Tutorial *	Muriel Medard	85	Are Ad-hoc Networks Able to Substitute Cellular Networks? ... *	Mesut Gunes
13:54-14:18	87	On the relation between Source and Channel Coding and Sensor Network Deployment *	Stavros Toumpis	59	Inherent Robustness of Reactive Routing Protocols against Selfish Attacks	Asad Amir Pirzada
14:18-14:42	80	On coded cooperative schemes: codes, choice of partners ...*	Andrej Stefanov	41	Flooding Techniques for Resource Discovery on High Mobility MANETs	Luis Bernardo
14:42-15:06	70	A Cross-Layer Approach to Decentralized Detection in Sensor Networks with ...	Gianluigi Ferrari	56	Simulation vs. Emulation: Evaluating Mobile Ad Hoc Network Routing Protocols	Furqan Haq
15:06-15:30	53	Decentralized Detection In Binary Dense Sensor Networks: To Transmit Or Not To ...	Antonio Artes	20	Statistical Analysis of Traffic Measurements in a Disaster Area Scenario ...	Nils Aschenbrück
MAC – Part I Lecture Theatre G.79				Ad Hoc Networks Lecture Theatre G.73		
Time	ID	Title (abstracts p.10)	Presenter	ID	Title (abstracts p.14)	Presenter
16:00-16:24	35	Performance Evaluation of a Stability-Oriented Clustering Protocol for Ad Hoc ...	Vincenzo Cacace	34	Session Initiation Protocol Deployment in Ad-Hoc Networks: a Decentralized ...	Simone Leggio
16:24-16:48	82	Modelling for Wireless Sensor Network Protocol Design *	Roberto Verdone	26	Integration of Heterogeneous Ad hoc Networks with the Internet	Nico Bayer
16:48-17:12	54	A MAC Protocol for Wireless Ad Hoc Networks with Power Control	Sylwia v. Heuvel	92	Towards End-to-End QoS in Ad Hoc Networks connected to Fixed ... *	David Remondo
17:12-17:36	74	A New Approach for the Throughput Analysis of IEEE 802.11 in Networks with ...	Athanasia Tsertou	33	Gateway Discovery Algorithm for Ad-Hoc Networks Using HELLO ...	Matthias Rosen-schon
17:36-18:00	7	Performance Evaluation of a Wireless LAN Dynamic Multi Channel Allocation Strategy	Chiara Taddia	40	Distributed Gateways in Multi-Plane Ad hoc Networks	Sutthisak Inthawadee

Workshop Presentations

Wednesday 25 May 2005 – Overview

Best Papers + Key Note Speeches Auditorium B.5						
Time		Presenter				
08:50-09:00		Wiley Best Paper Award, Dr Mischa Dohler, KCL				
09:00-09:30		Key Note Speech, Prof K. Raatikainen, Univ Helsinki				
09:30-10:00		Key Note Speech, Dr Sverrir Olafsson, BT				
MAC – Part II Auditorium B.5				Security & Service Lecture Theatre G.73		
Time	ID	Title (abstracts p.16)	Presenter	ID	Title (abstracts p.20)	Presenter
10:30-10:54	88	Towards High Speed Wireless Personal Area Network – Efficiency Analysis of ... *	Yunpeng Zang	58	Circumventing Sinkholes and Wormholes in Wireless Sensor Networks	Asad Amir Pirzada
10:54-11:18	18	Design and Implementation of a Low Cost Energy Efficient IEEE 802.11-based ...	George Papadopoulos	36	Secure Communication over Heterogeneous Networks with Clustered Mobile Ad ...	Gregory S. Yovanof
11:18-11:42	89	An Application-Tailored MAC Protocol for Wireless Sensor Networks *	Supriyo Chatterjea	39	Applying Clustering to a Framework for Generating Trust	Javesh Boodnah
11:42-12:06	77	Towards a Fully Distributed QoS-Aware MAC Protocol for Multihop Wireless Networks	Fethi Filali	12	Friendly Authentication and Communication Experience (FACE) for Ubiquitous ...	Benjamin Halpert
12:06-12:30	46	A Statistical Approach to detect NAV Attack at MAC layer	K. Sugantha	9	A Presence-Enabled Mobile Service System For Integrating Mobile ...	Xueshan Shan
Mobile VCE Auditorium B.5				Routing – Part III Lecture Theatre G.73		
Time	ID	Title (abstracts p.17)	Presenter	ID	Title (abstracts p.21)	Presenter
13:30-13:54	94	Experimental Capacity Analysis for Virtual Antenna Arrays in Personal and Body Area ...	Dries Neiryneck	75	A Simplified Model for Neighbor Discovery in Bluetooth Networks	Alessandro Leonardi
13:54-14:18	93	Performance Evaluation in Time-Synchronized Multi-Piconet Bluetooth ...	Imran Ashraf	104	On the Scalability of Internet Gateway Discovery Algorithms for Ad hoc ...	Mona Ghassemian
14:18-14:42	97	A Novel Piconet Coordinator Selection Method for IEEE802.15.3-Based WPAN	Yuefeng Zhou	64	Routing Strategy For Bluetooth Scatternet	Christophe Lafon
14:42-15:06	96	A High Survivability Route Selection Method in Wireless Ad Hoc Networks	Yuefeng Zhou	8	Novel Multicast Protocol For Mobile IP Networks	Yewen Cao
15:06-15:30	98	Quality-of-Service (QoS) Framework for Multi-rate Wireless Ad-hoc Network	Edwin Tan	1	A comparison based overview of destination distance sequence vector ...	Humayun Bakht
Location Positioning Auditorium B.5				Ad Hoc & Sensor Networks Lecture Theatre G.73		
Time	ID	Title (abstracts p.19)	Presenter	ID	Title (abstracts p.23)	Presenter
16:00-16:24	23	Knowledge Base Assisted Mapping for an Impulse Radio Indoor Location-sensing ...	Wenyu Guo	50	Retransmission Scheme with Code Sense for VSF/DS-UWB Ad-hoc Network	Wataru Horie
16:24-16:48	24	Enhanced-TDOA Measurement for Ad Hoc Networks Positioning	Michael Bocquet	60	Influence of directional antennas in STDMA ad hoc network schedule creation	Imanol Martinez
16:48-17:12	37	Algorithm for Nodes Localization in Wireless Ad-Hoc Networks Based on ...	Jean-Philippe Montillet	61	Evaluation of Cooperative Task Computing for Energy Aware Wireless Networks	Anders Brødlos Olsen
17:12-17:36	65	In-building location using Bluetooth	Miguel Rodriguez	73	Performance Evaluation of TCP in an Integrated WPAN and WLAN ...	Isameldin M. Suliman
17:36-18:00	71	A Statistical Modelling Based Location Determination Method Using Fusion ...	Luca Macchi	68	BLUESIC: context-aware information system for tourism, based on ...	Juan Pece

EU Cluster & Workshop Presentations

Thursday 26 May 2005 – Overview

EU Cluster Day Lecture Theatre G.73			
Time	ID	Title (abstracts p.25)	Presenter
09:00-09:30	105	The BETSY project on timeliness and energy aspects of wireless video streaming	Peter van der Stok
09:30-10:00	99	Using TinyOS Components for the Design of an Adaptive Ubiquitous System	Omer Sinan Kaya
10:00-10:30	100	Wireless Sensor Networks and Beyond: A Case Study on Transport and Logistics	Mark Bijl

EU Cluster Day Lecture Theatre G.73			
Time	ID	Title (abstracts p.26)	Presenter
11:00-11:30	101	Link and system-level analysis of structured multi-hop networks	Mike Hart
11:30-12:00	106	A simple architecture for a Wireless DVI UWB radio link	Domenico Porcino
12:00-12:30	107	Overview of Ultra-wideband (UWB) Regulatory Processes	Domenico Porcino

Hardware + Other Lecture Theatre G.73			
Time	ID	Title (abstracts p.26)	Presenter
13:30-13:54	4	Reliability Enhancement Strategies for Wireless Communication System	Stefanos Skoulaxinos
13:54-14:18	22	Wireless Temperature Sensor Using Bluetooth	Qingshan Shan
14:18-14:42	32	Transfer Sensor Data on a motor vehicle with GPRS Modem and CAN bus	Dan Feng
14:42-15:06	25	Persistent Bidirectional Peer Traffic in Fix-network augmented Broadband ...	Robert Hsieh
15:06-15:30	38	Channel Model at 868 MHz for Wireless Sensor Networks in Outdoor Scenarios	Victoria Bueno-Delgado

Other Lecture Theatre G.73			
Time	ID	Title (abstracts p.28)	Presenter
16:00-16:24	72	Insight Analysis into WI-MAX Standard and its trends	Hernan Córdova
16:24-16:48	63	Relative Proximity Estimation in a Confined Small-Scale Environment	See-Kiong Ng

IWWAN Closure Lecture Theatre G.73	
Time	Presenter
16:50-17:00	Hamid Aghvami

Tutorials

Monday 23 May 2005 – Abstracts

Tutorial I – morning

Title: **Fundamental Capacity Limits of Ad Hoc Networks**

Presenters: Dr Rohit Nabar, Imperial College
Dr Helmut Bolcskei, ETH Zurich

Room: Auditorium B.5

Time: 09:00 – 12:30

Duration: 3h

Breaks: Coffee (10:30-11:00) & Lunch (after tutorial)

TOC: 1. Basic building blocks of wireless networks – multiple access, broadcast, relay channels
2. Capacity of multiple access channels (MAC) and broadcast channels (BC), duality between MAC and BC
3. Capacity of relay channels
4. Cooperative diversity and space-time signalling for relay channels
5. Basics of network information theory
6. Capacity scaling in large AWGN networks
7. Capacity scaling in large wireless (fading) networks

Tutorial II – afternoon

Title: **Research Challenges in Wireless Sensor and Actor Networks**

Presenter: Prof Ian F Akyildiz, Georgia Tech

Room: Auditorium B.5

Time: 13:30 – 18:00

Duration: 4h

Breaks: Coffee (15:30-16:00) & Lunch (before tutorial)

Abstract: Wireless Sensor and Actor Networks (WSANs) refer to a group of sensors and actors (actuators) linked by wireless medium to perform distributed sensing and actuation tasks. The aim of this talk is to give an overview about research challenges in WSANs. First, the sensing and actuation tasks are explained and general differences between classical sensor and WSANs are pointed out. Further, the physical architecture of WSANs is presented and research challenges and requirements due to the presence of actuators are explored. In particular, the challenges for the design and development of sensor/actuator network communication protocols are presented.

Workshop Presentations

Tuesday 24 May 2005 – Abstracts

Tuesday, 10:30 – 12:30, B.5: Session I-a [Sensor Networks]

- ID: 48
Title: **On the Probability Distribution of the Minimal Number of Hops Between any Pair of Nodes in a Bounded Wireless Ad-Hoc Network Subject to Fading**
Authors: Sayandev Mukherjee, Dan Avidor
Affiliation: Wireless Research Laboratory, Lucent Technologies – Bell Laboratories, New Jersey, USA
Email: {sayan,avidor}@lucent.com
Abstract: We investigate an ad hoc network where node locations are distributed according to a homogeneous Poisson process with intensity λ_n . We assume that all the nodes are equipped with an identical wireless transceiver capable of operating satisfactorily up to a certain maximal link loss. Our link model depends on the length of the link and on random lognormal fading. Each node functions as a source and destination of data packets, and may also serve as a repeater to transport packets over multi-hop routes as determined by the network router. We focus on the probability distribution of the minimum number of hops between a source and a destination node known to be at distance D from the source. When the distribution of source-to-destination distances is known, the distribution of the minimal number of hops between any arbitrary pair of nodes can also be found. Many variations of this same problem have been studied in the literature. However, as far as we know, no exact closed form analytic results for fading environments have been presented before.
- ID: 21
Title: **On the Probability Bound for Uncovered Areas in Sensor Networks**
Authors: Wei Yen
Affiliation: Department of Computer Science and Engineering, Tatung University
Email: wyen@ttu.edu.tw
Abstract: In a sensor network, a large number of sensors are deployed in the sensing field. Although there are guidelines describing the recommended number of sensors, not many analyses have been done to capture the characteristics of the uncovered areas. Given the system parameters, this paper provides a probability bound that estimates the likeliness of the uncovered areas. We find that the probability bound is equal to the probability that no sensor is found in a corresponding circle. This bound has a concise form and provides quantitative measurement to deployment efficiency. In addition, it impacts other related research topics such as finding minimum full coverage sets for lengthening sensor expectancy. Numerical results are included to show how the bound changes along with various system parameters.
- ID: 30
Title: **A Hierarchical Model for a Sensor Network**
Authors: John Orriss, S.K. Barton, Roberto Verdone
Affiliation: University of Manchester
Email: orriss@cs.man.ac.uk
Abstract: This paper introduces a new model for a sensor network in which sensors report information to supervisors through cluster heads which are themselves selected at random from the sensors. Assuming an inverse power law for attenuation, various shadowing or fading models, and uniform random spatial distributions of sensors and supervisors, the probability distribution of the number of sensors reporting to a supervisor is obtained. The result is extended to the case of a hierarchy of supervisors, which may or may not themselves be sensors, each reporting to the next level up the hierarchy.

D: 90
Title: **Self-organizing sensor networks with information propagation based on mutual coupling of dynamic systems** [invited]
Authors: Sergio Barbarossa
Affiliation: Sergio Barbarossa, University of Rome "La Sapienza", INFOCOM Department
Email: sergio@infocom.ing.uniroma1.it
Abstract: Sensor networks are typically used as a distributed system, composed of a set of cheap, lightweight components, for detection of events of interest or estimation of physical parameters. The most typical approach consists in asking the sensors to collect data and to send them to a sensor fusion center which takes the final decision. In this paper, we propose a totally different approach. Each network node is composed of a sensor, that measures the parameter of interest, and of a dynamic system (oscillator), initialized by the sensor measurement. The oscillators of nearby nodes are mutually coupled. We show that, through proper local coupling strategies, we may design networks, with no fusion center, where each dynamic system, on each node, converges to the globally optimal maximum likelihood estimator that could have been achieved only by an ideal fusion center having access to all system parameters and observations perfectly.

ID: 83
Title: **Power and Energy Consumption for Multi-Hop Protocols: A Sensor Network Point of View** [invited]
Authors: Katja Schwiager and Gerhard Fettweis
Affiliation: Vodafone Chair Mobile Communications Systems, Dresden University of Technology, Mommsenstr. 18, D-01062 Dresden, Germany
Email: {schwieg, fettweis}@ifn.et.tu-dresden.de
Abstract: Information theoretic approaches often investigate power consumption of mobile nodes in wireless multi-hop networks. In high data rate systems high spectral efficiencies are required to transmit data at a given bandwidth. On the other hand, bandwidth efficiency is not very important in low data rate networks, namely sensor networks. Here, the design criterium number one is energy efficiency, as the nodes are battery operated. Using known results from information theory, we investigate power consumption in multi-hop networks with simple protocols. Moreover we bridge the gap between power consumption and energy consumption and propose a model for the relation between those. Applying real-world radio chips the analysis combines theoretical and practical approaches. We show what transmission distance has to be exceeded to make multi-hop more energy efficient than direct transmission.

Tuesday, 13:30 – 15:30, B.5: Session II-a [Network Capacity, Coding & Detection]

ID: 81
Title: **Network Coding for Wireless Applications: A Brief Tutorial** [invited]
Authors (alph.): Supratim Deb (3), Michelle Effros (4), Tracey Ho (3), David Karger (5), Ralf Koetter (2), Desmond Lun (1), Muriel Medard (1), Niranjan Ratnakar (2)
Affiliation: (1): Laboratory for Information and Decision Systems, Massachusetts Institute of Technology; (2): Coordinated Science Laboratory, University of Illinois Urbana-Champaign; (3) Lucent Bell Laboratories; (4) Data Compression Laboratory, California Institute of Technology; (5) Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology
Email: medard@MIT.EDU
Abstract: The advent of network coding promises to change many aspects of networking. Network coding moves away from the classical approach of networking, which treats networks as akin to physical transportation systems. We overview some of the main features of network coding that are most relevant to wireless networks. In particular, we discuss the fact that random distributed network coding is asymptotically optimal for wireless networks with and without packet erasures. These results are extremely general and allow packet loss correlation, such as may occur in fading wireless channels. The coded network lends itself, for multicast connections, to a cost optimization which not only outperforms traditional routing tree-based approaches, but also lends itself to a distributed implementation and to a dynamic implementation when changing conditions, such as mobility, arise. We illustrate the performance of such optimization methods for energy efficiency in wireless networks and propose some new directions for research in the area.

ID: 87
Title: **On the relation between Source and Channel Coding and Sensor Network Deployment** [invited]
Authors: Iordanis Koutsopoulos¹, Stavros Toumpis² and Leandros Tassioulas¹
Affiliation: ¹Department of Computer Engineering and Communications, University of Thessaly, Greece, and Center for Research and Technology Hellas (CERTH), ²Telecommunications Research Center Vienna (ftw.)
Email: {jordan,leandros}@uth.gr, toumpis@ftw.at
Abstract: In this paper, we identify analogies between the themes of source and channel coding and some problems that arise in the context of wireless sensor networks. Our aim is to establish a framework within which well-known methods from the former two areas are used in tackling problems associated to sensor networks. First, we address an important tradeoff between required precision and transmission rate in a class of sensor networks by using rate-distortion theory. We then address the problem of optimal placement of super-sensors in an area covered by sensors with the objective to minimize a generic cost factor that captures several special cases, and we show the analogy to a vector quantization problem. Based on the analogy of the resulting system with a discrete source emitting symbols, we show that a traffic load balancing problem in the sensor network can be reduced to an entropy maximization problem. Finally, we consider a hierarchical sensor coverage problem that involves deploying a set of sensors with sophisticated sensing capabilities over a grid of ordinary sensors. We cast the problem in the framework of channel coding by defining appropriate analogies under the common denominator of redundancy.

ID: 80
Title: **On coded cooperative schemes: codes, choice of partners and routes** [invited]
Authors: Liwen Yu, Jerry C.H. Lin, Andrej Stefanov
Affiliation: Polytechnic University, Brooklyn, NY
Email: stefanov@duke.poly.edu
Abstract: In this paper, we consider the applicability of cooperative information transmission to wireless local area networks (WLANs). As the next generation WLANs will utilise OFDM, we consider the analysis and design of cooperative codes in the context of OFDM systems. We then consider the information transfer through WLANs from an energy consumption perspective. For networks operating over a slowly Rayleigh fading channel, we consider the optimum choice of partners for cooperation and develop minimum energy cooperative routing protocols.

ID: 70
Title: **A Cross-Layer Approach to Decentralized Detection in Sensor Networks with Noisy Communication Links and Multiple Observations**
Authors: Gianluigi Ferrari and Roberto Pagliari
Affiliation: Universita di Parma, Dipartimento di Ingegneria dell'Informazione, Parco Area delle Scienze 181A, I-43100 Parma, Italy
Email: gianluigi.ferrari@unipr.it, roberto.pagliari@studenti.unipr.it
Abstract: This paper presents a general approach to distributed detection in sensor networks in scenarios with noisy communication links between the sensors and the fusion center (or access point, AP). The sensors are independent and observe a common phenomenon. While in most of the literature the performance metrics usually considered are missed detection and false alarm probabilities, in this paper we follow a Bayesian approach for the evaluation of the probability of decision error at the AP. We first derive an optimized fusion rule at the AP in a scenario with ideal communication links. We then consider the presence of noisy links and model them as binary symmetric channels (BSCs). In this case, we show that if the noise intensity is above a critical level (i.e., the cross-over probability of the BSC is above a critical value), the probability of decision error at the AP reduces when the AP selectively discards the information transmitted by the sensors with noisy links. We will also show that use of multiple observations at the sensors can be traded for increased robustness against channel impairments in the communication links.

ID: 53
Title: **Decentralized Detection In Binary Dense Sensor Networks: To Transmit Or Not To Transmit**
Authors: Marcelino Lazaro, Antonio Artes-Rodriguez, and Matilde Sanchez-Fernandez
Affiliation: Departamento de Teoria de la Senal y Comunicaciones, Universidad Carlos III de Madrid, Avda. Universidad 30, 28911, Leganes (Madrid) SPAIN
Email: {mlazaro,antonio,mati}@tsc.uc3m.es
Abstract: We consider the problem of binary decentralized detection in large-scale, randomly deployed, dense wireless sensor networks. We compare the performance of a Neyman-Pearson global detector under two different transmission strategies. The first one is based on a censoring scheme in which only the sensors with positive detections try to transmit; the second being the corresponding uncensored one. The aim of the paper is to determine in which situations each strategy needs less energy to achieve a given probability of error.

Tuesday, 16:00 – 18:00, G.79: Session III-a [MAC – Part I]

ID: 35
Title: **Performance Evaluation of a Stability-Oriented Clustering Protocol for Ad Hoc Networks using different Mobility Models**
Authors: Vincenzo Cacace, Danilo Blasi, Luca Casone
Affiliation: STMicroelectronics, Lecce Lab (Italy)
Email: {vincenzo.cacace, danilo.blasi, luca.casone}@st.com
Abstract: In wireless, infrastructure-less, self-organizing and multihop networks - generally termed 'Ad Hoc' – several clustering protocols have been designed to establish a virtual infrastructure in an otherwise flat network, thus enhancing communications reliability and network management efficiency. However, the usefulness of such hierarchical organizations strongly depends on how often they need to be refreshed because of hosts' movements: for that reason, any clustering scheme should be conceived to cope with nodes' mobility. In this paper, we test, by means of computer simulations, how a carefully designed clustering scheme – i.e. a protocol which correctly takes into account the scenario peculiarities and the fact that organized nodes may move over time – is effective in dominating the network dynamism, no matter what mobility model and mobility rates are chosen.

ID: 82
Title: **Modelling for Wireless Sensor Network Protocol Design [invited]**
Authors: Roberto Verdone, Chiara Buratti
Affiliation: CNIT, IEIIT-BO/CNR, DEIS, University of Bologna, Italy
Email: rvedone@deis.unibo.it; chiara.buratti@cnit.it
Abstract: Protocol design for a Wireless Sensor Network (WSN) must jointly take many aspects into account, owing to the embedded nature of the devices, and the needs for energy efficiency, scalability, self-organisation and robustness to heterogeneous and unplanned environments: all these are crosslayer issues. As usual for wireless systems, protocol design normally includes a heuristic design phase, followed by validation and optimisation that can be achieved through simulation, mathematical and/or experimental approaches. In the two former cases, models are needed to specify the environment addressed by the researcher: as usual, models should be simple and realistic at the same time, where these two characteristics must be defined according to the target of the evaluation procedure. Models should also be agreed and shared among the scientific world in order to allow the comparability of results achieved by different researchers. In a wider sense, modelling for protocol design should also include the definition of the performance figures that have to be selected to measure protocol optimality, or to benchmark them. Some models have got in the last year a natural consensus, like for instance the geometrical distribution of nodes, often considered to be (statistically) uniformly distributed over a square area. However, other models for WSN protocol design still need to find consensus. This paper addresses this aspect and discusses the relevance of some of the issues not sufficiently accurate when dealing with modelling for WSN protocol design. To provide a solid base to this discussion, some results achieved through different means, both via simulation, mathematical or experimental approaches, are reported in the paper; as a common denominator to the different approaches and algorithms discussed, the performance of WSNs is measured in terms of network lifetime (related to energy efficiency), for which a new definition is given in this paper.

ID: 54
Title: **A MAC Protocol for Wireless Ad Hoc Networks with Power Control**
Authors: Sylwia Van den Heuvel - Romaszko, Chris Blondia
Affiliation: University of Antwerp, PATS Research Group, Middelheimlaan 1, B-2020 Antwerpen
Email: sylwia.romaszko,chris.blondia@ua.ac.be
Abstract: We propose a MAC protocol which achieves better spatial reuse of spectrum thanks to power adjustments based on the number of neighbors in the one-hop neighborhood. Through many simulations we show that our algorithm outperforms the IEEE 802.11 standard, also in high interference environments.

ID: 74
Title: **A New Approach for the Throughput Analysis of IEEE 802.11 in Networks with Hidden Terminals**
Authors: Athanasia Tsertou, David I. Laurenson, John S. Thompson
Affiliation: Signals and Systems Group, School of Engineering and Electronics, The University of Edinburgh, EH9 3JL, Edinburgh, UK
Email: {a.tsertou, dave.laurenson, john.thompson}@ed.ac.uk
Abstract: The dominance of IEEE 802.11 in the area of singlehop wireless networks is self-evident and has been supported by both simulation results and analytical modeling. On the contrary, the question as to whether the Distributed Coordination Function (DCF) performs satisfactorily enough in multi-hop networks still remains open. In this paper, we aim to give an initial view of this by introducing an analytical framework for the evaluation of DCF in networks exhibiting hidden terminals. The accuracy of our model is determined by comparison with simulations.

ID: 7
Title: **Performance Evaluation of a Wireless LAN Dynamic Multi Channel Allocation Strategy**
Authors: C. Taddia, G. Mazzini
Affiliation: University of Ferrara, via Saragat 1, 44100 Ferrara, Italy
Email: ctaddia@ing.unife.it, g.mazzini@ieee.org
Abstract: In this paper we present a Per-Packet Dynamic Channel Allocation algorithm with QoS support to be applied in a wireless multichannel environment. The strategy has been studied both in a simulative and in a more general analytical perspective. The results, concerning the packet drop probability D and the average number of used channel per non dropped activity U , show a high system efficiency in the resource use, with the possibility to be increased by simply grow the number of available channels; measured trend results linear and this indicates that quite good performance may be obtained by the system really outperforming the classical not cooperative solutions. The drop tends to decrease with the number of available channels, even if it becomes very flat when more than 5 channel are considered. Furthermore we can remark that our Per-Packet algorithm allows a smarter channel reuse in respect with static channel allocation schemes.

Tuesday, 10:30 – 12:30, G.73: Session I-b [Routing Protocols – Part I]

ID: 29
Title: **A Novel Bus Lane Scheme for QoS Routing in Mobile Ad Hoc Networks**
Authors: Lin Xiao and Eliane Bodanese
Affiliation: Department of Electronic Engineering, Queen Mary, University of London
Email: lin.xiao@elec.qmul.ac.uk, eliane.bodanese@elec.qmul.ac.uk
Abstract: Ad hoc networks are multihop wireless networks without fixed infrastructure, whose topology changes frequently and unpredictably. How to issue routes in such networks with sufficient and constant bandwidth is a key problem for some real-time services like audio and video services. This paper proposes a novel QoS solution using code division multiple access (CDMA) scheme, named CDMA Bus Lane, which combines the network layer with lower layers together to set up and reserve an interferencefree path dynamically for each real-time flow according to its bandwidth requirements. The bandwidth calculation and the channel spreading code assignment method are introduced particularly in this paper. The code used in the Bus Lane scheme is the Original Variable Spreading Factor (OVSF) code. Also an on-demand routing algorithm has been proposed to calculate and reserve the bandwidth hop by hop from source to destination.

- ID: 49
 Title: **The capacity and packets delivery of MANET On Road: MANETOR**
 Authors: Jiang Hao^{1,2}, Kun Mean Hou¹, Jian-Jin Li¹, Jean-Pierre Chanet³, Christophe de Vaulx¹, Hai-Ying Zhou^{1,2}, Gil de Sousa¹
 Affiliation: ¹ LIMOS Laboratoire UMR 6158 CNRS, Campus des Cézeaux, BP 10125, AUBIERE 63173 CEDEX, France, ²Wuhan University, School of Electronic Information, Wuhan, Hubei, 430079, P.R.China, ³Cemagref, 24 Av. Des Landais, BP 50085 63172 Aubière, France
 Email: jianghao@isima.fr
 Abstract: IVC based on MANET has attracted the interests of many automobile manufactures and researchers. The MANET in IVC is named as MANETOR(MANET On Road). In this paper, the capacity and packets delivery are investigated. Through the theoretical analyse of MANETOR, it is clear that the capacity of MANETOR is limited, and a pipe model allowing to estimating the capacity of MANETOR is proposed. With limited capacity, packets delivery is hard in MANETOR. In fact some communication patterns in MANET, such as broadcasting and cross traffic, will impact the packets delivery in MANETOR. The probability model of packet delivery success is evaluated and three methods to improve the PDR(Packets delivery Ratio) of MANETOR are proposed. And they are proved by simulation in ns2.
- ID: 69
 Title: **Physical Layer-Constrained Routing in Ad-hoc Wireless Networks: A Modified AODV Protocol with Power Control**
 Authors: Gianluigi Ferrari¹, Simone A. Malvassori¹, Marco Bragalini¹ and Ozan K. Tonguz²
 Affiliation: ¹Universit-a di Parma, Dipartimento di Ingegneria dell'Informazione, I-43100 Parma, Italy; ²Carnegie Mellon University, Electrical and Computer Engineering Department, Pittsburgh, PA 15213-3890, USA
 Email: gianluigi.ferrari@unipr.it, malvassori@tlc.unipr.it, tonguz@ece.cmu.edu
 Abstract: Routing in ad hoc wireless networks is not only a problem of finding a route with shortest length, but it is also a problem of finding a stable and good quality communication route in order to avoid any unnecessary packet loss. In this paper, we propose a modified ad hoc on-demand distance vector (MAODV) routing protocol derived from the AODV routing protocol by considering the bit error rate (BER) at the end of a multi-hop path as the metric to be minimized for route selection. While the performance of MAODV is generally worse than that of AODV, we show that use of distributed power control (PC) dramatically improves the packet delivery ratio with MAODV routing protocol (at the cost of a delay increase), whereas has a negligible effect on the network performance guaranteed by the AODV routing protocol. Our results suggest that MAODV-PC protocol has to be preferred, in terms of packet delivery ratio, in network scenarios with low traffic load and limited node mobility.
- ID: 67
 Title: **Multivariate Analysis of the Cross-Layer Interaction in Wireless Networks Simulations**
 Authors: Jean-Michel Dricot, Philippe De Doncker, Esteban Zimanyi
 Affiliation: Computer & Network Engineering Dpt., Université Libre de Bruxelles, Av. Franklin Roosevelt, 50, 1050 Brussels,Belgium
 Email: jdricot@ulb.ac.be
 Abstract: While there exist many papers that compare the performances of different routing protocols for wireless ad-hoc networks, these analysis are often realized using tools from descriptive statistics (curves drawing, means and variances computation, etc.). In this paper we propose the use of multivariate statistics to unveil and characterize the interaction between the input variables of a wireless network simulation. The ANalysis Of VAriance (ANOVA) tool helps us in getting the impact of the four variables that we have studied: routing algorithm, propagation conditions, nodes density, and mobility scheme. Using our methodology we are able to show that not only a single layer of the protocol stack can affect the network operation but also the interactions between two or more inputs of the simulation. An important implication of the study is that the efficiency of the routing algorithm is strongly correlated with the environment (indoor/outdoor) and that the performance analysis of the lower levels of the OSI stack should be conducted by focusing on a single layer. In the same way, wireless networks simulators cannot be considered accurate if they neglect a realistic-enough implementation of the physical layer (i.e., propagation, interference and modulation)

ID: 78
Title: **A Cross-Layer Stability-based On-Demand Routing Protocol for Mobile Ad-Hoc Networks**
Authors: Lamia Romdhani, Christian Bonnet
Affiliation: Institut Eurecom
Email: {Romdhani, bonnet}@eurocom.fr
Abstract: It is widely known that having neighbourhood information can help on optimizing the operations of several protocols including routing and medium access protocols. This work presents a new stability-based routing protocol for mobile ad hoc protocols that effectively determine and use this information. Unlike existing similar protocols, our proposal has two main specific features. First, it is designed for on-demand routing protocols like AODV protocol and second, and most importantly, it uses the cross-layer paradigm to gather some useful measurement from the MAC layer. Hence, we develop adaptive stability metrics to identify stable links in a mobile wireless networking environment based on the analysis of routing protocol periodic messages. Our metrics then only rely on on-line statistical evaluation of observed link durations. Neither do they require information on signal strength, nodes speeds, nodes directions, radio conditions, or spacing of the mobile devices, nor do they depend on the availability of additional hardware such as GPS receivers or a synchronisation of the devices. We demonstrate the ability of the metrics to select stable links with a high probability in a wide range of scenarios using ns-2 simulations.

Tuesday, 13:30 – 15:30, G.73: Session II-b [Routing Protocols – Part II]

ID: 85
Title: **Are Ad-hoc Networks Able to Substitute Cellular Networks? A Performance Comparison of Ad-hoc Network Routing Protocols in Realistic Scenarios** [invited]
Authors: ¹Mesut Gunes, ²Jan Siekermann
Affiliation: ¹International Computer Science Institute (ICSI), Berkeley, CA, USA, ²Department of Computer Science, Informatik 4, RWTH Aachen University, Germany
Email: guenes@icsi.berkeley.edu, siggi@i4.informatik.rwth-aachen.de
Abstract: There are several deployment scenarios for mobile ad-hoc networks discussed in the literature. However, the most results have been made in artificial environments. In this paper we study the performance of state of the art routing protocols for mobile multi-hop ad-hoc networks in an environment which emulates a city downtown. The studied simulation environment differs in three aspects from that of well known: i) The used mobility model emulates a city downtown with several zones and different mobility models. ii) The number of mobile nodes and the number of connections is inspired from real traces. iii) We use duplex-connections.

ID: 59
Title: **Inherent Robustness of Reactive Routing Protocols against Selfish Attacks**
Authors: Asad Amir Pirzada and Chris McDonald
Affiliation: School of Computer Science & Software Engineering, The University of Western Australia, 35 Stirling Highway, Crawley, Western Australia, 6009
Email: {pirzada, chris}@csse.uwa.edu.au
Abstract: Mobile ad-hoc wireless networks generally comprise nodes having meagre computation and communication resources. To perform multi-hop communication in a dynamic topology, these nodes execute special routing protocols. Each node performs the function of a mobile router and directs packets to other nodes in the network. For accurate functioning of the network it is imperative that all nodes execute these routing protocols in a benevolent manner. However, as ad-hoc networks are usually established in a physically insecure wireless environment, the network memberships are violated allowing malicious nodes to also participate in the network. These nodes can launch an array of attacks against different network services including the routing process. In this paper, we evaluate the performance of three well known reactive routing protocols, in a network with varying numbers of malicious nodes. With the help of exhaustive simulations, we demonstrate that the performance of the three protocols varies significantly even under similar attack, traffic and mobility conditions.

ID: 41
Title: **Flooding Techniques for Resource Discovery on High Mobility MANETs**
Authors: Rodolfo Oliveira, Luis Bernardo, Paulo Pinto
Affiliation: Departamento de Engenharia Electrotechnica, Universidade Nova de Lisboa, Portugal
Email: rado@uninova.pt
Abstract: In this paper, we address high mobility AdHoc networks resource discovery problem. We use a virtual dynamic overlay network to perform broadcast flooding task optimization. Two new flooding techniques are proposed and compared with a global flooding strategy, and, a classical flooding scheme using source routing. Experimental results, obtained by several simulations implemented on ns-2, discourage the use of source routing in high-mobility MANETs, and show that most of the times, flooding-optimization techniques could achieve best successful resource discovery rates than using global or source-routing flooding.

ID: 56
Title: **Simulation vs. Emulation: Evaluating Mobile Ad Hoc Network Routing Protocols**
Authors: Furqan Haq and Thomas Kunz
Affiliation: Systems and Computer Engineering, Carleton University, Ottawa, Ont., Canada K1S 5B
Email: haq_furqan@hotmail.com, tkunz@sce.carleton.ca
Abstract: In order for simulation studies to be useful, it is very important that the simulation results match as closely as possible with the testbed results. This paper compares emulated testbed results with simulation results from NS2 and GloMoSim. OLSR was used as a routing protocol and NRL Mobile Network Emulator (MNE) for dynamic topology control and manipulation. Five Linux based laptops, equipped with IEEE 802.11b wireless network cards were used for testbed implementation. At low traffic rates, testbed results matched closely with the simulation results, at higher traffic rates, testbed results not only differed from the simulation results both qualitatively and quantitatively but the simulation results from both the simulators were barely comparable in some scenarios.

ID: 20
Title: **Statistical Analysis of Traffic Measurements in a Disaster Area Scenario Considering Heavy Load Periods**
Authors: Nils Aschenbruck, Matthias Frank, Peter Martini
Affiliation: University of Bonn, Institute of Computer Science IV, Roemerstr. 164, 53117 Bonn, Germany
Email: {aschenbruck, matthew, martini}@cs.uni-bonn.de
Abstract: Catastrophes cause an area of destruction including destroyed infrastructure. These disaster area scenarios are typical usage scenarios for mobile wireless ad-hoc networks (MANETs). The results of simulations used for performance analysis in MANETs strongly depend on the traffic model. In this paper, we perform statistical analysis of data, measured in a civil protection manoeuvre. Based on the analysis we generate traffic and compare it to the measured one by doing simulations of two broadcast routing protocols. Finally, we extend our model to concerning heavy load periods and examine the impact on the simulation results.

Tuesday, 16:00 – 18:00, G.73: Session III-b [Ad Hoc Networks]

ID: 34
Title: **Session Initiation Protocol Deployment in Ad-Hoc Networks: a Decentralized Approach**
Authors: Simone Leggio, Jukka Manner, Antti Hulkkonen, Kimmo Raatikainen
Affiliation: Department of Computer Science, University of Helsinki, Finland
Email: {simone.leggio, jukka.manner, antti.hulkkonen, kimmo.raatikainen}@cs.helsinki
Abstract: Ad-hoc networks constitute a peculiar computing environment, characterized by the lack of centralized support from pre-existing network entities. Applications and protocols designed for centralized environments must be adapted for use in ad-hoc environments. For example, the baseline Session Initiation Protocol (SIP) strongly relies on the presence of an infrastructure, the SIP servers, and cannot therefore be deployed as it is in ad-hoc networks. This paper proposes a solution that enables devices in adhoc networks to use SIP functionalities in a decentralized way. Particularly, we embed a limited set of SIP server functionalities in the end devices to allow distribute session management for SIP end devices, without network support.

- ID: 26
 Title: **Integration of Heterogeneous Ad hoc Networks with the Internet**
 Authors: Nico Bayer, Dmitry Sivchenko, Bangnan Xu ¹⁾, Sven Hischke ²⁾, Veselin Rakocevic³⁾, Joachim Habermann ⁴⁾
 Affiliation: ¹⁾T-Systems, SSC ENPS (Technologiezentrum), 64295 Darmstadt, Germany, ²⁾Deutsche Telekom AG, Friedrich-Ebert-Allee 140, D-53113 Bonn, Germany, ³⁾School of Engineering and Mathematical Sciences, City University, London EC1V 0HB, UK, ⁴⁾University of Applied Sciences Friedberg, 61169 Friedberg, Germany
 Email: Nico.Bayer@t-systems.com
 Abstract: This paper describes a testbed realized at T-Systems in Darmstadt (Germany) that handles the integration of ad hoc networks with the Internet. The testbed contains a Mobile Gateway that connects an IPv6 based ad hoc network over a cellular network (e. g. GPRS or UMTS) with the Internet. The testbed is also able to handle multiple gateways within the same ad hoc domain. This paper describes several mobility scenarios developed within the testbed, namely inter ad hoc domain mobility, intra ad hoc domain mobility and mobility of the whole ad hoc network. The paper also discusses main issues in the development of the testbed – gateway discovery, seamless mobility and the transmission of IPv6 packets over IPv4 infrastructures.
- ID: 92
 Title: **Towards End-to-End QoS in Ad Hoc Networks connected to Fixed Networks** [invited]
 Authors: David Remondo
 Affiliation: Telematics Engineering Dep, Catalonia Univ. of Technology (UPC), Av. Del Canal Olimpico s/n, 08860 Castelldefels (Barcelona), Spain
 Email: Remondo@mat.upc.es
 Abstract: We evaluate the scalability of a new protocol, named DS-SWAN, designed to support end-to-end QoS in ad hoc networks connected to fixed networks that use DiffServ. When congestion is excessive for the correct functioning of real-time applications, DS-SWAN determines the source of the problem and, if it is the case, allocates more resources to high priority traffic in the ad hoc network. The analysis includes the scalability with respect to the number of real-time traffic sources and node mobility in addition to the impact of best-effort traffic load. Simulation results show an improvement of end-to-end delays and jitter for real-time flows without starvation of background traffic.
- ID: 33
 Title: **Gateway Discovery Algorithm for Ad-Hoc Networks Using HELLO Messages**
 Authors: Matthias Rosenschon ^a, Tilmann Mänz ^a, Joachim Habermann ^a, Veselin Rakocevic^b
 Affiliation: ^aFH-Giessen-Friedberg, University of Applied Sciences, Wilhelm-Leuschner-Strasse 13, 61169 Friedberg, Germany, ^bSchool of Engineering and Mathematical Sciences, City University, London EC1V 0HB, United Kingdom
 Email: matthias.rosenschon@iem.fh-friedberg.de, joachim.habermann@iem.fh-friedberg.de, v.rakocevic@city.ac.uk
 Abstract: The connection of ad-hoc networks to the Internet is typically established via gateways. To start an Internet connection, in a first step gateways have to be discovered by the mobile nodes within the ad-hoc cluster. Several algorithms to perform the gateway discovery have been studied in the literature up to now. This paper describes an approach for gateway discovery based on HELLO packets of the AODV protocol. The performance of the new algorithm in terms of the discovery time and the handover delay is compared to the well known methods using NS-2 simulations. Conclusions are drawn from the simulations to further improve the performance of common gateway discovery algorithms.
- ID: 40
 Title: **Distributed Gateways in Multi-Plane Ad hoc Networks**
 Authors: Sutthisak Inthawadee and Dobri Atanassov Batovski
 Affiliation: St. Gabriel Telecommunications Laboratory, Department of Telecommunications Science, Faculty of Science and Technology, Assumption University, 682 Soi 24, Ram Khamhaeng Road, Hua Mak, Bang Kapi, Bangkok 10240, Thailand
 Email: sutthisak@MerlinsSolutions.com, 1H1Hdobri@scitech.au.edu
 Abstract: The concept of multi-plane ad hoc networks is introduced for two emerging applications, namely, multi-plane three-dimensional indoor topologies and virtual multi-plane routing in dense networks. The connectivity between different planes is established with the use of distributed gateways consisting of a prescribed number of interconnected nodes on each plane. Several typical node configurations are considered analytically as open Johnson's networks. The load balancing in a distributed gateway consisting of a number of connected nodes in a prescribed topology is considered in terms of the flow equalization of both departing and internal rates for arbitrary arrival rates.

Workshop Presentations

Wednesday 25 May 2005 – Abstracts

Wednesday, 10:30 – 12:30, B.5: Session I-a [MAC – Part II]

ID: 88
Title: **Towards High Speed Wireless Personal Area Network – Efficiency Analysis of MBOA MAC** [invited]
Authors: ¹Yunpeng Zang, ¹Guido R. Hiertz, ²Jörg Habetha, ²Begonya Ota, ²Hamza Sirin and ²Hans-J Reumerman
Affiliation: ¹Chair of Communication Networks, RWTH Aachen University, 52074 Aachen, Germany, ²Philips Research Aachen, 52066 Aachen, Germany
Email: zangyp@ieee.org
Abstract: A new generation of Wireless Personal Area Networks (WPANs) is intended for high data rate and multimedia applications. The MBOA WPAN system, which is standardized by the MultiBand OFDM Alliance (MBOA), is able to provide data rates up to 480Mb/s over a short distance based on the Ultra-Wideband (UWB) frequency band as well as support the Quality of Service (QoS) for both isochronous and asynchronous traffic. The MBOA system has been considered as one of the most potential solutions for the Physical layer (PHY) and Medium Access Control (MAC) of the next generation of WPANs. In addition to the high PHY data rates, the MBOA system provides also high MAC efficiency, especially for the high speed burst transmission and frames of small size. In this work we concentrate on the analysis of MBOA MAC layer efficiency via calculating the Theoretical Maximum Throughput (TMT). Both the numerical results and simulation results using the WARP2 simulation environment are presented for the efficiency evaluation of MBOA MAC. Index Terms—MultiBand OFDM Alliance (MBOA), Wireless Personal Area Network (WPAN), Medium Access Control (MAC), Distributed Reservation Protocol (DRP), Quality of Service (QoS), Ultra-Wideband (UWB).

ID: 18
Title: **Design and Implementation of a Low Cost Energy Efficient IEEE 802.11-based Ad Hoc Network**
Authors: Nikos Pogkas¹ and George Papadopoulos^{1,2}
Affiliation: ¹ Department of Electrical and Computer Engineering, University of Patras, Campus of Rio, Greece; ² Industrial Systems Institute, Rion, Greece
Email: npogas@ee.upatras.gr; papadopoulos@ee.upatras.gr
Abstract: Network energy consumption is a critical issue in mobile communications and especially so in ad-hoc and sensor networks where small sized battery operated nodes must communicate for a long duration in dynamic network topologies. This paper presents a low cost energy efficient solution for IEEE 802.11 based ad hoc networks. Energy efficiency is achieved by the combination of a low power mode algorithm and a power aware routing strategy in order to reduce communication energy consumption and increase node lifetime. Another objective of the proposed routing strategy is the selection of stable links in order to achieve robust network operation. Simulation studies indicate a reduction in energy consumption and a significant increase in node lifetime whereas the network performance (delivery ratio and routing overhead) is not affected significantly. Finally, the hardware/software architecture of the wireless nodes is presented for a low cost design implementation.

ID: 89
Title: **An Application-Tailored MAC Protocol for Wireless Sensor Networks** [invited]
Authors: S. Chatterjea, L.F.W. van Hoesel and P. Havinga
Affiliation: Department of Computer Science, University of Twente, P.O. Box 217, 7500AE Enschede, the Netherlands
Email: {supriyo, hoesel, havinga}@cs.utwente.nl
Abstract: We describe a data management framework suitable for wireless sensor networks that can be used to adapt the performance of a medium access control (MAC) protocol depending on the query injected into the network. The framework has a completely distributed architecture and only makes use of information available locally to capture information about network traffic patterns. It allows nodes not servicing a query to enter a dormant mode which minimizes transmissions and yet maintain an updated view of the network. We then introduce an Adaptive, Information-centric and Lightweight MAC (AI-LMAC) protocol that adapts its operation depending on the information presented by the framework. Our results demonstrate how transmissions are greatly reduced during the dormant mode. During the active mode, the MAC protocol adjusts fairness to match the expected requirements of the query thus reducing latency. Thus such a data management framework allows the MAC to operate more efficiently by tailoring its needs to suit the requirements of the application.

ID: 77
Title: **Towards a Fully Distributed QoS-Aware MAC Protocol for Multihop Wireless Networks**
Authors: Fethi Filali
Affiliation: Institut Eurécom, 2229 Route des Crêtes, BP-193, 06904 Sophia-Antipolis, France
Email: Fethi.Filali@eurecom.fr
Abstract: In this paper we propose a new MAC protocol designed for multihop wireless networks called QAMP (QoS Aware MAC Protocol). It is a distributed protocol and it supports QoS using a distributed reservation mechanism. Although QAMP could be implemented using a single channel, this paper focus on the QAMP's version using a common reservation channel and at least one data channel. QAMP's performance evaluation results are presented for several scenarios using analytical analysis and ns-2 simulations. We measure the saturation throughput and the delay of QAMP using the analytical analysis and based on the simulations, we show that our proposal outperforms 802.11 as it has a saturation throughput of about 97% of the physical capacity. Keywords: multi-hop wireless networks, medium access control, quality of service, reservation-based protocols, collision-free protocols.

ID: 46
Title: **A Statistical Approach to detect NAV Attack at MAC layer**
Authors: K.Sugantha, S.Shanmugavel
Affiliation: Anna University, India
Email: ksugantha@yahoo.com, ssvvel@annauniv.edu
Abstract: This paper proposes and investigates a statistical approach to detect the NAV attack in MAC layer. We present simulation and analytical results showing that the NAV attack can under perform the standard 802.11 MAC protocol. Further no approach has been explicitly specified to detect this attack. This approach is a simpler method to detect NAV attack using Glomosim simulator. In this work we investigate the vulnerabilities and detect the NAV attack.

Wednesday, 13:30 – 15:30, B.5: Session II-a [Mobile VCE]

ID: 94
Title: **Experimental Capacity Analysis for Virtual Antenna Arrays in Personal and Body Area Networks**
Authors: Dries Neiryneck, Chris Williams, Andrew Nix, Mark Beach
Affiliation: Centre for Communications Research, University of Bristol
Email: dries.neiryneck@bristol.ac.uk
Abstract: We report on a channel measurement campaign using body and personal area network devices, placed both in an office and on-body. Inspired by the theoretical work on cooperation between devices, which predicts MIMO-like capacity gains for co-operative systems, the capacity of MIMO and cooperating devices are examined. Significant capacity gain is observed, even under line-of-sight conditions in the body area network. Power imbalance between individual channels due to shadowing or orientation, however, degrades the capacity increase when significant compared to the signal-to-noise ratio.

ID: 93
Title: **Performance Evaluation in Time-Synchronized Multi-Piconet Bluetooth Environments**
Authors: Imran Ashraf, Athanasios Gkelias, Leila Musavian, Mischa Dohler, A.H. Aghvami
Affiliation: Centre for Telecommunications Research, King's College London, UK
Email: imran.ashraf@kcl.ac.uk
Abstract: The aim of this work is to evaluate the scalability of methods applied to interconnect ad hoc networks to the Internet. We describe some of the solutions proposed for Internet connectivity in ad hoc networks. We define scalability space, absolute, relative and weak relative scalability terms. The scalability comparison of these mechanisms is presented by means of analytical modelling with respect to different parameters such as number of mobile nodes, rate of link changes and rate of traffic sessions per each mobile node. To optimise the total amount of overhead generated by the discovery protocols, we propose a feedback control algorithm to adapt period and transmission range of gateway advertisements.

- ID: 97
Title: **A Novel Piconet Coordinator Selection Method for IEEE802.15.3-Based WPAN**
Authors: Yuefeng Zhou, David I. Laurenson, Stephen McLaughlin
Affiliation: School of Engineering & Electronics, University of Edinburgh Edinburgh, EH9 3JL, UK
Email: {Yuefeng.Zhou, Dave.Laurenson, Steve.McLaughlin}@ee.ed.ac.uk
Abstract: Power awareness is an essential component of wireless personal area networks (WPANs), due to the limited energy stored in battery-operated equipment. Moreover, a WPAN has to deal with coexistence problems, since it may simultaneously operate over many types of network. Especially, when UWB, which is a candidate PHY technology for IEEE802.15.3-based WPANs, is applied, decreasing the transmission power is necessary to meet the Federal Communications Commission (FCC) regulation and diminish interference to other communication systems. In a WPAN, the Piconet coordinator (PNC) acts as an important role for central controller of the whole Piconet. As specified in the standard, IEEE802.15.3, the most capable device in a Piconet could be dynamically selected as the PNC in terms of the capacity of devices. However, the standard does not explicitly define the capacity function. In this paper, a novel PNC selection method, named Least Distance Square PNC (LDS-PNC) selection for IEEE 802.15.3-based WPANs is proposed. Using the proposed selection method, the transmission power can be lessened, and the interference area introduced by PNCs can be diminished as well. The simulation results show that it has power-saving and interference mitigation characteristics.
- ID: 96
Title: **A High Survivability Route Selection Method in Wireless Ad Hoc Networks**
Authors: Yuefeng Zhou, David I. Laurenson, Stephen McLaughlin
Affiliation: School of Engineering & Electronics, University of Edinburgh Edinburgh, EH9 3JL, UK
Email: {Yuefeng.Zhou, Dave.Laurenson, Steve.McLaughlin}@ee.ed.ac.uk
Abstract: Energy limitation is a critical issue in wireless ad hoc networks. Researchers have developed some power-aware mechanisms in routing area to prolong the lifetime of connections in networks. The existed power-aware routing protocols often use residual energy, transmission power, or link distance as the metrics to select an optimal path. The investigation in this paper indicates that these route selections will cause rapid energy exhaustion in parts of the network, thus degrade the survivability of whole network. To average the energy consumption over the network with higher energy efficiency, a novel route selection mechanism, based on novel metrics, the relay capacity and the relay efficiency, is proposed. Simulation results show that this method saves energy with significantly more robust connectivity.
- ID: 98
Title: **Quality-of-Service (QoS) Framework for Multi-rate Wireless Ad-hoc Network (MWAN)**
Authors: Yow-Yiong Edwin Tan, Stephen McLaughlin, David I. Laurenson
Affiliation: Institute for Digital Communications, School of Engineering and Electronics, The University of Edinburgh, Alexander Graham Bell Building, Kings Buildings, Mayfield Road, Edinburgh EH9 3JL, U. K.
Email: yow.tan@ee.ed.ac.uk
Abstract: We propose MWAN, a multi-rate network model to deliver differentiated service in a wireless mobile ad-hoc network (MANET) with varying physical-layer link speed. The proposed architecture is modelled using a multi-dimensional Markov chain to support both real-time and non-real-time applications. It is demonstrated that various types of data arrival process can be modelled by a Markov Modulated Arrival Process (MMAP). Numerical analyzes are drawn to estimate the packet drop probability, effective throughput and packet queuing delay. We validate the scheme by simulating under different link utilizations with IEEE 802.11 Distributed Coordination Function (DCF) ad hoc mode. Analytical and simulation results are compared to determine the accuracy of the presented methods. Increased Quality-of-Service (QoS) performance is achieved for high priority traffic.

ID: 23
Title: **Knowledge Base Assisted Mapping for an Impulse Radio Indoor Location-sensing Technique**
Authors: Wenyu Guo, Simon L. Thomson, Nick P. Filer, Stephen K. Barton
Affiliation: School of Computer Science, University of Manchester, Manchester, UK
Email: {guow, thomsos2, nick, S.K.Barton}@cs.man.ac.uk
Abstract: An impulse radio indoor wireless location-sensing technique providing mapping and positioning information without deploying fixed references has been proposed. The environment surrounding an impulse radio network can be reconstructed using times of arrival (TOAs) of dominant impulses from different radio channels measured in individual radios. 2D Mapping and positioning algorithms based on various geometry-related assumptions have been developed for this technique. In order to find the correct assumption and its corresponding algorithm efficiently, a knowledge base, which comprises samples of each typical indoor environment either successfully reconstructed or which appears as a common substructure in most floor plans, is introduced for querying purposes. In this paper, an efficient and representative data format for the knowledge base is investigated, in order to achieve an optimised querying performance. A case study is used to demonstrate how this knowledge base can assist in mapping the surrounding environment and even predicting the upcoming ones.

ID: 24
Title: **Enhanced-TDOA Measurement for Ad Hoc Networks Positioning**
Authors: Michael Bocquet, Christophe Loyez, and Aziz Benlarbi-Delai
Affiliation: Institut d'Electronique de Microélectronique et de Nanotechnologie, IEMN/IRCICA/DHS/CNRS 8520 University of Lille I Avenue Poincaré - B.P. 69 59652 Villeneuve d'Ascq Cedex FRANCE
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Abstract: To maintain the Ad Hoc network connectivity and to perform efficient energy communication between several mobile stations (MS), optimized routing algorithms need accurate short-range localization or/and positioning data. Due to indoor propagation, multipath may dramatically increase location budget error and ask for innovative solutions allowing accurate time of flight measurement. An original solution, based on a like Ultra Wide Band (UWB) technology, uses millimeter multitone dual transmission acting like a pulse composite signal and a basic millimeter receiver involving Enhanced Time Difference Of Arrival measurements (E-TDOA).

ID: 37
Title: **Algorithm for Nodes Localization in Wireless Ad-Hoc Networks Based on Cost Function**
Authors: Jean-Philippe Montillet, Timo Braysy, Ian Oppermann
Affiliation: Center for Wireless Communications (CWC), University of Oulu, P.O. Box 4500, FIN-90014 University Of Oulu, Finland
Email: jeanfi@ee.oulu.fi
Abstract: A new distributed algorithm is described in this paper for localizing sensor network nodes in Wireless Sensor Networks (WSN). The algorithm shares a common three-phase structure: (1) determine node-beacon distances, (2) build a cost function for every sensor node, and (3) compute the coordinate of the node. The coordinates of the sensor nodes are computed using either the Davidson-Fletcher-Powell Quasi-Newton algorithm or the Direct Method. The algorithm is based on the capacity of the nodes to calculate the Time-of-Arrival (ToA) and Angle-of-Arrival (AoA) with their neighbors. The accuracy of the measurements rely on the use of Ultra Wide Band (UWB) technology. It has been shown that the properties of the UWB signal allow more accurate ToA measurements. In order to simulate the range measurement noise in ToA and AoA measurements, two independent random variables are introduced with two different variances for the ToA and AoA measurements. An extensive set of simulations is performed to assess the accuracy and performance of the algorithm. Also, we demonstrate its ability to localize the nodes in a large WSN.

ID: 65
Title: **In-building location using Bluetooth**
Authors: Miguel Rodriguez, Juan P. Pece, Carlos J. Escudero
Affiliation: Departamento de Electronica e Sistemas, Universidade da Coruna, Campus de Elvina s/n, 15.071. A Coruna. SPAIN
Email: escudero@udc.es
Abstract: This paper presents a new system for indoor location of a mobile device based on bluetooth technology. Bluetooth access points of a network are used for the location system and to access the network. Location is made by means of the signal strength received from those access points. The signal energy will be measured by the mobile device and it will be transmitted to a central server that calculates its location. Since location is made in a central server, it is possible to consider any kind of algorithm to estimate it. The location system also uses a previous scene analysis by considering a map of received signal strengths.

ID: 71
Title: **A Statistical Modelling Based Location Determination Method Using Fusion Technique In WLAN**
Authors: ¹Reetu Singh, Luca Macchi and Carlo. S. Regazzoni; ²Kostas.N. Plataniotis
Affiliation: ¹D.I.B.E, University of Genova, Opera Pia 11a, Genova, Italy; ²Edward S. Rogers department, University of Toronto, Ontario, Canada, MSS3G4
Email: reetu@ginevra.dibe.unige.it
Abstract: Location information is of paramount importance in context aware Ambient Intelligence (AmI), Smart Space, traffic monitoring, surveillance network and cooperative communications services. This paper describes a Positioning determination solution based on wireless local area network (WLAN) signals. Position determination is based on the statistical modeling of the received signal at any position. This paper presents a probabilistic based statistical modelling approach for location estimation which incorporates fusion strategy in final step to combine efficiently the location individually reported by each WLAN transmitter. The system builds a radio map of the environment. The presented system is easier to implement and provide sufficiently good performance under all conditions. The accuracy with the 90% probability is reported to be 1.85 meters where as average error is reported to be 2.1 meters.

Wednesday, 10:30 – 12:30, G.73: Session I-b [Security + Services]

ID: 58
Title: **Circumventing Sinkholes and Wormholes in Wireless Sensor Networks**
Authors: Asad Amir Pirzada and Chris McDonald
Affiliation: School of Computer Science & Software Engineering, The University of Western Australia, 35 Stirling Highway, Crawley, Western Australia, 6009
Email: {pirzada, chris}@csse.uwa.edu.au
Abstract: Sensor networks are formed with the help of a large number of wireless nodes, generally with limited energy, computation and transmission powers. Each node helps every other node in the network by forwarding their packets. All is well if such an altruistic attitude is upheld by all participating nodes. However, as these nodes often operate in a physically insecure environment, they are vulnerable to capture and compromise. In addition, the communication medium being wireless, restricts enforcement of rigorous node memberships and so a number of malicious nodes also participate in the network. These nodes, in order to snoop or sabotage, can carry out a variety of attacks against the network including sinkhole and wormhole attacks. In this paper, we present a novel trust-based scheme for identifying and isolating malicious nodes, which launch these two types of attacks in a sensor network.

ID: 36
Title: **Secure Communication over Heterogeneous Networks with Clustered Mobile Ad hoc Extensions**
Authors: Dimitrios Vogiatzis, Spyridon Vassilaras and Gregory S. Yovanof
Affiliation: Athens Information Technology
Email: {dvog, svas, gyov}@ait.edu.gr
Abstract: In addition to classical security issues, clustered ad hoc networks face the possibility that some nodes may exhibit uncooperative behaviour. Therefore, misbehaviour detection and reputation mechanisms need to be implemented in order to reinforce node cooperation. In this paper, we address the issue of detecting non-cooperative behaviour during packet forwarding in heterogeneous networks with clustered mobile ad hoc extensions. The proposed solution incorporates end-to-end authenticated acknowledgments for each transmitted packet, combined with explicit authenticated alarms sent by legitimate nodes along the path to the source, every time they encounter a suspicious event. Low computational overhead is achieved by employing an adapted version of the TESLA symmetric key broadcast authentication protocol.

ID: 39
Title: **Applying Clustering to a Framework for Generating Trust**
Authors: Javesh Boodnah and Eric M. Scharf
Affiliation: Queen Mary, University of London
Email: {javesh.boodnah; e.m.scharf}@elec.qmul.ac.uk
Abstract: This paper addresses the issue of trust within the ad hoc context. Several models which claim to model trust are evaluated and a trust framework is then devised which bases itself on clustering technology. Our model aims at providing trust information about originally unknown nodes while making optimum use of computational capacity, which can be quite scarce in pure ad hoc networks. The use of trust data to generate relationships between nodes is therefore strongly favoured to applied cryptography, which generally involves intensive resource consumption. The method proposed also draws on statistical derivations to propose a condition of normality while attempting to provide definition to behaviour.

ID: 12
Title: **Friendly Authentication and Communication Experience (FACE) for Ubiquitous Authentication on Mobile Devices**
Authors: Benjamin Halpert
Affiliation: Nova Southeastern University, Graduate School of Computer and Information Sciences
Email: bhalpert@nova.edu
Abstract: Current wireless personal area network (WPAN) standards provide no method for two previously unacquainted parties to authenticate to one another in a trusted manner upon first encounter. The paper details the research leading up to the development of Friendly Authentication and Communication Experience (FACE). The FACE methodology will be developed to be independent of wirelessly enabled mobile device types, such as smartphones, personal multimedia devices, personal digital assistants (PDAs), and mobile gaming platforms. FACE will enable individuals that have never met before to communicate in a trusted manner on the first attempt. FACE development will advance human interaction via wirelessly enabled mobile devices.

ID: 9
Title: **A Presence-Enabled Mobile Service System For Integrating Mobile Devices With Enterprise Collaborative Environment**
Author: Xueshan Shan
Affiliation: Avaya Labs Research, 1033 McCarthy Blvd., Milpitas, CA 95035, U.S.A.
Email: xshan@avaya.com
Abstract: Mobile worker's presence and availability at mobile devices can be very crucial in enterprise collaborative environment due to the not-always-on nature of the mobile devices. We identify the key challenges in tracking the presence status of mobile device and user and in the integration of mobile devices with enterprise collaborative environment. We present the design ideas of a Presence-Enabled Mobile Service (PEMS) system that uses a device-resident Mobile Presence Agent (MPA) to automatically determine and update the presence of a mobile device and its user and securely integrates the presence information with enterprise collaborative environment via Web Services and SMS for the synthesis of user's availability. A prototype system and its implementation are presented to verify the design concepts and the feasibility of the PEMS system.

Wednesday, 13:30 – 15:30, G.73: Session II-b [Routing Protocols III]

ID: 75
Title: **A Simplified Model for Neighbor Discovery in Bluetooth Networks**
Authors: Salvatore Gallo, Laura Galluccio, Alessandro Leonardi, Giacomo Morabito, Sergio Palazzo
Affiliation: Dipartimento di Ingegneria Informatica e delle Telecomunicazioni, University of Catania, Italy
Email: {sgallo, lgalluccio, aleonardi, gmorabi, palazzo}@diit.unict.it
Abstract: The self-organization in ad hoc networks requires the definition of new quality-of-service (QoS) parameters, which are often in contrast with each others. For example, the spontaneous neighbor discovery is the process allowing communication nodes to discover each other. However, the velocity of discovery is paid in terms of energy consumption and, consequently, an appropriate tradeoff has to be achieved. Analytical models can be utilized to represent the node behavior and optimize their performance. Adopted standards, like Bluetooth (BT), unfortunately may be rather complex and their performance computation may require many computational resources and a lot of time. In this paper a strategy to simplify the performance study in BT environment is derived. The accuracy of the simplified model is assessed comparing the performance results obtained through its use to the performance results obtained by simulation.

ID: 104
Title: **On the Scalability of Internet Gateway Discovery Algorithms for Ad hoc Networks**
Authors: Mona Ghassemian, Vasilis Friderikos, A. Hamid Aghvami
Affiliation: Centre for Telecommunications Research, King's College London, UK
Email: Mona.Ghassemian@kcl.ac.uk
Abstract: The aim of this work is to evaluate the scalability of methods applied to interconnect ad hoc networks to the Internet. We describe some of the solutions proposed for Internet connectivity in ad hoc networks. We define scalability space, absolute, relative and weak relative scalability terms. The scalability comparison of these mechanisms is presented by means of analytical modelling with respect to different parameters such as number of mobile nodes, rate of link changes and rate of traffic sessions per each mobile node. To optimise the total amount of overhead generated by the discovery protocols, we propose a feedback control algorithm to adapt period and transmission range of gateway advertisements.

ID: 64
Title: **Routing Strategy For Bluetooth Scatternet**
Authors: Christophe Lafon, and Tariq S. Durrani
Affiliation: Digital Signal Processing Department of Electronic and Electrical Engineering, University of Strathclyde, Glasgow Scotland UK
Email: christophe.lafon@strath.ac.uk
Abstract: Bluetooth has been introduced into the marketplace as a new short-range radio technology to form small wireless systems called piconet. Nowadays an enhanced concept requests to be elaborated to enlarge these wireless networks referred as scatternet. In this paper we propose a hierarchical scatternet concept adapted for large amount of devices connected along each other with a predefined routing strategy. All Piconets are coordinated according to a tree structure and are perfectly synchronised to a Leader. In the proposal structure, the number of devices present in a scatternet can be up to 400. The scatternet formation algorithm is developed specially to allow fast piconet switching, and to provide a dense scatternet that offers optimal bandwidth and low latency, with no interference between different piconets. A routing method is presented for inter-piconet communication, with the Leader becoming the head of the server and with Master and (Child)Master forwarding services that are given by any devices present in the scatternet. The goal is to facilitate the proximity and fluidity of communication by creating a new synchronise piconet without adding interferences.

ID: 8
Title: **Novel Multicast Protocol For Mobile IP Networks**
Authors: Yewen Cao and Khalid Al-Begain
Affiliation: School of Computing, University of Glamorgan, CF37 1DL Wales, UK
Email: ycao@glam.ac.uk ,kbegain@glam.ac.uk
Abstract: Ever-increasingly attentions are drawn to the provision of multicast service over mobile IP networks. Multicast over mobile networks have to face against the scalability problem. In the paper, a new mobile multicast scheme, called mobile scalable recursive multicast is proposed. Our approach is based on the concept of dynamic ranching node-based multicast tree, where a pair of branching node messages (BNMs) is used to gradually and dynamically construct a branching node-based multicast tree and recursively delivers multicast packets between branching nodes by unicast. Another pair of mobility control messages (MCMs) is used to implement the destinations mobility management. In our scheme, only branching nodes router (BNRs) keep the multicast state about their next BNRs and mobility information about destinations, and the process of join/leave of members of a multicast session is carried out locally. Our scheme is scalable and with low join/leave latency.

ID: 1
Title: **A comparison based overview of destination distance sequence vector routing (DSDV) and mobile ad hoc on demand data delivery protocol (MAODDP)**
Author: Humayun Bakht
Affiliation: School of Computing and Mathematical Sciences, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF, UK
Email: humayunbakht@yahoo.co.uk
Abstract: Mobile ad hoc network is an autonomous system of mobile nodes establishing ad hoc or short live network without the intervention of any fixed infrastructure. Routing in these types of network is an unresolved issue. Effort is going on to establish an effective routing mechanism for mobile ad hoc networks. Proposed protocols for mobile ad hoc network can be categorized into two types i.e. table's driven and on-demand routing protocols. Destination sequence distance vector routing is one of tables driven earliest proposed algorithms. DSDV maintains the consistent overview of the network. DSDV requires participating nodes broadcast updates after a regular interval of time. Most of the tables driven type protocol is either an extension or modified form of DSDV. Mobile ad-hoc on demand data delivery protocol follows an intermediate approach in compression with tables driven and on demand routing protocols. The key feature of MAODDP is to establish the route and deliver the data simultaneously at the same time one after the other. This paper is an effort to describe the detail functioning of these protocols. This paper also covers an analytical and discussion section to compare the various aspects of these protocols with each other.

Wednesday, 16:00 – 18:00, G.73: Session III-b [Ad Hoc & Sensor Networks]

ID: 50
Title: **Retransmission Scheme with Code Sense for VSF/DS-UWB Ad-hoc Network**
Authors: Wataru HORIE[†], Yukitoshi SANADA[†] and Mohammad GHAVAMI[‡]
Affiliation: [†]Dept. of Electronics and Electrical Engineering, Keio University, 3-14-1 Hiyoshi, Kohoku, Yokohama 223-8522 Japan; [‡]Centre for Telecommunications Research, King's College London, University of London, 26-29 Drury Lane London WC2B 5RL, UK
Email: {whorie, sanada}@snd.elec.keio.ac.jp, mohammad.ghavami@kcl.ac.uk
Abstract: In order to extend the communication range of UWB systems, multi-hop transmission is essential. However, since the number of hops increases, the packet loss increases as well. In this paper, to improve the reliability of the connection and make up for the packet loss, the retransmission scheme with code-sense for DS-UWB ad-hoc network is investigated and evaluated.

ID: 60
Title: **Influence of directional antennas in STDMA ad hoc network schedule creation**
Authors: Imanol Martinez, Jon Altuna
Affiliation: Signal Theory and Communications Department, Mondragon Unibertsitatea, Mondragon, Guipuzcoa, Spain
Email: {imartinez, jaltuna}@eps.mondragon.edu
Abstract: The Spatial reuse Time Division Multiple Access (STDMA) ad hoc networks take advantage of the electromagnetic spectrum reuse to increase the global capacity of the network. The schedule creation takes into account different variables. One of them, the Signal-Interference plus Noise Ratio (SINR) generates that the geographical distribution of nodes influences a lot the behavior of the network. The usage of directional antennas in this kind of networks improves the spatial reuse and consequently the capacity of the network. In this article the schedule in a STDMA network is analyzed using antennas with different lobe angles. The created frame lengths for different connectivities are analyzed as well as the number of links/nodes per slot or the spatial reuse that it is achieved comparing to the one in a Time Division Multiple Access (TDMA) network. Results are presented for link-based and node-based assignment methods.

ID: 61
Title: **Evaluation of Cooperative Task Computing for Energy Aware Wireless Networks**
Authors: Anders Brødløs Olsen, Frank H.P. Fitzek, Peter Koch
Affiliation: Department of Communication Technology, Aalborg University, Niels Jernes Vej 12, 9220 Aalborg Øst, Denmark
Email: {abo,ff,pk}@kom.aau.dk
Abstract: In this paper we propose cooperation on task-set computation for cooperative groups of mobile wireless terminals. Energy consumption for future generation terminals is important, calling for new innovative concepts to alleviate the present evolution of evermore energy hungry terminals. Related to cooperative concepts a novel energy conservation method is proposed, which we will refer to as D2VS. Our proposed method uses abstractions of traditional multi-processor environments, where terminals are considered as processing units connected by short range wireless networks. Energy conservation is obtained by the well known method of dynamic voltage scaling, which has proven to generate near optimum energy schedules of task sets. Our simulation experiments show that up to 40% energy reduction on two cooperating terminals is obtainable. This is compared to a single energy aware terminal.

ID: 73
Title: **Performance Evaluation of TCP in an Integrated WPAN and WLAN Environment**
Authors: Isameldin M. Suliman, Janne Lehtomaki, and Ian Oppermann
Affiliation: Centre for Wireless Communications, P.O. Box 4500, 90014 University of Oulu, Finland
Email: isam@ee.oulu.fi
Abstract: Short-range low power radio frequency systems such as Bluetooth and UWB enable the deployment of wireless personal area networks (WPAN). A WPAN can interface to larger networks to provide broader network access and Internet connectivity. We evaluate the performance of TCP over an integrated WLAN and WPAN system using a real network testbed. The end-to-end throughput is found to increase, when the window size is increased. However, for large window sizes, measurement results revealed that a wide range of round trip times (RTTs) is experienced. With small window sizes, the variability in the RTT is smaller. The measurements showed that in an integrated network long RTT delays and frequent duplicate acknowledgements lead to an increase in the number of packets transmitted unnecessarily. We study the effect of the number of active short-range devices (Bluetooth in this case) in a piconet. The results show that as the number of active slaves present in the WPAN increases, the bandwidth received by slaves exchanging data decreases. This behaviour is attributed to the Bluetooth scheduling mechanism which uses the round robin polling method. The main finding of our experiments is that for Bluetooth to be successful in enabling WPAN, the time slot allocation scheme should be efficient and fair. Finally, the issue of fair bandwidth allocation among multiple TCP streams is also investigated. The results show that for small number of TCP connections, the bandwidth is fairly distributed. However, as the number of simultaneous TCP connections increases, bandwidth distribution seems to become somewhat less fair.

ID: 68
Title: **BLUESIC: context-aware information system for tourism, based on Bluetooth technology**
Authors: Juan Pece, Carlos Fernández, Carlos J. Escudero
Affiliation: Departamento de Electrónica y Sistemas, Universty of A Coruña, Campus de Elviña s/n, A Coruña, España
Email: juan_pece@yahoo.es ,carlosfernadezherranz@yahoo.es, escudero@udc.es
Abstract: In this paper it is introduced Bluesic, a new context-aware information system for tourism based on Bluetooth technology. The system has been designed for mobile devices, such as phones or PDAs. Information is provided by a web application using some parameters, such as location and kind of device, to filter and to adapt the requested information. The access to the system is made through Bluetooth access points, which are distributed in around a place of interest (building, city ...). When a user (tourist) arrives to a place of interest with Bluesic, he/she gets connected to the system across the corresponding Bluetooth access point. This way, the system knows the access point giving service and, therefore, the location of the request origin. A client application, designed for the system, shows the information to the tourist in his mobile device

EU Cluster Day & Workshop Presentations

Thursday 26 May 2005 – Abstracts

Thursday, 09:00 – 10:30, G.73: Session I [EU Cluster Day]

ID: 105
Title: **The BETSY project on timeliness and energy aspects of wireless video streaming**
Authors: M. Sénéclauze, J-D Decotignie (CSEM), P. van der Stok, H. de Groot, M. van Hartkamp, G. van Doren, D. van Heesch, C. Otero Perez (PR), M Joosten (C-lab), C. Blanch, J. Bormans (IMEC), M. Geilen, T. Basten, B. Theelen (TU/e), C. Koulamas, G. Papadopoulos, A. Prayati (ISI), G. Fohler, D. Isović (MDH), G. A. Papadopoulos, P. Cheng, Z Abraham (UCy)
Affiliation: see above
Project: IST-BETSY [www.hitech-projects.com/euprojects/betsy]
Email: peter.van.der.stok@philips.com
Abstract: The BETSY project focuses on the seamless adaptation of multimedia streams on wireless hand-held devices to fluctuating network conditions and available terminal resources. Consequently, the user can enjoy true multimedia experiences with freedom of movement in a networked home or at any hot-spot. A stream model is developed during the project to optimize the energy consumption and satisfy the timeliness constraints and optimize the energy consumption. The project is in its first 8 months. The initial stream model that is the basis of further work is described and motivated.

ID: 99
Title: **Using TinyOS Components for the Design of an Adaptive Ubiquitous System**
Authors: Omer Sinan Kaya, Ozlem Durmaz Incel, Stefan Dulman, Roland Gemesi, Pierre Jansen, Paul Havinga
Affiliation: The Department of Computer Science, University of Twente, PO-Box 217, 7500 AE Enschede, The Netherlands
Projects: IST-EYES [www.eyes.eu.org]
Smart Surroundings [<http://smart-surroundings.org>]
STW-PROGRESS Featherlight
Email: {o.s.kaya, durmazo, dulman, gemesir, jansen, havinga}@cs.utwente.nl
Abstract: This work is an initiative attempt toward component-based software engineering in ubiquitous computing systems. Software components cooperate in a distributed manner to meet a demand, and adapt their software bindings during run-time depending on the context information. There are two main research topics investigated in this study. The first topic is how to build an architecture, consisting of software components, that supports adaptation and self-configuration. We explain why that component is needed, what the requirements are and how it will be designed. Besides component-based design, we build our architecture on top of Publish/Subscribe (P/S) model. We like to reuse the TinyOS components and as a second topic, we investigate the problems that will be experienced when converting these components to our P/S oriented environment. Our experiences during this research pointed out that; buffer exchange and flexible interface name representation are not suitable for ubiquitous systems.

ID: 100
Title: **Wireless Sensor Networks and Beyond: A Case Study on Transport and Logistics**
Authors: L. Evers, M. J. J. Bijl, M. Marin-Perianu, R. Marin-Perianu, P. J. M. Havinga
Affiliation: The Department of Computer Science, University of Twente, PO-Box 217, 7500 AE Enschede, The Netherlands
Projects: IST-EYES [www.eyes.eu.org]
Smart Surroundings [<http://smart-surroundings.org>]
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Abstract: Wireless Sensor Networks provide opportunities even outside their usual application domain of environmental monitoring. In this paper we present a case study on the use of Wireless Sensor Networks for the control and management of transport and logistics processes. In this study nodes will track all activities, and check for errors that might occur in the process of handling and distributing goods. The nodes will be programmed to warn when errors occur, and keep an activity record of the entire process. An overview of the current situation, and the errors that occur therein, is given. A system architecture is described that can solve or reduce the current problems by incorporating a Wireless Sensor Network in the process.

Thursday, 11:00 – 12:30, G.73: Session II [EU Cluster Day]

ID: 101
Title: **Link and system-level analysis of structured multi-hop networks**
Authors: M. J. Hart and S. K. Vadgama
Affiliation: Fujitsu Laboratories of Europe Ltd, Hayes Park Central, Hayes, UK UB4 8FE
Project: IST-ROMANTIK [www.ist-romantik.org]
Email: Mike.Hart@uk.fujitsu.com
Abstract: The IST-ROMANTIK project focussed on resource management and advanced receiver architectures for multi-hop networks, running from February 2002 for 3 years. A modified UMTS HSDPA system level simulator incorporating relaying nodes was used to confirm gains predicted from a link level analysis of the propagation loss enhancement associated with the use of multi-hop techniques. This paper provides a brief overview of the link level propagation analysis developed within the project. Whilst the link level interference analysis is not presented in this paper, system level simulation results are presented. In particular these indicate that for two specific deployment scenarios a significant increase in coverage, especially at the cell edge, as well as a capacity gain was achievable. However, these gains were shown to be dependent on both careful positioning of the relays and optimal setting of the transmit power.

ID: 106
Title: **A simple architecture for a Wireless DVI UWB radio link**
Authors: Domenico Porcino
Affiliation: Philips Research Laboratories - Wireless Group, Cross Oak Lane, Redhill, Surrey RH1 5HA, England
Project: IST-PULSERS [www.pulsers.net]
Email: domenico.porcino@philips.com
Abstract: *not available at moment of publication*

ID: 107
Title: **Overview of Ultra-wideband (UWB) Regulatory Processes**
Authors: Walter Hirt
Affiliation: IBM Research GmbH, Switzerland
Project: IST-PULSERS [www.pulsers.net]
Email: hir@zurich.ibm.com
Abstract: *not available at moment of publication*

Thursday, 13:30 – 15:30, B.5: Session II [Hardware Demo + Other]

ID: 4
Title: **Reliability Enhancement Strategies for Wireless Communication System**
Author: Stefanos Skoulaxinos
Affiliation: School of MACS, Heriot-Watt University, Edinburgh, UK, EH14 4AS
Email: S.Skoulaxinos@hw.ac.uk
Abstract: This paper presents the development of a wireless communication system, the Long Range Identification Tag, built and tested in Heriot Watt University. The design commences in Spin, a high level model checking tool optimized for the verification of distributed systems. The abstract software model is synthesized automatically to HDL (Verilog/VHDL) and subsequently downloaded to the targeted FPGA platform. To enhance autonomous capacity of the device, run-time fault tolerance schemes such as watchdog timers and forward error correction routines are also developed. The wireless application is finally tested under a lab emulated EMI scheme and system survivability is examined and quantified. The principal objective of the paper and the associated research project (launched in 2002) is to investigate how a number of high-level reliability enhancement strategies can be utilized to promote more dependable embedded applications.

ID: 22
Title: **Wireless Temperature Sensor Using Bluetooth**
Authors: Qingshan Shan, David Brown
Affiliation: Dept. of Creative Technologies, Portsmouth University, UK
Email: qingshan05@yahoo.co.uk
Abstract: Convenient and reliable temperature monitoring systems are increasingly demanded in vehicle refrigerators. However, difficulties exist in wiring between temperature recorders and sensors in vehicles such as trailer-tractor. To solve this problem, this paper provides a novel solution: wireless temperature sensors using Bluetooth. A prototype of the wireless temperature sensors has been developed. The technologies and mathematical models used are presented in this paper.

ID: 32
Title: **Transfer Sensor Data on a motor vehicle with GPRS Modem and CAN bus**
Authors: Dan Feng, ChengTao LU, Ke ZHOU, Fang WANG
Affiliation: Key Laboratory of Data Storage System, Ministry of Education, Huazhong University of Science and Technology, Wuhan 430074, P. R. China
Email: dfeng@hust.edu.cn
Abstract: A Fault Monitoring and Detection System (FMDS) combines the technology of CAN bus and communication technology of GPRS, has been applied in a kind of loading vehicle for remote fault diagnoses. Data is collected from many sensors by CAN bus and transmitted to the remote diagnoses system by GPRS modem. The implementation of the system is described and the reliability of the communication is analyzed. It also applies to the local industry data transfer.

ID: 25
Title: **Persistent Bidirectional Peer Traffic in Fix-network augmented Broadband Wireless Access**
Authors: Robert Hsieh, Jari Iinatti
Affiliation: University of Oulu, Centre for Wireless Communications, FI-90014 University of Oulu, Finland
Email: roberth@ee.oulu.fi, ji@ee.oulu.fi
Abstract: Currently, the Internet is experiencing the grid accelerated file transfer phenomenon (swarming). It has gained immense popularity and dominance through BitTorrent and has thus far accounted for a substantial amount of the total Internet traffic. In this paper, we borrow ideas liberally from the literature to argue that the use of swarming protocol for traffic/content delivery within the wireless networking milieu is inefficient. We generalize the problem into the delivery of persistent bidirectional peer traffic in wireless hierarchical topology, and further argue that current approaches for fix network augmented broadband wireless access (e.g. 802.11x) has left the problem ill-addressed. A novel system architecture is sketched to rectify such a shortcoming. Hence, the purpose of this short position paper is to stimulate ideas and proposals that may result into important avenues of future research.

ID: 38
Title: **Channel Model at 868 MHz for Wireless Sensor Networks in Outdoor Scenarios**
Authors: J.M. Molina-Garcia-Pardo, A. Martinez-Sala, M.V. Bueno-Delgado, E. Egea-Lopez, L. Juan-Llacer, J. García-Haro
Affiliation: Department of Information Technologies and Communications, Polytechnic University of Cartagena, E-30202, Spain
Email: {josemaria.molina, alejandros.martinez, mvictoria.bueno, esteban.egea, leandro.juan, joang.haro}@upct.es
Abstract: Wireless Sensor Networks (WSN) are formed by a large number of sensing nodes at the ground level. These devices are monitoring and measuring physical parameters from the environment. Simulation is used to study WSN, since deploying test-beds supposes a huge effort. However simulation results rely on physical layer assumptions, which are not usually accurate enough to capture the real behaviour of WSN. In this work several measurement campaigns are performed in three different scenarios: an open quasi-ideal area, a university yard and a park. The main contribution of this work is that a two slopes lognormal path-loss near ground outdoor channel model at 868 MHz is validated, and compared to the widely used one slope model. This model is useful for simulations because its computational cost is low.

ID: 72
Title: **Insight Analysis into WI-MAX Standard and its trends**
Authors: H. Córdoba, P. Boets, L. Van Biesen
Affiliation: Vrije Universiteit Brussel (Dept ELEC/TW); Pleinlaan 2; B-1050 Brussels (Belgium)
Email: {hcordova, pboets, lvbiesen}@vub.ac.be
Abstract: This paper presents the features of the Worldwide for Microwave Interoperability Access (WiMAX) technology and pretends to establish some valid criterions for future trends of possible applications of WiMAX. A discussion is given by comparing Wireless Fidelity (Wi-Fi) and WiMAX. Several references have been included at the end of the article for those willing to know in detail about certain specific topics.

ID: 63
Title: **Relative Proximity Estimation in a Confined Small-Scale Environment**
Authors: Wei-Khing For ^{1,2} See-Kiong Ng ¹ Xiaoming Bao ¹ Woon-Seng Gan ²
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Abstract: Recent advances in genomic research and biotechnology have led to an increased level of technological sophistication in today's biology laboratories. With the promising current advances in pervasive computing, we can expect ubiquitous smart services to be deployed in smart bio-laboratories of the future to simplify the increasingly complex experiments that are now becoming routine. In this paper, we investigate the provision of location aware computing through K-Nearest Neighbor (KNN) relative proximity estimation. Our results show that K-NN can provide low-cost and reliable relative proximity estimation services, even in a challenging small-scale confined environment such as a smart bio-laboratory operating in the common IEEE 802.11b based wireless network environment.

Workshop Papers

not attending – Abstracts

ID: 6
Title: **Wireless Sensor Actor Networks And Routing Performance Analysis**
Authors: Dung Van Dinh¹, Minh Duong Vuong¹, Hung Phu Nguyen², Hoa Xuan Nguyen³
Affiliation: ¹ Research Institute of Posts and Telecoms (RIPT), ² Post and Telecommunications Institute of Technology (PTIT), ³ Hanoi University of Technology (HUT)
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Abstract: With recent advances in micro-electromechanical systems technology, wireless communications, and digital electronics, the research on wireless sensor networks becomes a “hot” topic. Wireless sensor and actor network (WSAN) is referred to a group of sensors and actors linked by wireless medium to perform sensing and acting tasks. This paper is to present a comprehensive review of recent research achievements on WSANs, open research issues, and the simulation based actor-to-actor routing protocols performance analysis. The review is followed the layers of sensor networks: application, transport, network, link, transmission, and management (power, mobility, task). The performance analysis is considered for three popular ad-hoc networks routing protocols and investigated with respect to the routing packet delay and end-to-end throughput. As a result, the DSR protocol is proposed to handle actor-to-actor communications.

ID: 57
Title: **Probabilistic Geographic Routing Protocol for Ad Hoc and Sensor Networks**
Authors: Tanya Roosta
Affiliation: Department of EECS, UC Berkeley
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Abstract: In this paper, we present Probabilistic Geographic Routing (PGR), a novel approach for the problem of power-aware routing in wireless ad hoc and sensor networks. Our protocol uses only local information to probabilistically forward the packet to the next hop. Every node relies on a beaconing process to keep track of the changes in the set of its neighbors. In order to forward a packet, the node selects a subset of its neighbors. These candidate nodes are then assigned a probability proportional to their residual energy and the link reliability. We simulated PGR in NS-2 and compared the performance to two existing protocols, GPSR and Probabilistic Flooding. Based on the simulation results, PGR improves the throughput by 40%, increases the lifetime of the network by 30%, and decreases the overall end-to-end delay. In addition, we have implemented PGR on a real sensor network test-bed to verify our protocol.

ID: 5
Title: **Performance issues of Voice over Wireless LAN (VoWLAN) and comparing it with Wired LAN**
Authors: Ashish Bhatia
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Abstract: The emerging next generation networking environment presents an IP based core interconnecting many wireless radio access networks providing ubiquitous access to end users through a vast variety of wireless devices. VoIP over wireless LAN is freeing the telephone from cord is an obvious next step. The convergence of voice and data networks enables new applications and cost reduction. There are number of factors that inhibit wide spread adoption of VoWLAN. Data was reviewed on voice quality effects of excessive latency and jitter, degraded voice quality, poor convergence, interrupted voice service, roaming latency, security problem, retransmission and dropped packets, low capacity and reduced number of calls, voice and data coverage and power coverage environments. The subjective was to find out if VoIP works well enough in wireless LAN to be useful. For this comparison of the behavior of voice over IP in a 100MB/s Ethernet is done and quality of service parameters is measured in both environments. These days wireless environment is getting more and more important so the objective in concern of voice data was to discover if it is possible to do telephone calls in a wireless LAN with voice over IP with good enough speech quality.

ID: 43
Title: **Security Enhancement in the NTP Protocol Using Fuzzy Techniques**
Authors: S.Radha, M.S.Jayapriya
Affiliation: Sri Siva Subramaniya Nadar College of Engineering, Old Mahabalipuram road, SSN nagar-603110, Tamil Nadu, India.
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Abstract: AdHocNetworks are a new generation of networks offering unrestricted mobility without any underlying infrastructure. Primary applications of Ad Hoc networks are in military, tactical and other security sensitive operations, where the environment is hostile. Hence, security is a critical issue. Due to the nature of Ad Hoc networks, conventional security measures cannot be used. New techniques of security measures are essential for high survivability networks. The performance of the network will be severely affected, in the presence of compromised nodes, which cause undetermined and unpredictable complex failures. This project is mainly to identify the misbehaviors caused by some malicious node for NTP (Node Transition Probability) protocol, and eliminate them from the network. The performance analysis is done based upon two cases .In first case the complete network topology is studied and based upon it a threshold value is fixed to detect the malicious activity and eliminate it. In the second case a fuzzy model is introduced so that automation of threshold can be done for anomaly detection of malicious nodes in network with varying topology. In contrast to the case one -- intrusion detection models for ad hoc networks we have implemented an efficient and bandwidth-conscious framework that takes into distributed nature of ad hoc wireless network management and decision policies.

ID: 51

Title: **Virtual Cellular Infrastructure for Mobile Ad hoc Network**

Authors: Muthu Chidambaranathan.P, Sundaresan S

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Abstract: In this paper, we introduce a protocol which develops a dynamic infrastructure for wireless mobile ad hoc network. The architecture and operation of dynamic infrastructure is similar to conventional cellular network infrastructure. In this protocol, a mobile terminal (MT) is elected by a set of MTs to act as their temporary base station within their base station area based on residual battery power. MTs elected as base stations (BS) are used to track other MTs in the ad hoc network. The dynamic infrastructure routing protocol utilizes the mobility tracking mechanism to route packets from an MT to another MT in the network. This protocol is more efficient than any existing ad hoc routing protocols in terms of energy and load balancing. The infrastructure based ad hoc mobile network is less congested and fast converging to network topology change. This scheme provides different medium access control, bandwidth allocation policies and quality of service (QoS) guaranteed communication in ad hoc networks. It performs well in interactive and multimedia service in ad hoc network.

ID: 62

Title: **Improving the Performance of Probabilistic Flooding in MANETs**

Authors: M. Bani Yassein, M. Ould Khaoua, L. M. Mackenzie and S. Papanastasiou

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Abstract: Broadcasting in mobile ad hoc networks has traditionally been based on flooding, which swamps the network with large number of rebroadcast packets in order to reach all network nodes. The appropriate use of probabilistic broadcasting can reduce the number of packet transmission, effectively alleviating the problem of contention. In particular, a good probabilistic broadcast protocol can achieve higher saved rebroadcast and higher reachability. This paper presents a new probabilistic approach that dynamically adjusts the rebroadcasting probability as per the node distribution and node movement. This is done based on locally available information and without requiring any assistance of distance measurements or exact location determination devices. We evaluate the performance of our approach by comparing it with simple flooding as well as a fixed probabilistic approach. The results show that the new algorithm exhibits superior performance in terms of both the reachability and saved rebroadcasts.

ID: 76

Title: **On demand Temporary Route Recovery For Frequent Link Failures In Adhoc Networks**

Authors: S.Radha, M.Tharanian, K.K.Thyagarajan

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Abstract: Adhoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of existing network infrastructure or centralized administration. Each node acts as a router by itself and forwards all the packets which it receives. There is a frequent link failure in adhoc Networks, which causes packet to be lost or packets doubt to reach destination. In this scenario a different mechanism and a scheme is proposed and implemented to make the important time critical data like real time or voice data to reach the destination without any loss. The mechanism used is a special propagation which propagates a unique kind of route discovery for real time application scenario to send

the time critical data safely. The scheme used is temporary route recovery builds a temporary path between the nodes during link failure. The important node then forwards the buffered packets to the destination without any loss which is on-demand based on type of information a node forwards. Special buffer is allocated for the nodes marked important during special propagation. The significant nodes are assumed and simulated by using a simulation tool GloMoSim. This extensive model is compared with standard models performance metrics such as throughput, retransmission and end-to-end delay are analysed.

ID: 55
Title: **On the evaluation of TCP in MANETs**
Authors: Stylianos Papanastasiou, Mohamed Ould-Khaoua, Lewis M. Mackenzie
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Abstract: Past research efforts have denoted the problematic behaviour of traditional TCP agents in MANET environments and have proposed various remedies across the networking stack. However, there has not been an overall performance evaluation of different TCP agents under varying mobility conditions which takes into account past experiences in MANET evaluation. This work aims to rectify this shortcoming through detailed evaluation of prevalent TCP variants in different topology settings over the AODV routing protocol. Subsequent results reveal the performance merits of TCP Vegas and NewReno in MANETs with respect to Reno which is further explored and accounted for. Finally, insight is provided through extensive tracing on the interaction of TCP with the routing protocol.

ID: 45
Title: **Performance Evaluation of UWB Sensor Network with Aloha Multiple Access Scheme**
Authors: Romeo Giuliano¹ and Franco Mazzenga²
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Abstract: The performance of a multi-hop Ultrawideband (UWB) sensor network based on Aloha multiple access technique is evaluated in terms of the average link outage probability and the overall network throughput for different coverage radius of the UWB sensor device. The architecture of the considered sensor network is based on the creation of multi-hop routes using intermediate nodes for each source-destination pair. Packets transmission at each node follows a Poisson distribution with assigned normalized traffic. Performances are obtained using a novel semi-analytical procedure that allows to account for multiple access interference and realistic propagation conditions. The proposed calculation procedure can be used for sensor network design based on Aloha with multi-hop as well as for analysis of an existing installation.

ID: 66
Title: **Effective Link Capacity of Imperfect Reconfigurable Wireless Networks**
Authors: Ulrico Celentano, Savo Glisic
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Abstract: This paper presents a model for the link service capacity that an imperfect adaptive radio link provides to upper layers. As the main contribution of this paper, the model includes a number of imperfections in the link adaptation chain, as well as implementation implications. The average goodput is expressed also in compact form and its dependence on the impairments is discussed using analytical, numerical, and simulations results. The model integrates physical channel, transceiver characteristics, and imperfections in a flexible way, by independent, separate matrices.

ID: 79
Title: **IEEE 802.15.4/ZigBee™ Compliant IF Limiter and Received Signal Strength Indicator for RF Transceivers**
Authors: Rajshekhar Vajinath, Ashudeb Dutta and T K Bhattacharyya
Affiliation: Advanced VLSI Design Laboratory, Indian Institute of Technology Kharagpur-721302 (India)
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Abstract: This paper presents a low-voltage, low-power CMOS circuit for an intermediate frequency (IF) limiting amplifier and received signal strength indicator (RSSI). Using a single 1.8-V supply voltage, simulated results demonstrate the input dynamic range is larger than 80 dB and a sensitivity of around -80dBm. A low intermediate frequency of 2 MHz is chosen for our application. Power dissipation is 6mW and the input referred noise is 16 μ V. The prototype is implemented using a 0.18 μ CMOS technology. This architecture is designed for RF transceivers complying IEEE 802.15.4/ ZigBee™.

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