



WiMob2010

Niagara Falls, Canada. Oct 11 - 13

**2010 IEEE 6th International Conference on
Wireless and Mobile Computing, Networking
and Communications**



A stylized, light gray silhouette of a city skyline with various skyscrapers and buildings, positioned behind the word 'Welcome'.

Welcome

WiMob2010

Niagara Falls, Canada. Oct 11 - 13

WiMob'2010

Welcome Message from the General Chairs

On behalf of the Organizing Committee, we would like welcome you to the Sixth Annual IEEE International Conference on **Wireless and Mobile Computing, Networking and Communications** (WiMob). The tremendous advances in wireless communications and mobile computing, combined with the rapid evolution in smart appliances and devices have generated new challenges and

problems requiring solutions that rely on interactions between different network layers and applications in order to offer advanced mobile services. **WiMob'2010** addresses three main areas: Wireless Communications, Mobile Networking, Ubiquitous Computing and Applications. IEEE WiMob has grown to become one of the major events in these areas, and it aims to stimulate interactions among participants and enable them to exchange new ideas and practical experiences in their respective areas.

This year conference is being held in the Sheraton on the Falls hotel, Niagara Falls, Canada, from October 11 to 13, 2010. The conference received submissions from 50 different countries, with the main track receiving 228 submissions out of which 66 papers were selected for oral presentation. In addition to the main program, the conference is co-hosting the following six workshops:

- Third IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STMWC'10),
- Second International Workshop on Network Assurance and Security Services in Ubiquitous Environments (NASSUE 2010),
- First Workshop on Cooperative Mobile Protocols and Applications (CMPA 2010),
- First International Workshop on VEhicular COmmunications and Networking (VECON 2010),
- First International Workshop on Advances in Wireless Sensor and Actuator Networks (AWSAN 2010),
- First International Workshop on Performance Enhancements in MIMO-OFDM Systems (PEMOS 2010).

We would like to thank the TPC Co-Chairs, TPC members and all the reviewers, the Workshop Co-Chairs, the Publicity Co-Chairs and the Publication Chair and all the members of the organizing committee for their assistance in making this conference a success. We would also to thank our two distinguished keynote speakers, Dr. Weihua Zhuang and Dr. Pierre Boucher who have agreed to address the conference attendees.

We would also like to acknowledge the continuing sponsorship of IEEE WiMob by the IEEE Computer Society and IEEE.

We look forward to seeing you at the conference, and we hope that you enjoy the conference and your stay in Niagara Falls

Abderrahim Benslimane

General Chair for IEEE WiMob 2010

Ali Miri

General Co-Chair for IEEE WiMob 2010



Abderrahim Benslimane is Full Professor of Computer Science and Engineering at the University of Avignon (France) since September 2001. He has been as Associate Professor at the University of Technology of Belfort-Montbéliard since September 1994. He obtained the title to supervise researches (HDR 2000) from the University of Cergy-Pontoise, France. He received the PhD degree (1993), DEA (MS 1989) from the Franche-Comte University of Besançon, and BS (1987) from the University of Nancy, all in Computer Science.

His research and teaching interests are in wireless ad-hoc and sensor networks. Particularly, he works on multicast routing, inter-vehicular communications, Quality of service, energy conservation, localization, intrusion detection and MAC layer performance evaluation. He was also interested in specification and verification of communication protocols, group communication algorithms and multimedia synchronization. He has several refereed international publications (book, journals and conferences) in all those domains.

He has served as technical program chair and co-chair, member of a number of international conferences. He has been reviewer of a great number of journals, of national research projects sponsored by the ANR/Telecom. He is the header of Computer Networks and Multimedia Applications team (RAM) of the Computer Laboratory of Avignon.

He was responsible of the speciality RTM (Networks, Telecoms and Multimedia), Professional and Research, of the Master (MSc) Computer Engineering and Mathematic, Techniques and Sciences of the University of Avignon 2001-2006.

He is involved in many national and international projects. He is member of many editorial boards of international journals. He chairs many IEEE international conferences. He participates to the steering and the program committee of many IEEE international conferences. He is IEEE senior member, member of the CA of the IEEE French section, of the Technical Committee IEEE ComSoc Communications and Information Security (CISTC), Vice-President of the France IEEE student activities and of the SPECIF/France and Vice-chair publications of CISTC IEEE COMSOC. He was member of the "Conseil National des Universités" 2003-2007 (27ème section).

He has many international collaborations, for supervising MSc and PhD students. He supervised many Ph.D thesis in localization in sensor networks, security in ad hoc networks, QoS in WiMAX and cross layer energy conservation in ad hoc networks and many MSc research supervision (and co supervision) of students in Univ. Avignon, Univ. Montreal, Univ. Concordia, Ecole Polytechnique of Montreal.

He is editorial member of many international journals, general chair of WiMob and symposium co-chair in Globecom and ICC. He was guest editor of many special issues.



Ali Miri has been a Full Professor at School of Computer Science, Ryerson University, Toronto since 2009. He has also been with the School of Information Technology and Engineering and Department of Mathematics and Statistics since 2001 as an Assistant Professor, and later as an Associate Professor in 2005 and a Full Professor at 2008. He is the founder and the director of Computational Laboratory in Coding and Cryptography (CLiCC) at the University of Ottawa. He has held visiting positions at the Fields Institute for Research in Mathematical Sciences, Toronto in 2006, and Université de Cergy-Pontoise, France in 2007, and Alicante and Albecete Universities in Spain in 2008. His research interests

include computer networks, digital communication, and security and privacy technologies and their applications. By combining his expertise in mathematics, computer science and engineering, he has made significant contributions to these areas, writing and co-authoring more than 120 peer-reviewed papers in international conference and journals. Dr. Miri has served in more than 50 organizing and technical program committees of international conferences and workshops. He has chaired/co-chaired The 14th workshop on Selected Areas in Cryptography (SAC), 2007, The Fields workshop on New Direction on Cryptography, 2008, IFIP Conference in Wireless Sensor and Actor Networks (WSAN), 2008, The Canadian Workshop in Information Theory (CWIT), 2009, The Eighth International Conference on Privacy, Security, and Trust (PST), 2010, IEEE International Conference on Wireless and Mobile Computing, Networking and Communications (WiMoB), 2010, and he will co-chairing The 18th workshop on Selected Areas in Cryptography (SAC), 2011. He has served as a guest editor for Journal of Ad Hoc and Sensor Wireless Networks, Journal of Telecommunications Systems, and is currently serving on the editorial board of International Journal On Advances in Internet Technology.

He is a member of Professional Engineers Ontario, ACM and a senior member of IEEE.

General Information

Registration

Delegates may register on:

- Monday, October 11: 8:00 AM to 5:00 PM
- Tuesday, October 12: 8:00 AM to 3:00 PM
- Wednesday, October 13: 8:00 AM to 10:00 AM

Wireless Internet Access

Username: wimob

Password: Conference

Program at a glance

Sunday, October 10

Time	Upper Fallsview Studio B
05:00 PM – 7:30 PM	Reception

Monday, October 11

Time	Strategy Room 1	Strategy Room 2	Strategy Room 3
08:30 AM			Keynote: Vehicular Networking: Challenges and Opportunities
09:30 AM	Break @ Prefunction Space Strategy Room		
10:00 AM	Wireless and Ad-Hoc Networks (I)	Mobile Networking	
12:00 PM	Lunch @ Great Room B		
01:20 PM	Wireless and Ad-Hoc Networks (II)	Sensor Networks (I)	
3:00 PM	Break @ Prefunction Space Strategy Room		
03:30 PM	Vehicular Communications		
05:20 PM	NASSUE: Second International Workshop on Network Assurance and Security Services in Ubiquitous Environments (NASSUE 2010)	Sensor Networks (II)	

Tuesday, October 12

Time	Strategy Room 1	Strategy Room 2	Strategy Room 3
08:40 AM	STWMC1: Third IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STMWC'10) -1	CMPA: First Workshop on Cooperative Mobile Protocols and Applications (CMPA 2010)	
10:10 AM	Break @ Prefunction Space Strategy Room		
10:30 AM	STWMC2: Third IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STMWC'10)-2	VECON1: First International Workshop on Vehicular Communications and Networking (VECON 2010) -1	
12:10 PM	Lunch @ Great Room B		
01:20 PM	AWSAN: First International Workshop on Advances in Wireless Sensor and Actuator Networks (AWSAN 2010)	VECON2: First International Workshop on Vehicular Communications and Networking (VECON 2010) -2	
3:00 PM	Break @ Prefunction Space Strategy Room		
03:30 PM	STWMC3: Third IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STMWC'10)-3	PEMOS: First International Workshop on the Performance Enhancements in MIMO-OFDM Systems (PEMOS 2010)	

6:30 PM Dinner @ Great Room B

Wednesday, October 13

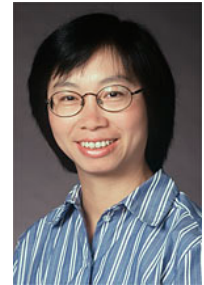
Time	Strategy Room 1	Strategy Room 2	Strategy Room 3
08:30 AM			Keynote: Towards 50 Billion Devices: A Sustainable Evolution of Mobile Networks
9:30 AM	Break @ Prefunction Space Strategy Room		
10:00 AM	Air Interfaces	Smart Systems	
12:00 PM	Lunch @ Great Room B		
01:20 PM	Mobility and Nomadicity (I)	Next Generation Networks (I)	
3:00 PM	Break @ Prefunction Space Strategy Room		
03:30 PM	Next Generation Networks (II)	Mobility and Nomadicity (II)	

Keynote Speakers

Dr. Weihua Zhuang

Professor, PhD, FIEEE, PEng, Tier I (Senior) Canada Research Chair

Title: Vehicular Networking: Challenges and Opportunities



Abstract

Vehicular ad hoc networks (VANETs) aim at providing communications among vehicles, and between vehicles and nearby roadside equipment, with very limited or no infrastructure support. VANETs are envisioned to be a cornerstone for road safety, intelligent transportation, mobile Internet access, and many location dependent commercial applications. The growing importance of inter-vehicular communications has been recognized by governments, academia, and industry. In comparison with general-purpose mobile ad hoc networks, VANETs have unique features that provide opportunities for optimizations, but also have complex aspects that challenge the system design and implementation, such as very fast network topology changes due to high vehicle speed. This presentation will provide an overview of vehicular communication networks, discuss research challenges and open issue, and provide some solutions to resource allocation, network control, and service provisioning in VANETs.

Bio

Weihua Zhuang received the B.Sc. and M.Sc. degrees from Dalian Maritime University, China, and the Ph.D. degree from the University of New Brunswick, Canada, all in electrical engineering. In October 1993, she joined the Department of Electrical and Computer Engineering, University of Waterloo, Canada, as an Assistant Professor. She was promoted to the rank of Associate Professor with tenure in July 1997, and then to Full Professor in July 2002. Since May 2010, she has been a Tier I (Senior) Canada Research Chair in wireless communication networks. Her current research focuses on resource allocation and QoS provisioning in wireless networks. She is a co-author of the textbook *Wireless Communications and Networking*, which has been published by Prentice Hall since 2003, and has been translated to Chinese and published by the Publishing House of Electronics Industry in China since 2004.

Dr. Zhuang is a co-recipient of the Best Paper Awards from IEEE VTC-Fall 2010, IEEE WCNC 2007 and 2010, IEEE ICC 2007, and the International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness (QShine) 2007 and 2008. She received the Outstanding Performance Award in 2005, 2006, and 2008 from the University of Waterloo for outstanding achievements in teaching, research, and service, and the Premier's Research Excellence Award in 2001 from the Ontario Government for demonstrated excellence of scientific and academic contributions.

Dr. Zhuang is the Editor-in-Chief of *IEEE Transactions on Vehicular Technology*, and an Editor of *EURASIP Journal on Wireless Communications and Networking*, *International Journal of Sensor Networks*, and the *ETRI Journal*. She was an editor of *IEEE Transactions on Wireless Communications* (2005-2009). She is the TPC Co-Chair for *Wireless Networks Symposium of IEEE Globecom 2008*, *Cross Layer Designs and Protocols Symposium of Int. Wireless Communications and Mobile Computing Conference (IWCMC) 2007 and 2006*, and the *ACM Workshop on Wireless Multimedia Networking and Performance Modeling (WMuNeP) 2005*. She is a Fellow of IEEE and an IEEE Communications Society Distinguished Lecturer. Dr. Zhuang is a licensed Professional Engineer in the Province of Ontario, Canada. She is the Chair of the Vehicular Technology Chapter, IEEE Kitchener-Waterloo Section.

Keynote Speakers (cont.)

Dr. Pierre Boucher

DIRECTOR, RESEARCH

Ericsson Canada Inc.

Title: Towards 50 Billion Devices: A Sustainable Evolution of Mobile Networks



Abstract

Mobile networks are evolving rapidly and will be moving from connecting people to connecting things. This poses some research challenges in terms of network efficiency but also in terms of the use of these new kinds of networks on our daily lives.

Bio

Pierre Boucher is Director for Research at Ericsson's R&D center in Montreal. He is responsible for research activities on broadband systems and networks for the R&D center's collaborative research and innovation projects with universities and institutions. Areas covered by his group include next generation networks, service architectures and advanced radio applications. His interests are in the application of networked multimedia technologies like IMS in sectors such as healthcare and entertainment. Pierre is also chairman of Prompt, a research promotion organization. He represents Ericsson on various boards promoting research and innovation in the telecommunications sector and in the community, such as CATA, ADRIQ and TechnoMontréal. Prior to his 15 years at Ericsson, Pierre worked for Rogers in Network Research with a focus on OSS systems.

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Guy Pujolle (University of Paris 6, France)

Monday, October 11, 2010

8:30 – 9:30 AM

Keynote: Vehicular Networking: Challenges and Opportunities

Speaker: Dr. Weihua Zhuang

Room: Strategy Room 3

Chair: Ali Miri (Ryerson University & University of Ottawa, Canada)

10:00 AM - 12:00 PM

Wireless and Ad-Hoc Networks (I)

Room: Strategy Room 1

Chair: Joan Garcia-Haro (Polytechnic University of Cartagena, Spain)

Effective Traffic Control for Military Tactical Wireless Mobile Ad-hoc Network

Ji-Sang You (Agency for Defense Development, Korea)

The MIL-STD-188-220 is the military tactical wireless mobile ad-hoc communication standard which makes a smooth data and voice communication possible. This standard is known as the Interoperability Standard for Digital Message Transfer Device Subsystems. However, the standard has the problem to generate the meaningless traffic due to the failure of topology update, in the case of transmitting the only packet not requiring the acknowledgments to the destination node away from the radio propagation scope. Moreover, a source requires the intranet end-to-end acknowledgment from all destinations to confirm a packet delivery, regardless of the hop distance to destination nodes. This method has the problem to generate unnecessary traffic in the case to confirm the packet delivery within 1-hop distance. In order to resolve these problems, this paper has proposed the methods that restrain the meaningless traffic generation and simplify the procedure that confirms a packet delivery within 1-hop distance.

Performance of Transparent Conductive Polymer Antennas in a MIMO Ad-hoc Network

Nicholas J. Kirsch (Drexel University, USA); Nicholas Vacirca (Drexel University, USA); Timothy Kurzweg (Drexel University, USA); Adam Fontecchio (Drexel University, USA); Kapil Dandekar (Drexel University, USA)

Multiple antenna communication systems are a solution to meet the demand for pervasive computing and ubiquitous wireless communications. As multiple antenna communication systems become more broadly deployed, integrating unobtrusive antennas into various form factors is becoming increasingly important. Antennas that are flexible and transparent can ease this design constraint. In this paper, we present a dipole conductive polymer antenna array that is flexible and transparent. The focus of this paper is to show how well this antenna works in a communications network by evaluating channel capacity and packet error rate.

Bandwidth Balancing in Mobile Ad Hoc Networks

Congzhou Zhou (Columbia University, USA); Nick Maxemchuk (Columbia University, USA)

In this paper, we extend bandwidth balancing technique in wired networks to operate in mobile ad hoc networks (MANETs). In bandwidth balancing in Distributed-Queue-Dual-Bus (DQDB), different nodes occupy the same channel, and information about the bandwidth is transferred between nodes in the unused bandwidth. Similarly, in wireless networks, the capacity on a channel is shared by several sources at different nodes and the bandwidth information can be monitored on the shared medium. Using the bandwidth balancing technique, we introduce a flow control scheme for MANETs that limits each flow at each node in a transmission region to take only a fraction of the remaining capacity. Extensive simulations demonstrate that our flow control scheme is effective and can provide Quality of Service (QoS) guarantees for flows in MANETs.

An improved Map-based Location Service for Vehicular Ad Hoc Networks

Nadia Brahmi (Irseem - Esigelec, France); Mounir Boussejra (IRSEEM-ESIGELEC Technopole du Technopôle du Madrillet, France); Joseph Mouzna (Esigelec-Irseem, France); Kiran Cornelio (I&CT, MIT, Manipal, India); Manohara Pai (Manipal Institute of Technology, Manipal University, India)

Routing remains one of the key challenges in vehicular networks due to their special properties such as the high mobility and the intermittent connectivity. Almost all the efficient routing solutions proposed for VANETs are based on geographic information provided by the navigation systems widely deployed in the new generation of vehicles. Typically, in these position-based protocols, a source node has to discover the location of destination node before sending the data. In this paper, we propose a distributed hierarchical location service called Density aware Map-Based Location Service (DMBLS) for Vehicular Ad-hoc Networks. DMBLS makes use of the street digital maps and the traffic density information to define a three level-hierarchy of locations servers. This infrastructure-less scheme has proven to be robust to node mobility and well suited to dynamic networks. Simulation results obtained with different scenarios demonstrate that DMBLS achieves promising performances in terms of location query success ratio as well as the query and update delays with a good accuracy.

Capability Reconciliation for Virtual Device Composition in Mobile Ad Hoc Networks

Eric Karmouch (University of Ottawa, Canada); Amiya Nayak (SITE, University of Ottawa, Canada)

The proliferation of networked appliances or dedicated function consumer devices with embedded processors and network connection capabilities is driving the virtual device concept, whereby such appliances can be controlled, monitored, managed, and extended beyond what they were initially designed to do. The dynamic and ad hoc nature of the discovery and composition of such devices and the services they provide inevitably leads to capability differences, whereby the input of a service B is not compatible with the output of a service A; A and B needing to be composed. Moreover, current schemes for service composition in MANETs do not consider capability differences. We present a distributed constraint satisfaction problem for capability reconciliation in MANETs, and through simulation show its effectiveness and efficiency.

A Semantic Database Framework for Context Management in Heterogeneous Wireless Networks

Mehdi Loukil (TELECOM SudParis, France); Takoua Ghariani (Institut Telecom / Telecom SudParis, France); Badii Jouaber (Institut TELECOM - Telecom SudParis, France); Djamal Zeglache (Institut TELECOM, TELECOM SudParis, France)

Recent developments in computer science and networking raise the need to develop new families of applications that are sensitive to user and ambient contexts. The objective is to offer personalized services that can be adapted to users' needs within heterogeneous, complex and dynamic environments. This requires enhanced and generic solutions for context representation and retrieval as well as for the interactions between heterogeneous system components. In this paper, we propose a conceptual model and a software framework using semantic ontologies to build semantic context databases. This approach is then applied to the heterogeneous wireless networks' use case. Contextual information is implemented using first order logic and OWL to promote expressiveness and interoperability. The different steps to build the framework are detailed. Measurements and performance results are then provided.

10:00 AM - 12:00 PM

Mobile Networking

Room: Strategy Room 2

Chair: Srinivas Sampalli (Dalhousie University, Canada)

A Tabu Search DSA Algorithm for Reward Maximization in Cellular Networks

Hany Kamal (Telecom-ParisTech, France); Marceau Coupechoux (TELECOM ParisTech, France); Philippe Godlewski (Ecole Nationale Supérieure de Telecommunication, France)

In this paper, we present and analyze a Tabu Search (TS) algorithm for DSA (Dynamic Spectrum Access) in cellular networks. We study a mono-operator case where the operator is providing packet services to the end-users. The objective of the cellular operator is to maximize its reward while taking into account the trade-off between the spectrum cost and the revenues obtained from end-users. These revenues are modeled here as an increasing function of the achieved throughput. Results show that the algorithm allows the operator to increase its reward by taking advantage of the spatial heterogeneity of the traffic in the network, rather than assuming homogeneous traffic for radio resource allocation. Our TS-based DSA algorithm is efficient in terms of the required memory space and convergence speed. Results show that the algorithm is fast enough to suit a dynamic context.

Robustness in Context-Aware Mobile Computing

Hannes Wolf (University of Stuttgart, Germany); Kurt Rothermel (University of Stuttgart, Germany, Germany); Klaus Herrmann (University of Stuttgart, Germany)

High level context recognition and situation detection are an enabling technologies for unobtrusive mobile computing systems. Significant progress has been made in processing and managing context information, leading to sophisticated frameworks, middlewares, and algorithms. Despite great improvements, context aware systems still require a significantly increased recognition accuracy for high-level context information on uncertain sensor data to enable the robust execution of context-aware applications. Recently Adaptable Pervasive Workflows (APF)s have been presented as innovative programming paradigm for mobile context-aware applications. We propose a novel Flow Context System (FlowCon) that builds upon APFs. FlowCon uses structural information from the APF to increase accuracy of uncertain high-level context information up to 49%. This way we make an important step to enable robust execution of mobile context-aware applications.

Mobile Systems Location Privacy: "MobiPriv" A Robust K Anonymous System

Leon Stenneth (University of Illinois at Chicago, USA); Philip Yu (University of Illinois Chicago, USA); Ouri Wolfson (University of Illinois, USA)

With the rapid advancement of positioning and tracking capabilities (mobile phones, on-board navigation systems) location based services are rapidly increasing. Privacy in location based systems is addressed in many papers. Our work is focused on the trusted third party privacy framework that utilizes the concept of k-anonymity with or without l-diversity. In previous anonymization models K may be defined as a personalization parameter of the mobile user or as uniform system parameter for all mobile users. Clearly, K other users may not be available at the time of request in these systems. These requests are discarded because the quality of service (QoS) they require cannot be satisfied. In this paper we introduce a novel suite of algorithms called

MobiPriv that guarantees a 100% success rate of processing a mobile request using k-anonymity with diversity considerations. We evaluated our suite of algorithms experimentally against previously proposed anonymization algorithms using real world traffic volume data, real world road network and mobile users generated realistically by a mobile object generator.

[I Want to Go Home: Empowering the Lost Mobile Device](#)

Chi Zhang (Polytechnic Institute of NYU, USA); Robert Fisher (Carnegie Mellon University, USA); Joel Wein (Polytechnic, USA)

It is estimated that over 8 million cell phones are lost or stolen each year [7]; often the loss of a cell phone means the loss of personal data, time and enormous aggravation. In this paper we present machine-learning based algorithms by which a cell phone can discern that it may be lost, and take steps to enhance its chances of being successfully recovered. We use data collected from the Reality Mining project [10] to create a suite of realistic test cases that model lost cell phone behavior. On these data sets our best algorithms can identify cases of a lost mobile device, based on its behavior over the previous 3 hours, with close to 100% accuracy. In addition, the algorithm generates false positive identifications with probability less than 3%; for individuals with relatively predictable lifestyles the False Positive Rate is substantially less. We also use the Reality Mining data to construct a set of test cases that model the behavior of a stolen phone, and show that similar algorithmic techniques give reasonable results in this setting as well.

[The Resource-Oriented Mobile Web Server for Long-Lived Services](#)

Fahad Aijaz (RWTH Aachen University, Germany)

The Web Servers are globally accepted as the back-bone of the Internet. The researchers in the area of the enterprise computing have studied, analyzed and implemented several architectures to optimize the performance of the large-scale Web Servers. However, due to the convergence of the IT and the mobile communication domains, the mobile nodes now are also been viewed as the service hosting platforms. The aim of this article is to present an optimized Mobile Web Server architecture for provisioning the Mobile Web Services (MobWS) as lengthy processes. For that reason, the asynchronous interaction strategy is derived, and later used to comprehensively discuss the server architecture, which is based on the Representational State Transfer (REST) design principles. The manuscript presents a detailed performance evaluation of the architecture and compares the results with the server based on the Simple Object Access Protocol (SOAP) standard. The results show promising performance improvements due to the reduced payload requirements of the REST server.

[Compensation for HPA Nonlinearity and I/Q Imbalance in MIMO Beamforming Systems](#)

Jian Qi (University of Quebec, INRS-EMT, Canada); Sonia Aissa (University of Quebec, INRS-EMT, Canada)

In this paper, we investigate the effects of high-power amplifier (HPA) nonlinearity and in-phase and quadrature-phase (I/Q) imbalance on the performance of multiple-input multiple-output (MIMO) transmit beamforming (TB) systems. Specifically, we propose a compensation method for HPA nonlinearity and I/Q imbalance together in MIMO TB systems. The performance of the MIMO TB system under study is evaluated in terms of the average symbol error probability (SEP) and system capacity, considering transmission over uncorrelated frequency-flat Rayleigh fading channels. Numerical results are provided and show the effects of several system parameters, such as the HPA parameters, image-leakage ratio, numbers of transmit and receive antennas, length of pilot symbols, and modulation order of phase-shift keying (PSK), on performance.

1:20 PM - 3:00 PM

Wireless and Ad-Hoc Networks (II)

Room: Strategy Room 1

Chair: Rafael Cepeda (Toshiba Research Europe Ltd, United Kingdom)

A New Algorithm for Backbone Formation in Ad Hoc Wireless Networks of Nodes with Different Transmission Ranges

Hossein Kassaie (Concordia University, Canada); Lata Narayanan (Concordia University, Canada)

We consider the problem of backbone formation in ad hoc wireless networks composed of heterogeneous nodes. A virtual backbone in an ad hoc wireless network provides a hierarchical infrastructure that can be used to address important challenges such as efficient routing, multicasting/broadcasting, activity-scheduling, and energy efficiency. We model a wireless network in which nodes have different transmission ranges by a disk graph. A virtual backbone in such a network can be modeled by a Strongly Connected Dominating and Absorbent Set (SCDAS) in the associated disk graph. For practical reasons, it is desirable to minimize the size of this backbone. In this paper, we propose an efficient distributed algorithm for the construction of an SCDAS in ad hoc networks modeled by disk graphs. Our algorithm relies on local information in the construction of the SCDAS. It also provides the flexibility to adjust the tradeoff between the degree of locality of information exchange and the size of the sets it generates. Extensive simulation results show that the SCDAS constructed by our algorithm is significantly smaller than that generated by the algorithms prior to our work.

Minimal TCB for MANET Nodes

Vinay Thotakura (Mississippi State University, USA); Mahalingam Ramkumar (Mississippi State University, USA)

Securing any MANET routing protocol requires measures to ensure that routing information advertised by a node (to its neighbors) is consistent with routing information assimilated by a node (from its neighbors). We investigate a minimal trusted computing base (TCB) for MANET nodes to achieve this requirement. We outline low complexity TCB functions which can be executed inside trustworthy boundaries of resource limited trustworthy MANET modules. The TCB functions are used to maintain a table of active neighbors, create routing records (RR), authenticate RRs to TMMs in neighboring nodes, receive authenticated RRs, and update RRs subject to simple rules. Even while the dynamic RR database of every node is stored outside the TMM, by storing the root of an index ordered Merkle hash tree (IOMT) (a novel construct proposed in this paper) the TMMs can ensure that nodes cannot modify, replay or even hide RRs that exist in the dynamic database.

Client-based Intrusion Prevention System for 802.11 Wireless LANs

Yaqing Zhang (Dalhousie University, Canada); Srinivas Sampalli (Dalhousie University, Canada)

Denial of Service (DoS) attacks on 802.11 wireless LANs can be caused by management frames sent by rogue access points. Unfortunately, such attacks can be successful even if the wireless network is protected by a high-level security protocol such as WiFi Protected Access Version 2 (WPA2). We present a novel client-based scheme for the prevention of such intrusions. By using a Medium Access Control (MAC) filtering mechanism, the "smart" client is able to differentiate between legitimate and forged management frames. The proposed mechanism is noncryptographic, has low overheads and can be deployed in existing IEEE 802.11 WLANs. We

have built and tested a prototype of our scheme. We demonstrate that our mechanism can protect wireless clients against management frame DoS attacks launched at the MAC layer.

Interference Aware Scheduling for Ultra Wideband Networks

Holger Rosier (RWTH Aachen University, Germany); Jens Frerichs (Communication Networks (ComNets) Research Group, RWTH Aachen University, Germany); Sebastian Max (RWTH Aachen University, Germany)

Wireless Personal Area Networks (WPANs) are used for a wide variety of applications. Former WPANs, like Bluetooth, offer data rates only for low rate communication. Nowadays, consumer electronic devices have high demands on communication systems, e.g. for high definition video transmission. Users expect future WPANs to act like wired systems by means of reliability, that is, packet loss and distortion. Multimedia systems are ubiquitous; hence, it can be expected, that future WPANs have to operate in dense network topologies. For that reason new technologies have to be evaluated in terms of interference mitigation and their ability to cooperate with Simultaneously Operating Piconets (SOPs). This paper focuses on Ultra Wideband (UWB) communication according to ECMA-368, called WiMedia. WiMedia's reservation-based medium access for high throughput and strict QoS requirements is evaluated taking inter-piconet interference into account. Strategies for distributed interference aware scheduling are proposed and examined by simulation to show system capacity for given scenarios.

Soft ZF MIMO detection for turbo codes

Pingping Shang (Chonbuk National University, Korea); Sooyoung Kim (Chonbuk National University, Korea); Kwonhue Choi (Yeungnam University, KOREA, Korea)

In this paper, we present a soft zero forcing (ZF) scheme for turbo-coded multi-input multi-output (MIMO) schemes. The complexity of maximum likelihood (ML) soft detection for turbo coded MIMO schemes increases exponentially by the number of antennas and modulation orders, and thus it is a NP hard problem. In this paper, we divide the soft detection process as three sequential steps and this highly reduces the computational complexity. The three sequential steps include ZF detection of the transmitted modulation symbol, soft demapping, and application of proper channel gain. We demonstrate the simulation results on fast and slow fading channels and show that the proposed soft ZF scheme can achieve just a dB power loss with dramatically reduced detection complexity compared to ML detection.

1:20 PM - 3:00 PM

Sensor Networks (I)

Room: Strategy Room 2

Chair: Ashay Dhamdhere (University of New South Wales, Australia)

MASY: MAnagement of Secret keYs for Federated Mobile Wireless Sensor Networks

Jef Maerien (K.U.Leuven, Belgium); Sam Michiels (Katholieke Universiteit Leuven, Belgium); Christophe Huygens (Katholieke Universiteit Leuven, Belgium); Wouter I Joosen (University of Leuven, Belgium)

Wireless Sensor Networks are becoming federated and mobile environments. These new capabilities pose a lot of new possibilities and challenges. One of these challenges is to create a secure environment to allow multiple trusted companies to share and merge their sensor network infrastructure. The most basic need for a secure environment is the deployment of key material. However, most current day research assumes pre-shared secrets between the sensor nodes of most, if not all, companies in a federation. These solutions are often not scalable nor mobile enough to meet realistic business requirements. Additionally, most key deployment protocols totally omit any connectivity with back-end infrastructure. This paper proposes a novel deployment protocol for MAnagement of Secret Keys (MASY). MASY allows secure deployment of a key to a sensor node when it enters a previously unknown network. By off-loading the trust creation process to the resource-rich back-end infrastructure, the burden of the sensor nodes remains very limited.

A Lightweight Dynamic Optimization Methodology for Wireless Sensor Networks

Arslan Munir (University of Florida, Gainesville, Florida, USA); Ann Gordon-Ross (University of Florida, USA); Susan Lysecky (University of Arizona, USA); Roman Lysecky (University of Arizona, USA)

Technological advancements in embedded systems due to Moore's law have lead to the proliferation of wireless sensor networks (WSNs) in different application domains (e.g. defense, health care, surveillance systems) with different application requirements (e.g. lifetime, reliability). Many commercial-off-the-shelf (COTS) sensor nodes can be specialized to meet these requirements using tunable parameters (e.g. voltage, frequency) to specialize the operating state. Since a sensor node's performance depends greatly on environmental stimuli, dynamic optimizations enable sensor nodes to automatically determine their operating state in-situ. However, dynamic optimization methodology development given a large design space and resource constraints (memory and computational) is a very challenging task. In this paper, we propose a lightweight dynamic optimization methodology that intelligently selects initial tunable parameter values to produce a high-quality initial operating state in one-shot for time-critical or highly constrained applications. Further operating state improvements are made using an efficient greedy exploration algorithm, achieving optimal or near-optimal operating states while exploring only 0.04% of the design space on average.

Using LQI to Improve ClusterHead Locations in Dense ZigBee based Wireless Sensor Networks

Cherif Diallo (Institut TELECOM; Telecom SudParis, France); Michel Marot (Institut TELECOM; Telecom SudParis, France); Monique Becker (Institut TELECOM; Telecom SudParis, France)

In WSN, it is not often desirable to use the GPS technology. Indeed, the use of GPS is expensive and may reduce the overall network performance. Moreover, indoor reception of the GPS signal is not possible. The Link Quality Indicator (LQI) is defined in the 802.15.4 standard, but its context of use is not specified in this standard. Some works on the LQI, few of which are field experiments, have shown that the LQI decreases as the distance increases. However, the challenge of clustering mechanisms is to form the smallest number of clusters by maximizing distances separating cluster heads to provide an efficient cover of the network and also minimizes the cluster overlaps. This reduces the amount of channel contention between clusters, and also improves the efficiency of algorithms that run at the level of the cluster heads. Therefore we propose an analytical model based on the use of the LQI in order to derive an optimally one-dominating set in which the smaller distance separating two cluster heads is improved.

Relay Node Placement for Wireless Sensor Networks Deployed in Tunnels

Ruoshui Liu (University of Cambridge, United Kingdom)

Node placement plays a significant role in the effective and successful deployment of Wireless Sensor Networks (WSNs), i.e., meeting design goals such as cost effectiveness, coverage, connectivity, lifetime and data latency. In this paper, we propose a new strategy to assist in the placement of Relay Nodes (RNs) for a WSN monitoring underground tunnel infrastructure. By applying for the first time an accurate empirical mean path loss propagation model along with a well fitted fading distribution model specifically defined for the tunnel environment, we address the RN placement problem with guaranteed levels of radio link performance. The simulation results show that the choice of appropriate path loss model and fading distribution for typical environments is vital in the determination of the number and the positions of RNs. Furthermore, we adapt a two-tier clustering multi-hop framework in which the first tier of the RN placement is modeled as the minimum set cover problem, and the second tier placement is solved using the search-and-find algorithm. The implementation of the proposed scheme is evaluated by simulation, and it lays the foundations for further work in WSN planning for underground tunnel applications.

Priority-Based Node Selection and Scheduling for Wireless Multimedia Sensor Networks

Mohammad Alaei (Universitat Politècnica de Catalunya (UPC), Spain); Jose M. Barcelo-Ordinas (Universitat Politècnica de Catalunya (UPC), Spain)

A critical aspect of applications with wireless sensor networks is network lifetime. Sensing and communications consume energy particularly in wireless multimedia sensor networks (WMSN) due to huge amount of data generated by the multimedia sensors. Therefore, judicious power management and sensor scheduling can effectively extend network lifetime. In this paper we consider the problem of scheduling multimedia sensor activities to maximize network lifetime. The environment is divided in domains monitored by clusters of multimedia sensor nodes. Network lifetime increment is achieved by cooperation between multimedia sensors in two priority-based ways: Intra-cluster cooperation and Inter-cluster cooperation. We will see that the lifetime of cluster nodes is considerably increased under the proposed node selection and scheduling procedures. As for big clusters, the lifetime even is prolonged to 5.5 times with respect to the ordinary un-cooperative node awakening.

3:30 PM - 5:10 PM

Vehicular Communications

Room: Strategy Room 1

Chair: Juan Jose Alcaraz Espin (Technical University of Cartagena, Spain)

A privacy-aware location service for VANETs using Chaum's mixes

Florian Scheuer (University of Regensburg, Germany); Matthias Brecht (University of Regensburg, Germany); Hannes Federrath (University of Regensburg, Germany)

Protecting the privacy of VANET users is an important issue. We present in this paper an architecture that aims at this goal by integrating Chaum's mix network into a distributed but infrastructure-based location service for position-based routing. In addition we enable the user to decide when he wants to reveal his position to anyone else. Thus neither entity of the VANET is in full knowledge about the location and the identity of any user at the same time. The proposed system can be integrated in most published VANET security frameworks and our evaluation shows that an implementation is feasible.

How to Disseminate Vehicular Data Efficiently in both Highway and Urban Environments?

Mohamed Cherif (France Telecom, France); Sidi-Mohammed Senouci (University of Bourgogne - ISAT Nevers, France); Bertrand Ducourthial (Université de Technologie de Compiègne, France)

Vehicular networks are a class of mobile networks in which vehicles are equipped with radio interfaces and are therefore able to communicate with an infrastructure (if existing) or other vehicles in an opportunistic way. Information dissemination enjoys wide applicability in these types of networks, ranging from traffic information and warnings, to parking availability, fuel prices, road conditions, and advertisements. Hence, we propose an efficient dissemination protocol: ROD (Road Oriented Dissemination) that consists in two modules: (i) Optimized Distance Defer Transfer module, and (ii) Store and Forward module. This protocol permits to increase the delivery ratio and optimize the bandwidth use by limiting the number of vehicles having to relay each packet. The protocol has been implemented and tested on the roads. In this paper we report its performance studies, performed by means of simulations, and we compare them to other dissemination protocols results. Performance study shows interesting results of ROD compared to existing solutions.

Mapcast: A Map-Constrained Broadcast Solution for VANETs

Hector Agustin Cozzetti (Istituto Superiore Mario Boella, Italy); Riccardo M. Scopigno (Istituto Superiore Mario Boella, Italy); Luca Casone (STMicroelectronics, Italy); Giuseppe Barba (STMicroelectronics, Italy)

Solutions for Vehicular Ad-Hoc Network (VANET) are challenging due to the intrinsic nature of the network which involves, by definition, node mobility, scarce or null fixed nodes and, at the current state of art, lack of solutions for the real-time tracking of positions. Moreover VANETs are meant to provide primarily a solution for the improvement of road safety, by the proper forwarding of messages: this makes the overall service scenario even more critical due to the delay-constraints and the scalability issues. While some solutions have already been proposed in literature to optimize message multi-hop forwarding based on mutual positions of nodes and exploiting CSMA/CA MAC mechanisms, in this paper a novel solution is presented: it extends the intuitive

concepts of Geo-Broadcast (that is, broadcast forwarding based on distances) towards a more precise idea of Map-Driven forwarding (or Mapcast), where the real-life road topology leads forwarding policies. Mapcast solves some issues left open by previous art and simulatively shows interesting potentials.

Adapting Statistical Broadcast to Linearly Oriented Networks for VANETs

Michael J Slavik (Florida Atlantic University, USA); Imad Mahgoub (Florida Atlantic University, USA)

Broadcast is a critical component in ad-hoc wireless networks. Some vehicular network (VANET) applications in particular use broadcast communications extensively. VANETs exhibit a wide variety of node density and distribution patterns, so broadcast protocols designed to support these applications must be adaptive to those conditions. We show that the distance method of statistical broadcast can be used to design a protocol that performs well in one-dimensional or two-dimensional uniformly distributed networks, but not both. We propose using the quadrat method of spatial analysis to characterize the distribution pattern at each node and use the resulting metric, K , as a factor in computing the statistical threshold function. The result, the Distribution-Adaptive Distance (DAD) method, is shown to exhibit a high level of reachability and efficient bandwidth utilization across a range of distribution patterns from purely linear to purely two-dimensional and sparsely distributed to densely distributed. More generally, the design methodology presented in this work provides a procedure enabling statistical broadcast protocol designers to build protocols that are adaptive to both node density and node distribution. This capability is a key prerequisite for design of practical broadcast protocols to support VANET applications.

Performance Modeling of Safety Message Delivery in Vehicular Ad Hoc Networks

Ghada Badawy (Ryerson University, Canada); Jelena Misić (Ryerson University, Canada); Terence D. Todd (McMaster University, Canada); Dongmei Zhao (McMaster University, Canada)

Vehicular ad-hoc networks (VANETs) will enable a wide variety of future inter-vehicle and vehicle-to-roadside applications. These services will span a large range of functionality, such as those supporting vehicular safety, to those used for best-effort roadside advertising. To support this wide range, the IEEE 802.11p standard defines seven communication channels, consisting of a single control channel for safety applications, and six service channels which can be used for other purposes. To allow a single radio interface to support both types of applications, the standard defines a channel coordination mechanism that allows the vehicular radio to alternately access the control and service channels. When this happens it is very important that safety messages are transmitted with high reliability and low latency. Using analytical models, this paper provides a performance evaluation of vehicular safety message delivery. Our results show that the mechanism defined in the standard can satisfy the needed latency requirements, but cannot satisfy the required reliability for safety message delivery.

3:30 PM - 5:10 PM

Sensor Networks (II)

Room: Strategy Room 2

Chair: Nidal Nasser (University of Guelph, Canada)

Dynamic Service Policy-based Clustered Wireless Sensor Networks

Akramul Azim (University of Waterloo, Canada); Mohammad Mahfuzul Islam (BUET, Bangladesh)

Energy is one of the main obstacles to deploy wireless sensor networks (WSNs) because tiny sensor nodes cannot accommodate sufficient energy for achieving the desired level of usage. The clustering protocols of wireless sensor network attains the acme popularity among the researchers because of making effective usage of energy preserved in sensor nodes through implementing clustering concepts based on locality and electing a cluster head for each of them. We get motivations from the energy saving clustering schemes and propose an enhancement of clustering schemes by saving energy and prolonging the lifetime of sensor network significantly. The Low Energy Adaptive Clustering Hierarchy (LEACH) achieves a supreme popularity for its simplicity and applicability in WSNs. A large number of works exist that modifies LEACH to strengthen the applicability of this scheme in practical life, but only limited to the cluster set-up phase. In this paper, we observe a major problem that exists in all of the clustering protocol based on LEACH. LEACH and its variant encounter premature death of cluster heads because of this fixed round time problem. Our proposed dynamic service policy based scheme decreases the premature death of cluster head and the packets loss significantly.

Energy-Aware Multi-Hop Transmission for Sensor Networks based on Adaptive Modulation

Abdellah Chehri (University of Ottawa, Canada); Hussein Mouftah (University of Ottawa, Canada)

Wireless Sensor networks (WSN) have become a focus of research in the last few years. WSN is composed of small battery-powered devices that has sensors and wireless communication capabilities. Energy management is one of the key issues in WSNs because it directly impacts the network life-time. In order to overcome this restriction, several energy-efficient approaches for different layers have been investigated. In this paper, energy optimization on physical layer is analyzed. The node's power consumption is optimized through scaling the modulation scheme used in node communications. Results show that an optimal modulation scheme can lead to the minimum power consumption over the whole wireless sensor network.

Performance study of multiple cover-set strategies for mission-critical video surveillance with wireless video sensors

Pham CongDuc (Univ. of Pau, France); Abdallah Makhoul (University of Franche-Comté, France)

A Wireless Video Sensor Network (WVSN) consists of a set of sensor nodes equipped with miniaturized video cameras. Unlike omni-directional sensors, the sensing region of a video node is limited to the field of view of its camera. In this paper, we study the problem of coverage by video sensors in randomly deployed WVSN. We focus on the performance of various fast cover set construction strategies for enabling efficient scheduling of nodes in mission-critical surveillance applications. Simulation results show the performance of the various strategies in terms of percentage of coverage, network lifetime, intrusion stealth time and number of intrusion detection.

Characterizing Link and Path Reliability in Large-Scale Wireless Sensor Networks

Turgay Korkmaz (University of Texas at San Antonio, USA); Kamil Sarac (University of Texas at Dallas, USA)

Reliable data transfer (RDT) is one of the key issues in wireless sensor networks (WSNs) and can be achieved by using link-level re-transmissions and multi-path routing. Another key issue is the scalability of WSNs. In this paper, we try to better understand and characterize/quantify the relationships between reliability and scalability, and identify possible design options for the future RDT protocols in large-scale WSNs. With this in mind, we conduct actual experiments to characterize link reliability measures in an actual sensor network setting. We then used these measures and analyze how commonly used RDT mechanisms impact overall path reliability. In general, our analysis shows that the combination of link-level re-transmissions and multi-path routing is a viable solution in small-scale WSNs. However, due to the increased length of paths between sensor nodes and sinks in large-scale WSNs, it becomes costly to sustain the overall reliability at an acceptable level. Therefore, the future RDT protocols should focus on minimizing the path lengths using hierarchical structures in large-scale WSNs. It is also necessary to couple RDT protocols with routing protocols that can take link reliability measures into account.

Mobility-assisted Detection of the Replication Attacks in Mobile Wireless Sensor Networks

Xiaoming Deng (University of Science and Technology of China, P.R. China); Yan Xiong (University of Science and Technology of China, P.R. China); Depin Chen (University of Science and Technology of China, P.R. China)

Wireless sensor networks are often deployed in harsh environments, where the adversary is able to capture certain sensors. Once a sensor is compromised, the adversary can easily replicate it and deploy several replicas back into the network for further malicious activities. Although a number of protocols have been proposed to tackle such node replication attacks, few of these schemes are suitable for mobile wireless sensor networks. In this paper, we propose two novel mobility-assisted distributed solutions to node replication detection in mobile wireless sensor networks. In both protocols, after receiving the time-location claims, witnesses carry these claims around the network instead of transmitting them. That means data are forwarded only when appropriate witnesses encounter each other. Unary-Time-Location Storage & Exchange (UTLSE) detects the replicas by each of the two encountered witnesses which stores only one time-location claim. Multi-Time-Location Storage & Diffusion (MTLSD), by storing more time-location claims for each tracked node and introducing time-location claims diffusion among witnesses, provides excellent resiliency and sub-optimal detection probability with modest communication overhead. Due to the mobility-assisted property, our protocols do not rely on any specific routing protocol, which makes them suitable for various mobile settings. Our theoretical analysis and simulation results show that our protocols are efficient in terms of detection performance, communication overhead and storage overhead.

A Load-Distributive QoS Routing Protocol for Multi-Service Wireless Mesh Networks

Mehdi Khabazian (INRS-EMT, Canada); Sonia Aissa (University of Quebec, INRS-EMT, Canada)

This paper proposes a novel routing protocol for multi-service wireless mesh networks (WMNs). Our protocol provisions quality of service (QoS) using bandwidth reservation and bandwidth splitting mechanisms in the network layer and enhanced distributed contention access mechanism in the MAC layer. A performance analysis is conducted and the results show that the proposed resource management mechanism enables high-priority traffics to better access network resources and achieve lower delays. Low-priority traffics, on the other hand, may be routed through higher number of hops and may experience more delays or meet lower available bandwidth. The proposed bandwidth offer mechanism results in an efficient traffic load distribution in the network and eliminates bottle-neck situations. The results also show the interaction between the MAC and routing protocols in terms of joint QoS provisioning.

Wednesday, October 13

8:30 AM - 9:30 AM

Keynote: Towards 50 Billion Devices: A Sustainable Evolution of Mobile Networks

Pierre Boucher, Ericsson Canada

Room: Strategy Room 3

Chair: Abderrahim Benslimane (University of Avignon & LIA/CERI, France)

10:00 AM - 11:40 AM

Air Interfaces

Room: Strategy Room 1

Chair: Shihab Jimaa (Khalifa University, UAE)

Effect of Channel Interference on Indoor Wireless Local Area Network Positioning

Eddie Chan (The Hong Kong Polytechnic University, Hong Kong); George Baciu (The Hong Kong Polytechnic University, Hong Kong)

Localization systems for indoor areas have recently been suggested that make use of existing wireless local area network (WLAN) infrastructure and location fingerprinting approach. However, most existing research work ignores channel interference between wireless infrastructures and this could affect accurate and precise positioning. A better understanding of the properties of channel interference could assist in improving the positioning accuracy while saving significant amounts of resources in the location-aware infrastructure. This paper investigates to what extent the positioning accuracy is affected by channel interference between access points. Two sets of experiments compare how the positioning accuracy is affected in three different channel assignment schemes: ad-hoc, sequential, and orthogonal data is analyzed to understand what features of channel interference affect positioning accuracy. The results show that choosing an appropriate channel assignment scheme could make localization 10% more accurate and reduce the number of access points that are required by 15%. The experimental analysis also indicates that the channel interference usually obeys a right-skewed distribution and positioning accuracy is heavily dependent on channel interference between access points (APs).

On the Impact of Multipath Propagation and Diversity in Performance of Iterative Block Decision Feedback Equalizers

Fábio Coelho (Universidade Nova de Lisboa, Portugal); Rui Dinis (ISR-IST, Technical University of Lisbon, Portugal); Nuno Souto (ISCTE/Instituto de Telecomunicações, Portugal); Paulo Montezuma (FCT-UNL, Portugal)

SC modulation (Single-Carrier) with FDE(Frequency-Domain Equalization) combined with iterative(turbo) FDE schemes has excellent performance in severely time-dispersive channels, making it a promising candidate for future broadband wireless systems. In fact, it was observed that the performance can be close to the MFB(Matched Filter Bound). In this paper we consider a class of iterative FDE schemes and we study the impact of the number of multipath components and the diversity order on its performance. It is shown that for a high number of separable multipath components the asymptotic performance approaches the MFB, even without diversity. When we have diversity the performance approaches the MFB faster, even when we have just a small number of separable multipath components.

Parallel soft ZF detection for turbo-coded QO-STBC scheme

Unhee Park (Electronics and Telecommunications Research Institute, Korea); Sooyoung Kim (Chonbuk National University, Korea); Youngmin Kim (Chonbuk National University, Korea); Dae-Sub Oh (Electronics and Telecommunications Research Institute, Korea); Bon-Jun Ku (Electronics and Telecommunications Research Institute, Korea)

A zero forcing (ZF) decoder using the pseudo inverse of a channel matrix is generally used for detection of quasi-orthogonal space time block coding (QO-STBC). This ZF detection for QO-STBC should sacrifice not only the decoding complexity but also the diversity gain compared to a simple linear detection for orthogonal STBC schemes. This disadvantage of QO-STBC schemes are mainly result from the interference terms in the detection matrix. In this paper, we propose a parallel detection scheme for QO-STBC, which may enhance the computational efficiency compared to the conventional ZF scheme, especially when combining with turbo codes. We present a very efficient soft decision metrics to be used at the iterative decoder for turbo codes. The simulation results in this paper reveal that the proposed detection scheme produces an almost the same performance to that of the the maximum likelihood (ML) detection, with greatly enhanced computational efficiency.

[An ID-based Authentication Scheme For the IEEE 802.11s Mesh Network](#)

Aymen Boudguiga (Telecom & Management SudParis, France); Maryline Laurent (Institut Télécom, Télécom SudParis, France)

Nowadays authentication in Wireless Mesh Networks (WMN) refers to the 802.1X authentication methods or a Preshared key authentication, and makes use of certificates or shared secrets. In wireless environments, management of certificates is disadvantageous. Certificates require deploying a Public Key Infrastructure (PKI) and Certification Authorities (CA) and they require defining a certificate management policy to control the generation, transmission and revocation of certificates. Management of certificates is a cumbersome task and does not match the limited (power and memory) resources available at wireless nodes. Moreover it does not match the non permanent connectivity to CA. In this paper, we propose an ID-based method, as an alternative to the PKI, to provide nodes with private and public keys, and we present an authentication scheme that uses the ID-based cryptographic concepts. As illustrated in the paper, the authentication scheme is shown as suitable to the WMN networks.

[Computationally Efficient Lattice Reduction for MIMO-OFDM Systems](#)

Wei Liu (Oregon State University, USA); Kwonhue Choi (Yeungnam University, KOREA, Korea); Huaping Liu (Oregon State University, USA)

We propose a computationally efficient lattice reduction (LR) algorithm for multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) systems in frequency-selective fading channels. In our proposed algorithm, we exploit the inherent feature of unimodular transformation matrix P that remains the same for frequency components which have relatively high amplitude correlation. We eliminate the redundant calculations by reducing brute-force LR iterations among adjacent subcarriers. We simulate the error performance and complexity of the proposed algorithm under various MIMO-OFDM system configurations. The results demonstrate that the proposed algorithm could significantly reduce the LR complexity by up to 90% multiplications and 99% divisions of brute-force LR while maintaining the system performance.

10:00 AM - 11:40 AM

Smart Systems

Room: Strategy Room 2

A Novel Reduced Complexity Detection Scheme for Distributed Single-Carrier Frequency Domain Equalization

Homa Eghbali (Simon Fraser University, Canada); Sami Muhaidat (Simon Fraser University, Canada); Naofal Al-Dhahir (University of Texas at Dallas, USA)

In this paper, we propose a new detection scheme for single carrier frequency-domain equalization (SC-FDE) for relay-assisted transmission scenario over frequency selective channels. We show that, by incorporating linear processing techniques, our new receiver significantly outperforms the minimum mean square error (MMSE)-distributed (D)-SC-FDE receiver in terms of the error rate performance. Simulation results and complexity analysis demonstrate that our proposed receiver outperforms the conventional cooperative MMSE-SC-FDE receiver by performing close to matched filter bound (MFB), while incurring a minimal additional computational complexity

Minimum Bit Error Rate Multiuser Detection of SDMA-OFDM System Using Differential Evolutionary Algorithm

Jehad Ababneh (Jordan University of Science and Technology, Jordan); Taimour Aldalgamouni (Jordan University of Science and Technology, Jordan); Asmaa Alqudah (Jordan University of Science and Technology, Jordan)

Space division multiple access aided orthogonal frequency division multiplexing (SDMA-OFDM) is a promising technique for high data rate future wireless communications. In this paper, a minimum bit error rate (MBER) differential evolution (DE) algorithm based multiuser detector (MUD) for SDMA-OFDM system is proposed. The proposed algorithm directly minimizes the bit error rate (BER) cost function by selecting the optimum weight vectors. Simulation results show that the proposed DE based MUD outperforms the minimum mean-squared error (MMSE) based MUD in terms of the achievable BER. Simulation results also show that the performance of the DE based MUD is comparable to that of the particle swarm optimization (PSO) based MUD.

Cooperative Relaying in Interference Limited Cognitive Radio Networks

Asaduzzaman Asad (University of Ulsan, Korea); Hyung-Yun Kong (University of Ulsan, Korea)

In this paper, we consider a cooperative relaying based cognitive radio (CR) networks in which the primary receivers are protected by peak interference power constraint. In such scenario, finding the transmission opportunity with a target data rate by maintaining the interference power constraint is the prime goal of the system. We show that cooperative relaying techniques can significantly reduce the outage probability equivalently, improve the transmission opportunity of the CR networks in slow-fading channels. We consider both distributed space time code (DSTC) based simultaneous transmission and single relay selection based transmission from the relays. The exact expressions of the outage probabilities of different cooperative relaying schemes are derived for arbitrary number of relays and interference power constraint in Rayleigh fading

environment. Results show that the single relay selection based schemes outperform the DSTC based scheme, in terms of both outage probability and implementation complexity, in multi-relay CR network.

COPAL: An Adaptive Approach to Context Provisioning

Fei Li (Vienna University of Technology, Austria); Schahram Dustdar (Vienna University of Technology, Austria); Sanjin Sehic (Vienna University of Technology, Austria)

Context-aware services need to acquire context information from heterogeneous context sources. The diversity of service requirements on context challenges context provisioning system as well as its programming model. This paper proposes COPAL (COntext Provisioning for ALI) --- an adaptive approach to context provisioning. COPAL is at first a context provisioning system, which provides loose-coupling between context and its processing. The component architecture of COPAL ensures new context processing functions can be added dynamically. A set of context processing patterns are proposed to customize context attributes and compose context provisioning schemes. The COPAL components and models are reflected in a Domain Specific Language (DSL), which can further reduce the development efforts on context provisioning by automatic code generation. An motivating scenario is used throughout the paper to illustrate COPAL approach.

Channel Aware Deferring Strategies to Improve Packet Scheduling in OFDMA Systems

Israel Guío (University of Zaragoza, Spain); Angela Hernández-Solana (University of Zaragoza, Spain); Vanesa Montero (University of Zaragoza, Spain); Javier Lafuente-Martínez (University of Zaragoza, Spain); Antonio Valdovinos (University of Zaragoza, Spain)

In this paper, we analyze the performance gain achieved when a channel-aware deferring (CaD) strategy is applied to defer the allocation of users with transitory bad channel state in a mobile OFDMA system. Users with good channel conditions receive more resources and the radio resource utilization improves. To reduce the impact of the CaD strategy on the quality of service (QoS) provisioning for the deferred users, a delay-dependent criterion is also applied. We show that the CaD significantly reduces both the dropping rate and the mean delay for the most restrictive traffic in a multi-service scenario, under a certain power and subcarrier allocation (PSA) algorithm that efficiently controls the inter-cell interference (ICI).

TOA-Based Lateral Distance Measurement System Using UWB Impulse Radio

Keiichi Nakamura (The University of Tokyo, Japan); Shinsuke Kobayashi (The University of Tokyo, Japan); Hisanori Matsumoto (YRP Ubiquitous Networking Laboratory, Japan); Noboru Koshizuka (The University of Tokyo, Japan); Ken Sakamura (The University of Tokyo, Japan)

Lateral distance between two traffic participants is an important context for intelligent transportation systems for realizing a collision prediction system. Obtaining lateral distance requires costly hardware, prohibiting traffic participants such as pedestrians and/or bicyclists to receive benefits of lateral distance information for securing their safety. In this paper, a time-of-arrival (TOA) based bilateration is proposed for estimating relative lateral distance using ultra-wideband impulse radio (UWB-IR). Ranging error of UWB-IR systems affecting the estimation accuracy of lateral distance is coped with applying a low pass filter to angular data. Experimental results show that the estimation error is reduced from 8 m to 3 m when the relative distance between a target vehicle and a pedestrian is less than 15 m, using a portable UWB-IR system with 30 cm ranging accuracy.

1:20 PM - 3:00 PM

Mobility and Nomadicity (I)

Room: Strategy Room 1

Chair: George Baciú (The Hong Kong Polytechnic University, Hong Kong)

Multi-Gateway Multi-path Routing Protocol for 802.11s WMN

Hu Yun (University of Science and Technology of China, P.R. China)

To enhance the capacity of wireless mesh network, multi-gateway architecture is invited. We use engineering methods to develop an implementable multipath multi-gateway routing protocol (MPMG) extended from HWMP to provide multipath functionality. We firstly develop a routing protocol with lower management overhead, then we develop three optimizing strategy to deal with the bottleneck problems appearing in simulations. At last we propose an implementable MPMG and evaluate it in typical scenarios. Performance comparisons of MPMG with HWMP, AODV and OLSR are done by NS-2. The simulation results show that MPMG outperforms the other three routing protocols. Specially MPMG improves the network throughput by 12.8% and reduces routing overhead by about 80% compared to HWMP.

An SSP Formulation of Routing in DTN Networks

Youssef Iraqi (Khalifa University, UAE)

In this paper we present a Stochastic Shortest Path (SSP) formulation of routing in DTN networks where all the nodes are potentially mobile and where only an aggregate mobility information is available. We present a solution to the optimal case and present two heuristics to solve the problem. Extensive simulations assess the performance of the proposed schemes.

Promoting Congestion Control in Opportunistic Networks

Andrew Grundy (University of Nottingham, United Kingdom); Milena Radenkovic (University of Nottingham, United Kingdom)

We are concerned with congestion aware forwarding algorithms within opportunistic networks. We remove the reoccurring assumption of unlimited storage, making it evident that congestion is a prominent problem that needs to be addressed. We propose a context-driven, distributed congestion control algorithm that adaptively chooses the next hop based on contact history, contact statistics, as well as storage statistics. We aim to distributed the load away from the storage hotspots in order to spread the traffic around. We perform an extensive set of trace driven simulations for "several-to-many" communication patterns in opportunistic networks. We show that congestion control is an essential component to be included in the transfer of data in opportunistic networks, which is achievable by disseminating statistics concerning a nodes state of availability. Our results show a that by using the availability heuristic it is possible to achieve higher levels of sent and delivered packets.

Pareto-Metaheuristic Multi-Objective Network Optimization for OFDMA-based Systems

Anas F. Al Rawi (University of Newcastle Upon Tyne, United Kingdom); Bayan Sharif (University of Newcastle Upon Tyne, United Kingdom); Charalampos C. Tsimenidis (Newcastle University, United Kingdom)

In this paper, a new planning method is proposed for the next generation wireless networks that are based on Orthogonal Frequency Division Multiple Access (OFDMA). As a consequence of the wide variety service demands in terms of data rate and Quality of Service (QoS), the traffic pattern is considered to be heterogeneous. Therefore, the complexity of obtaining Base Stations (BSs) positions increases with the randomness of the traffic distribution. In addition to this challenge, the capacity of each BS is limited due to power and bandwidth constraints, propagation losses, Gaussian antenna pattern, and the Co-Channel Interference (CCI), which in turn increase the complexity measures for an efficient network design. According to Nash Equilibrium, combined efficient systems must perform equally to achieve certain performance. This implies that the traffic of a cellular system should be equally distributed over all the BSs to achieve the highest network performance. Hence, we formulate the planning problem as a non-linear multi-objective optimization problem. The optimum solution should not dominate the throughput of one BS over the others and this is referred to as Pareto optimal. However, loading all cells equally may not be possible in certain traffic distributions. Therefore, the proposed method tends to approach the optimal solution by tackling the problems of BS positioning and resource allocation simultaneously. We adopt a hybrid approach, i.e. Pareto-Metaheuristic (PMH) that achieves a balanced throughput over all cells as well as minimizing the number of the installed BSs targeting a certain service outage probability. Simulation results show that, in addition to maximizing the individual cell throughput, the network throughput variation decreases as the number of iteration increases.

[Experimental Study of Mobility in the Soccer Field with Application to Real-Time Athlete Monitoring](#)

Vijay Sivaraman (University of New South Wales, Australia); Sarthak Grover (Indian Institute of Technology Roorkee, India); Alexander Kurusingal (University of New South Wales, Australia); Ashay Dhamdhere (University of New South Wales, Australia); Alison Burdett (Toumaz Technologies Ltd., United Kingdom)

Live monitoring of athletes during sporting events can help maximise performance while preventing injury, and enable new applications such as referee-assist and enhanced television broadcast services. A major challenge is the extraction of athlete physiological data in real-time, since the radio range of body-worn sensor devices is limited, necessitating multi-hop routing mechanisms. However, little is known about the highly dynamic operating conditions on a soccer field under which communication protocols need to operate. In this work we conduct field experiments in which we outfit first-division soccer players with sensor devices and record their inter-connectivity during a real game. Our first contribution profiles the key properties of the dynamic wireless topologies arising in the soccer field, and highlights the consequences for routing mechanisms. We show that the topology is in general sparse, with short encounters and power-law distributed inter-encounters. Importantly, the co-ordinated movement of players in the field gives rise to significant correlations amongst links, an aspect that can potentially be exploited by routing. Our second contribution develops a model for generating synthetic topologies that mirror connectivity in a real soccer game, and can be used for simulation studies of routing mechanisms. Its novelty lies in explicitly modelling the underlying auto-correlation and cross-correlation properties of the links, from which derived measures such as inter-encounter times and

neighbourhood distributions follow. Our study is an important first step towards understanding and modelling dynamic topologies associated with sports monitoring, and paves the way for the design of real-time routing algorithms for such environments.

1:20 PM - 3:00 PM

Next Generation Networks (I)

Room: Strategy Room 2

Dimensioning of the LTE Access Transport Network for Elastic Internet Traffic

Xi Li (University of Bremen, Germany); Umar Toseef (University of Bremen, Germany); Thushara L Weerawardane (University of Bremen, Germany); Wojciech Bigos (Nokia Siemens Networks, Poland); Dominik Dulas (Nokia Siemens Networks, Poland); Carmelita Goerg (University of Bremen, Germany); Andreas Timm-Giel (Hamburg University of Technology, Germany); Andreas Klug (Nokia Siemens Networks, Germany)

This paper proposes efficient analytical models to dimension the required transport bandwidths for the Long Term Evolution (LTE) access network for the elastic Internet traffic (which is carried by the TCP protocol). The dimensioning models are based on the use of Processor Sharing queuing theory to guarantee a desired end-to-end application QoS target. For validating the analytical dimensioning models, a developed LTE system simulation model is used. Extensive simulations are performed with various traffic and network scenarios. The analytical results derived from the proposed dimensioning models are compared against the simulation results. The presented results demonstrate that the proposed analytical models can appropriately estimate the application performances of different QoS priorities and thus be used for the link dimensioning for various traffic and network scenarios.

Scheduling and Resource Allocation for Multiclass Services in LTE Uplink Systems

Oscar Delgado (Concordia University, Canada); Brigitte Jaumard (Concordia University, Canada)

We propose two scheduling and resource allocation schemes that deal with Quality of Service (QoS) requirements in Uplink Long Term Evolution (LTE) systems. QoS for a multiclass system has been seldom taken into account in previous resource allocation algorithms for LTE uplink. In one of the new algorithms, we investigate the possibility of assigning more than one resource block and its consequences on satisfying stringent QoS requirements in the context of heavy traffic, either in terms of end-to-end delays or of minimum rates. System capacity and the number of effectively served requests are used as performance metrics. Numerical results show that it is possible to manage a multiclass scheme while satisfying the QoS constraints of all requests. Allowing the assignment of more than one resource block per request did not appear to be a meaningful advantage. Indeed, it is only useful when there is an heavy traffic, and some of the requests have stringent QoS requirements. But then, satisfying those requests can only be done at the expense of reducing the overall system capacity and of limiting the number of users that can be served.

Spectral Efficiency Performance of MBSFN-enabled LTE Networks

Christos Bouras (University of Patras and RACTI, Greece); Antonios Alexiou (University of Patras, Greece); Vasileios Kokkinos (RACTI and University of Patras, Greece); George Tschritzis (University of Patras and RACTI, Greece); Andreas Papazois (RACTI and University of Patras, Greece)

Long Term Evolution (LTE) constitutes the latest step towards the 4th generation (4G) of radio technologies designed to increase the capacity and speed of mobile communications. To support Multimedia

Broadcast/Multicast Services (MBMS), LTE offers the possibility to transmit Multimedia Broadcast multicast service over a Single Frequency Network (MBSFN), where a time-synchronized common waveform is transmitted from multiple cells for a given duration. This enables over-the-air combining, thus improving the Signal to Interference plus Noise Ratio (SINR) and spectral efficiency (SE) significantly compared to conventional MBMS operation. In this paper, we analytically calculate the SE performance achieved in a MBSFN area for a dynamically changing user topology and different modulation and coding schemes (MCS). Finally, based on the SE measurement, we determine the MCS scheme that either maximizes or achieves a target SE for the corresponding user distribution

[Efficient Resource Allocation for Device-to-Device Communication Underlying LTE Network](#)

Mohammad Zulhasnine (Carleton University, Canada); Changcheng Huang (Carleton University, Canada); Anand Srinivasan (Carleton University, Canada)

D2D (device-to-device) communication as an underlying cellular network empowers user-driven rich multimedia applications and also has proven to be network efficient offloading eNodeB traffic. However, D2D transmitters may cause significant amount of interference to the primary cellular network when radio resources are shared between them. During the downlink (DL) phase, primary cell UE (user equipment) may suffer from interference from the D2D transmitter. On the other hand, the immobile eNodeB is the victim of interference by the D2D transmitter during the uplink (UL) phase when radio resources are allocated randomly. Such interference can be avoided otherwise diminish if radio resource allocated intelligently with the coordination from the eNodeB. In this paper, we formulate the problem of radio resource allocation to the D2D communications as a mixed integer nonlinear programming (MINLP). Such an optimization problem is notoriously hard to solve within fast scheduling period of the Long Term Evolution (LTE) network. We then propose an alternative greedy heuristic algorithm that can lessen interference to the primary cellular network utilizing channel gain information. We also perform extensive simulation to prove the efficacy of the proposed algorithm.

[ARBR: Adaptive Reinforcement-Based Routing for DTN](#)

Ahmed Elwhishi (University of Waterloo, Canada)

Abstract--- This paper introduces a novel routing protocol in Delay Tolerant Networks (DTNs), aiming to solve the online distributed routing problem. By manipulating a collaborative reinforcement learning technique, a group of nodes can cooperate with each other and make a forwarding decision for the stored messages based on a cost function at each contact with another node. The proposed protocol is characterized by not only considering the contact time statistics under a novel contact model, but also looks into the feedback on user behavior and network conditions, such as congestion and buffer occupancy sampled during each previous contact with any other node. Therefore, the proposed protocol can achieve high efficiency via an adaptive and intelligent routing mechanism according to network conditions. Extensive simulation is conducted to verify the proposed protocol, where a comparison is made with a number of existing encounter-based routing protocols in term of the number of transmissions of each message, message delivery delay, and delivery ratio.

3:30 PM - 5:30 PM

Next Generation Networks (II)

Room: Strategy Room 1

Chair: Amir Qayyum (M. A. Jinnah University, Islamabad & Center of Research in Networks and Telecom, Pakistan)

Adaptive Multiuser MIMO Transmission in Wireless Systems with Cooperating Cells

Jinhee Lee (Korea University, Korea); Young-Chai Ko (Korea University, Korea); Hong-Chuan Yang (University of Victoria, Canada)

In multicell wireless systems with insufficient frequency reuse, user transmission will suffer other-cell interference (OCI). Cell cooperation is an effective way to mitigate OCI and increase the system sum rate. An adaptive scheme for serving one user in each cell was proposed in [1]. In this paper, we generalize that scheme by serving more than one user in each cell with adaptive zeroforcing beamforming (ZF) strategies. Based on our derived statistics of the signal-to-noise plus interference ratios, we choose the scheme to maximize the total ergodic sum-rate based on user locations. Through the numerical examples, we show that the total system sum rate can be improved by selecting appropriate transmitting strategy adaptively. As a result, our proposed system can explore spatial multiplexing gain without additional power and thus improves total system sum rate significantly.

Orientation-based Wi-Fi Positioning on the Google Nexus One

Eddie Chan (The Hong Kong Polytechnic University, Hong Kong); George Baciu (The Hong Kong Polytechnic University, Hong Kong)

While localization systems for indoor areas using the existing wireless local area network (WLAN) infrastructure have recently been proposed, wireless LAN localization approaches suffer from a number of significant drawbacks. To begin with, there is inaccurate position tracking due to the orientation of the mobile device and signal fluctuation. In this paper, we apply a orientation filter and a Newton Trust Region (TR) algorithm to eliminate the noisy location estimation. We implement the localization algorithm on the Nexus which is a Wi-Fi enabled device with a digital compass. Our experimental analysis shows that orientation-based Trust Region method enhances our previous work with 10% fewer access points and 7% more accurate for location estimation. The proposed orientation-based Trust Region method leads to substantially more accurate and robust localization system.

Hybrid Streaming Delivery over DVB-H Broadcast and WiMAX Mobile Networks

Hsin-Ta Chiao (Industrial Technology Research Institute (ITRI), Taiwan); Chi-Te Tseng (Industrial Technology Research Institute (ITRI), Taiwan); Jhih-Wei Jiang (Industrial Technology Research Institute (ITRI), Taiwan); Hsin-An Hou (ITRI, Taiwan)

Hybrid streaming delivery over converged mobile and broadcast networks can enable operators to transmit multimedia contents in a more efficient and flexible way. Consequently, the functions related to hybrid streaming delivery are recently standardized in the IP-based service layer standards for DVB-H, i.e. DVB-IPDC and OMA BCAST standards. In both standards, seamless service switching is one of the key building blocks for achieving hybrid streaming delivery. In this paper, we describe the experiences for implementing the function

of streaming service switching between DVB-H broadcast and WiMAX mobile networks according to the abovementioned standards. In our implementation, instantiating two sets of audio and video codecs in parallel during service switching is avoided for reducing the required hardware resources in a terminal. In addition, the experiment results of streaming service switching are provided to show the performance of our implementation in an extreme test environment where the level of a DVB-H signal could be varied rapidly for simulating the observed room or building penetration loss for a moving terminal.

[Robust Data-Partitioned Video Streaming over a WiMAX Channel](#)

Laith A Al-Jobouri (University of Essex, United Kingdom); Martin Fleury (University of Essex, United Kingdom); Mohammad Ghanbari (University of Essex, United Kingdom)

This paper demonstrates a robust layered video scheme based on data-partitioning and intended for IPTV streaming over wireless broadband. Equal error protection through rateless coding is applied, whereby higher-priority DP packets are protected by appropriate selection of quantization parameter and picture slicing, so as to regulate packet size. Both packet drops from congestion and adverse channel conditions are shown to be affected by packet size in the mobile WiMAX channel investigated. The main proposal is for adaptive rateless coding in which additional redundant data are retransmitted to heal corrupted packets. However, though these packets are always repairable, delay increases as the percentage of corrupted packets increases, which affects the design parameters. Intra-refresh MBs are added to prevent the objective video quality falling below an acceptable level. Picture slicing further reduces the packet size to increase robustness in the face of measurement noise during channel estimation and the effects of slow and fast fading.

[Strategy of Self-organization in Sensors and Actuators Networks](#)

Bilel Romdhani (Université de Lyon INRIA, INSA Lyon F-69621, France, France); Dominique Barthel (Orange Labs, France); Fabrice Valois (INSA Lyon, France)

In Wireless Sensors and Actuators Networks (WSANs), actuator nodes are nodes richer in resources (processing capacity, power transmission and energy storage) and better suited than sensor nodes to process the data, make decisions based on sensed values and perform appropriate actions. In addition, in order to provide timely action, coordination between sensors and actuators is necessary. Thus, in addition to the classical energy constraints of Wireless Sensor Networks (WSNs), WSANs also impose new challenges such as how to support and benefit from the nodes heterogeneity while preserving energy in the self-powered sensor nodes. New communication protocols, specific to WSANs, are needed. In this paper, we propose a hybrid self-organizing data-collection protocol in order to provide energy efficiency, low end-to-end delay and high delivery ratio while taking advantage of the resource available on the actuators nodes in the network. This new self-organization protocol constructs its structure from the actuators and other resource-plentiful nodes. The nature of the structure is different inside and outside of transmission range of these resourceful nodes.

[A Bit Collision Detection Based Query Tree protocol for Anti-Collision in RFID System](#)

Haosong Gou (Pusan National University, Korea); Younghwan Yoo (Pusan National University, Korea)

Anti-collision algorithms in the RFID system can be divided into two categories: ALOHA based and binary tree based algorithm. Each of them has its own advantages or disadvantages. The QT protocol, as a classic binary tree based algorithm, was proposed to achieve the reliable throughput of identification by using prefix to avoid collisions. This paper proposes an improved QT protocol called Bit collision detection based Query Tree (BQT) by adopting individual bit collision detection, which can detect the collision in each bit. It can reduce the collision for the tags which have the same prefix and accelerate identification process. The simulation results

and analysis show that our BQT protocol could reduce the collisions and achieve much better performance on tag identification.

3:30 PM - 5:30 PM

Mobility and Nomadicity (II)

Room: Strategy Room 2

Chair: Andreas Papazois (RACTI and University of Patras, Greece)

Anytime and Anywhere Monitoring For the Elderly

Yunfeng Chen (University of Guelph, Canada); Nidal Nasser (University of Guelph, Canada)

In this paper we propose a system architecture for telemonitoring system. The proposed architecture is not limited to only indoor environment. By employing a mobile phone that implements a personal server, the system also supports the monitoring of old people while away from home. In addition to the system architecture, we also propose the middleware architecture for the personal server and the cross-layer protocol stack architecture for the sensor node. The middleware and the cross-layer stack improve the flexibility and expansibility of the system.

A Comparative Assessment of Routing for Mobile Networks

Devan Bing Rehunathan (University of St Andrews, United Kingdom); Saleem N Bhatti (University of St Andrews, United Kingdom)

Wireless mobile devices are becoming increasingly prevalent in society. As a result, aggregation of network connectivity through the use of mobile networks is becoming increasingly relevant to service providers as well as for mobile users. The current approach being pursued within the IETF Mobile Extensions for IPv6 (MEXT) WG, is based on the Network Mobility (NEMO) architecture. NEMO uses IP-in-IP tunnelling for providing mobile network capability on an existing IPv6 network. This approach can result in non-optimal routing between source and destination nodes. Other proposals such as OptiNets extend NEMO and try to address issues such as sub-optimal routing. There are alternative approaches also being proposed, such as the Identifier Locator Network Protocol (ILNPv6), which is based on the use of naming, to enable a flexible and integrated mobile network capability based on IPv6. We have conducted a comparative analysis of the cost of providing optimal routing, in terms of packet and bandwidth overhead, based on an emulation, using data from the London Circle Line metropolitan railway as a scenario. Our analysis shows that these different approaches to mobility offer significantly different performance trade-offs in routing for mobile networks, depending on the constraints of the network scenario.

ARUM: a Cooperative Middleware and an Experimentation Platform for Mobile Systems

Matthieu Roy (LAAS-CNRS, University of Toulouse, France); Marc-Olivier Killijian (Laboratoire d'Analyse et d'Architecture des Systèmes (LAAS-CNRS), France); Gaëtan Séverac (LAAS-CNRS, University of Toulouse, France)

In this paper, we present a middleware architecture for dependable mobile systems and an experimentation platform for its evaluation. The proposed architecture includes three building blocks tailored for mobile cooperative applications: a Proximity Map, a Trust and Cooperation Oracle, and a Cooperative Data Backup service. To illustrate our platform, we developed a Distributed Black-box application, whose aim is to record critical data while tolerating the failure of a node, and implemented a hardware evaluation platform of mobile

systems for experimenting with the application. We provide here some insights on the development of the platform, focusing on wireless communication.

[An Eco-Friendly Routing Protocol for Delay Tolerant Networks](#)

Tamer A AbdelKader (University of Waterloo, Canada)

In sparse mobile networks, nodes are connected at discrete periods of time. This disconnection may last for long periods in urban and rural areas. In addition, mobile nodes are energy and buffer sensitive, such as in mobile sensor networks. The limited power and storage resources, combined with the intermittent connection have created a challenging environment for inter-node networking. This type of networks is often referred to as Delay Tolerant networks (DTN). Routing protocols developed for DTN focused mainly on maximizing the delivery ratio and minimizing the end-to-end delay. Therefore, they tend to spread many copies of the same packet into the network, assuming the availability of buffer and power. Decreasing number of transmissions reduces energy consumption which helps in maintaining a clean environment. In this paper, we formulate a mathematical model for optimal routing in DTN to achieve minimum number of transmissions. In addition, we study and analyze the DTN heuristic routing protocols. After that, we propose an Eco-friendly routing protocol, EFR-DTN, that efficiently use simple information provided from the network to achieve minimum energy consumption, while maintaining higher delivery ratio than the other protocols. Simulation results show the outperformance of the proposed protocol under different buffer capacities, traffic loads, and packet TTL values.

[On the Implementation of End-to-End Mobility Management Framework \(EMF\)](#)

Ehsan Elahi (M. A. Jinnah University, Islamabad Pakistan, Pakistan); Muhammad Yousaf (CASE, Islamabad, Pakistan); Ambreen Sheikh (Muhammad Ali Jinnah University, Islamabad, Pakistan, Pakistan); Muhammad Maaz Rehan (CoReNeT, M. A. Jinnah University, Islamabad, Pakistan); Muhammad Omer Chughtai (CoReNeT, Pakistan); Amir Qayyum (M. A. Jinnah University, Islamabad, Pakistan)

Traditionally the mobility problem has been solved mostly at network layer. However the End-to-End Mobility Management Framework (EMF) [1] provides the solution to this problem above the transport layer. EMF overcomes some limitations of current mobility management solutions by effectively providing mobility services such as soft handover, willful handover, location updates etc. EMF neither requires any support of additional entities in the network nor requires the changes in the current implementation of TCP. This paper describes a portable implementation design of the EMF framework along with the tradeoffs involved in implementing the framework. The results of some experiments for performance analysis are also presented that quantify the protocol and computational overheads.

[Virtual Keyboard BCI using Eye blinks in EEG](#)

Rajesh Singla (Dr BR Ambedkar NIT, India); Rameshwar Jha (Dr BR Ambedkar NIT, India); Brijil Chambayil (Dr BR Ambedkar NIT, India)

A Brain Computer Interface (BCI) provides a new communication channel between human brain and the computer. This paper is concentrated on developing a BCI system, a Virtual Keyboard using the LabVIEW platform. The EEG signal contains the technical artifacts (noise from the electric power source, amplitude artifact, etc.) and biological artifacts (eye artifacts, ECG and EMG artifacts). Eye blink is one of the main artifacts

in the EEG signal. But in this context the Eye blinks are not artifacts and are control signals to select the blocks/characters in the Virtual Keyboard. The kurtosis coefficient and amplitude characteristics of the eye blink signals are used to detect the control signals.

Workshops

- 1. NASSUE: Second International Workshop on Network Assurance and Security Services in Ubiquitous Environments (NASSUE 2010)**
- 2. CMPA: First Workshop on Cooperative Mobile Protocols and Applications (CMPA 2010)**
- 3. STWMC: Third IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STMWC'10)**
 - 3.1. STWMC1: Wireless Communications**
 - 3.2. STWMC2: Ubiquitous Computing, Services and Applications**
 - 3.3. STWMC3: Mobile Networking, Mobility and Nomadicity**
- 4. VECON: First International Workshop on VEHicular COmmunications and Networking (VECON 2010)**
 - 4.1. VECON1**
 - 4.2. VECON2**
- 5. AWSAN: First International Workshop on Advances in Wireless Sensor and Actuator Networks (AWSAN 2010)**
- 6. PEMOS: First International Workshop on the Performance Enhancements in MIMO-OFDM Systems (PEMOS 2010)**

1. NASSUE: Second International Workshop on Network Assurance and Security Services in Ubiquitous Environments (NASSUE 2010)

This workshop is focused on network assurance and security (NAS) measure, which has become an important research issue in ubiquitous environments (UE). The objective of this workshop is to provide an effective forum for original scientific and engineering advances in NAS issues in UE. It will highlight the various aspects of NAS - especially on the crucial linkage between availability, compliance, and security. NASSUE 2010 aims to bring together researchers, practitioners, developers, and policy makers to share and exchange ideas and to learn about latest developments, problems and solutions related to NAS issues in UE.

Workshop Program Chairs

- Binod Vaidya, Univ. of Ottawa, Canada
- Shih-Jeng Wang, Central Police Univ., Taiwan
- Joel Rodrigues, Inst. of Telecommunications, Univ of Beira Interior, Portugal

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- Xinxin Fan, Univ of Waterloo, Canada
- Amr Youssef, Concordia Univ, Canada
- Bidi Ying, Univ of Ottawa, Canada

NASSUE 2010

Monday, October 11

5:20 PM - 7:00 PM

Room: Strategy Room 1

Chair: Binod Vaidya (University of Ottawa, Canada)

Improved Two-factor User Authentication in Wireless Sensor Networks

Binod Vaidya (University of Ottawa, Canada); Dimitrios Makrakis (University of Ottawa, Canada);
Hussein Mouftah (University of Ottawa, Canada)

Wireless sensor networks (WSNs) are considered due to the ubiquitous nature, ease of deployment, and wide range of possible applications. WSNs can be deployed in unattended environments, where a registered user can login to the network and access data collected by the linked sensors. Authenticating users in resource constrained environments is one of the major security concerns. Since sensor nodes have limited resources and computation power, it is desirable that the authentication protocol is simple and efficient. In 2009, M. L. Das proposed a two-factor authentication for WSNs, where a user has to prove possession of both, a password and a smart card. Since his scheme utilizes only cryptographic one-way hash function and exclusive-OR operation, it is well-suited for resource constrained environments. However, Khan and Algathbar pointed out that Das's scheme has some flaws and is vulnerable to various attacks and proposed an alternative solution. In this paper, we show that both, Das's and Khan-Algathbar's schemes have flaws and remain vulnerable to various attacks including stolen smart card attacks. To overcome the security weaknesses of both schemes, we propose an improved two-factor user authentication that is resilient to stolen smart card attacks as well as other common types of attacks. We provide security evaluation of the proposed protocols showing its robustness to various attacks and analyzed the scheme's performance to determine its efficiency. Compared to the previous schemes, it is proven more robust and provides better security.

Pre-broadcast based Time Efficient Privacy Protocol for Secure Vehicular Communications

Bidi Ying (University of Ottawa, Canada); Dimitrios Makrakis (University of Ottawa, Canada)

Privacy and security are two important issues in vehicular networks. Users wish to maintain location privacy and anonymity, meaning the identity, location/direction of move of their vehicles remains unknown to everybody with possible exception law enforcement authorities responsible by law to know and maintain such private information. In this paper, we propose a Pre-broadcast based Time Efficient Privacy (PTEP) scheme, which, instead of performing any asymmetric verification, uses Message Authentication Code (MAC) functionality and HASH operations to authenticate messages. Moreover, we use two-level key (upper-level hash chain and low-level hash chain) which assists avoiding message losses. Analysis shows that the proposed PTEP scheme superior performance in terms of packet loss rate and packet latency. In addition, it can be used to serve emergency and routine messages as well, while most of existing solutions can only work with routine messages.

A Framework Toward a Self-Organizing and Self-Healing Certificate Authority Group in a Content Addressable Network

Anuchart Tassanaviboon (University of Waterloo, Canada)

Public-key provision in an Internet scale is crucial for securing peer-to-peer (P2P) applications. This paper proposes a framework for a self-organizing and self-healing certificate authority (CA) in a Content Addressable

Network (CAN) that can provide certificates without a centralized Trusted Third Party (TTP). In our framework, a CA group is initialized by bootstrapping nodes and then grows to a mature state by itself. Based on our group management policies, the membership in the CA group is dynamic and has a uniform distribution over the P2P community. Meanwhile, a Byzantine agreement algorithm is deployed to maintain the honest majority of the CA group; all shares of the CA group are refreshed gradually and continuously. A security analysis shows that the framework enable key registration and certificate issue with resistance to man-in-the-middle (MITM), collusion and node impersonation attacks.

Forming Virtualized Secure Framework for Location Based Services (LBS) using Direct Anonymous Attestation (DAA) protocol

Hanunah Othman (University Teknologi MARA, Malaysia); Habibah Hashim (Universiti Teknologi MARA, Malaysia); Jamalul-lail Ab Manan (MIMOS Berhad, Malaysia); Mohd Ameer Yuslan Razmi (Universiti Teknologi MARA, Malaysia)

The tremendous growth in mobile and wireless communications comes with more pervasive applications. Current mobile device platform does not allow a local or remote user to attest the target platform. The limitation of using existing software-based alone protection can be easily affected by malicious codes and it cannot assure its own integrity. In this paper, we explore a new approach of anonymity issues in Privacy Enhancing Technologies (PETs) which will result in the privacy enhancement of user personal data and location information in mobile network services. We create the foundation for running trusted applications, network and services on top of existing Mobile Location Protocol (MLP). Also forming Virtualized Secure Framework between mobile devices (clients) and Location Based Services (LBS) Server in Virtual Machine (VM) environment based on Direct Anonymous Attestation protocol. Trusted Platform Module (TPM) acts as a basis for software security mechanisms and to preserve privacy of user's information stored in trusted platform. Virtualization is needed to improve the utilization of existing computing resources and to reduce hardware. Every single devices found in a physical machine will be virtually created by these software to act like a physical devices in the VMs. DAA protocol is proposed to anonymously verify the authority of users and preserving privacy of user's private location information.

A Trust Evaluation Model using Controlled Markov Process for MANET

Kevin Ouyang (University of Ottawa, Canada); Binod Vaidya (University of Ottawa, Canada); Dimitrios Makrakis (University of Ottawa, Canada)

A distributed trust evaluation model is presented for MANETs by which uncertainties of trust are transformed into probability vectors giving the probability distribution of trust levels. The system evolves over time as a finite-state Markov process with variant transition matrixes. We attempt to predict the trustworthiness values of entities that are determined by their inherent error patterns. The Markov process is associated to a Bonus-Malus System and controlled by the estimated error patterns of individual entities involved. As well, an iteration algorithm is designed to prevent inaccurate predictions for trust values because of the properties of Markov process. The simulation results demonstrate that our model is able to predict local trust successfully for entities in MANETs by estimating their actual error patterns accurately.

2. CMPA: First Workshop on Cooperative Mobile Protocols and Applications (CMPA 2010)

Cooperative communication has emerged as a promising technique for modern wireless communication systems. Certain characteristics of mobile environments create a natural need for nodes to cooperate among themselves to overcome certain limitations. These characteristics include (1) adverse channel conditions and lack of resources (in terms of bandwidth) which necessitate cooperation at the physical layer (2) lack of infrastructure which creates the need for nodes to cooperate in ad-hoc routing protocols for example. (3) limited-resource devices which might create a need to applications to cooperate and distribute computing tasks and share their excess of processing power. The workshop is seeking papers on on-going research that involves cooperation in mobile environments at any layer of the protocol stack.

Workshop Chairs:

- Ashraf Matrawy, Carleton University
- Mohamed Hossam Ahmed, Memorial University of Newfoundland
- Muhammad Jaseemuddin, Ryerson University

CMPA 2010

Tuesday, October 12

8:40 AM - 10:00 AM

Room: Strategy Room 2

Chair: Muhammad Jaseemuddin (Ryerson University, Canada)

Joint Routing and Relay Selection in DAF Multi-Hop Cooperative Ad hoc Networks

Salah Abdulhadi (Ryerson University, Canada)

Cooperative diversity techniques have recently received a lot of attention due to their ability to provide spatial diversity in fading wireless environment, thus increases link reliability, provides higher capacity and reduces transmit power for the same level of performance. In this paper we study a joint problem of relay selection, power allocation and routing in multihop wireless ad hoc networks based on cooperative transmission. In particular, an optimal routing strategy is proposed to minimize the end-to-end total transmission power subject to end-to-end target rate. An ad-hoc routing strategy is proposed to find an optimal route (in terms of total transmit power minimizing) for decode-and forward strategy based on the well known Dijkstra algorithm which can be easily implemented in distributed way. Simulation results show that the proposed strategy has great improvement in terms of power saving compared with traditional non-cooperative shortest path algorithms, by more than 70% in some simulation scenario.

Design, Implementation and Evaluation of a Structured P2P Algorithm for Vehicular Communication Systems

Vivian Prinz (Technische Universität München, Germany); Roland Bader (BMW Research and Technology GmbH, Germany); Wolfgang Woerndl (Technical University of Munich – Department of Informatics, Germany)

Distributed information management is particularly powerful in vehicular networks. For example, it enables vehicular communication systems to persistently provide up-to-the-minute information about accessible parking spaces, existing hazards or traffic densities and to keep these items up to date. The Vehicular Information Space framework (VIS) implements distributed information management. Vehicles running the VIS form a kind of distributed database. They are able to provide information items in a location-aware and fully distributed manner. Moreover, they can retrieve, modify and delete these items. For this purpose, the VIS divides the vehicular network into separate, interacting segments each running the VIS Structured P2P Algorithm (VSPA). This article focuses on the VSPA's design, implementation and evaluation. The algorithm is based on features derived from existing structured P2P algorithms and extended to suit the specific characteristics of vehicular networks. Simulation studies show that the VSPA overlay state maintains consistent given long-run simulations. On inconsistencies, the overlay stabilizes rapidly. This is evaluated using an urban traffic environment implying few messages for network adjustments. Also, it is examined on a motorway given high vehicular density and high data load to investigate scalability. Finally, we show that the VSPA is able to rebuild an overlay in case of a network breakdown.

An Efficient Relay Assignment Scheme for Multiuser Cognitive Radio Networks with Discrete Power Control

Udit Pareek (Simon Fraser University, Canada); Muhammad Naeem (Simon Fraser University, Canada); Daniel Lee (Simon Fraser University, Canada)

In this paper, we present a binary particle swarm optimization (BPSO) based low-complexity interference aware relay assignment scheme for multiple user cognitive radio networks with discrete power control. First, we formulate the joint relay assignment, source and relay's power allocation as a mixed integer non linear programming problem. This is further reduced into an integer programming problem. We propose a BPSO based relay assignment scheme with discrete power control at source and relays for the integer programming problem. The proposed scheme has low computational complexity and simulation results show that its performance is close to the optimal exhaustive search algorithm.

Relay Selection Approaches for Wireless Cooperative Networks

Tauseef Jamal (University Lusofona, Portugal); Paulo M. Mendes (University Lusofona, Portugal)

Wireless networks are characterized by having limited resources accessed by a large number of mobile stations with distinct capabilities. In such challenged environment the dynamic control of resources is of major importance to mitigate the limitations of wireless networks, such as the impact of low data rate stations and wireless channel oscillations. Such augmented usage of wireless resources can be implemented based upon cooperative relaying schemes, which have the potential to support the desired system performance and network lifetime. However, the introduction of cooperative relay raises several problems such as the issue for relay selection and resource allocation. Due to the significant number of different cooperative relaying approaches, this article aims to provide a systematic analysis and classification of major relay selection procedures, and to identify open research directions as well as the most suitable evaluation methods for an efficient analysis of different approaches.

- 3. STWMC: Third IEEE International Workshop on Selected Topics in Mobile and Wireless Computing (STMWC'10)
 - 3.1. Wireless Communications
 - 3.2. Ubiquitous Computing, Services and Applications
 - 3.3. Mobile Networking, Mobility and Nomadicity

STMWC2010 - 1

Tuesday, October 12

8:40 AM - 10:00 AM

Room: Strategy Room 1

Chair: Pham CongDuc (Univ. of Pau, France)

Network Assisted Auctioning for Cognitive Radios

Jia Long (Carleton University, Canada); Changcheng Huang (Carleton University, Canada); James Yan (Carleton University, Canada)

In this paper, the use of a centralized server to assist cognitive radio users in accessing bands in licensed spectrums is proposed. Typical cognitive radios are opportunistic users of spectrum bands. Therefore, they must scan the spectrum to detect existing users in order to avoid interference. The use of a centralized server can remove the need for spectrum scanning if all users inform the server about their presence. The server will coordinate and distribute channels to cognitive radio users using auctioning mechanisms. Our approach removes the need for cognitive radio users to spectrum scan. Scanning can be costly in terms of time and power consumption. In addition, collisions between users due to hidden node problem can be removed. The use of a centralized server allows for higher layer solution that would allow users of different wireless technologies to communicate. Due to its flexibility of use across different wireless networks, SIP is adopted as the communication protocol between the central server and the primary and secondary users of the licensed spectrum. Using a SIP server to coordinate channel allocation through auctioning approach can generate revenue for the incumbent network. Results show that revenue can be generated while still meeting the goal of efficient spectrum utilization.

Service Discovery for mobile multi-domain multi-language environments

Nor Shahniza Kamal Bashah (Norwegian University of Science and Technology, Norway); Atif Bhatti (Norwegian University of Science and Technology, Norway); Imran Aslam Choudhary (Norwegian University of Science and Technology, Norway); Ivar Jørstad (Ubisafe AS, Norway); Van Thanh Do (Telenor/ Norwegian University of Science and Technology, Norway)

In mobile multi-domain multi-language environments, a service can be anything and introduced by anybody. Consequently, same or equivalent services may have different names and services with same name or type may be completely different. Existing service discovery systems are incapable of handling these situations. We propose a service discovery, which is able to discover all these new service types. In addition, it is capable to find services that are not exact matches of the requested ones. More semantics are introduced through attributes like EquivalenceClass, ParentType and Keywords.

Efficient Mobile Object Localization Using RFID

Kirti Chawla (University of Virginia, USA); Gabriel Robins (University of Virginia, USA); Liuyi Zhang (University of Virginia, USA)

Location-awareness of mobile objects is the key to several emerging ubiquitous computing applications. We show that RFID technology can be leveraged to achieve mobile object localization in an inexpensive, power efficient, scalable, widely applicable, flexible, and user-friendly manner. We outline the challenges that can adversely affect RFID-based localization techniques, and propose solutions to mitigate them. Also, we present several algorithms for RFID-based mobile object localization, comparing favorably with previous methods in terms of accuracy, speed, reliability, and scalability.

Using Web Technologies in Assessment of Context-Aware Pervasive/Ubiquitous Systems: A Tourist Guide Service

Waldir Ribeiro Pires Junior (Federal University of Minas Gerais, Brazil); Antonio A.F. Loureiro (Federal University of Minas Gerais, Brazil); Ricardo Augusto Rabelo (UFMG/DCC, Brazil)

An important aspect in the design of pervasive/ubiquitous applications is to evaluate them before their deployment in real scenarios. A possible strategy to assess them is to perform simulations that provide useful insights and results to the application designer. However, the simulation of pervasive/ubiquitous applications and environments has proven to be a considerable challenge for several reasons. For instance, many of the technologies (e.g., hardware and software) required to assess them either do not yet exist or are not momentarily available or accessible in terms of cost and readiness, not to mention other important requirements such as monitoring, communication management and profile/context state tracking of entities in the system. In order to make this process simpler and feasible, we defined a Web assessment tool that provides a simulation approach for ubiquitous environments by using Web technologies such as Asynchronous JavaScript and XML, Web application frameworks and a mapping/location Web service. Using these technologies, we implemented a pervasive service: a tourist guide service. With this tool, we were able to evaluate the proposed service quantitatively by studying the interactions between the users/entities involved, monitor their profile/context states, and track their movements across a predefined map area.

STMWC2010 - 2

Tuesday, October 12

10:30 AM - 11:50 AM

Room: Strategy Room 1

Chair: Bijan Raahemi (University of Ottawa, Canada)

[SEAODV: A Security Enhanced AODV Routing Protocol for Wireless Mesh Networks](#)

Celia Li (Student, Canada); Zhuang Wang (Student, Canada); Cungang Yang (Ryerson University, Canada)

In this paper, we propose a Security Enhanced AODV routing protocol (SEAODV) for wireless mesh networks (WMN). SEAODV employs Blom's key pre-distribution scheme to compute the pairwise transient key (PTK) through the flooding of enhanced HELLO message and subsequently uses the established PTK to distribute the group transient key (GTK). PTK and GTK authenticate unicast and broadcast routing messages respectively. In WMN, a unique PTK is shared by each pair of nodes, while GTK is shared secretly between the node and all its one-hop neighbours. A message authentication code (MAC) is attached as the extension to the original AODV routing message to guarantee the message's authenticity and integrity in a hop-by-hop fashion. Security analysis and performance evaluation show that SEAODV is more effective in preventing identified routing attacks and outperforms ARAN and SAODV in terms of computation cost and route acquisition latency.

[Effects of Mobility on Stability in Vehicular Ad Hoc Networks](#)

Liren Zhang (United Arab Emirates University, UAE)

This paper focuses on the characterization of vehicle mobility in vehicular ad hoc networks (VANETs). The performance of vehicle mobility in terms of link available time and the number of inter-vehicle link changes for maintaining active links in VANET is analyzed using both the handover and random moving models. The theoretical analysis is verified by simulation experiments. The numerical results indicate that the vehicle random moving analytical model is able to provide a more accurate description of the complicated vehicle moving behavior than the conventional random way point mobility model, especially when vehicles are moving relatively fast.

[Smoothing of Video Transmission Rates for an LTE Network](#)

Khaled Shuaib (United Arab Emirates University, UAE); Farag Sallabi (UAE University, UAE)

Video smoothing techniques can be used to facilitate more effective transmission and to preserve better video quality. In this paper we develop a semi-optimal video smoothing approach to manage the transmission rates of MPEG-4 and H.264 video over a QoS-based wireless LTE network. The proposed technique utilizes a smoothing buffer with pre-defined thresholds to smooth the transmission rates while assuming minimal information about the video to be transmitted. The results obtained showed a significant improvements in smoothing transmission rate variability. In addition, we show a model for the wireless LTE channel and use it as a feedback to manage smoothing and regulate and map the transmission rates based on the availability of network resources.

Power Allocation For Non-Regenerative relaying in Cognitive Radio Systems

Muhammad Naeem (Simon Fraser University, Canada); Udit Pareek (Simon Fraser University, Canada);
Daniel Lee (Simon Fraser University, Canada)

In this paper, we present a low-complexity power allocation scheme for non-regenerative (amplify and forward) relaying for cognitive radio systems. The main objective of power allocation is to maximize the signal to noise ratio (SNR) at the destination under the constraint of acceptable interference to the primary users (PU). In this paper, we propose an iterative power allocation using SNR upper Bound (IPAUB) for non-regenerative relaying. The proposed algorithm has low computational complexity, and its effectiveness is verified through simulation results.

STMWC2010 – 3

Tuesday, October 12

3:30 PM - 5:30 PM

Room: Strategy Room 1

Chair: Matthieu Roy (LAAS-CNRS, University of Toulouse, France)

Sensors-Actuators Cooperation in WSAWs for Fire-Fighting Applications

Pawel Kulakowski (AGH University of Science and Technology, Poland); Eusebi Calle (University of Girona, Spain); Jose Luis Marzo (Universitat de Girona, Spain)

Wireless sensor and actuator networks for environmental operations are discussed in this paper. A scenario of a forest being under fire is analyzed. While the forest fire detection is a classical application for sensor networks, here this research area is extended, taking into account actuators and focusing on sensors-actuators cooperation. First, the spreading of the fire is illustrated, adapting a well-known model based on percolation theory and explaining its relations with epidemics propagation models. Then, it is shown how the temperature data gathered by sensors can be used by actuators to automatically perform actions to battle with blaze. Finally, the simulation results are presented, documenting the correctness of the decisions taken by the system and the efficiency of fire-fighting actions related to the sensors density.

A Neighbor-based Holdoff Reduction Scheme for Distributed Scheduling in Wireless Mesh Networks

Sara Lakani (Azad University of Science And Research, Iran); Hossein Ghaffarian (Iran University of Science and Technology (IUST), Iran); Mahmood Fathy (Bournemouth university, United Kingdom); Bijan Raahemi (University of Ottawa, Canada)

The IEEE 802.16 standard of wireless mesh networks includes various scheduling algorithms, both centralized and distributed, to determine the proper time slot that each wireless node can transmit its data. In this paper, we introduce a new scheduling scheme to improve scalability and resource utilization in wireless mesh networks where all nodes compete to gain access to the transmission time slot. In our proposed method, the transmission time of a node is modified according to the transmission status of its neighbors, resulting in a shorter hold off time, and consequently, reducing the transmission delay and throughput. The simulation results confirm the efficiency and performance of the proposed algorithm over the IEEE 802.16-mesh standard in terms of throughput and delay.

Compromise in Decoding for a Concatenated Turbo and Space-time Block Coded System

Xuanxuan Lv (Zhejiang University, P.R. China); Minjian Zhao (Zhejiang University, P.R. China); Jie Zhong (Zhejiang University, P.R. China); Cen Peng (Zhejiang University, P.R. China); Jun Zheng (Zhejiang University, P.R. China); Liping Yang (Zhejiang University, P.R. China)

In this paper, we investigate the performance of iterative decoding for concatenated Turbo coded and Space-time block coded (STBC) system. In our proposed system the soft parity bit needs to be estimated, which differs

from traditional Turbo decoding, as the receiver adopts iterative decoding not only to Turbo codes but the entire system. In this case a simplified and effective method of obtaining the soft information of parity bit is presented, resulting in a moderate increase of complexity. Simulation results demonstrate that performance improvement can be obtained using the iterative scheme compared with non-iterative decoding system. Meanwhile the increase of complexity in exchange for performance improvement is considered. Our proposed scheme makes an optimal trade-off between complexity and performance for transmitting in Rayleigh fading channel.

Evaluation of soft detection of STBC schemes for turbo codes

Youngmin Kim (Chonbuk national University, Korea); Sooyoung Kim (Chonbuk National University, Korea)

In this paper, we present an efficient turbo-coded space time block coding (STBC) schemes in block fading channels. It has been reported that proper utilization of soft decision information is one of the important factors affecting the performance of turbo codes. If a STBC scheme is used with turbo codes, the output of the STBC decoder must be fed into a turbo code decoder in the form of soft decision information. In addition, the performance of a turbo code is subject to how much diverse channel information a decoder can utilize in a codeword. In this paper we evaluate the performance of turbo coded STBC schemes over block fading channels, and present an efficient STBC scheme with very simple maximum likelihood detection capability.

Baseband MIMO receiver architecture for MC-CDMA and its FPGA implementation

Isabelle LaRoche (Université Laval, Canada); Sebastien Roy (Laval University, Canada); Paul Fortier (Laval University, Canada); Jean-Francois Beaumont (Defence Research and Development Canada - Ottawa, Canada)

A baseband multi-input, multi-output (MIMO) multi-carrier code division multiple access (MC-CDMA) downlink system meeting wideband CDMA (WCDMA) bandwidth requirements is simulated and its receiver part is implemented into a field programmable gate array (FPGA). The receiver was designed by integrating an existing single-input, single-output (SISO) fixed-point MC-CDMA receiver with an existing floating-point MIMO receiver. The receiver employs temporal multiplexing in order to use a single Vertical Bell Laboratories LAYered Space-Time (V-BLAST) detector. Simulation results of a complete MIMO MC-CDMA system show improvements over the SISO case. Implementation results show that it is possible to implement this receiver design into a single FPGA device.

4. VECON: First International Workshop on Vehicular Communications and Networking (VECON 2010)

4.1. VECON1

4.2. VECON2

The goal of this workshop is to present and discuss recent advances in the area of vehicular wireless communications and networking. Significant efforts are being carried out by industry, academia and government agencies to improve safety, decrease fuel consumption, and increase the capacity of existing roadways by exploiting vehicular communications and networking technologies. These technologies, which are generally referred to as VANET (Vehicular Ad-hoc Networks) or by the more general term VCS (Vehicular Communication Systems), include vehicle-to-infrastructure, vehicle-to-vehicle communications and can be based on short- and medium-range communication as well as on cellular systems. The development and deployment of VCS are also considered one of the most critical issues for the Intelligent Transportation System (ITS) industry.

Workshop Co-chairs

- Juan Jose Alcaraz, Polytechnic University of Cartagena (UPCT), Spain
- Esteban Egea-Lopez, Polytechnic University of Cartagena (UPCT), Spain

Technical Program Committee

- Jose Maria Barcelo, UPC, Spain
- Paolo Bellavista, Universita di Bologna, Italy
- Carlos Jesus Bernardos, UC3M, Spain
- Vicente Casares-Giner, UPV, Spain
- Nirbhay Chaubey, ISTAR, India
- Jacek Danda, AGH University, Poland
- Felipe Garcia-Sanchez, UPCT, Spain
- Pawel Kulakowski, AGH University, Poland
- Christoph Mecklenbrauker, TU Wien, Austria
- Xavier Perez-Costa, NEC Laboratories Europe, Germany
- Vicent Pla, UPV, Spain
- Javier Vales-Alonso, UPCT, Spain
- Oliver Yang, University of Ottawa, Canada

VECON 2010 -1

Tuesday, October 12

10:30 AM - 11:50 AM

Room: Strategy Room 2

Chair: Juan Jose Alcaraz Espin (Technical University of Cartagena, Spain)

Testing viability of relay policies for reactive CCA applications in VANETs

Juan-Bautista Tomas-Gabarron (Polytechnic University of Cartagena, Spain); Esteban Egea-Lopez (Polytechnic University of Cartagena (UPCT), Spain); Joan Garcia-Haro (Polytechnic University of Cartagena, Spain); Rocío Murcia Hernández (Polytechnic University of Cartagena, Spain)

Relaying mechanisms for Chain Collision Avoidance (CCA) applications in Vehicular Ad-hoc Networks (VANETs) are crucial when one hop transmissions are not enough to reach all of the vehicles in a platoon at risk of accident. Taking into account that CCA-related information must be distributed to as many vehicles as possible in the shortest affordable time, a reasonable way to determine the viability of using such relay policies is by evaluating the delay to spread information to all recipients and the associated occupation of the communications channel. Furthermore, the inherent transition to reach full technology penetration in the market requires to study how the system of vehicles will behave at different stages of deployment and how different relaying mechanisms may affect the general functionality of the system and what is the influence of background data traffic which can obviously worsen the successful delivery rate (SDR) of warning notification messages.

DYMES: a Dynamic Messaging Service for VANETs

Adrian Holzer (Ecole Polytechnique de Montréal, Canada); Saida Maaroufi (Ecole Polytechnique de Montréal, Canada); Samuel Pierre (Ecole Polytechnique de Montreal, Canada)

Applications aimed at enhancing the experience of vehicular transportation have been increasing in recent years with the widespread diffusion of smart mobile devices with network capabilities and access to user location. Such applications include navigation systems and location-based timetables. However, most of these applications only use individual contextual information in order to provide useful services to the end user. Sharing contextual information with other users can open a host of new possibilities, such as providing live traffic monitoring, where the location and speed of individual cars is shared and indicates the flow of traffic; or friend locating, where the location of friends can be displayed on a map. In this paper, we argue that there is a lack of specialized programming support for such applications and we present DYMES, a dynamic messaging service devised to help fill this gap. Central to DYMES is a dynamic publish/subscribe system, which the publication of dynamic contextual information and the creation of dynamic context-based message filters. We present the core APIs provided by DYMES and illustrate their usage via two typical VANET applications. Furthermore, we identify and discuss implementation issues which guide the architectural choices in our ongoing work.

TrafRoute: A Different Approach to Routing in Vehicular Networks

Raphael Frank (University of Luxembourg, Luxembourg); Eugenio Giordano (University of California at Los Angeles, USA); Pasquale Cataldi (EURECOM, France); Mario Gerla (University of California at Los Angeles, USA)

In the near future vehicular networks based on wireless technology will be part of our lives. Efficient and robust routing algorithms will play a key role in the success of such technology. In this paper we present TrafRoute, an efficient and robust routing scheme for vehicular networks, suitable for both Vehicle-to-Vehicle and Vehicle-to-Infrastructure communications. TrafRoute introduces a novel approach to routing that involves landmark-based routes and forwarder self-election, exploiting the knowledge of the underlying road network. We demonstrate TrafRoute's efficiency and robustness through simulation studies performed with accurate mobility and propagation models.

Unified Pseudonym Distribution in VANETs

Joseph Benin (Georgia Institute of Technology, USA); Michael Nowatkowski (United States Military Academy at West Point, USA); Henry Owen (Georgia Institute of Technology, USA)

VANETs continue to mature and their installation is becoming a reality. Many ideas have been exchanged on how best to balance privacy and security. The use of pseudonyms has been almost universally accepted as a critical part of this equation. Simulated results, using ns-3, demonstrate the need for more than a single RSU contact for pseudonym refill due to the limited number of certificates that can be issued in that transit. This paper provides a universal protocol using multiple RSUs and multiple service channels for the distribution of pseudonyms for refill, intra-regional, and inter-regional purposes.

VECON 2010 - 2

Tuesday, October 12

1:20 PM - 3:00 PM

Room: Strategy Room 2

Chair: Esteban Egea-Lopez (Polytechnic University of Cartagena (UPCT), Spain)

Reactive Service Location in IEEE WAVE

Andry Cruz Diaz (Glasgow Caledonian University, United Kingdom); Tuleen Boutaleb (Glasgow Caledonian University, United Kingdom); Huan X Nguyen (Glasgow Caledonian University, United Kingdom); Huaglory Tianfield (Glasgow Caledonian University, United Kingdom)

The IEEE Wireless Access in Vehicular Environments (WAVE) family of standards is the leading worldwide standardisation effort in terms of Dedicated Short Range Communications (DSRC), and it aims at defining a common set of requirements and functionalities that are necessary in order to enable intercommunication and interoperability between the nodes in a Vehicular Ad hoc Network (VANET). Nonetheless, WAVE does not aim at defining a full software architecture for VANET despite its constituting standards outline a given structure that spans the complete protocol stack, therefore, mere compliance to its guidelines does not imply that the levels of cooperativeness required by a distributed, heterogeneous and dynamic system like those supported by VANET, are achieved. WAVE provides, however, the necessary primitives that allow for the adoption of a Service-Oriented Architecture (SOA) for VANET that guarantees meeting the goals of those networks and the systems that depend on them. This paper describes how to accomplish reactive service location, a desired functionality in the context of an SOA for VANET; based on the combination and further enhancement of the elements already specified by WAVE, exemplifying how complex objectives can be attained from the basic set of functionalities in a WAVE-compliant node.

Secure Compression of Privacy-preserving Witnesses in Vehicular Ad Hoc Networks

Bo Qin (Universitat Rovira i Virgili, Spain); Qianhong Wu (Universitat Rovira i Virgili, Spain); Lei Zhang (Universitat Rovira i Virgili, Spain); Josep Domingo-Ferrer (Universitat Rovira i Virgili, Spain)

Vehicular ad hoc networks (VANETs) are designed to improve traffic safety and efficiency. To this end, the traffic communication must be authenticated to guarantee trustworthiness for guiding drivers and establishing liability in case of traffic accident investigation. Cryptographic authentication techniques have been extensively exploited to secure VANETs. Applying cryptographic authentication techniques such as digital signatures raises challenges to efficiently store signatures on messages growing with time. To alleviate from the conflict between traffic liability investigation and limited storage capacity in vehicles, this paper proposes to aggregate signatures in VANETs. Our proposal can preserve privacy for honest vehicles and trace misbehaving ones, and provides a practical balance between security and privacy in VANETs. With our proposal, cryptographic witnesses of safety-related traffic messages can be significantly compressed so that they can be stored for a long period for liability investigation. Our proposal allows a large number of traffic messages to be verified as if they were a single one, which speeds up the response of vehicles to traffic reports.

Architecture of a Simulation Platform for the Smart Navigation Service Investigation

Andrea Toppan (IEIIT CNR sez. Bologna, Italy); Alessandro Bazzi (WiLab, IEIIT-BO/CNR, University of Bologna, Italy); Barbara M Masini (University of Bologna, Italy); Paolo Toppan (WiLab, IEIIT-BO/CNR, Italy); Oreste Andrisano (University of Bologna, Italy)

Efficient mobility management is an issue of vast economic importance for its consequences on urban and suburban mobility. In this context, telecommunications are gaining a key role, allowing to increase people safety, traffic efficiency, and travel comfort. To investigate the telecommunication systems behavior in new infomobility scenarios, advanced simulations tools are needed jointly taking into account realistic road traffic mobility and telecommunication networks protocols in all their aspects. In this paper we discuss the architecture of a complex and complete simulation platform we are developing on the behalf of the Italian project PEGASUS: the choice of traffic simulators, the network simulation and their interface will be presented and described.

OPAL-VCN: Open-Air-Lab for Vehicular Communication Networks

Alexander Gladisch (University of Rostock, Germany); Robil W. Daher (University of Rostock, Germany); Martin Krohn (University of Rostock, Germany); Djamshid Tavangarian (University of Rostock, Germany)

Vehicular Communication Networks (VCNs) provide a promising communication platform for Intelligent Transportation System (ITS) services as well as for value added services in different road systems. Despite the high demand on test fields for VCN related technical solutions and services, there are currently very few test fields for the immense requirement on test and R&D activities. Moreover, the known VCN-related test fields such as sim-TD and VII-California mainly focus on V2X communication, while there is less consideration of the requirements of related roadside backbone networks. This paper presents the Open-Air-Lab for VCNs (OPAL-VCN), concentrating on roadside backbone networks specified for VCN requirements. The OPAL-VCN deals with the design, development and installation of a real-world test field for VCNs, and comprises a test field of a total length of at least 30 km on the German highway A19 / A20 near Rostock (in Mecklenburg-Western Pomerania). Moreover, the OPAL-VCN test field is based on a wireless multi-layer roadside backbone network that employs modular and scalable system architecture. Consequently, OPAL-VCN provides an effective platform for R&D activities as well as for education and industry and can be used as basis for investigating and developing VCN related technologies and services.

The Case for a Network Adaptation Framework in VANETs

Carlos Caloca (Ensenada's Center for Scientific Research and Advanced Education, Mexico); J. Antonio García (Ensenada's Center for Scientific Research and Advanced Education, Mexico); Thierry Delot (University Lille North of France, France)

The diverse communication requirements of different vehicular applications and the innate dynamicity of VANET networks complicate the design of a network layer proposal that is adequate for all applications and network conditions. This paper highlights the necessity for adaptation of network protocols in VANETs, and describes our ongoing work on a platform (adaptation framework) that will provide VANET developers an environment where they can build the network protocols that adapt based on context decisions. The design of our adaptation framework relies heavily on the separation of concerns principle by separating the adaptive protocol in subcomponents, and we model the adaptation as a combination of these subcomponents; for the protocol subcomponent we define specific points where the adaptation can take place. These subcomponents will be developed and compiled independently of adaptation framework code, and link to the framework at runtime, this thanks to the use of a plug-in platform and component-oriented programming. We describe the framework architecture and how the framework interacts with the users, applications and the network

protocols. Lastly we briefly talk about the framework's initial implementation and a case study that we are developing to test the adaptation framework.

5. AWSAN: First International Workshop on Advances in Wireless Sensor and Actuator Networks (AWSAN 2010)

Wireless sensor and actuator networks (WSANs), as a research topic, are currently the subject of intensive world-wide research activities. The sensor technology promises multiple applications: from monitoring an environment in dangerous regions or enemy forces in a battlefield to controlling traffic in streets, inventory in storehouses and tracking patients in hospitals. On the one hand, small and cheap sensing devices create possibilities for gathering huge amounts of data in a non-intrusive way. On the other hand, actuators add a new network dimension and capabilities: the whole system can also react to the forthcoming events. The goal of the First International Workshop on Advances in WSANs is to gather people from academia and industry and discuss the most emerging issues and future challenges in this area.

Workshop Chair:

- Pawel Kulakowski, AGH University of Science and Technology, Poland

Technical Program Committee:

- Chiara Buratti, University of Bologna, Italy
- Sudhakar Ganti, University of Victoria, Canada
- Antonio-Javier Garcia-Sanchez, Technical University of Cartagena, Spain
- Felipe Garcia-Sanchez, Technical University of Cartagena, Spain
- Pawel Kulakowski, AGH University of Science and Technology, Poland
- Miguel Lopez-Guerrero, Universidad Autonoma Metropolitana, Mexico
- Fernando Losilla, Technical University of Cartagena, Spain
- Wieslaw Ludwin, AGH University of Science and Technology, Poland
- Antonio G. Ruzzelli, University College Dublin, Ireland
- Cedomir Stefanovic, University of Novi Sad, Serbia
- Dejan Vukobratovic, University of Strathclyde, UK

AWSAN 2010

Tuesday, October 12

1:20 PM - 3:00 PM

Room: Strategy Room 1

Chair: Pawel Kulakowski (AGH University of Science and Technology, Poland)

Range-Free Localization for Air-Dropped WSNs by Filtering Node Estimation Improvements

Eva Garcia (University of Castilla-La Mancha, Spain); Aurelio Bermudez (University of Castilla-La Mancha, Spain); Rafael Casado (University of Castilla-La Mancha, Spain)

Some sensor network applications involve an aerial deployment of many sensor nodes over a particular area of interest. In this context, current range-free localization proposals, based on an iterative refinement and exchange of node estimations, are not directly applicable, because they introduce a high traffic overhead. In this paper, we propose to control this overhead by means of avoiding the transmission of certain localization packets. The criterion applied by this new localization technique to filter packets is based on the amount of improvement shown after updating an estimation and the time from the last transmission. We also tune this filter in order to find an optimal trade-off between the benefit in traffic and the penalty in time.

Reliability Model for Extending Cluster Lifetime using Backup Cluster Heads in Cluster-Based Wireless Sensor Networks

Shafiq Ullah Hashmi (University of Ottawa, Canada); Sk. Md. Mizanur Rahman (University of Ottawa, Canada); Hussein Mouftah (University of Ottawa, Canada); Nicolas D. Georganas (University of Ottawa, Canada)

In cluster-based two-tier Wireless Sensor Networks (WSNs), the cluster-head nodes (CHs) gather data from sensors and then transmit to the base station. When these cluster head nodes start to die, the coverage of the respective clusters is lost and it leaves the region unmonitored. Even if the CHs are rotated and reassigned after some time, until the next rotation that cluster in question will be out of cluster head, causing a loss of information and loss of coverage. To select a Backup Cluster Head (BCH) is suggested for those CHs which are close to deplete their energy [1]. When the CH dies, BCH takes over the responsibility and continues to work as a new cluster head. In this paper we present an analytical model of cluster reliability in cluster-based WSN using BCH, based on Markov chain model. We use non-homogeneous Markov process, along with Forward Chapman-Kolmogorov equations to illustrate the cluster monitoring period in a finite three state space model. We test the accuracy of the model by applying the probabilities of failure of CH and BCH nodes, for a fixed number of sensor nodes in a cluster. The results show that the presented model is able to match the behaviour of the cluster state transition accurately and validates the simulation results and analysis published in [1].

An IEEE 802.15.4/ZigBee Based Wireless Sensor Network for Energy Efficient Buildings

Cengiz Gezer (University of Bologna, Italy); Michele Niccolini (University of Bologna, Italy); Chiara Buratti (University of Bologna, Italy)

Realizing energy efficient control strategies in the buildings is one of the innovative and challenging field of application for wireless sensor networks. To achieve the goal of reduced energy consumption and optimized

use of energy in the buildings, the deployment of sensors and actuators is crucial. Simple affordable sensors can be used to monitor the power consumed by each appliance in the building in order to turn them on/off when it is efficient in the use of energy. The ARTEMIS Joint Undertaking project eDIANA (Embedded Systems for Energy Efficient Buildings) funded by the European Commission aims to improve energy efficiency in buildings by using embedded technologies. In the eDIANA platform the energy consumed by household or office appliances is monitored by using IEEE 802.15.4/Zigbee-compliant devices. The aim of the study is to show the feasibility of the IEEE 802.15.4/Zigbee technology to the eDIANA application scenario and to provide guidelines for the network design. For this purpose two studies have been carried out: (i) a simulation analysis of a large apartment where many nodes are deployed; (ii) a real testbed composed of IEEE 802.15.4/ZigBee-compliant devices. In the first case performance, in terms of packet error rate, average delay and energy consumption, is evaluated by varying the number of nodes in different traffic conditions. In the second case, instead, the statistics of the delay is provided. The study shows that simulation results are in line with the results achieved through the measurements. Moreover results fulfil the eDIANA requirements.

[Energy-aware Routing Protocol for Mobile Sensor Networks Using Learning Automata Algorithms](#)

Maryam Kalantary (Azad university in Qazvin, Iran); Mohammad Reza Meybodi (Amirkabir University of Technology, Iran)

This paper proposes an energy-aware location-based routing protocol for mobile sensor networks that consist of frequently moving sensors. Our proposed protocol uses learning automata to select best routes that maximize delivery ratio and network lifetime. The protocol uses the location and remaining energy information of sensors to assign a cost function to each sensor node. Each node in network is equipped with a learning automaton which selects least-cost paths for each packet. Simulation results show that the proposed method achieves higher delivery ratio, lower routing overhead and lower energy consumption.

[Configuration & Deployment of Sensor Network Applications using Filesystem Abstractions](#)

Bhanu Pisupati (Indiana University, USA); Geoffrey Brown (Indiana University, USA)

Large scale sensor networks are non trivial to deploy due to their heterogeneous, distributed nature. This paper presents a technique to configure and deploy sensor applications on heterogeneous networks that is based on the use of virtual filesystem abstractions. The approach can augment existing sensor software build procedures with the ability to configure and deploy software, all using the filesystem framework. The paper presents an architecture to implement the idea and illustrates its use by means of a prototype. Automation of the configuration and deployment processes by use of scripting based techniques implemented using the filesystem abstractions is described.

6. PEMOS: First International Workshop on the Performance Enhancements in MIMO-OFDM Systems (PEMOS 2010)

Orthogonal frequency division multiplexing (OFDM) is a promising modulation technique for high data rate wireless transmission. OFDM combined with multiple antennas at the transmitter and receiver (i.e., MIMO) to increase the diversity gain and/or to enhance the system's performance on time-variant and frequency-selective fading channels, resulting in a MIMO-OFDM configuration. Combining both techniques enables to enhance the overall performance. This workshop brings together academics and active research and development professionals working in the field of wireless communication's optimization to promote exchange of research ideas and possible collaboration. Audience will be exposed to many performance optimizations in MIMO-OFDM systems and will be able to recognize the impact of such enhancement on the reliability and the efficiency of the standard MIMO-OFDM communication system. PEMOS 2010 will introduce the research community (industry, academia, and Government) to the up-to-date research in the area of MIMO-OFDM wireless communication systems and promote team collaboration among organizations having relevant expertise to execute an advanced research in this area.

Workshop Chair

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Technical Chair

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- Mohammad M. Banat, Jordan University of Science and Technology, Jordan
- Mustafa Matalgah, University of Mississippi, USA
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- Ridha Hamila, University of Qatar, Qatar
- Salama Said Ikki, University of Waterloo, Canada
- Saleh Al-Araji, Khalifa University of Science, Technology, and Research, UAE
- Yichuang Sun, University of Hertfordshire, UK

PEMOS 2010

Tuesday, October 12

3:30 PM - 5:30 PM

Room: Strategy Room 2

Chair: Shihab Jimaa (Khalifa University, UAE)

[PAPR Reduction by Nulled Subcarrier Distortion in Per-subcarrier Antenna Selection Systems](#)

Rafael Cepeda (Toshiba Research Europe Ltd, United Kingdom); Justin Coon (Toshiba TRL, United Kingdom)

We propose a rate-lossless technique for reducing the peak-to-average power ratio (PAPR) in orthogonal frequency-division multiplexing systems employing antenna selection on a per-subcarrier basis. The proposed technique, which is from the family of the active constellation extension (ACE) approach to PAPR reduction, exploits the nulled subcarriers (for a given antenna) that arise through the antenna selection process to reduce the PAPR by introducing a controlled level of distortion to these subcarriers. We show that the new scheme is capable of achieving a much lower PAPR than traditional ACE methods applied to per-subcarrier antenna selection systems. Moreover, we demonstrate through simulation analyses that the distortion transmitted on the nulled subcarriers will not hinder practical system performance.

[Bit and Power Allocation Strategy for AMC-based MIMO-OFDMA WiMAX Systems](#)

Muayad Al-Janabi (Newcastle University, United Kingdom); Charalampos C. Tsimenidis (Newcastle University, United Kingdom); Bayan Sharif (University of Newcastle Upon Tyne, United Kingdom); Stephane Y. Le Goff (University of Newcastle upon Tyne, United Kingdom)

In this paper, we propose a bit and power allocation strategy for adaptive modulation and coding (AMC) based spatial multiplexing multi-input-multi-output (MIMO) orthogonal frequency division multiple access (OFDMA) systems. This strategy aims to maximize the average system throughput by allocating the available resources optimally among the utilized bands depending on the corresponding channel conditions and the total transmission power constraints. The average system throughput is represented as a trade-off criterion between the spectral efficiency and bit error rate (BER). The considered AMC technique utilizes distinct modulation and coding scheme (MCS) options rather than adopting fixed or uncoded approaches. The transmitter divides the OFDMA frame at each transmit antenna into bands depending on the number of active users in an assigned base station (BS). The simulation results show superior performance of the MIMO-AMC-OFDMA system, which adopts the proposed strategy, over other conventional schemes.

[Time-Varying Channel Estimation Using Amplitude-Division Based Parallel NLMS Technique](#)

Rubaiyat Yasmin (Saitama University, Japan); Tetsuya Shimamura (Saitama University, Japan)

In this paper, we propose a channel estimation technique to combat the rapidly time-varying characteristics of multipath channel. The proposed method uses a normalized least mean square (NLMS) based novel adaptation scheme with amplitude-division technique. It supposes multiple linear transversal filters as estimators, which are arranged in a parallel fashion. The coefficient vectors for each estimator are formed with the amplitude-

division based classification technique according to the information of the channel coefficient values. The coefficient vector selected at each iteration is adapted with the NLMS algorithm to handle the time variation effect of the rapidly time-varying channel. Computer simulation results demonstrate that the proposed estimator provide better tracking performance than the conventional NLMS estimator and amplitude-division parallel LMS (ADPLMS) estimator for a second order Markov communication channel in various fade rate conditions.

MIMO-OFDM with Pilot-Aided Channel Estimation for WiMax Systems

Fabien Delestre (University of hertfordshire, United Kingdom)

This paper describes a channel estimation scheme for Multiple Input Multiple Output (MIMO)-Orthogonal Frequency Division Multiplexing (OFDM) systems based on training sequence. We first develop an approach to channel estimation which is crucial for the decoding of the transmitted data. We then discuss the implementation of the proposed method for WiMax systems under various channel conditions. The efficiency of the new algorithm is demonstrated through the simulation of the MIMO-OFDM system for two and four transmit antennas and different number of receive antennas. The Space-Time Coding with 192 information subcarriers per codeword is used as defined in the WiMax standard. Through simulations, it is shown that the proposed method has between 1.5 dB and 2dB loss compared to the ideal case where the channel coefficients are known at the receiver. In summary, with the proposed channel estimation technique, combining diversity using Space-Time Codes with OFDM is proved to be a promising technique for the present and future wireless communications.

Iterative Detection for Zero-Padded OFDM in Non-Regenerative Cooperative Wireless Networks

Homa Eghbali (Simon Fraser University, Canada); Sami Muhaidat (Simon Fraser University, Canada)

Zero-Padding Orthogonal Frequency Division Multiplexing (ZP-OFDM) has recently been introduced to avoid coded-OFDM's high decoding complexity. Various sub-optimal ZP-OFDM receivers have been developed in the literature to tradeoff performance with implementation complexity. In this paper, we propose a new iterative detection scheme for ZP-OFDM transmissions tailored to broadband cooperative networks with single relay and amplify-and-forward relaying. By avoiding channel dependent matrix inversion, which is the case in minimum mean square error (MMSE)-ZP-OFDM transmissions, and incorporating linear processing techniques, we show that our proposed receiver is able to bring significant complexity reduction in the receiver design, while outperforming cooperative MMSE-ZP-OFDM.

Random-Based Fair Allocation in Multi-Relay Cooperative OFDM System

Ibrahim Y Abualhaol (Khalifa University, UAE); Youssef Iraqi (Khalifa University, UAE)

In this paper, a novel Multi-relay Adaptive Random Selection (MARS) strategy in a dual-hop multi-relay OFDM system is proposed. In this strategy, the relays cooperate according to contribution factors suggested by each relay. The selection of the OFDM sub-channels is based on uniform random distribution where the thresholds of the uniform random variable are associated with the contribution factors. This approach guarantees fairness in allocating the resources in each relay. The approach is compared with static allocation of the OFDM sub-channels. The MARS strategy is tested in a multi relay system over flat and selective Rayleigh fading channels. Simulation results show the superiority of the proposed scheme in improving the OFDM system performance in

terms of BER. The performance is achieved by creating a virtual diversity by randomizing the allocation where no channel information is required.