

Ultra High-Speed Mobile Information and Communication

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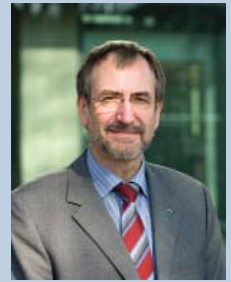
Message from the UMIC Coordinator

2011 will be a very busy year for the UMIC team. We are organizing two major symposia: DySPAN 2011 (www.ieee-dyspan.org) and ISWCS 2011 (www.ti.rwth-aachen.de/iswcs2011) – each expecting several hundred participants – and the ITG Workshop on Smart Antennas (WSA2011, www.wsa2011.rwth-aachen.de). Besides attracting events to Aachen, UMIC will also go “on the road”. You are invited to visit our booth at the Mobile World Congress (February 12-17, 2011) in Barcelona when you are attending this event (Hall 7 App Planet, 7EM14). Another opportunity to see UMIC at an exhibition will be in June at DAC 2011 in San Diego. Last but not least we are preparing a renewal proposal for UMIC covering the next

period of the German Excellence Initiative from 2012 to 2017.

This newsletter features project reports about OFDM related research at UMIC and a project whose results were used by UCSD (University of California, San Diego) to develop a tool for removing persons from Google Streetview images rather than dithering them. Besides a number of best paper awards and prizes awarded to UMIC members, a team of 20 RWTH Computer Science students won – under support and supervision of Prof. Dr. Ulrike Meyer, UMIC IT-Security research group - in a worldwide hacker competition. They succeeded in the “capture-the-flag” contest, where they had to conquer

a data code from their competition. Such a contest is an excellent training opportunity which will help the students in their later professional life, when they may have to secure the computer systems of their employers against intruders.



Enjoy reading the newsletter, more information about our research and a list of the publications is available on the UMIC web site (www.unic.rwth-aachen.de).

The UMIC DAY 2010

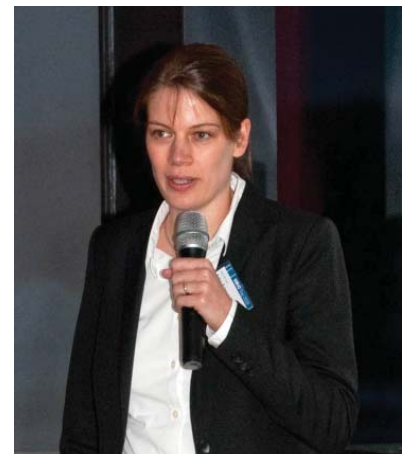


Important dates for the cluster of excellence UMIC were Monday, the 18th and Tuesday, the 19th of October 2010. The advisory board meeting, and subsequently, the annual UMIC Day took place. On Monday we organized a workshop with eight presentations across the four research areas of UMIC in order to present recent results to our advisory board, and to get feedback from our board. The morning of the second day was filled by presentations from the steering committee accompanied

by intensive discussions on how to harmonize and coordinate research from diverse areas like “three-dimensional picture representations”, “RF-DAC based multi-standard transmitters”, and “efficient implementations of capacity-achieving modulation schemes”. Invaluable comments and suggestions were given by our advisory board, whose members themselves are coordinators of research projects of similar size like UMIC and experienced leaders from industry. A great thanks goes to

them, these people spend a lot of time and effort to help to improve our cluster of excellence.

Tuesday afternoon the UMIC Day 2010 took place, an event of central importance. The opening keynote speech was given by Dr. Magnus Frodigh, Director Wireless Access Networks from Ericsson, Sweden. He gave us an overview of future challenges in mobile communications, particularly on reducing energy consumption and coping with the ever growing traffic demand. He also showed potential technologies and developments which Ericsson regards as



enablers of future demands. For UMIC it is important to synchronize its view of future research with telecommunication companies, being daily confronted with the needs of customers and the market.

Following Dr. Frodigh's speech, four UMIC junior professors introduced their respective fields in a series of impressive talks, ranging from information theory to mobile computer vision. Dr. Anke Schmeink started with a presentation on "Bio-Inspired Condensation of Information". How can we use a principle in evolution, namely high robustness against failure and massive parallelism in modern communication systems? In her talk, she presented a basic information theoretic model, which is applicable to cooperative communications and spectrum sharing in cognitive radio.



Dr. James Gross presented his research "On Schedulability in OFDMA Networks". He developed lower and upper bounds by analytical means and carefully investigated improvements by appropriate scheduling for a wireless LAN network. His results apply perfectly to present and future cellular systems like LTE and LTE Advanced.



The focus of Dr. Anupam Chattopadhyay was "Energy-efficient MPSoC Design". Do you know that the total amount of energy consumption for communications has already reached the level of global air traffic, and amounts to 2% of the total carbon dioxide emission on earth? Dr. Anupam presented interesting physical bounds on what can be achieved to decrease energy consumption of chips, and also offered approaches to achieve this goal.



The concluding talk was given by Dr. Bastian Leibe on "Building Mobile Vision Applications". Two main applications were treated, both amenable to the same smart computer vision principles: localization by taking a picture on a mobile device and comparing its characteristics to a database of

geo-tagged reference images. Furthermore, he demonstrated by impressive computer animated movies how confidential information in pictures like people, cars and personal items can be recognized and substituted by generic entities of the same type.

The concluding event of the UMIC day usually refers to displaying "ultra high-speed" and "mobility" by uncommon means. This time we found an absolute highlight in form of a Latin American dancing formation from the "Aachen Dancing Club Blue Silver".



Everybody who has seen the performance will join me in saying that the award-winning formation of four couples gave an awesome performance. The combination of rhythm, motion and costumes fascinated us all. Well done, Blue Silver! The UMIC Day 2010 concluded by getting together with excellent food and drinks.

Rudolf Mathar, TI

Optimizing OFDMA - Orthogonal Frequency-Division Multiple Access

Orthogonal Frequency-Division Multiple Access is a smart multi-carrier transmission scheme, invented already around 1950, but realizable only since the efficient hardware implementation of the fast Fourier transform and its inverse. OFDM has recently enabled unexpected high data rates for a variety of new services. For instance, DSL (digital subscriber line) has become a common internet access for the majority of households, it uses OFDM as baseband transmission technology. The terrestrial television DVBT (digital video broadcasting terrestrial), WLAN (wireless local area network) transmission, and the fourth generation mobile communications standard LTE (long term evolution) rely

and allows for using also weaker subcarriers. In modern communication systems, all subcarriers receive the same, uniformly spread transmission power, although, due to the broadband characteristic, some of them may have a low path loss, hence high quality, and others may be weak in the sense that the signal is strongly attenuated and high power is needed to get the signal through at an acceptable SNR (signal-to-noise ratio). There seems to be large potential in using the subcarriers not uniformly, but in an optimal way. Subchannels of good quality should be used more intensively than others. If the subchannel quality is too low, it should not be used at all, since

data rates, low energy consumption and robustness against time varying channels. Preliminary investigations demonstrate that compared to existing OFDMA systems a factor of two in data rate or energy consumption may be achievable, of course at the cost of higher complexity of transmitter, receiver and channel state information exchange.

Optimizing and robustifying OFDMA is a major UMIC project at the Institute for Theoretical Information Technology (TI), chaired by Prof. Dr. Rudolf Mathar. A number of people are contributing to this project, particularly (in alphabetic order): Simon Görtzen, Chunhui Liu, Rudolf Mathar, Michael Reyer, Virgilio Rodriguez, Anke Schmeink, and Milan Zivkovic. A variety of problems is considered, ranging from deep continuous and combinatorial optimization methods to practical implementations of modulation, channel estimation and signal processing on general purpose hardware with up-conversion and transmission conducted by USRP boards.

The project has also a strong impact onto teaching. A software defined radio hands-on training course for students has evolved over the last terms. Furthermore, a number of Diploma, Bachelor and Master theses has been derived from current research activities in this project.

Some technical details of the road map in Fig. 1 are substantiated in the following. A central point is certainly water-filling, as visualized in Fig. 2. A linear complexity algorithm with a couple of extensions to higher order problems is available at TI.

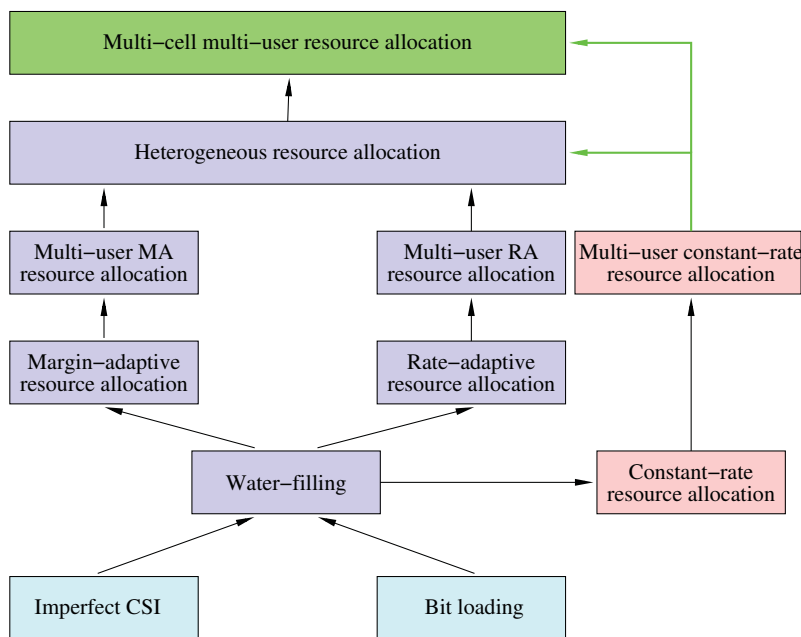


Fig. 1: Optimizing OFDMA - the road map

on the principles of OFDM and its multi-access version OFDMA. The basic principle of OFDM is to divide the available spectrum into a large number of subcarriers, split the incoming bitstream of high rate into separate streams of lower rates, and transmit each over a corresponding subchannel. The main advantage is the extension of symbol duration which helps to reduce inter-symbol interference in multipath propagation environments

this would mean a waste of energy spent against a malicious adversary. Moreover, a flexible adaptive assignment of data to subcarriers is desirable such that the whole system can react to varying subchannel states. This is particularly important for mobile communication where customers are moving and the channel is subject to permanently changing conditions. An adaptive and optimized OFDMA transmission scheme promises high

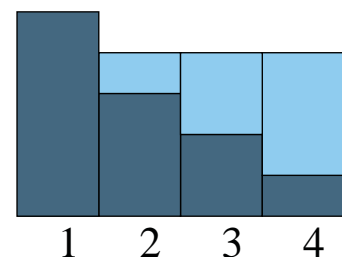


Fig. 2: Water-filling as basic optimization principle

The key problem is to numerically “pour” a certain amount of available power (the water, light blue) into bins of different bottom height (dark blue) such that the water level in each bin is the same. Water-filling is a key element to solve two related optimization problems for finding an optimum subcarrier assignment. One is called margin-adaptive, it means to minimize total power con-

Margin-adaptive (MA):

Minimize power subject to rate demands

$$\begin{aligned} \min \quad & \sum_{k=1}^K \sum_{n=1}^N \psi(r_{k,n}) \frac{\sigma_{k,n}^2}{h_{k,n}} \\ \text{s.t.} \quad & \sum_{n=1}^N r_{k,n} \geq R_k \\ & \sum_{n=1}^N r_{k,n} r_{l,n} = 0, \quad k \neq l \end{aligned}$$

sumption over all subscribers in the system while maintaining certain user rates. A dual approach is the rate-adaptive problem, which stands for maximizing the total rate subject to a given power budget and certain minimum rate requirements. In mathematical terms these problems read as follows.

Function ψ relates rate and power, $\psi(r)$ denotes the power to achieve rate r . R_k is the rate required by user k , and $r_{k,n}$ the rate allocated to subcarrier n for user k . $\sigma_{k,n}^2$ denotes the corresponding noise power and $h_{k,n}$ the channel gain.

Reality is often more complicated than covered by the above optimization problems. Users may have different trac and power demands, depending on the service presently used. Hence mixtures of the above approaches must be considered. The function which describes the interdependence between power and rate on each single link is not continuous but a step function, determined by the available modulation, channel coding and bit mapping schemes. This complicates the

problem a lot, since methods from discrete optimization prevail. If the transmitter switches modulation schemes on subcarriers very often, the receiver has to be informed, generating a certain amount of overhead. To avoid this, multi-user constant-rate transmission at minimum power is the goal, which is also a subject of theoretical, algorithmic

Rate-adaptive (RA):

Maximize rate subject to power and minimum rate constraints

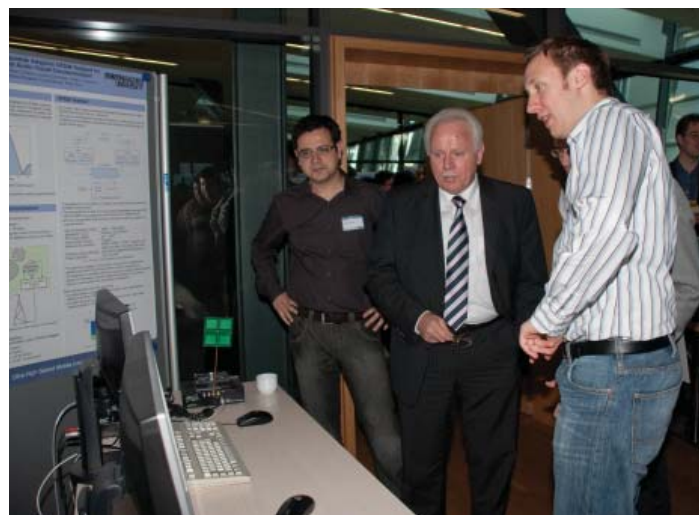
$$\begin{aligned} \max \quad & \sum_{k=1}^K \sum_{n=1}^N r_{k,n} \\ \text{s.t.} \quad & \sum_{n=1}^N r_{k,n} \geq R_k \\ & \sum_{n=1}^N r_{k,n} r_{l,n} = 0, \quad k \neq l \\ & \sum_{k=1}^K \sum_{n=1}^N \psi(r_{k,n}) \frac{\sigma_{k,n}^2}{h_{k,n}} \leq P \end{aligned}$$

and implementational importance at TI. Our final target is a multi-cell multi-user resource allocation policy, regarding technical subtleties of the LTE advanced standard such that the cellular system has outstanding spectral efficiency, is extremely robust against channel variations induced by mobility, and treats subscriber demands in a fair and balanced manner. About 30

papers in journals and conference proceedings on OFDMA optimization and related topics are available from TI’s web page at <http://www.ti.rwth-aachen.de/publications/>.

Most of the basic ideas are implemented in a software dened radio testbed. The corresponding demonstrator was shown at different occasions, the most prominent ones being CeBIT (Hannover, 2009), WinTECH (Beijing, 2009, awarded the second prize in SDR), DySPAN (Singapore, 2010), NGMN Industry Conference & Exhibition (Shanghai, 2010), and next years Mobile World Congress (Barcelona, 2011). The prototypical demonstrator is continuously being refined and further enhanced. The nal goal is a testbed for different interfering OFDMA radio links with the whole system optimizing in a self-organizing manner. Many fundamental problems are still open or demand for improved algorithmic solutions. Our vision is an implementation on a versatile UMIC chip from the NUCLEUS project with a UMIC proprietary multi-band front-end, endowed with smart iterative coding schemes contributed by other UMIC projects. We jointly aim at it, even if the remaining path is wound and challenging.

R. Mathar, TI



OFDMA demo at the UMIC Day’10

RWTH Aachen CTF Team Achieves Second Place at the iCTF and Wins the RuCTFe 2010

On December 3-4, the RWTH Aachen CTF team Old EurOpe participated in the UCSB International Capture the Flag (also known as the iCTF) event. The team Old EurOpe consists of up to 20 students and PhDs students and is organized and guided by the IT-Security research group at the UMIC research centre. The iCTF, organized by Prof. Giovanni Vigna of the Department of Computer Science at UCSB, is the largest international distributed hacking competition for universities with participants from different countries. The goal of the competition is to test and train security skills by competing in a game of hacking against teams of the other universities. Therefore, all teams are connected to an internal environment by a VPN and attacks are only allowed within the VPN. The teams have to steal so-called flags (32 bit codes) from other teams in order to obtain points. This year, 72 teams from 16 different countries lined up against each other and Old EurOpe was one of them. The theme of the iCTF 2010 was about a corrupt country Litya who became a major player for illegal activities and who is the herder of a botnet with bots in different countries.

Each team represented such a country where the bot was provided as a vulnerable VM image. All teams took part in a joint strike against Litya's infrastructure to earn as much points as possible. The infrastructure consisted of different missions which carried out certain activities with associated services. The goal was to hack active services to obtain an flag which yields points for the team who had stolen the flag. As an additional barrier, the connection between the countries (bots) and Litya (botnet herder) was protected by a snort IDS system. The IDS triggered alerts on certain attack types and the responsible team became disconnected. However, the used rules for the IDS were public. In order to avoid those

alerts the snort IDS system was installed locally and attacks were first tested against this local version of the IDS. In addition, all teams could solve side challenges to earn money which could then be used to bribe Litya's network administrators to reconnect to Litya's network after a disconnection. The event started at 8 am, PST. Information about the missions, in particular the schedule and ordering of the activities and services, were revealed several hours before. At 1 pm, the first team hacked a service and stole a flag earning the first points in the iCTF. The submit system only accepted active flags where the activity of a flag was based on the state of a mission. So, the previously published information about timing and order-

Mellon University, USA. Two weeks later, Old EurOpe won the RuCTFe 2010 with 55 other participating teams, organized by the Ural State University, Russia. The event was a classical CTF where each team has their own vulnerable system (usually provided as a VM image) running different services. On the one hand, each team had to secure their own system (defense) and on the other hand, each team had to hack into the system of other teams to steal flags (offense). Points were given for defense as well as offense.

In the summer semester the IT-Security research group will host a CTF for the first time. The theme of the CTF will be "Cyberwar the Flag" and consists of a hybrid system, i. e. vulnerable VM images and a sepa-



ing of activities had to be analyzed. At 1:30 pm Old EurOpe also hacked its first service and earned their first points in the event. Overall, we hacked two services and stole flags for those services. New flags were published every 3 minutes. Besides, our team also had root access to other systems (bots) belonging to different teams such that those teams could be disturbed or used as a test system for flag submission or exploitation. Overall, we finished the competition as the second-best team behind the Carnegie

rate challenge network. CTF events are in general useful to train security skills and a good practical complement for students who obtained theoretical security knowledge at the university. If you are interested in such events or want to learn more about upcoming competitions, please contact us or have a look at our homepage.

André Egners, Georg Neugebauer, IT-Security

Removing Pedestrians from Streetview Images

Google's recent image recording activities for its Streetview mapping service have given rise to a widespread public debate about privacy. Despite Google's efforts to blur the faces of people visible in the Streetview images, critics have uttered their concerns that people may still in some cases be identifiable. As reported by MIT Technology Review (<http://www.technologyreview.com/computing/25972/?a=f>), researchers at UC San Diego led by Prof. Serge Belongie have proposed a better solution based on state-of-the-art visual object detection

technology developed by UMIC researcher Prof. Bastian Leibe.

The basic idea behind this approach is to use a probabilistic object detection algorithm (developed by Prof. Leibe) in order to locate pedestrians in the Streetview images and to delineate them from the background. A second Streetview image from a neighboring viewpoint is then used to identify the background structure behind the detected person, which is warped to fill in the cut-out hole in place of the pedestrian. The visual effect is that the pedestrian is removed from the image, leaving

behind just a slightly blurred region on the filled-in facades and the occasional minor artifact, such as a pair of smoking shoes or a dog on an owner-less leash. The approach is currently restricted to isolated pedestrians and does not work for crowded scenes where no unobstructed view of the background is available. Future extensions could include removal of other privacy-sensitive objects such as cars, for which Prof. Leibe's UMIC research group has also developed powerful object detection algorithms.

Bastian Leibe, MMP

Eduard Rhein Technology Award 2010



Prof. Dr.-Ing. Jens-Rainer Ohm from UMIC / RWTH Aachen University received together with Prof. Dr.-Ing. Thomas Wiegand from Heinrich Hertz

Institute, Fraunhofer Society, Berlin the prestigious Eduard Rhein Technology Award: For outstanding and internationally recognized contributions to video coding and the development of the standard H.264/AVC, in particular for developing novel approaches to motion compensation using multiple reference pictures, hypotheses and picture hierarchies, for contributions to 3D video coding, for scalable and multi-view video coding, for video coder control, that helped to lay the ground for many new application areas of video coding.

Video Coding and the H.264/AVC Standard

The constantly growing number and increased resolution of video signals creates a continuing demand for more efficient video compression. The compression of video signals is a key technology for media transmission via broadcast, Internet, mobile networks, communication and

for storage applications. During the last decade, this development was primarily influenced by the emergence of the H.264/AVC standard (officially called Recommendation ITU-T H.264 / ISO/IEC 14496-10 MPEG-4 part 10: Advanced Video Coding). H.264/AVC achieves significantly higher compression performance than all previous MPEG-x or H.26x standards. The extensions of H.264/AVC give efficient support for additional functionality such as scalability at the bit stream level as well as stereo and multi-view coding. In the meantime, certainly more than one billion devices have been built that are running H.264/AVC. The following applications are particularly important:

- Mobile telephony: H.264/AVC is shipped with the vast majority of mobile phones that support video.
- Mobile TV: H.264/AVC is the only video codec used in this application e.g. in USA, Japan, Korea, Italy, Malaysia, Qatar, Finland and many more countries.
- Mobile video players: Apple's iPod and Sony's PlayStation Portable are running H.264/AVC in millions of devices.
- TV broadcast: H.264/AVC is used in all recent launches of digital TV broadcast, e.g. in France, Norway, Brazil, Estonia. Practically every HDTV broadcast in USA and Europe is based on H.264/AVC. As an

example, DirecTV in USA is broadcasting more than 1000 HDTV channels – all coded with H.264/AVC. All German HDTV services are using H.264/AVC, as well as in most other European countries. World-wide, almost any IPTV service is based on H.264/AVC.

- Blu-Ray Disc: H.264/AVC is a mandatory codec in all Blu-Ray players, and a large percentage of movies on Blu-Ray Discs are coded in H.264/AVC.
- Internet Video: Apple's Quicktime, Adobe's Flash as well as Microsoft's Silverlight and Media Player support H.264/AVC. In particular, Adobe's Flash is used largely within the Internet, e.g. in YouTube by several 100 million users. Therefore, it can be said that the vast majority of movies sent over the Internet is coded by H.264/AVC.
- Video conferencing and Internet chat: All new videoconferencing applications are based on H.264/AVC (e.g. Polycom, Tandberg, LifeSize, Sony) or on its SVC extension (e.g. Vidyo).

Both award winners have significantly contributed to the H.264/AVC standard by their scientific visions, development of technical solutions and by participating in the management team responsible for the standard's development. (see also <http://www.eduard-rhein-stiftung.de>, Prof. Dr Hans-Joachim Grallert)

UMIC Guest Lecture: Dr. Earl McCune

The Chair of Integrated Analog Circuits with support of the Mixed-Signal CMOS Circuits group was pleased to host the UMIC guest lecture by the distinguished Dr. Earl McCune. Dr. McCune, a graduate of UC Berkeley, Stanford, and UC Davis, has more than 35 years of experience in wireless communication technology, systems, and circuit design. His expertise in the field is demonstrated by over 40 US patents and its frequent appearance as invited speaker at conferences worldwide. He has been a Silicon Valley entrepreneur since 1986, starting up two groundbreaking technology companies that both provided successful exits to the investors. He is now a semiretired consultant, instructor, and visiting professor at multiple universities.

In his highly topical and vivid course he explored practical digital wireless signals. After giving an introduction of basic nature of digital wireless modulation schemes trying to give the audience a physically intuitive



understanding of wireless communication signals, he went through all of the major modulations used in digital wireless communication, including ASK, FSK, PSK, QAM, and OFDM. System principles such as an extensive discussion of the Shannon capacity limit, plus the physical basis of Nyquist filtering,

were also covered. Important system parameters and analysis tools, which are common to any modulation type, were presented and demonstrated. He also demonstrated the need for coding, its fundamental types and their top level costs and benefits.

Ahmed Aref, MSCC

Award

Best Paper Award ITG Speech Communication 2010

Laurent Schmalen and Peter Vary from the Institute of Communication Systems and Data Processing (IND) received the Best Paper Award of the 9th ITG Conference on Speech Communication, held in Bochum from October 6- 9.

Their work "Reconstruction of Multiple Descriptions by MMSE Estimation" describes how to improve the decoding quality of multiple descriptions. Multiple description coding is a concept that is frequently used in audio, image, and video codecs designed for the transmission over networks that are prone to packet losses. The signal is partitioned into two or more descriptions that are individually transmitted in separate packets. If one or more packets are missing, the audio-visual sig-



nal can still be reconstructed, with a degraded quality however. In the award-winning paper, the authors exploit the residual redundancy of the signal after source coding for improving the reconstruction qual-

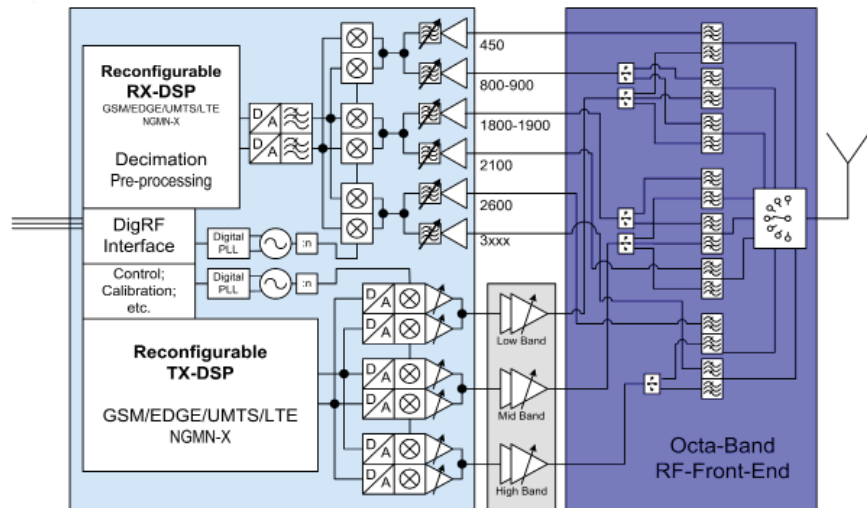
ity in the presence of packet losses. They furthermore show the reconstruction can also be improved in the presence of bit errors.

UMIC Workshop on Software Defined and Cognitive Radios from an RF Point of View, EEEfCOM, Ulm 2010

The UMIC Workshop on Software Defined and Cognitive Radios from an RF Point of View was held on June 17, 2010 at the Science Park of Ulm University in the frame of the "Electrical and Electronic Engineering for Communication" EEEfCOM exhibition. The EEEfCOM exhibition is one of the leading RF, communication and microwave exhibitions in Germany. The half-day workshop was organised by the Mixed-Signal CMOS Circuits group in collaboration with the Chair of Integrated Analog Circuits at RWTH Aachen University to illustrate the point of view of the RF designer on the development of software defined and cognitive radios to the industrial and academic attendees.

ter an overview on the challenges for future RF integration of flexible frontends, first the ongoing high dy-

The EEEfCOM exhibition has offered a good platform to showcase the UMIC Research Centre and,



In six presentations and subsequent discussions the presenters emphasised in general on the feasibility and, in particular, on the architectural requirements of the RF frontend for enabling multimode multistandard user terminals. Af-

dynamic receiver and then the UMIC transmitter research projects have been presented in detail. Finally, the aspects of system-level modeling and virtual prototyping of digital-centric frontends were addressed.

especially its RF focused research activities. It also provided an opportunity to actively interact with representatives of academia and industry during the annual exhibition.

Björn Thiel, MSCC

News

GOLD LEAF Certificate PRIME 2010

Björn T. Thiel, Stefan Dietrich and Renato Negra have been recognised with the GOLD LEAF Certificate at the PRIME 2010

The paper 'Digital Polyphase Baseband for Direct Digital Generation of High Sample Rate Radio Frequency Signals' by Björn T. Thiel, Stefan Dietrich and Renato Negra has been recognised with the GOLD LEAF Certificate at the 6th Conference on

Ph.D. Research in Microelectronics & Electronics (PRIME 2010).

The Conference on Ph.D. Research in Microelectronics & Electronics has been established over the recent years as an important conference where in particular Ph.D. students can present their project results and can get in contact with people from the industry. Based on the reviewer's evaluation each year top 10% of the papers will be recognised with the GOLD LEAF Certificate.

The paper discusses an approach for handling different wireless communication standards, like modulation schemes and frequency bands, by using a highly reconfigurable RF transmitter. The feasibility of direct-digital generation of pulse-width/position modulated RF signals with gigahertz carrier frequencies has been shown through system-level simulations and circuit-level evaluation of critical elements.

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Esther Horbert / MMP

Esther Horbert received her Diploma degree in Computer Science from the RWTH Aachen University in July 2010.

During her studies she spent one year at the KTH Stockholm University, Sweden, where she developed an interest in Computer Vision. After returning to Aachen she wrote her thesis at the MMP Group and stayed as a research assistant.

Her present research topic is level set segmentation and tracking of pedestrians and cars for dynamic scene analysis. In realistic scenarios this is highly challenging since both the camera and other traffic participants can move quickly through an unknown and complex environment. The focus lies on applications like mobile robots and driver assistance systems.



Zheng Wang / MPSoC Architectures

Zheng Wang was born in Tianjin, China. He received his Bachelor degree in Physics from Jiaotong University of Shanghai and his Master degree in Communication Electronics from Technical University of Munich. During his master study he worked in the field of fault tolerant processor architecture as student assistant and did his master thesis in the field of multiprocessor real-

time scheduling at Infineon Technologies AG.

Since September 2010 he joined the research group for Multi-Processor Systems-on-Chip Architectures at UMIC as a research assistant under the guidance of Prof. Dr. Anupam Chattopadhyay. His research interests lie in the area of low power and reliable processor design by high-level design tools.



Luis Gabriel Murillo / SSS

Luis Gabriel Murillo received his Diploma degree in Electronics Engineering from the University of Antioquia, Colombia in 2007, and his Master's degree in Embedded Systems Design from the University of Lugano, Switzerland in 2009. In October 2009, he joined the Chair for Software for Systems on Silicon (SSS) of RWTH as a research assistant. His current research activities deal with new simulation and debugging techniques to support

design and programming of complex MPSoC systems. Luis is actively participating within the Nucleus project of UMIC, by enabling fast and accurate virtual prototypes of modern wireless systems with advanced debugging and profiling capabilities. Investigations on MAC-PHY joint development and optimizations are being carried out using such technologies.



Aamir Ishaque / ISS

Aamir Ishaque received his Bachelor degree in Electrical Engineering from the University of Engineering and Technology, Lahore, Pakistan in 2004. Between 2004 and 2007, he was with Zhong Xing Telecommunication Corporation (ZTE) as a system engineer. There, he mainly worked in the fields of mobile radio network planning and RF optimization. He obtained his Master degree in communications engineering from RWTH Aachen University

in 2010, under auspices of DAAD scholarship. Since spring 2010, he is a research assistant at the Institute for Communication Technologies and Embedded Systems (ICE) of RWTH. His current research interests lie in the area of the synchronization in MIMO-OFDM systems, the compensation of radio front-end imperfections, and the study of the impact of RF processing impairments on system performance. Another focus of his research deals



with the evaluation of a reconfigurable cognitive radio physical layer on many-core computing fabrics.

Christian Dombrowski / MNP

Christian Dombrowski received his Dipl.-Ing. degree in Computer Engineering in 2009 from the Technische Universität Berlin. During university studies he worked for Nokia Siemens Networks in Berlin as a software engineer. In the beginning of 2010, he joined the Mobile Network

Performance Group at UMIC as a research assistant under the guidance of Prof. Dr. James Gross. His fields of interests encompass Cognitive Radio technologies and reliability in wireless networks, as well as practical implementation aspects thereof.



Donald Parruca / MNP

I received my Bachelor degree in Telecommunications Engineering at the Polytechnical University of Tirana, Albania, and finished my Master degree in Communications Engineering at the RWTH Aachen

University in June 2010. Since July 2010 I am working on the PhD degree at the Mobile Network Performance Group of UMIC. My research interest is in interference coordination of LTE networks.



UMIC at the IFIP World Computer Congress

A cooperation between the two UMIC groups "Mobile Network Performance" (Prof. Dr. James Gross) and "Logic and Theory of Discrete Systems" (Frank Radmacher, Prof. Dr. Wolfgang Thomas) led to a joint paper that was presented at the 21st IFIP World Computer Congress in Brisbane (September 2010). This main conference of the "International Federation for Information Processing" takes place every two years; it spans a great number of different topics. This year there were more than 1000 participants and about 300 papers were accepted. Our contribution was presented in the track on theoretical computer science. The paper shows fundamental results on routing over dynamic networks. In a game-theoretic model it is clarified under which assumptions routing algorithms



exist that work under adversarial conditions. The basic model fits for example the dynamic spectrum access paradigm where the model can be used to analyze malicious behavior of secondary nodes and their impact on the connectivity (in

more theoretical terms, the reachability) of primary nodes. The paper got positive feedback and the trip to Australia was long but nice!

Frank Radmacher, i7

PhD News

Current and Evolved Physical Layer Concepts: Potentials and Limitations of Mobile Broadband Wireless Access

Helge Lüders, IND

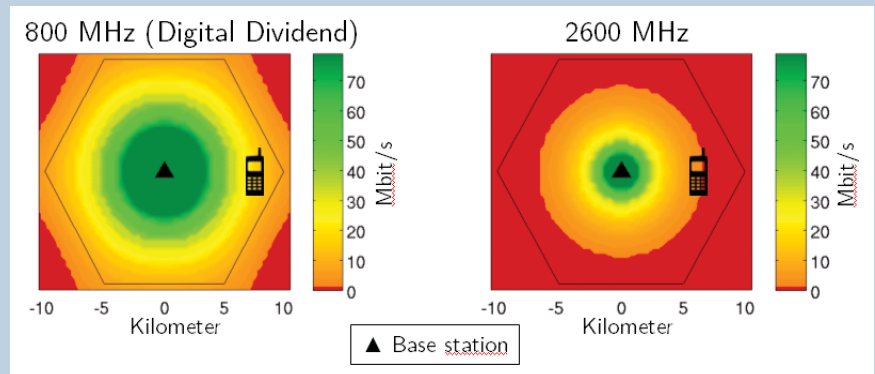
Two important factors fuel the fast evolution of mobile broadband access technologies: The ever-increasing demand for high data rates due to the availability and acceptance of mobile devices and applications and the demand for affordable broadband access in under served areas where radio technologies are regarded as a substitute to fixed line technologies.

This thesis highlights potentials and limitations of current and future mobile radio systems for area-wide mobile broadband access. It describes and thoroughly analyzes the physical layer of the current Release 8 of the UMTS LTE mobile radio standard implemented as single-antenna system. Different novel modifications and alternative concepts are introduced and analyzed which aim at either increasing the physical layer performance or at decreasing the computational complexity. In addition, upper bounds on the performance concerning the obtainable bits per channel use are regarded for single- and multiple-antenna systems. It is observed that single-antenna LTE operates at approximately 65% of the Shannon limit.

On top of the physical layer simulation results, system-level simu-

lations of the downlink in a cellular environment are performed to evaluate the potentials and limitations of UMTS LTE and the introduced physical layer modifications concerning the coverage, quality and capacity of a radio cell within a mobile radio network. Two car-

the cell edges these individual user goodputs might drop to only one tenth of the user goodputs that are achieved near the base station. The average cell goodput is derived and given for all combinations of the considered system-level parameters. It is shown that the achieved good-



Cell Sizes in UMTS and UMTS-LTE

rier frequencies are considered: 0.8GHz and 2.0GHz representing the frequencies from the digital dividend and of current UMTS deployments, respectively. The employed frequency bandwidths of 5MHz and 20MHz represent the frequency bandwidth of current UMTS and the largest frequency bandwidth supported by UMTS LTE Release 8, respectively. Additionally, different propagation scenarios representing typical mobile radio environments are considered.

System-level simulation results reveal an imbalance concerning the individual user goodputs (error-free throughput) within a radio cell: near

puts scale linearly with the available frequency bandwidth. The influence of the carrier frequency is observed to significantly influence the coverage and capacity of a radio cell only if it is interference limited.

In the future, major gains can be expected from more sophisticated coding and signal processing. The most promising options are multiple-antenna systems and intelligent interference management algorithms. With the derived bounds it is shown that in theory, a capacity achieving 4x4 multiple-antenna system using 20MHz frequency bandwidth and ideal interference cancellation could achieve an average cell goodput > 1Gbit/s.

News

Prof. Jarke Presents Keynote Talk on UMIC at INFORMATIK 2010

The annual national conference of Gesellschaft für Informatik (GI) e.V., INFORMATIK 2010, drew over 1200 participants from business and science to 600 year-old Uni-

versity of Leipzig from September 27 - October 1, 2010. On the plenary day of the conference, Prof. Dr. Matthias Jarke (Informatik 5 and Fraunhofer FIT) presented an invited keynote lecture "Mobile Information and Communication Services:

Cooperative, Environment-Friendly, Secure?" in which he gave an overview of the research questions and accomplishments within DFG-funded Excellence Cluster UMIC.

UMIC Research Centre Demonstrated Recent Research Achievements at the 2. IuK-Tag NRW

UMIC research center demonstrated recent research achievements on radio resource management and binaural audio-visual communication at the "2. Tag der Informations- und Kommunikationswirtschaft Nordrhein-Westfalen (IuK-Tag NRW)", held in Wuppertal, on November 10, 2010. Organized by the Ministry of Economic Affairs, Energy, Building, Housing and Transport, the IuK-Tag NRW is the high ranking annual meeting which gives impulses for future strategies for the IT business sector of NRW.

Most participants are coming from the IT business sector, politics and administration of NRW as well as representatives of international companies and research institutions. The meeting offered great possibility for professional networking and information exchange providing valuable contacts for future cooperation in research and development.

The demonstration "A Reconfigurable Adaptive OFDM Testbed for Binaural Audio-Visual Communications", developed within the UMIC cluster, was presented at the co-located exhibition where the leading IT companies from NRW showed their latest innovations. The dem-



onstration attracted a lot of interest and triggered inspiring discussions about a possible implementation of future audio-visual communication solutions based on adaptive transmission systems.

As part of the Forum on IT-Security, Prof. Dr. Meyer gave a talk on "Mobile Botnets – Threat of the Future?" This talk gave a short introduction to the topic of botnets in general including the types of attacks herders mount with the help of botnets, the ways botnets are controlled and the

challenges in detecting and tearing down botnets. The main part of the talk then discussed the potential threats that may arise from botnets formed by mobile devices in the future. The talk was very well received by a fairly large audience and led to a lively discussion immediately after the talk as well as during the following coffee break.

Milan Zivkovic (TI), Matthias Rüngeler (IND), Ulrike Meyer (IT-Sec)

PhD News

Social Software and Community Information Systems

Habilitation, Ralf Klamma, Computer Science 5

Community information systems (CIS) are information systems using a variety of Internet engineering technologies to support communities of practice. In contrast to organizational information systems supporting defined organizational structures, CIS depend on a complex interplay of informal and evolving CoP structures, evolving technology and the mostly hidden rules of network structures. Therefore, CIS need the possibility to reflect about their development processes and to elicit the networks roles and

structures. The advent of the Web 2.0 and social software generates even more demands on CIS, since most business models rely on the networking of people to achieve goals set by the communities.

The research has contributed to existing research areas connected to information systems engineering but also to the development of emerging research disciplines like Web Science. In Web Science both engineering and science play important roles in understanding the Web as a social graph and to design for a desired behaviour. In addition to a comprehensive survey of literature on CIS, the main contributions of the thesis are the following.

* A methodology called ATLAS for the engineering of CIS based on continuous elicitation and assessment of community needs, the reflection on social roles in communities of practice and a socio-technical information system development process incorporating the communities as stakeholders.

* A service-oriented architecture called LAS for the realization of reflective community information systems by measuring, analyzing and simulating the use of information systems.

* A model and a repository for community-centered cross-media social network analysis called the Media-Base.

UMIC Co-Organizes International eCommerce Conference

The 12th International Conference on Electronic Commerce (ICEC 2010) was held at the University of Hawaii, Manoa, from August 2-4, 2010. Under the theme "Roadmap for the Future of Electronic Business." Conference co-chairs were Professors X. Tung Bui (University of Hawaii) and Matthias Jarke (RWTH Aachen University), program co-chairs Professors Vasant Dhar (New York University) and Helmut Krcmar (TU Munich). As e-business has come of age with spectacular successes in a number of business areas - from the explosion of B2B to the worldwide growth of e-tailing and e-marketing, conference participants from computer science, business administration, business practice, and venture capital pondered about the next possible wave of e-business - from social commerce to the new technologies that would further enable new e-business models, such as mobile applications. These two themes were addressed in the two conference tracks in which a total of 27 research paper selected after a strict refereeing process were presented.

All the papers are accessible on the Web at <http://icec2010.shidler.hawaii.edu>;



ICEC conference chairs Matthias Jarke, Vasant Dhar, Helmut Krcmar and Tung Bui

[waii.edu](http://www.waii.edu); selected papers will also be published in a post-conference proceedings volume by ACM Press and in a special journal issue. Some of the highlights of research results presented include an analysis of the factors enabling the success of Facebook over competing social network platforms, perspectives and limitations of (mobile) ePayment mechanisms and social finance, studies of social shopping models, and risk aspects. A mem-

orable conference dinner was held on an evening cruise in front of the Waikiki coastline. Next year's ICEC conference will be held in Liverpool, UK, in August 2011 on the theme of mobile e-commerce which was also the topic of the final plenary panel at ICEC 2010, in which an overview of UMIC research themes and results was given.

Matthias Jarke, i5

News

1st Huawei Compiler/Tools Symposium in Shenzhen

Huawei Technologies, a fast growing worldwide market leader in telecom equipment such as base stations, organized their first international Compiler/Tools Symposium at the Huawei headquarters in Shenzhen (China), during September 6-8. During this time, Shenzhen, a 12 million people city north of Hongkong, also officially celebrated its 30 (!) years anniversary, thus being clearly a symbol of China's rapid economic growth in the past years. The symposium program largely consisted

of invited talks by embedded system design technology experts from Europe, US, and Asia, including Barbara Chapman (University of Houston), Saman Amarasinghe (MIT), and Tsuyoshi Isshiki (Tokyo-Tech). The focus has been on how to solve the challenges of complex multicore platform programming and high-level design. Prof. Rainer Leupers from the SSS chair presented about "Programming Heterogeneous Embedded Multicore Architectures" and put this into the UMIC context and research roadmap. Later, he also used the oppor-

tunity for a short visit to the Huawei site in Shanghai for further discussions. The perfectly organized three days symposium in Shenzhen was rounded up by breakout discussion meetings, social events, and a guided tour through Huawei's impressive product exhibition hall as well as the data center and logistics facilities on the campus. While several UMIC chairs already collaborate with Huawei in different forms, the symposium identified new grounds for intensified cooperation in the near future.

UMIC Results Presented at Top International Conferences

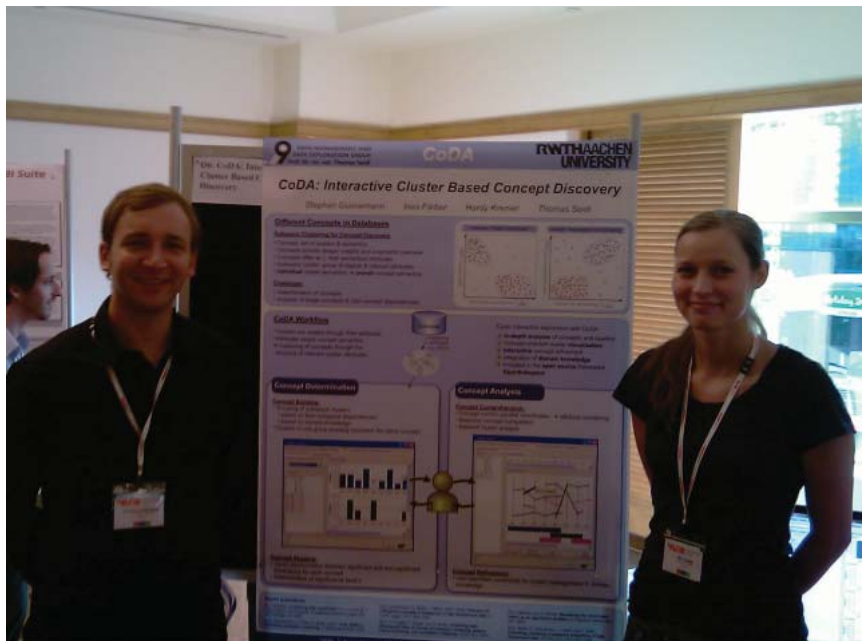


ect “Energy Awareness of Applications” at the VLDB conference 2010, a top Data Base venue. In this project, we focus on data analysis of distributed sources for energy efficient data provisioning, including mobile social networks and distributed sensor networks. With more than 20 peer reviewed publications in top international conferences and journals in 2010, it was an active and very successful year for these two UMIC projects.

Philipp Kranen, i9

The group from i9, headed by Prof. Dr. T. Seidl, presented recent UMIC research results at various top international conferences in 2010. This picture shows a presentation of achievements from the UMIC B project “Mobile Stream Data Mining” at the ACM SIGKDD 2010 conference, a top Data Mining venue. In this project, we conduct basic research on efficient stream data mining algorithms, and support methods and tools for the open source benchmarking framework MOA (“Massive Online Analysis”) in collaboration with the University of Waikato in New Zealand.

The next picture shows a presentation of results from the UMIC proj-

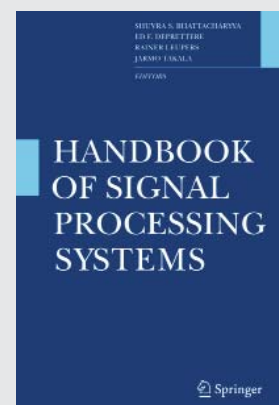


News

New Book: Handbook of Signal Processing Systems

Bhattacharyya, S.S.; Deprettere, E.F.; Leupers, R.; Takala, J. (Eds.) This handbook is essential for those involved in R&D in the design, ar-

chitecture, and implementation of a wide array of signal processing systems. This handbook is also suitable as a first point of entry to the field for undergraduate and post-graduate students in engineering, computer sciences, and system engineering.



ICE Presents parSC: Parallel SystemC Simulation at Embedded Systems Week 2010

For the success of future LTE implementations, as envisioned by UMIC, the availability of sufficient computational power is critical. To provide ever larger computing capabilities without exceeding the strictly limited energy budget of a mobile device, MPSoC (multi-processor systems-on-chip) occur to be the only viable solution for future terminal hardware implementations.

However, the typical number of processor cores in real-life MPSoC is growing steadily. With increasing complexity, MPSoC performance and behavior becomes more difficult to predict and such systems are becoming intricate to program and debug. Simulators contribute substantially to alleviating this problem. With legacy simulation technologies, the user experiences a performance degradation linear to the number of simulated cores.

The Chair for Software for Systems on Silicon (SSS) headed by Prof. Dr. Rainer Leupers, member of the Institute for Communication Technology and Embedded Systems (ICE), developed a new, universally applicable parallel simulation technique to accelerate simulation of models specified in the industry-proven language SystemC. The main differentiators to existing approaches are as follows: The technique can give strong guarantees regarding the simulation accuracy and determinism of the simulation result. Such guarantees are essential e.g. for performance verification purposes and debugging race conditions,

which are a particularly severe kind of software defects. Further on, it is not necessary to statically partition the simulation to the available host

tems Week / International Conference on Hardware/Software Codesign and System Synthesis).



cores. It is possible to let the simulation engine handle the load distribution dynamically during runtime. Finally, the realization is carefully tuned for efficiency, so that many simulations that are intrinsically not well suited for parallelization can still be accelerated to some extent.

While earlier this year, a demonstrator of parSC had been successfully exhibited at DAC (Design Automation Conference), this time the scientific background was presented to the research community and potential industry users at ESWeek/CODES+ISSS (Embedded Sys-

The presentation of the research paper (parSC: Synchronous Parallel SystemC Simulation on Multi-Core Host Architectures) was well-attended, and led to extensive and fruitful discussions during the follow-up poster session. Here, our thinking that fast and accurate simulation is a crucial asset to the ESL (Electronic System Level) design community was absolutely reconfirmed. Especially conference participants from industry showed deep interest.

Christoph Schumacher, SSS

UMIC at
Mobile World Congress 2011





CALL FOR PAPERS

Dynamic spectrum access (DSA) allows devices/networks to utilize the radio spectrum in a dynamic manner, rather than on a fixed basis, which has the potential to greatly improve spectrum utilization. There has been tremendous progress in the research and development of DSA in recent years. IEEE DySPAN is the premier conference to discuss, publish and present recent results in DSA and Cognitive Radio Domain. IEEE DySPAN 2011 builds on the success of IEEE DySPAN 2005 (Baltimore, USA), IEEE DySPAN 2007 (Dublin, Ireland), IEEE DySPAN 2008 (Chicago, USA), and IEEE DySPAN 2010 (Singapore).

IEEE DySPAN 2011, like its predecessors, is a unique symposium that gathers technology, policy and regulatory communities together. We will have special program tracks for technology and policy papers. The fifth symposium will also include system demonstrations, panels, invited talks, and tutorials some of those tailored for special target audiences such as regulators and industry.

IEEE DySPAN 2011 welcomes contributions dealing with policy and regulation issues on dynamic spectrum access, theoretical studies, algorithm and protocol design for cognitive radios and networks, as well as application-oriented contributions dealing with architectures, platforms, signaling and multiple access schemes. Selected conference papers will be fast-tracked to journal publications.

In 2011, we are particularly looking for papers reporting on systems aspects and prototypes, summaries of the regulatory advancements, recent spectrum measurements and analysis of white space opportunities, and business cases for DSA. The contributions outlining advances in self-optimization, learning, and context sensitivity of cognitive radios and DSA concept that consider whole networks and describe novel optimization are encouraged. We seek original and unpublished work not currently under review by any other journal/magazine/conference. We will be developing specific technology and policy programs with topics including, but not limited to, the following:

TECHNOLOGY PROGRAM

- Spectrum measurement and models
- Architecture and platform for dynamic spectrum access networks
- Efficient and broadband spectrum sensing
- Spectrum sensing mechanisms and protocol support
- Interference metrics and measurements
- Radio resource management and dynamic spectrum access networks
- Applications of DSA
- New spectrum sharing models
- Multiple access schemes for cognitive radio networks
- Cross-layer optimization for cognitive radio networks
- Information-theoretic aspects of cognitive radio networks
- QoS provisioning and MAC protocol
- Trust and security issues
- Experimental prototypes and results

POLICY PROGRAM

- Business model / Pricing for dynamic spectrum access
- Market trends for secondary spectrum usage
- Regulations for dynamic spectrum access
- Software regulation / standardization and equipment certification
- Industrial and government role in dynamic spectrum access
- Dynamic spectrum auction and economics
- Spectrum etiquettes for unlicensed bands
- Defining / Enforcing rights / responsibilities of spectrum licensees and easements

PAPER SUBMISSIONS: The conference language is English. Papers should be concisely written. Maximum paper length for review is 12-pages in IEEE conference proceedings format (two-column and 10-point font).

IMPORTANT DATES

Paper Submissions Due	15 November 2010 (firm)
Tutorial, Panel, Demo Proposals Due	15 November 2010
Abstract Registration	8 November 2010
Acceptance Notification	8 February 2011

IEEE and IEEE COMMUNICATIONS SOCIETY POLICIES

Each accepted paper must have a FULL (member or non-member) non-refundable registration fee associated with it. If an author has multiple accepted papers, up to three papers may be covered by one registration fee. Registration fees must be paid prior to uploading the publication-ready version of the accepted paper.

Accepted papers will be published in the IEEE DySPAN 2011 Conference Proceedings. Only accepted and presented papers will be published in the IEEE DySPAN 2011 Conference Proceedings and in IEEE Xplore®.

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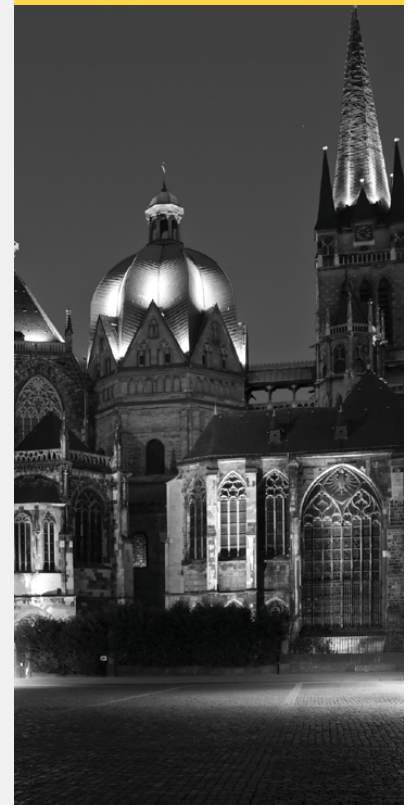
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Call for Papers

International ITG Workshop on Smart Antennas (WSA 2011)

February 24-25, 2011

Aachen, Germany

<http://www.wsa2011.rwth-aachen.de>



The International ITG Workshop on Smart Antennas (WSA 2011) provides a forum for presentation of the most recent research on smart antennas. The objective is to continue, accelerate, and broaden the momentum already gained with a series of ITG Workshops held since 1996. This call for papers intends to solicit contributions focusing on latest research of this key technology for wireless communications systems.

Workshop topics include, but are not limited to:

- Antennas for beamforming and diversity
- Multi-antenna channel measurements
- Spatial channel modeling
- Beamforming and source localization
- Diversity techniques
- Space-time processing
- Space-time coding
- MIMO systems
- Multicarrier and multiuser communications
- Precoding and limited feedback
- Relaying and multihop
- Cooperative and sensor networks
- Crosslayer optimization
- Radio resource management
- Cellular systems
- Link, system and network level simulations
- Hard- and software implementation issues



There will be oral as well as poster presentations.

The proceedings will be published in the IEEE Xplore digital library.

Paper Submission related dates:

Abstract	Nov. 7, 2010 (max. 2 pages A4)
Notification of Acceptance	Dec. 17, 2010
Full Paper	Jan. 23, 2011 (max. 8 pages A4)

Abstracts should include the title of the paper, names of all authors, full address details, e-mail address and telephone number, and indicate the workshop topic. They should be submitted electronically (PDF document) through EDAS.

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The Eighth International Symposium on Wireless
Communication Systems

**RWTH AACHEN
UNIVERSITY**

ISWCS 2011



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Wireless Communications is at the centre of a new and passionate era characterised by smart and flexible transceiver concepts, the convergence of systems and technologies, a transition towards all-IP networks, and the development of technologies with a user-centric focus. In this context, the International Symposium on Wireless Communication Systems (ISWCS) is positioning itself as a recognised and dynamic forum for researchers and technologists to present and discuss original ideas and contributions in all fields related to mobile wireless communication systems.

The aim of this symposium is to provide a forum for researchers and technologists to present new ideas and contributions in the form of tutorials, panel discussions, keynote speeches, technical papers, posters and testbed implementations. ISWCS'11 seeks to address and capture highly-innovative and state-of-the-art research from academia, the wireless industry and standardization bodies. The scope of the conference includes a wide range of technical challenges encompassing wireless communications, quality of service support, wireless networking, signal processing, cross-layer air interface design for improved performance, wireless broadband access, and cooperative communications.

Topics of interest include but are not limited to

- Cooperative communication and relaying
- Cognitive radio
- Radio resource management
- Wireless access techniques
- Cross-layer air interface
- Information and communication theory
- Bio-inspired communications
- Signal processing, including VLSI architecture
- Estimation and detection
- Coding and modulation
- Network coding
- Compressive sensing
- MIMO communications
- Multi-carrier systems, OFDM
- Spread spectrum and UWB
- Antennas and propagation
- Self organizing networks
- Ad-hoc, mesh and sensor networks
- Mobility management and modeling
- QoS provisioning
- Wireless network architectures and technologies
- Smart grid communications
- Innovative services and applications
- Wireless privacy and security

Paper Submission Guidelines

Submission guidelines will be downloadable from the symposium web page: URL:

www.ti.rwth-aachen.de/iswcs2011

Important Dates

Submission deadline special sessions: Monday, May 2, 2011

Submission deadline tutorials: Monday, May 2, 2011

Submission deadline full papers: Monday, May 30, 2011

Notification of acceptance: Monday, August 1, 2011

Camera-ready version due: Monday, September 12, 2011



Cluster of Excellence
RWTH Aachen University

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