

Coordinator:
Prof. G. Ascheid
gerd.ascheid@iss.rwth-aachen.de

UMIC Research Centre
Mies-van-der-Rohe-Str. 15
52074 Aachen

Phone +49 241 8020720
Fax +49 241 8022730
public.relations@umic.rwth-aachen.de
www.umic.rwth-aachen.de

By car

Coming from Düsseldorf (A44), coming from Köln (A4) just until the motorway junction "Kreuz Aachen":

- Direction Heerlen/Antwerpen (follow A4)
- Exit Laurensberg/Richterich
- Turn right towards Aachen Zentrum/RWTH
- Change direction to the right after approx. 2km and follow the expressway (Toledoring) with direction Klinikum
- Third exit: RWTH-Hörn (Halifaxstraße)
- Third possibility to the left: Mies-van-der-Rohe-Straße
- Second possibility to the right: UMIC building

By bus

Aachen main station:

- Route 3A: Bus stop Mies-van-der-Rohe-Straße

UMIC Research Centre

The UMIC research centre hosts a new associate professor for IT-security with her research team and newly established research groups, headed by assistant professors. These research groups work on information theory, performance and reliability, mobile multimedia and MPSoC design.

Offering work spaces for interdisciplinary research teams and four labs with state of the art equipment, namely a wireless communication lab, a multimedia lab, an IT-security lab and a multi-processor-system-on-chip (MPSoC) lab, the UMIC research centre hosts the core of the cluster research. The centre's meeting area features meeting and lecture rooms of different size and a demonstrator space with advanced video/audio equipment.

Cluster of Excellence



Ultra High-Speed Mobile Information and Communication



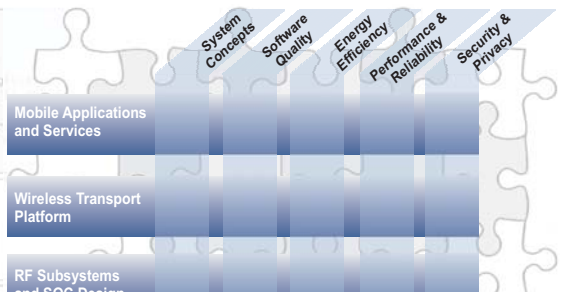
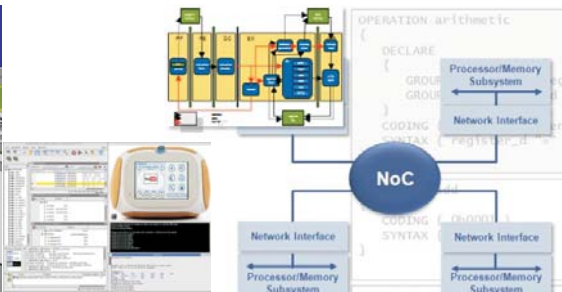
UMIC is a research cluster established under the German Federal and State Government Excellence Initiative. In its focus are Ultra high-speed Mobile Information and Communication systems (UMIC) supporting the demands of future mobile applications and systems. As an academic research centre with strong links to industry and mobile network operators, UMIC pursues research on basics concepts and new paradigms, on key solutions and tools, the development of prototypes and demonstrators, and the technology transfer to industry.

A major strength of the UMIC research cluster is the interdisciplinary research combining the expertise of more than 15 institutes from computer science and electrical engineering and covering all aspects from mobile applications, networks and terminals down to design and implementation of radio frequency subsystems and multi-processor systems on chip.

The UMIC research programme is structured into three „horizontal“ research areas:

- **Mobile Applications and Services**
- **Wireless Transport Platform**
- **RF Subsystem and SoC Design**

The three „horizontal“ research areas of UMIC are complemented by a fourth „vertical“ research area **Cross Disciplinary Topics** focussing on topics cutting through all horizontal areas.



Research Area

Mobile Applications & Services

Research challenges addressed in this area are basic concepts and functionalities for next generation mobile applications.

A major aspect is the mapping of existing web services to the wireless transport platform. Issues like the detection and integration of heterogeneous services as well as the scalability of various system properties need to be addressed. Moreover, the critical problems emerging from decentralized network infrastructures and security issues have to be considered. The central goal is to keep the quality of user experience as high as possible. This is achieved by application frameworks that adapt to changing data throughput, to temporal loss of connection, and to the characteristics of different networks.

From the user perspective, the most important added feature that multimedia applications can leverage if they "go mobile" is the geographical context. To obtain a unified reference structure, a virtual copy of this context has to be generated by (semi-automatically) reconstructing 3D models of real environments like rooms, buildings, or cities. Addressing non-expert users imposes a number of requirements and restrictions to the design of services and their user interfaces but it also provides the opportunity to custom-tailor the system feedback to the user's expectations.

Research Area

Wireless Transport Platform

Activities range from fundamental research on mobile links and networks to development of actual prototypes, as well as measuring and modeling of the characteristics of radio channels. Two major focus areas are: cognitive radio networks & technologies, and development of novel iterative MIMO-OFDM transceiver techniques. There is a strong synergy between these flagship topics, which aim at providing not only theoretical breakthroughs but also concepts for future commercially viable networks. In addition, topics such as capacity and self-organization of network architectures, low-power MAC design, novel audio-visual processing methods, and cross-layer optimization in wireless transport platforms are addressed.

Lab facilities with advanced equipment are available, different SDR-platforms are employed, testbeds and demonstrators, including one for cognitive radios, enable studying also network level behaviour.

Our objective is to go beyond Shannon's limit barrier of single-link and enable ultra fast communication without losing sight on the fact that realistic systems need to provide also a decent geographical coverage.

Research Area

RF Subsystem and SoC Design

This research area addresses key challenges in digital, analog and RF hardware architecture design and implementation. The major target architectures are flexible, energy efficient Systems-on-Chip (SoC) for the PHY and MAC layers of future communication systems. The common research theme of our projects, therefore, is "flexible transceiver design", enabling cognitive radio techniques implemented in nano-scale CMOS. These projects cover innovative RF subsystems and RF architectures, multiprocessor SoC (MPSoC) architectures, as well as system-level design tools.

In the digital IC domain, major research issues include co-design of algorithms, architectures, and tools, methods for HW/SW performance and cost modeling, and achieving the right balance between flexibility and energy efficiency of transceivers. In RF design, research is targeting, for instance, flexible "digital friendly" RF architectures for nano-scale CMOS and high dynamic range transceiver concepts enabling flexible RF front ends. Moreover, it is investigated how the domains of analog and digital design can be bridged via mixed signal prototyping.

Research Area

Cross-Disciplinary Topics

This area provides the methodical basis for the cross-disciplinary and cross-layer challenges in UMIC. New analysis and design methods are devised, cast into tool prototypes and evaluated in demonstrator applications. Particular emphasis is put on formal methods and continuous use of models in different design phases and on different abstraction layers. To stay focussed research is structured according to key challenges: *performance and reliability, security and privacy, energy efficiency, and software quality.*

In each of these topical domains, several, mostly interdisciplinary and cross-layer projects with a broad method spectrum are conducted. For instance, the performance of different kinds of mobile networks is analysed with the help of stochastic model-checking, mathematical learning theory or simulation approaches; the reliability of dynamically changing networks and protocols is verified by means of game-theoretical and static analysis methods, and energy efficiency is treated by making the applications aware to energy issues.