June 10–15, 2018
Munich, Germany

Association for
Computing Machinery

Advancing Computing as a Science & Profession

MobiSys '18

Proceedings of the 16th ACM

International Conference on Mobile Systems, Applications, and Services

Association for
Computing Machinery

Advancing Computing as a Science & Profession

The Association for Computing Machinery
2 Penn Plaza, Suite 701
New York, New York 10121-0701

ISBN: 978-1-4503-5720-3

Additional copies may be ordered prepaid from:
ACM Order Department
PO Box 30777
New York, NY 10087-0777, USA

Phone: +1 800 342-6626 (USA and Canada)
+1 212 626-0500 (Global)
Fax: +1 212 944-1318
Email: acmhelp@acm.org
Hours of Operation: 8:30 am–4:30 pm ET

Contents

MobiSys 2018 Welcome Message from the General Chairs

On behalf of the organizing committee, we are pleased to welcome you to the 16th ACM International Conference on Mobile Systems, Applications, and Services (ACM MobiSys 2018) held in Munich, Germany on June 10-15, 2018. ACM MobiSys is a premier international conference dedicated to addressing systems challenges in dynamic networks and computing. It aims bringing together researchers and practitioners from a broad spectrum of networking research to present the most up-to-date results and achievements in the field.

ACM MobiSys 2018 features a number of outstanding highlights: We are proud to have two very renowned keynote speakers, namely Martin Hauschild (BMW, Germany) talking about "The Future Mobility: How digitalization is transforming mobility of tomorrow?" and Prof. Tommaso Melodia (Northeastern University) talking about "The Internet of Medical Things: Toward Implantable Ultrasonic Sensor Networks". Furthermore, we found excellent speakers from all over the world participating in the PAWR Panel on "Trending towards the Pasteur's Quadrant? How a systems engineering approach is accelerating wireless research."

In 2018, for the first time, the conference also co-locates the ACM IoT Day, which is the first event of its kind bringing together distinguished experts in the field of the Internet of Things. In addition to the main technical program, the conference also features seven workshops and a poster and demo session.

Coming to Munich, the social program certainly includes a taste of the local beer. We have a welcome reception at the BMW Museum, which features vintage cars and engines from all eras of the century of BMW history. Technical University of Munich (TUM) is among the few universities that offers BSc and MSc degrees in Brewing and Beverage Technology and has a sizable institute including its own brewery for education and research. Next to the brewery is Bräustüberl, where we host the conference dinner in a vaulted cellar.

ACM MobiSys 2018 is hosted by TUM. We are very grateful to acknowledge sponsorship from the following supporters: Microsoft (Gold), Intel, Nokia Bell Labs, and Samsung (Silver), and Google as well as the Zentrum Digitalisierung Bayern (ZD.B) (Bronze). We have further received travel grants from the US National Science Foundation and ACM SIGMOBILE.

Furthermore, we would like to express our sincere thanks and appreciation to all the organizing committee members, the technical program committee members and reviewers, and all the local staff for their great efforts and contributions to the conference. The steering committee provided valuable advice on the organization of the conference.

We would particularly like to thanks all the authors for submitting, and finally presenting and discussing their work to the conference.

The highly selective technical program has traditionally brought together a unique blend of researchers and practitioners, thereby influencing the direction of a wide range of wireless networking research areas. We hope that you will find the conference intellectually stimulating.

Best wishes for another great ACM MobiSys conference experience!

ACM MobiSys 2018 General Co-Chairs

Jörg Ott
Technical University of Munich (TUM)

Falko Dressler
Paderborn University

Welcome to the First ACM Open IoT Day

The growing pervasiveness and continuous improvement of communication technologies is finally enabling the long-standing vision of an actual **Internet of Things (IoT)**, where connected objects are fully integrated into smart environments at multiple scales, from individual homes to whole cities. In fact, the IoT world is still in its infancy, and much of its potential is yet to be discovered, understood, and leveraged. These are thus exciting and unique times for devising and proposing novel ideas that will shape the evolution of the IoT ecosystem in the coming years.

To support a continuous active and stimulating exchange, ACM is organizing the Open IoT Day, a new initiative supported by the ACM President aimed at increasing ACM's visibility with IoT industry and practitioners. ACM is launching IoT Day at MobiSys this year due to the mobile computing nature of the conference and because its location (Munich) is convenient to attract IoT-related industry attendance – and also draw on the distinct academic audience joining ACM MobiSys. The event will rotate through other conferences (including other SIGs) in future years.

We are excited about this unique opportunity and even more so that we are able to bring you a fascinating program looking at the Internet of Things from many perspectives, putting a forward the theme of "Transparency, Trust, and Ethics in the Pervasive Internet of Things" to emphasize the importance that the rapid technical evolution also reflects societal (long-term) demands for a sustainable development.

We are thrilled to have Vint Cerf as our distinguished keynote speaker who will address this very perspective when presenting his visions on "Desirable Properties of an IoT Ecosystem."

He will be followed by one of the ACM SIGMOBILE 2018 Test-of-Time Award winners, Mahadev Satyanarayanan (CMU), who will put his still fresh 2001 paper "Pervasive Computing: Vision and Challenges" into the recent context of the Internet of Things. Satya will present his visions in an interview with Vint Cerf.

We have six exalted speakers from industry sharing their IoT visions: Jari Arkko (Ericsson) will look at the "Evolving Focus for Security in the Internet" in the light of IoT. Martin Kienzle (IBM) discusses "Creating an Internet of Intelligent Things", which Martin Arend (BMW) gives an automotive touch when speaking about "Internet of Things – Hype or Necessity in Connected Vehicles". Lieven Trappeniers (Nokia Bell Labs) will consider what to do with all these "things" when arguing for "World Wide Streams – a new World Wide Web for in-the-moment information." Even Schooler (Intel) will explore a further aspect related to real-time data in her talk "When everything is a camera: Distributed Data Stewardship in the IoT." Nitin Agrawal (Samsung) will finally address handling the growing data floods from sensors In his talk "Sink or Swim: How Not to Drown in Colossal Streams of Data?"

Our industry speakers will be complemented by renowned Professor S. Keshav (University of Waterloo) who links IoT to another recent mainstream topic, distributed ledgers, in his talk "On Trustworthy Cyber-physical Gateways for Blockchains."

The program of our First Open IoT Day will be completed by six vision talks accepted from our open call. Marcel von Maltitz (Technische Universität München) will present an architecture that allows "Leveraging Secure Multiparty Computation in the Internet of Things", and security and trust will also be addressed by Ioannis Psaras (University College London) in his talk about "Supporting the IoT through Distributed Trust". How to deploy more easily accessed IoT services is the focus of the talks of Jianxin Zhao (University of Cambridge) on "Data Analytics Service Composition and Deployment on IoT Devices", and Seon Ho Kim (University of Southern California) who will present "An IoT Marketplace for Smart Communities". Shahriar Nirjon (UNC Chapel Hill) will then discuss how to implement "Lifelong Learning on Harvested Energy", and Laura Marie Feeney (Uppsala University) will try "Avoiding an IoT tragedy of the commons" by debating on the challenging interference environment faced by IoT networks.

The Open IoT Day will leave ample room for personal discussions in breaks and will end with a reception at the BMW Museum in Munich, jointly with ACM MobiSys.

We hope you will enjoy an exciting and stimulating day full of fruitful discussions (and likely more questions than answers) and will evolve your own perspective on the future of IoT!

Jörg Ott	**Falko Dressler**	**Marco Gruteser**	**Marco Fiore**
TUM	Paderborn University	Rutgers University	CNR

MobiSys 2018 Welcome Message from the PC Chairs

Welcome to the 16th ACM International Conference on Mobile Systems, Applications, and Services (MobiSys 2018) held at the Sheraton hotel at Munich Arabella park in Munich, Germany. ACM MobiSys 2018 is a highly selective, single-track conference seeking to present innovative and significant research on all aspects of mobile systems, applications, and services. The conference values technical contributions with working implementations and practical evaluations.

This year's program includes 37 papers covering topics ranging from secure and trustworthy mobile systems to new human computer interfaces, from virtual and augmented reality to novel ideas in wireless, and from localization to acoustic sensing. The program committee carefully evaluated the most creative and interesting ideas in mobile systems among the submissions, and discussed them during a one-day PC meeting. Each paper accepted was shepherded by a program committee member to clarify the feedback and to help the authors improve their final papers.

We are very pleased with the quality and creativity found in the final list of papers. We hope you enjoy the program.

ACM MobiSys 2018 Program Committee Co-Chairs

Stefan Saroiu
Microsoft

Prabal Dutta
UC Berkeley