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## *Editor Message*

Sehr geehrte KuVS Mitglieder,

wir möchten Sie recht herzlich zur vierten Ausgabe des KuVS Newsletters begrüßen. Nach dem dritten Newsletter vor einem halben Jahr haben wir zahlreiche positive Rückmeldungen und weitere interessante Beiträge für den neuen Newsletter erhalten. In diesem Rahmen möchten wir sowohl über aktuelle Geschehnisse der Fachgruppe, als auch deren Mitglieder berichten. Hierzu zählen insbesondere Geschäftsberichte der Fachgruppe, Neuigkeiten aus den Arbeitsgruppen (Promotionen, Auszeichnungen, Stellenbewegungen), Projektberichte, sowie Veranstaltungsberichte und Calls. Der Newsletter ist auf ein halbjährliches Erscheinen ausgerichtet. Die nächste Ausgabe erscheint im Juni des nächsten Jahres.

Aktuelle Informationen finden Sie unter <https://www.kuvs.de/newsletter/>.

Die aktuelle Ausgabe ist geprägt von Berichten zu zwei Best Paper und einem Best Poster Award, der (Co-)Organisation der ACM ICN und der ACM SIGCOMM im nächsten Jahr, sowie einer spannenden Ausgründung der Arbeitsgruppe von Prof. Dr. Burkhard Stiller. Gerne möchten wir auch dazu aufrufen, geeignete Kandidaten für das GI Juniorfellowship zu nominieren. Der Newsletter stellt die Verlängerung des SFB 1053 MAKI sowie die Bewilligung des Projekts X-Check im Programm des IKT 2020 vor. Einblicke in die vergangenen Tagungen geben Berichte zu der SASO<sup>ST</sup> 2016, dem KuVS SDN Summer School, dem First RIOT Summit, dem IETF Warm-Up, sowie dem 2016 International Teletraffic Congress (ITC).

Der Newsletter beinhaltet weiterhin Ausschreibungen zu offenen Stellen und zu abgeschlossenen Promotionen. Einreichungen für den nächsten Newsletter sind herzlich erbeten.

Wir wünschen viel Spaß bei der Lektüre des vorliegenden Newsletters.

Ihre Newsletter Editoren,

Kalman Graffi  
Heinrich-Heine-Universität Düsseldorf

Oliver Hohlfeld  
RWTH Aachen

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## *Neues aus den Arbeitsgruppen*

### **2.1 Best Paper Awards**

#### **2.1.1 Best Paper Award CNSM Universität Würzburg**

Auf der ACM/IEEE ComSoc International Conference on Network and Service Management (CNSM) 2016 wurde das Team um Christopher Metter, Michael Seufert, Florian Wamser, Thomas Zinner und Phuoc Tran-Gia mit dem Best Paper Award ausgezeichnet. Das Paper trägt den Titel Analytic Model for SDN Controller Traffic and Switch Table Occupancy. Diese Arbeit beschäftigt sich mit dem Einfluss von Applikationsverkehr auf die SDN Controller Signalisierungsrate und der Auslastung der Flow Tables von SDN Switchen. Sie verknüpft dazu klassische Verkehrstheorie mit einer aktuellen Problemstellung und ermöglicht die szenariospezifische Optimierung der Timeout-Zeiten der Tabelleneinträge basierend auf einem analytischen Modell.

#### **2.1.2 Best Paper Award WPMC Heinrich-Heine-Universität Düsseldorf**

Auf der IEEE Comsoc 19th International Symposium on Wireless Personal Multimedia Communications (WPMC) ging der Best Paper Award an das Team um Raed Al-Aaridhi, Ahmet Yüксеktepe, Tobias Amft und Kalman Graffi für das Paper "Distributed Data Structures Improvement for Collective Retrieval Time". In diesem Paper werden dezentrale Index-Caches vorgeschlagen und evaluiert, die hochskalierende verteilte Datenstrukturen durch Parallelisierung schneller abrufbar gestalten.

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## 2.2 Best Poster Awards

### 2.2.1 CST@FU Berlin and iNET@HAW Hamburg win Best Poster Award at ACM SIGCOMM ICN 2016

At the 3rd ACM SIGCOMM Conference on Information-Centric Networking (ICN) 2016, Oliver Hahm, Cédric Adjih, Emmanuel Baccelli, Thomas C. Schmidt, and Matthias Wählisch received the Best Poster Award for their work on “ICN over TSCH: Potentials for Link-Layer Adaptation in the IoT”.

In their contribution, the authors start the discussion on leveraging inherent ICN communication patterns to dynamically optimize the use of TSCH (Time Slotted Channel Hopping), a wireless link layer technology increasingly popular in the IoT. The high-level idea is to derive media access following request response property in NDN, a common ICN approach. Data only flows after an Interest in the data was observed. Through a series of experiments on IoT-LAB interconnecting typical IoT hardware, the authors found that their proposal is fully robust against wireless interference, and almost halves the energy consumed for transmission when compared to CSMA. Most importantly, the adaptive scheduling prevents the time-slotted MAC layer from sacrificing throughput and delay. The TPC identified the preliminary results as promising for subsequent relevant follow-up work.

More details: <http://dx.doi.org/10.1145/2984356.2985226>.

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## 2.3 Berlin, Göttingen, Hamburg, Stuttgart organize ACM SIGCOMM ICN 2017

Matthias Wählisch  
Freie Universität Berlin



The fundamental concept in Information-Centric Networking (ICN) is to provide accessing named data as a principal network service, evolving the Internet from today's host based packet delivery towards directly retrieving information objects by names in a secure, reliable, scalable, and efficient way. These architectural design efforts aim to directly address the challenges that arise from the increasing demands for highly scalable content distribution, from accelerated growths of mobile devices, from wide deployment of Internet-of-things (IoT), and from the need to secure the global Internet.

ACM SIGCOMM Conference on Information-Centric Networking is the premier venue on ICN. ACM ICN 2017 will take place at Freie Universität Berlin, Germany in September 26-28, 2017. This single track conference is technically co-sponsored by ACM and ACM SIGCOMM.

Thomas Schmidt (HAW Hamburg) and Jan Seedorf (HFT Stuttgart) have been appointed as General Chairs, Matthias Wählisch (Freie Universität Berlin) and Mayutan Arumathurai (Universität Göttingen) serve as Local Chairs. The Technical Program Committee is chaired by Dave Oran and Christian Tschudin (University of Basel).

The preliminary submission dates are:

- May 1, 2017: Paper Registration Deadline (Long and Short), *hard deadline*
- May 8, 2017: Paper Submission Deadline (Long and Short), *hard deadline*

ACM ICN welcomes industrial sponsors and supporters. Feel free to send any inquires or comments to [jan.seedorf@hft-stuttgart.de](mailto:jan.seedorf@hft-stuttgart.de) and [t.schmidt@haw-hamburg.de](mailto:t.schmidt@haw-hamburg.de).

More details: <http://conferences.sigcomm.org/acm-icn/2017>.

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## 2.4 Berlin and Göttingen part of ACM SIGCOMM 2017 organization team

Matthias Wählisch  
Freie Universität Berlin



SIGCOMM is the flagship annual conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications, technologies, architectures, and protocols for computer communication. ACM SIGCOMM 2017 will be held on UCLA campus in Los Angeles, CA, USA on August 21-25, 2017. Matthias Wählisch (Freie Universität Berlin) has been appointed as Poster Chair and Mayutan Arumathurai (Universität Göttingen) serve as Publicity Co-Chair. The Call for Posters and Demos will be available end of January 2017. For further details check <http://conferences.sigcomm.org/sigcomm/2017/>.

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## 2.5 New Springer Journal “Quality and User Experience”

Tobias Hofffeld  
Universität Duisburg-Essen

In 2016, the Springer journal “Quality and User Experience” was launched (Editors-in-Chief: S. Möller; M. Tscheligi). It presents research on the human experience and quality perception of digital media, telecommunication and Information Communications Technology (ICT) products and interactive services. It explores human-centered and technology-centered approaches and examines a range of perspectives on quality of experience. Coverage includes mobile and pervasive applications, augmented and virtual reality, gaming, video conferencing, telepresence, and video-on-demand. Tactics can be human centered (e.g., to characterize user perceptions) or technology centered (to guide product development). As a result of this research, technologies, products and systems can be evaluated and optimized to provide optimum experience; this optimization process is also targeted by the journal.

The journal promotes integration of knowledge by assembling a range of disciplinary perspectives on experience quality: quality of experience (QoE), user experience (UX), quality management, usability engineering, human-centered design, cognitive processes, subjective audio & video quality assessment, and human-computer interaction.

The journal will encourage and enable first class research from any scientific discipline that contributes to and shows relevance to quality of experience and user experience. Examples include: development of a new metric based on subjective or objective analysis; taxonomies and models to define and explain quality of experience and user experience; relationship to other concepts such as user acceptance or value systems; lab or situated studies delivering insights to specific experience aspects, discussion of influence factors on UX and QoE and their relationships; the significance of time for the dynamics of user experience and quality of experience, relevant insights from different disciplines such as design, psychology, social sciences or material science; research in contextual experiences to capture specific situations including specific domain aspects; tools and frameworks towards the development of next generation experiences; methods to capture, analyze, design and evaluate user experience and quality of experience; user experience research related to special user groups, special needs as well personal differences; insights on the design of experiences from the constructive as well as from the process perspective; experience design approaches and methods; viewpoints on the meaning of experience design; and experience design for specific application domains.

Please note that QUEX offers permanent free access to all articles published in 2016 and 2017.

More information: [link.springer.com/journal/41233](http://link.springer.com/journal/41233)





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## 2.6 Start-up: Blockchains for Coldchains

Burkhard Stiller, CSG@IfI, University of Zürich, Switzerland

The Communication Systems Group CSG of the Department of Informatics IfI at the University of Zürich UZH, Switzerland has started with [Modum.io](#) a start-up company in 2016, which combines blockchain technology with IoT (Internet-of-Things). Blockchains open an interesting technology alternative for an unforgeable, auditable distributed data base, thus, combining traditional distributed protocol processing with data storage. In this dedicated application case here, the blockchain is used to persist temperature data monitored of each and every medical drugs parcel, equipped with a temperature sensor, during shipment within the pharmaceutical supply chain between the pharmaceutical company and the wholesaler.

The Chief Systems Architect Dr. Thomas Bocek, Senior Researcher at the CSG, lead for the SME the technical development and set-up a team of highly skilled students with Andreas Knecht, Tim Strasser, and Sacha Uhlmann, who designed, prototyped, and evaluated the approach. Prof. Dr. Burkhard Stiller acts as a Technical Advisor. With modum.io's CEO, Malik El Bay, responsible for all business plans and marketing as well pilots, and Marc Degen, the Business Advisor on board, the new solution to support temperature measurements for medical goods' distribution decided to use the Ethereum blockchain in combination with reliable and cost-effective IoT devices.

The new approach composes temperature measurements - collected by Bluetooth Low-energy-based temperature sensors - in pharmaceutical packages with the blockchain to ensure an auditable and EU regulation-compliant 100% monitoring (according to the Goods Distribution Practice regulation in effect since January 2016) in a much cheaper and technically fully reliable and secure manner, especially compared to traditional approaches in place. In July and September 2016 two pilots were run with the new system within Switzerland, especially with Schaer Pharma as the main partner. Additionally, a third pilot into Jordan took place successfully in November 2016 with Acino Pharma and Global Health as the two partners.

This technical idea, combined with a well-balanced business plan, was pitched as the "Blockchain for Coldchain" idea successfully at the Venture Kick event in Lausanne in August 2016. The start-up Modum.io received 10.000 CHF funding from the Venture Kick and started in turn the 3-month Swiss Kickstart Accelerator at the EWZ Selnau in Zürich - an open SME development space from August to November 2016. Out of 850 companies and business proposals CSG's and modum.io's idea won the first price of the Swiss Kickstart Accelerator 2016 on November 4, 2016 in the vertical of "Future Emerging Technologies", besides three other winners in the verticals on FinTech and Food, which added 25.000 CHF to start-up funds.

Next steps on the technological side started already by optimizing the prototype, by adding a new User Interface for cargo companies drivers, and by developing ideas on minimizing blockchain-based transaction fees within the Ethereum blockchain. A new pilot with a larger Swiss cargo company is at hands and will be planned for an early 2017 operation on a larger basis with regular shipments to a geographically wider distribution of goods within Switzerland to varying destinations.

<http://www.csg.uzh.ch> — <https://modum.io>

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## 2.7 Nominierung von Kandidaten aus der Fachgruppe KuVS als GI Junior Fellows

Die Fachgruppe Kommunikation und Verteilte Systeme der GI und der ITG bittet ausdrücklich um die Nominierung von Kandidaten für ein Junior Fellowship der Gesellschaft für Informatik. In unseren Reihen gibt es exzellente junge Leute, die sicherlich eine Nominierung verdient haben.

Mit der Auszeichnung als Junior Fellow soll der Nachwuchs in der Informatik gefördert und ermutigt werden, sich für die weitere Entwicklung der Informatik und der GI zu engagieren. Dafür bietet die GI den Junior-Fellows einen Rahmen, eigenverantwortlich Ideen zur Gestaltung der Informatik in Gesellschaft und Wissenschaft zu entwickeln und umzusetzen. Die GI unterstützt ihre Junior-Fellows hierbei fachlich, ideell und finanziell. Damit haben die Junior-Fellows die Gelegenheit, in die größte Informatik-Fachgesellschaft in Deutschland hineinzuwirken und mit national und international renommierten Informatikerinnen und Informatikern in Kontakt zu kommen. Sie stehen im engen Austausch mit Vorstand und Präsidium und nehmen damit maßgeblich Einfluss auf die zukünftige Ausrichtung der GI.

Das Junior-Fellowship richtet sich an Personen, die hervorragende Leistungen in der Informatik gezeigt haben, in ganz unterschiedlichen Bereichen: etwa in praktisch-technischer oder wissenschaftlicher oder organisatorischer Hinsicht oder in der Lehre oder bei der Vermittlung von Informatik-Themen in der Gesellschaft.

Kandidatinnen und Kandidaten sollten in der Regel nicht älter als 35 Jahre sein und haben sich durch eigene hervorragende Leistungen in der Informatik "einen Namen" gemacht oder erfüllen eine Vorbildfunktion. Der Gestaltungsort der Kandidaten spielt dabei keine Rolle. Es kann ebenso eine Firma oder Behörde wie eine lehrende oder forschende Einrichtung sein. Freiberuflich wirkende Kandidaten sind genauso willkommen wie Angestellte oder Firmeninhaber.

Die Fähigkeit und Bereitschaft zur interdisziplinären Zusammenarbeit und dem Verantwortungsbewusstsein für die Wirkung der Informatik auf die Gesellschaft werden vorausgesetzt. Die GI erwartet von den Junior-Fellows die Bereitschaft, sich mit gesellschaftlichen, wissenschaftlichen, und politischen Facetten der Informatik kritisch auseinanderzusetzen. Die Junior-Fellows initiieren eigenständig Projekte und Klausursitzungen zu selbstgewählten Themen.

Nähere Informationen sind auf den Web-Seiten der GI unter folgender URL zu finden:

<https://www.gi.de/wir-ueber-uns/personen/junior-fellows/ausschreibung.html>.

## 2.8 Stellenausschreibungen

Auf den folgenden Seiten finden Sie aktuelle Stellenausschreibungen.

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## NOKIA Bell Labs

## SOFTWARE/CLOUD SYSTEMS RESEARCHER

### Bell Labs

Bell Labs is the innovation engine of Nokia and a global research organization with sites in the US, Europe and Asia. Bell Labs builds on a rich history of industry-changing innovations like UNIX, C and C++, modern information theory, the laser and the transistor. It is chartered to create outstanding research and innovative technologies that define tomorrow's networking, communication, and software systems.

Bell Labs is looking for enthusiastic post-doctoral and senior-level researchers to join our research efforts on software and cloud systems in Stuttgart, Germany.

A successful candidate is expected to have experience in one or more of the following topics:

- **Cloud computing technologies,**
- **Distributed systems and algorithms,**
- **Software systems and architectures,**
- **Cloud-related network technologies,**
- **Software-defined networks,**
- **Big data and data analytics.**

#### Role description

- Identify new and ambitious research challenges and create innovative results to address these challenges.
- Publish results in major scientific venues worldwide, including top conferences and journals.

- Collaborate with researchers in Bell Labs and the external research community.
- Partner with Nokia business units to transfer research into products.
- Generate intellectual property through patenting of ideas.

#### Qualifications, skills, and experience

Candidates must have a PhD in computer science or electrical engineering or a related field.

A proven track record of high-quality research publications in major international conferences and an in-depth understanding of the field are required.

Candidates are expected to have the ability to conduct independent research while also contributing to team-oriented projects that often span across multiple Bell Labs sites.

Strong written and spoken communication skills and the ability to participate in robust discussions in English are required. German language skills are helpful but not mandatory.

#### Application

In order to apply, please send an e-mail including your CV and publication record to [volker.hilt@nokia-bell-labs.com](mailto:volker.hilt@nokia-bell-labs.com). More information about Bell Labs is available at [www.bell-labs.com](http://www.bell-labs.com).

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## Post-Doctoral Research Fellow (m/f)

As a Post-Doctoral Research Fellow in systems and networking at NetApp, you will work as part of the Advanced Technology Group in the framework of the EU H2020 project SSICLOPS (Scalable and Secure Infrastructures for Cloud Operations), which is collaboratively researching and designing cutting-edge cloud networking technologies.

This position requires an exceptional individual that is able to make independent, significant scientific contributions and can prototype and evaluate them in the context of cloud systems. A high degree of creativity, self-motivation, analytic thinking and scientific rigor are essential in this position, as are good communication and team working skills.

The position is for 1.5 years, with a flexible starting date (sooner is better). It is renewable based on funding availability, and based in Munich, Germany.

### Essential Functions

- Academic research into new cloud networking technologies, architectures, protocols and systems, collaboratively within an EU project
- Prototyping (designing, coding) and analytic experimentation (testing, measurements, analysis) of new cloud and cloud-related technologies
- Generation of academic publications, open source code contributions, potential participation in relevant standards efforts

### Requirements

- Ability to perform original research, demonstrated by a good academic publication record
- In-depth knowledge of the BSD or Linux network stack internals are desirable; other related experience (drivers, etc.) is a plus
- C/C++ coding experience is desirable; kernel-level experience is a plus, as are additional languages and experience with distributed code versioning tools
- Excellent oral and written communication skills in English are essential; some degree of spoken German is a plus with regards to local office interactions but not a requirement

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## Education & Experience

- A PhD Degree in Computer Science, Electrical Engineering or related fields is required.

## Contact

### **NetApp Deutschland GmbH**

Sonnenallee 1

D-85551 Kirchheim bei München

### **Maximilian Malsy-Mink**

Senior Recruiter / Teamlead CEMEA

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## Neue Projekte

### 3.1 Sonderforschungsbereich MAKI wird weitere vier Jahre gefördert



*Die Deutsche Forschungsgemeinschaft (DFG) hat der Technischen Universität Darmstadt die fortlaufende Förderung des Sonderforschungsbereichs (SFB) MAKI – Multi-Mechanismen-Adaption für das künftige Internet bewilligt. Der im Januar 2013 eingerichtete SFB 1053 wird für vier weitere Jahre mit insgesamt rund elf Millionen Euro finanziert.*

In dem Sonderforschungsbereich befassen sich Ingenieure und Informatiker gemeinsam mit Wirtschaftswissenschaftlern mit der technischen Infrastruktur im Internet der Zukunft. Sprecher des SFB 1053 ist Prof. Dr.-Ing. Ralf Steinmetz, Leiter des Fachgebiets Multimedia Kommunikation an der TU Darmstadt. Im Verbund mit anderen wissenschaftlichen Einrichtungen und Universitäten schaffen wir die Grundlage dafür, dass das zukünftige Netz fit ist für das Internet der Dinge, neue Formen der digitalen Kommunikation und Internetdienste, die wir uns zum jetzigen Zeitpunkt nicht einmal vorstellen können, so Professor Ralf Steinmetz.

Eine Prämisse in der Arbeit des Forscherteams wird während der zweiten Förderperiode sein, dass das Internet auch in Zukunft aus vielen verschiedenen Verbindungen, Mechanismen und Protokollen besteht. Die Herausforderung ist, dass diese nahtlos und ohne Unterbrechung zusammenarbeiten. So muss beispielsweise der Wechsel zwischen Bluetooth, Wifi und LTE gelingen, ohne dass der Datenstrom zwischenzeitlich aussetzt.

Durch diese sogenannten Transitionen lässt sich ein Internet realisieren, das trotz steigender Datenlast stets verlässlich verfügbar ist. Dass das keine Selbstverständlichkeit ist, zeigen regelmäßige Ausfälle im mobilen Netz, wenn viele Menschen am gleichen Ort zusammenkommen, zum Beispiel bei Events wie großen Sportveranstaltungen. Der Nutzen der Transitionen konnte in der ersten Förderperiode gerade in solchen Szenarien nachgewiesen werden, beispielsweise beim Videostreaming oder Augmented-Reality-Spielen.

In der zweiten Phase soll die Flexibilität der Kommunikationsnetze weiter gestärkt werden. Standen in der ersten Förderperiode hauptsächlich mobile Endgeräte im Fokus der Wissenschaftler, wird in den kommenden vier Jahren auch der Kern des Netzes betrachtet. Software-definierte Infrastrukturen, Konzepte der Netzvirtualisierung, ein weltweites Testbed sowie Proaktivität und eine ganzheitliche Betrachtung stehen im Fokus der Forschung der circa 50 beteiligten Wissenschaftler.

In der zweiten Phase arbeiten im SFB zwölf Fachgebiete und Forschungsgruppen an der TU Darmstadt zusammen, davon fünf aus der Informatik und sechs aus der Elektro- und Informationstechnik. Ein Wissenschaftler stößt aus den Wirtschaftswissenschaften hinzu. Zusätzlich

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sind ein Fachgebiet der RWTH Aachen, ein Fachgebiet der Universität Mannheim sowie eine Forschungsgruppe der University of Illinois at Urbana-Champaign dem SFB involviert. Dieser Zusammenschluss gewährleistet flächendeckende Expertise bei der Erforschung von Kommunikationsmechanismen.

Weitere Informationen: <http://www.maki.tu-darmstadt.de/>

## Beteiligte Institutionen/Antragssteller:

Christian Becker	Information Systems II, Universität Mannheim
Patrick Eugster	Programmierung Verteilter Systeme, TU Darmstadt
Bernd Freisleben	Vernetzte Systeme und Anwendungen, TU Darmstadt & Universität Marburg
Oliver Hinz	Wirtschaftsinformatik Electronic Markets, TU Darmstadt
Oliver Hohlfeld	Kommunikation und Verteilte Systeme, RWTH Aachen
Matthias Hollick	Sichere Mobile Netze, TU Darmstadt
Anja Klein	Kommunikationstechnik, TU Darmstadt
Heinz Koeppel	Bioinspirierte Kommunikationssysteme, TU Darmstadt
Boris Koldehofe	Multimedia Kommunikation, TU Darmstadt
Andreas Mauthe	Informationszentrische Kommunikationssysteme, TU Darmstadt
Mira Mezini	Softwaretechnologie, TU Darmstadt
Max Mühlhäuser	Telekooperation, TU Darmstadt
Klara Nahrstedt	Multimedia Operating Systems and Networking, University of Illinois
Amr Rizk	Multimedia Kommunikation, TU Darmstadt
Guido Salvaneschi	Softwaretechnologie, TU Darmstadt
Andy Schürr	Echtzeitsysteme, TU Darmstadt
Ralf Steinmetz	Multimedia Kommunikation, TU Darmstadt
Klaus Wehrle	Kommunikation und Verteilte Systeme, RWTH Aachen

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## 3.2 X-Check: Detection of Security Incidents at IXPs

The overall goal of X-Check (*Cross-Check*) is to provide improved security for ICT-systems by leveraging data from Internet Exchange Points (IXP). X-Check designs and implements a system for the large-scale detection of (a) known security incidents and (b) novel, unconventional anomalies at central Internet nodes. X-Check is sponsored by the Federal Ministry of Education and Research within the programme “IKT 2020 – Research for Innovation”.

The project group consists of Freie Universität Berlin (Matthias Wählisch, coordinator), Technische Universität München (Georg Carle), HAW Hamburg (Thomas Schmidt), the DFN-CERT, and the Internet Exchange Points BCIX and DE-CIX.

More details: <http://x-check.realmv6.org/>



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## *Calls und Berichte zu Veranstaltungen*

### 4.1 Report on the International Workshop on Self-Adaptive and Self-Organising Socio-Technical Systems (SASO<sup>ST</sup> 2016)

Jean Botev

University of Luxembourg

The design and operation of computer systems has traditionally been driven by technical aspects and considerations. However, the characteristics and utilisation of information and communication systems are both implicitly and explicitly determined by social interaction between users. The increasing popularity of social network applications on the Internet is but one evidence of this trend.

The SASO<sup>ST</sup> workshop series addresses all aspects of self-adaptive and self-organising mechanisms in socio-technical systems, covering different perspectives of this exciting research area that range from normative and trust management systems to socio-inspired design strategies for distributed algorithms, collaboration platforms, and communication protocols. Such systems require a highly interdisciplinary approach, which is why the workshop brings together experts from diverse areas, e.g., distributed computer systems, complex systems, and the social sciences, to discuss their findings and elaborate on the topic from various complementary perspectives.



The fourth edition of SASO<sup>ST</sup> again offered an attractive and varied programme, featuring original research contributions along with invited talks and a closing discussion. Held on September 16 as part of the FAS\* conference alliance in conjunction with the Tenth IEEE International Conference on Self-Adaptive and Self-Organising Systems (SASO 2016) in Augsburg, Germany, the workshop comprised an introductory keynote by Kurt Geihs (ITeG, University of Kassel) on major challenges in the engineering of socio-technical systems as well as dedicated sessions on socio-technical systems design and on communities and social influence.

Starting the diverse sessions was Chelsea Barabas (MIT Media Lab) who proposed socio-inspired design strategies for restoring network integrity in the Bitcoin cryptocurrency ecosystem. Following that, Jeremy Pitt (Imperial College London) provided an overview of value-sensitive design approaches and interactive self-governance in socio-technical systems. In her invited talk, Birgit Lugrin (University of Würzburg) then discussed the challenge of modelling culture-dependent behaviour into virtual agent systems. In the afternoon session, Christopher Stifter (University of Augsburg) suggested a norm adjustment strategy in heterogeneous agent societies followed by Ricardo Honorato-Zimmer (University of Edinburgh) who presented his work on emergence and detection of socio-cognitive communities.

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The active discussion revolving around the presented topics and upcoming research trends and issues rounded up the workshop, and we are looking forward to the next edition in the coming year. The SASO<sup>ST</sup> workshop was organised by Gerrit Anders (University of Augsburg), Jean Botev (University of Luxembourg) and Markus Esch (Fraunhofer FKIE).

Further Information and full programme: <http://sasost.isse.de>

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## 4.2 Report on KuVS SDN Summer School

Holger Karl, Wolfgang Kellerer, Martina Zitterbart  
Universität Paderborn, TU München, Karlsruhe Institute of Technology



KuVS has a tradition of organizing a summer school on various topics, addressing on-going research and "hot topics". In 2016, three KuVS members – Holger Karl, Wolfgang Kellerer, and Martina Zitterbart – organized a summer school on Software-Defined Networking and Network Function Virtualization (<https://cs.uni-paderborn.de/cn/events/kuvs2016/>). Both topics have seen considerable interest from both academia and industry. It hence seemed a great topic for a summer school.



As all KuVS summer schools, the primary target audience were fresh PhD students, just starting or about to start their academic careers. In addition, it has been the goal of the organizers to bring relevant industry and academia closer together. Hence, participants from outside the academic world have been invited, in particular. Overall, the organizers targeted a program that emphasized the industrial relevance of SDN and NFV, highlighting the research needs based on experience with actual deployments.

The resulting program included eight speakers from industry who gave in-depth presentations about current developments and research issues but also about practicality constraints. These talks were accompanied by tutorial talks by the three organizers, providing introduction and basic understanding to anybody not already familiar with SDN and NFV in a highly condensed form.

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The industrial speakers focused on the following topics:

- José Bonnet, Portugal Telecom/AlticeLabs: DevOps for NFV
- Artur Hecker, Huawei: Mobile core networks evolution in 5G, using ideas from SDN and NFV
- Lorenz Claas, Genua: Security for SDN
- Andreas Mäder, NOKIA: A paradigm shift in radio access? Impact of NFV and SDN on 5G radio architecture
- Josep Martrat, ATOS (ARI): Current developments of SDN and NFV in the 5G context
- Johannes Riedl, Siemens: SDN/NFV for WindParks
- Jürgen Quittek, NEC Euro labs: Developments in hardware for programmable switches
- Hagen Woesner, BISDN: OF-DPA

With this program, the summer school attracted a reasonably sized group of 28 attendees from a mix of different European countries. While the lion share of attendees was from KuVS member institutes from Germany, there were also participants from Italy (Politecnico di Milano, Roma Tre University, and CreateNet), Ireland (Trinity College Dublin), and Luxembourg (University of Luxembourg). In addition, there were attendees from industry (e.g., Nokia). For future summer schools, it might be useful to attempt to broaden the international scope even more, as some participants expressed disappointment on the mix of the group.



In addition to the talks, the summer school had invited all participants to bring along a poster or a demo about their ongoing or incipient research work. This was a thoroughly embraced offer! Almost all academic participants showed up with a poster in hand, eager to give the one-minute madness presentation to lure other attendees to come and discuss their work at their poster. With two poster sessions, this was a lively part of the summer school, with eager and energetic discussions going on across the entire room. Many attendees agreed that this was a pinnacle of the program!

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But in the best tradition of summer schools, there was not just all work, but also some play in the form of one-day team building event. For this, the organizers took the opportunity of another long tradition of summer schools: Run the school in the middle of nowhere. The selected venue was Glücksburg, on the Baltic coastline close to Flensburg, in a youth hostel-style sailing school. Hence, the natural team building was to go sailing for a day. With the help of an instructor, it became quickly obvious that in order to get anything accomplished on a boat, everybody must contribute and everybody must fulfill their roles. At the end of the day, despite being exhausted, it seemed that this message had been accepted by everybody.

In the end, it seemed that everybody left the summer school with additional, new experiences and knowledge – but perhaps also glad to return to more urban places.



Social Event

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## 4.3 Report on First RIOT Summit

Matthias Wählisch  
Freie Universität Berlin



RIOT is the friendly operating system for the Internet of Things (IoT). Based on research work at Freie Universität Berlin, this open source project was founded by a group around Emmanuel Baccelli (INRIA), Thomas Schmidt (HAW Hamburg), and Matthias Wählisch (Freie Universität Berlin) in 2013. Since then, RIOT emerged as one of the most agile and state of the art operating system for constrained devices in the IoT. The international developer community includes more than 150 regular contributors from Europe, North America, and Asia. The RIOT community does not only consists of academics and hobbyist but also of companies such as Cisco, Silicon Labs, and Nordic Semiconductors.



RIOT was presented at major events such as IEEE Infocom, CeBIT, and Embedded World. However, after three very successful years, it was time to meet more personally. The RIOT Summit aimed for bringing together RIOTers, beginners and experts, as well as people interested in the IoT in general and decision makers who plan to deploy RIOT in the future. The event combined talks, hands-on tutorials, and demos. It did not only inform about latest developments, but also helped to gather feedback from the community to shape the RIOT future.

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Keynote by Ralph Droms

The Summit took place at Freie Universität Berlin from July 15-16, 2016. More than 130 participants attended both days and enjoyed a very lively event, consisting of discussions and coding.

16 speakers, mostly from industry, shared their insights on recent and upcoming trends in the IoT. The keynote about new networking paradigms for the IoT was given by Ralph Droms. Other talks, e.g., from Carsten Bormann, discussed IoT standards and implementation challenges across the IoT network stack as well as lessons learned when developing for the IoT. All slides are available via <http://summit.riot-os.org/slides-online/>. The next Summit will take place before ACM ICN 2017.

More details about the Summit and RIOT:  
<http://summit.riot-os.org> and <http://riot-os.org/>.

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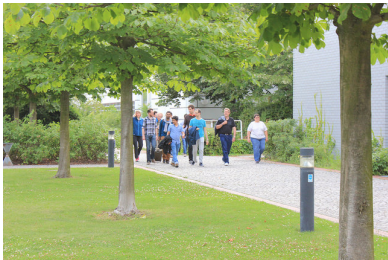
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## 4.4 Report on IETF Warm-Up

Matthias Wählisch  
Freie Universität Berlin

The 96th meeting of the Internet Engineering Task Force (IETF) took place in Berlin this summer from July 17-22, 2016. IETF meetings are packed with very focused work on Internet technologies. To meet colleagues and friends working on the Internet right before starting the IETF in Berlin, networking researchers from Berlin and Hamburg organize the IETF Warm-Up, together with the Berlin Internet Exchange Point (BCIX). This casual social brings together the operational and research community in an informal setting. This year, more than 150 participants enjoyed a rich and tasty BBQ at Freie Universität Berlin. We started at 7:00 pm and ended around 3:00 am, after thorough open, informal discussions. In particular, the IETF Warm-Up was a perfect opportunity for students to network with the operational Internet community.

More details: <http://ietf96-warmup.realmv6.org/>.





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## 4.5 2016 International Teletraffic Congress (ITC 28) Report

Tobias Hofffeld  
Universität Duisburg-Essen

The 28th International Teletraffic Congress (ITC 28) was held on 12–16 September 2016 at the University of Würzburg, Germany. ITC 28 was technically co-sponsored by IEEE Communications Society (IEEE ComSoc) and the Information Technology Society within VDE (ITG VDE), and in-cooperation with ACM SIGCOMM. In total, 117 delegates from 33 countries participated in the ITC 28 conference.

ITC is the first international conference in networking science & practice which witnesses the evolution of communications and networking. Its inherent root in solid methodological foundations has allowed ITC to constantly adapt its technological focus without losing its original identity. ITC 28 has continued the tradition, while employing some new approaches to attract high-quality papers and researchers. ITC 28 introduced the concept of areas as well as a demo session. ITC 28 was structured into eight different areas which addressed hot topics in networking. Each area was chaired by two internationally well recognized experts in that area. The area chairs organized a smaller TPC per area. The idea was that the area chairs invited experts for their areas from the ITC community as well as other well-known experts worldwide. On the one hand, the concept was aimed at expanding the ITC community and attracting high-quality submissions. On the other hand, the areas helped to improve the quality of the review process. The area chairs assigned the reviews to experts in their domain and evaluated all papers in their domain.

The main theme of ITC 28 was Digital Connected World to reflect the evolution of communications and networking which is changing the world we are living in. ITC 28 attracted 157 (short and full) paper registrations from which 108 full papers were finally submitted and reviewed. On average, each paper was reviewed by 3.5 independent expert reviewers. Finally, 37 full papers were accepted out of the 108 full paper submissions, yielding an acceptance rate of 34%. From among the authors of accepted papers, 28% were from USA and Canada, 61% from Europe/Middle East/Africa, 8% from Asia/Pacific and the remaining were from Latin America.

The technical program was composed of 37 contributed full papers and 6 short demo papers presented in two parallel sessions, three keynote addresses and a demo session. The sessions addressed timely topics in networking but also the methodological foundations: Performance Analysis and Modeling; Measurements; Traffic and Network Management; Clouds and Data Center; Wireless and Cellular; Video Streaming; Caching; Information Centric Networks; Softwarization; Virtualization.

The first ever demo session in the long history of ITC was held at ITC 28 in Würzburg. All demonstrations were first introduced to the plenary either in a 30 minute presentation for full paper demos or a 3 minute lightning talk for short paper demos. Additionally, the demos were shown live during a dedicated demonstration period in separate rooms.

Three workshops dedicated to timely topics were sponsored: Workshop on Programmability for Cloud Networks and Applications (PROCON), 2016 International Workshop on Quality of

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Experience Centric Management (QCMan), COST Action ACROSS Workshop on “Quality Engineering for a Reliable Internet of Services”.

A detailed report on ITC 28 and and a summary of all sessions can be found on the ITC 28 Homepage: <http://itc28.org>.

Contact and more information about ITC: <http://itc-conference.org/>



*Phuoc Tran-Gia is opening ITC 28. Keynote talk by Nikhil Jain (Vice President of Technology, Qualcomm Technologies, Inc.) “Internet of Everything: Engineering Challenges and Opportunities”. Keynote talk by Wolfgang Kellerer (Technical University of Munich (TUM), Germany) on “Towards flexible networking in dynamically changing environments”. Impression from the demo session. ITC offered a number of travel grants to support full-time students for attending ITC 28.*

#### 4.5.1 Arne Jensen Life Time Award: Phuoc Tran-Gia

The Arne Jensen Lifetime Award is presented at ITCs to an individual who has provided exceptional contribution to traffic modeling, control and performance, and dedication to the teletraffic community. The International Advisory Council (IAC) of the International Teletraffic Congress (ITC) is pleased to announce that the recipient of the 2016 Arne Jensen Lifetime Award is Prof. Dr.-Ing. Phuoc Tran-Gia (University of Würzburg, Germany) for his huge contribution to teletraffic research and exceptional dedication to the ITC organization and community.

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## 4.5.2 ITC 28 Awards

The IAC has also set up three prestigious best paper awards for ITC 28.

- ITC 28 Best Paper Award: Access-time Aware cache Algorithms  
by Giovanni Neglia; Damiano Carra; Mingdong Feng; Vaishnav Janardhan; Pietro Michiardi;  
Dimitra Tsigkari
- ITC 28 Best Student Paper Award: Port Based Capacity Extensions (PBCEs): Improving  
SDNs Flow Table Scalability  
by Robert Bauer; Martina Zitterbart
- ITC 28 Best Demo Award: Self-Optimization of Software Defined Radios Through Evo-  
lutionary Algorithms  
by Zubair Shaik; Andreas Puschmann; Andreas Mitschele-Thiel

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## 4.6 Report on the Fourth International IEEE Workshop on Quality of Experience Centric Management

Oliver Hohlfeld  
RWTH Aachen University

The 4th International Workshop on Quality of Experience Centric Management (QCMan 2016) waimed at providing an international forum for researchers exploring this rapidly evolving domain of QoE Centric Management. It was organized by *Thomas Zinner* (University of Wuerzburg), *Oliver Hohlfeld* (RWTH Aachen University), *Raimund Schatz* (AIT Wien), and *Prasad Calyam* (University of Missouri). Current research aspects are reflected in the technical program of QCMan 2016, which consisted of five full and two short paper presentations and was complemented with both a motivating keynote and a panel discussion. The panel discussion focused on discussing challenges of managing QoE for immersive media-rich applications. The panelists were *Michael Jarschel* (Nokia Bell Labs, Germany), *Markus Fiedler* (BTH Karlskrona, Sweden), *Alexander Raake* (TU Ilmenau, Germany), and *Dominik Strohmeier* (Mozilla, Germany).

The program was further complemented by a keynote entitled “What’s the number? Monitoring IP-based video with standardized QoE models”, given by Alexander Raake, who is a professor and head of the Audiovisual Technology Group at TU Ilmenau. The keynote emphasized efforts in QoE management by exploring the complete model development cycle – from model creation in user studies over ITU standardization to ISP-level deployment – and its challenges; based on lessons he and his team learned while creating and standardizing the IPTV quality model now recommended by the ITU.

A total of 19 papers were registered, 15 papers were finally submitted and 4 paper were withdrawn. All submitted papers underwent a rigorous review process with 3-4 reviews per paper. Based on these reviews, 5 full papers and 2 short papers were selected for publication, resulting in an acceptance rate of 46.67%.

Further information: <http://qcmn.org/>



Keynote by Alexander Raake

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## *Abgeschlossene Promotionen*

### 5.1 André Gomes (Torsten Braun, Universität Bern)

**Title:** Performance Enhancement of Content Delivery in Mobile Networks

**Abstract:** With the recent advances in mobile technology, such as the boom in the usage of smart-phones and mobile networks, content demand of mobile users has increased significantly. This exponential increase exposed several limitations on the current mechanisms for content delivery. Namely, the current paradigm for requesting content focuses on resources and not on content as it would be ideal to improve content delivery. Despite the existing efforts to overcome this limitation that greatly affects overall performance and efficiency, there are still open challenges that need to be addressed. The first challenge is how to explore new technologies together with a new content request paradigm, aiming at having deeper integration with existing networks and availability of compute, storage and network resources whenever and wherever they are necessary to handle different amounts of user loads. The second challenge is dealing with the integration of content delivery mechanisms with mobile networks and all its particularities, such as constrained architectures and demanding processing requirements. The third challenge is the usage of multiple radio technologies in a transparent and coordinated manner to improve overall efficiency and performance of mobile networks. The fourth challenge is the extension of content caching to the edge of mobile networks with efficient usage of storage resources and reduced latency for content delivery. The fifth and last challenge is the proper distribution of content among edge caches ensuring adaptability to the mobility of users. The key contributions of this thesis aim at addressing those challenges, by providing an integrated architecture with a set of strategies, mechanisms and algorithms that tackle the identified problems in detail and span across multiple knowledge domains. A first contribution concerns a cloud-based system for content delivery, which is easily deployable in new locations, integrates with other services and adapts itself to different user loads. Later on, the integration of this system with mobile networks is depicted to bring the enhancements of that system directly to content delivery in mobile networks, and mechanisms to ensure that it is feasible and follows current standards and specifications are described. Afterwards, and considering that multiple network technologies can be used simultaneously, strategies are proposed to efficiently handle load balancing and offloading of content delivery between different radio technologies in mobile networks, ensuring complete transparency for end users and efficient usage of available resources. Next, and because the previous contributions make caching at the edge of mobile networks a reality, caching strategies for the edge of mobile networks are highlighted, focusing on maximizing performance in terms of latency reduction while optimizing storage usage. Finally, content distribution strategies for edge caches based on users' movement and their interests are presented. These aim at improving edge caching by trying to guarantee that content is cached where it yields the greatest benefits for nearby users. Results gathered from the evaluation of the contributions of this thesis demonstrate that they bring major benefits for content delivery

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and that performance is greatly enhanced. These improvements are very important from multiple perspectives, as all the involved stakeholders, from mobile users to content providers and mobile operators, may benefit at different levels such as quality of experience, satisfaction and costs.

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## 5.2 Carlos Anastasiades (Torsten Braun, Universität Bern)

**Title:** Information-centric communication in mobile and wireless networks

**Abstract:** Information-centric networking (ICN) is a new communication paradigm that has been proposed to cope with drawbacks of host-based communication protocols, namely scalability and security. In this thesis, we base our work on Named Data Networking (NDN), which is a popular ICN architecture, and investigate NDN in the context of wireless and mobile ad hoc networks. In a first part, we focus on NDN efficiency (and potential improvements) in wireless environments by investigating NDN in wireless one-hop communication, i.e., without any routing protocols. A basic requirement to initiate information-centric communication is the knowledge of existing and available content names. Therefore, we develop three opportunistic content discovery algorithms and evaluate them in diverse scenarios for different node densities and content distributions. After content names are known, requesters can retrieve content opportunistically from any neighbour node that provides the content. However, in case of short contact times to content sources, content retrieval may be disrupted. Therefore, we develop a requester application that keeps meta information of disrupted content retrievals and enables resume operations when a new content source has been found. Besides message efficiency, we also evaluate power consumption of information-centric broadcast and unicast communication. Based on our findings, we develop two mechanisms to increase efficiency of information-centric wireless one-hop communication. The first approach called Dynamic Unicast (DU) avoids broadcast communication whenever possible since broadcast transmissions result in more duplicate Data transmissions, lower data rates and higher energy consumption on mobile nodes, which are not interested in overheard Data, compared to unicast communication. Hence, DU uses broadcast communication only until a content source has been found and then retrieves content directly via unicast from the same source. The second approach called RC-NDN targets efficiency of wireless broadcast communication by reducing the number of duplicate Data transmissions. In particular, RC-NDN is a Data encoding scheme for content sources that increases diversity in wireless broadcast transmissions such that multiple concurrent requesters can profit from each others' (overheard) message transmissions. If requesters and content sources are not in one-hop distance to each other, requests need to be forwarded via multi-hop routing. Therefore, in a second part of this thesis, we investigate information-centric wireless multi-hop communication. First, we consider multi-hop broadcast communication in the context of rather static community networks. We introduce the concept of preferred forwarders, which relay Interest messages slightly faster than non-preferred forwarders to reduce redundant duplicate message transmissions. While this approach works well in static networks, the performance may degrade in mobile networks if preferred forwarders may regularly move away. Thus, to enable routing in mobile ad hoc networks, we extend DU for multi-hop communication. Compared to one-hop communication, multi-hop DU requires efficient path update mechanisms (since multi-hop paths may expire quickly) and new forwarding strategies to maintain NDN benefits (request aggregation and caching) such that only a few messages need to be transmitted over the entire end-to-end path even in case of multiple concurrent requesters. To perform quick retransmission in case of collisions or other transmission errors, we implement

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and evaluate retransmission timers from related work and compare them to CCN-Timer, which is a new algorithm that enables shorter content retrieval times in information-centric wireless multi-hop communication. Yet, in case of intermittent connectivity between requesters and content sources, multi-hop routing protocols may not work because they require continuous end-to-end paths. Therefore, we present agent-based content retrieval (ACR) for delay-tolerant networks. In ACR, requester nodes can delegate content retrieval to mobile agent nodes, which move closer to content sources, can retrieve content and return it to requesters. Thus, ACR exploits the mobility of agent nodes to retrieve content from remote locations. To enable delay-tolerant communication via agents, retrieved content needs to be stored persistently such that requesters can verify its authenticity via original publisher signatures. To achieve this, we develop a persistent caching concept that maintains received popular content in repositories and deletes unpopular content if free space is required. Since our persistent caching concept can complement regular short-term caching in the content store, it can also be used for network caching to store popular delay-tolerant content at edge routers (to reduce network traffic and improve network performance) while real-time traffic can still be maintained and served from the content store.



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## 5.3 Zan Li (Torsten Braun, Universität Bern)

Gewinner des Fritz-Kutter-Preis 2016

<http://www.kutter-fonds.ethz.ch/PreviousPrizewinners.html>

**Title:** Fine-grained indoor positioning and tracking systems

**Abstract:** Indoor positioning has attracted considerable attention for decades due to the increasing demands for location based services. In the past years, although numerous methods have been proposed for indoor positioning, it is still challenging to find a convincing solution that combines high positioning accuracy and ease of deployment. Radio-based indoor positioning has emerged as a dominant method due to its ubiquitousness, especially for WiFi. RSSI (Received Signal Strength Indicator) has been investigated in the area of indoor positioning for decades. However, it is prone to multipath propagation and hence fingerprinting has become the most commonly used method for indoor positioning using RSSI. The drawback of fingerprinting is that it requires intensive labour efforts to calibrate the radio map prior to experiments, which makes the deployment of the positioning system very time consuming. Using time information as another way for radio-based indoor positioning is challenged by time synchronization among anchor nodes and time-stamp accuracy. Besides radio-based positioning methods, intensive research has been conducted to make use of inertial sensors for indoor tracking due to the fast developments of smart-phones. However, these methods are normally prone to accumulative errors and might not be available for some applications, such as passive positioning. This thesis focuses on network-based indoor positioning and tracking systems, mainly for passive positioning, which does not require the participation of targets in the positioning process. To achieve high positioning accuracy, we work on some information of radio signals from physical-layer processing, such as timestamps and channel information. The contributions in this thesis can be divided into two parts: time-based positioning and channel information based positioning. First, for time-based indoor positioning (especially for narrow-band signals), we address challenges for compensating synchronization offsets among anchor nodes, designing timestamps with high resolution, and developing accurate positioning methods. Second, we work on range-based positioning methods with channel information to passively locate and track WiFi targets. Targeting less efforts for deployment, we work on range-based methods, which require much less calibration efforts than fingerprinting. By designing some novel enhanced methods for both ranging and positioning (including trilateration for stationary targets and particle filter for mobile targets), we are able to locate WiFi targets with high accuracy solely relying on radio signals and our proposed enhanced particle filter significantly outperforms the other commonly used range-based positioning algorithms, e.g., a traditional particle filter, extended Kalman filter and trilateration algorithms. In addition to using radio signals for passive positioning, we propose a second enhanced particle filter for active positioning to fuse inertial sensor and channel information to track indoor targets, which achieves higher tracking accuracy than tracking methods solely relying on either radio signals or inertial sensors.

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## 5.4 Andreas Witsch (Kurt Geihs, Universität Kassel)

**Title:** Decision Making for Teams of Mobile Robots

**Abstract:** In collaborative multi-robot systems autonomous robots combine their capabilities to accomplish difficult tasks that exceed the abilities of individual robots. However, achieving such a collaborative behaviour requires a team decision making process that copes with potential communication challenges of dynamic application environments.

The thesis addresses a decentralized multi-robot decision process, which works under unreliable and transient communication conditions. This process is supported by the PROViDE middleware which extends our multi-agent coordination language ALICA. The first step encompasses the specification of the decision problem as a continuous nonlinear constraint satisfaction problem. The second step addresses the calculation of solution proposals for this problem specification. We propose an efficient solution algorithm that integrates incomplete local search and interval propagation techniques into a satisfiability modulo theories (SMT) solver. In the third decision step, the PROViDE middleware replicates the solution proposals among the robots. This replication process offers a choice of consistency guarantees for the replicated proposals. In step four conflict resolution is performed whereby an acceptance method ensures that each robot supports one of the replicated proposals. In order to avoid the execution of conflicting proposals, the last step comprises a decision method, which selects a proposal for implementation in case the conflict resolution fails.

The evaluation of our work shows that the usage of incomplete solution techniques of the constraint satisfaction solver outperforms the runtime of other state-of-the-art approaches for many typical robotic problems. We further show by experimental setups and practical application in the RoboCup environment that our decision process is suitable for making quick decisions in the presence of unreliable communications and dynamic team membership. Moreover, PROViDE requires less memory and communication bandwidth compared to other state-of-the-art middleware approaches.

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## 5.5 Julian Timpner (Lars Wolf, TU Braunschweig)

**Title:** On Vehicular Networking for Advanced Parking Management Systems

**Abstract:** Viele Städte leiden unter der Last zunehmenden Straßenverkehrs und bedürfen Lösungen für eine effiziente Nutzung der zur Verfügung stehenden Infrastruktur, um ihren Bewohnern eine lebenswerte und nachhaltige Umgebung zu bieten. Ein ständig wachsender Fahrzeugbestand, insbesondere in Schwellenländern, führt dabei unter anderem zu einer Verknapfung von innerstädtischem Freiraum, der somit zu einer kostbaren Ressource wird. Die Suche nach freien Parkplätzen wird daher zunehmend schwieriger.

Die sich abzeichnende Verbreitung von Kommunikationsnetzen im Fahrzeugumfeld (englisch: Inter-Vehicle Communication, IVC) bietet das Potential, innovative Verkehrsleit- und Fahrerassistenzsysteme zu realisieren. In dieser kumulativen Dissertation wird untersucht und gezeigt, wie IVC zur Entwicklung vernetzter Parkleit- und Parkinformationssysteme eingesetzt werden kann. Die Zielsetzung ist, die Belastung des Straßennetzes durch eine effiziente Nutzung von Parkraum sowie anderen Ressourcen, wie Ladestationen für Elektromobilität, maßgeblich zu verringern. Aufgrund des breiten Spektrums möglicher Anwendungen und der unterschiedlichen Umgebungen, in denen Fahrzeuge am Straßenverkehr teilnehmen, ist dabei eine Untersuchung zwei verschiedener Klassen vernetzter Parkleit- und Parkinformationssysteme zweckmäßig.

Zentralisierte Systeme, wie kommerzielle Parkhäuser und OEM-betriebene mobile Online-Dienste, stützen sich auf Backends um Parkinformationen zu aggregieren oder Parkressourcen zu verwalten. Basierend auf den Ergebnissen des EU FP7-Projektes V-Charge stellt diese Dissertation dar, wie Fahrzeugführer sich auf sichere Weise bei Online-Diensten registrieren und die kryptographischen Schlüssel für die Fahrzeug-zu-Infrastruktur-Kommunikation (englisch: Vehicle-to-Infrastructure, V2I) auf ihr Fahrzeug verteilen können. Als eine Beispielanwendung für das automatisierte Valet-Parken des V-Charge-Projektes wird eine Strategie für die Optimierung der Parkdichte präsentiert. Ferner werden Erkenntnisse über die Nutzung von IVC zur herstellerübergreifenden Sammlung von Floating Car Data diskutiert, die eine deutlich höhere Dienstgüte ermöglichen als traditionelle Ansätze. Dezentralisierte Systeme nutzen Fahrzeug-zu-Fahrzeug-Kommunikation (englisch: Vehicle-to-Vehicle, V2V) für einen Peer-to-Peer-Austausch von Parkplatzinformationen. Somit sind diese nicht auf zentrale Autoritäten oder Infrastrukturinstallationen angewiesen. Jedoch stellen sie somit in der Regel größere Herausforderungen aus Netzwerksicht dar. In dieser Arbeit werden daher die Machbarkeit und die Performanz eines reaktiven Geocast-basierten Kommunikationsmodells diskutiert. Da in dezentralisierten Systemen keine vertrauenswürdige dritte Partei existiert, stellt sich zudem die Frage, wie Vertrauen in die ausgetauschten Parkplatzinformationen hergestellt werden kann. Ein möglicher Ansatz, der im Detail vorgestellt wird, ist die dynamische Bildung vertrauenswürdiger Fahrzeug-Gruppen, die sich gegenseitig bei der Parkplatzsuche unterstützen. Im Hinblick auf die zunehmende Bedeutung der Elektromobilität wird außerdem die effiziente Nutzung von Laderessourcen betrachtet. Hierfür wird ein anreizbasiertes Verfahren vorgestellt und evaluiert, welches für eine möglichst frühe Freigabe von Ladestationen für das nächste

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Elektrofahrzeug sorgt. Somit lässt sich die Auslastung und Verfügbarkeit der Ladestationen steigern und eine schnelle Markteinführung der Elektromobilität unterstützen.

**Aktueller Arbeitgeber:** Volkswagen, Wolfsburg

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## 5.6 Ulf Kulau (Lars Wolf, TU Braunschweig)

**Title:** On Reliable Undervolting in Wireless Sensor Networks

**Abstract:** Die langsame Entwicklung der Kapazität von Batterien auf der einen und die wachsende Anzahl von anspruchsvollen Anwendungen auf der anderen Seite erfordern Energiemanagement-Techniken auf allen Ebenen des WSN. Aus diesem Grund wurde seither viel Aufwand betrieben, um die Energieeffizienz von WSNs zu optimieren. Viele existierende Arbeiten gehen dabei jedoch sehr zurückhaltend vor und betonen stets die Stabilität, anstatt die Fehlertoleranz eines WSNs beziehungsweise der jeweiligen Anwendung auszunutzen.

Eine bekannte Methode zur Verlängerung der Laufzeit von Sensorknoten und WSNs ist die Anpassung der Versorgungsspannung. Der technische Hintergrund ist hierbei, dass beinahe alle Komponenten eines Sensorknotes auf der CMOS Technologie basieren. Da die dynamische Leistungsaufnahme von CMOS stark von der Versorgungsspannung abhängt, sorgt eine Anpassung der Spannung für eine erhöhte Energieeffizienz. Aus diesem Grund existieren diverse Ansätze, welche darauf abzielen die Spannung auf das spezifizierte Minimum zu reduzieren. Um die Leistungsaufnahme weiter zu reduzieren, ist Undervolting ein eher risikoorientierter Ansatz, bei dem die Komponenten eines Sensorknotens mit Spannungen unterhalb ihrer Spezifikation betrieben werden. Durch den exponentiellen Zusammenhang zwischen Betriebsspannung und Verlustleistung der zugrunde liegenden CMOS-Technologie, bietet Undervolting ein enormes Energieeinsparpotential. Die erhöhte Energieeffizienz wird jedoch durch ein erhöhtes Risiko von Fehlern begleitet. In dieser Arbeit werden Strategien behandelt, welche eine effektive Nutzung von Undervolting in WSNs ermöglichen, ohne die Zuverlässigkeit der Anwendung einzuschränken.

Die Untersuchung von aktivem Undervolting auf drahtlosen Sensorknoten erfolgt dabei zunächst durch theoretische Betrachtungen und prototypische Projektstudien. Es zeigt sich, dass bei einer gleichbleibenden Spannung eine Korrelation zwischen der Temperatur und dem Auftreten von Fehlern besteht. Ideale Arbeitspunkte sind also stark Temperaturabhängig. Betrachtet man in diesem Zusammenhang WSNs im Außeneinsatz, so können Sensorknoten teilweise extremen Temperaturen ausgesetzt sein. Daher muss selbst für solch herausfordernde Umgebungsbedingungen eine zuverlässige Nutzung von aktivem Undervolting gewährleistet werden. Hierfür wurde ein Verfahren zum Lernen und Prädizieren sicherer Arbeitspunkte (überwachtes Lernen) entwickelt. Knoten sparen durch aktives Undervolting stets so viel Energie wie möglich ein und werden gleichzeitig in einem sicheren Betriebszustand gehalten. Diverse kleinere Experimente und Evaluationen betätigen dabei die zuvor getroffenen theoretischen Annahmen und zeigen die Machbarkeit und Effizienz dieses Ansatzes. Die Ergebnisse zeigen, dass Energieeinsparungen von bis zu 42% möglich sind. Auch für Peripheriekomponenten eines Sensorknotens führt ein niedrigerer Spannungspegel zu einer geringeren Stromaufnahme. Eine regelbarer Peripheriespannungspfad ermöglicht daher Energieeinsparungen, indem die Spannung in Abhängigkeit der jeweilig aktiven Peripheriekomponente dynamisch angepasst wird. Hierfür wird ein Algorithmus vorgestellt, welcher die Mehrkosten zum Umschalten der Spannung gegenüber den Einsparungen abwägt. Während eine aktive Periph-

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erikomponente immer mit der empfohlenen Spannung betrieben wird, können inaktive Komponenten unterhalb ihrer Spezifikation versorgt werden. Unter Duldung dieses passiven Under-voltings kann die Nutzung von Peripheriekomponenten hocheffizient geplant werden, wodurch Energieeinsparun- gen von bis zu 47.9% möglich sind. Schließlich wird mit Hilfe einer Testumgebung für 'Smart Farming' Anwendungen gezeigt, dass die entwickelten Ansätze (i) langfristig stabil sind, (ii) die Basiszuverlässigkeit von WSNs nicht beeinträchtigen und (iii) weitere Forschungsfelder im Bereich energieeffizienter aber zuverlässiger WSNs eröffnen.

**Aktueller Arbeitgeber:** TU Braunschweig, Institut für Betriebssysteme und Rechnerverbund

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## 5.7 Julius Rückert (David Hausheer, TU Darmstadt)

**Title:** Large-scale Live Video Streaming over the Internet – Efficient and Flexible Content Delivery Using Network and Application-Layer Mechanisms

**Abstract:** Video delivery over the Internet continues to dominate network traffic all over the world. After the success of video-on-demand services over the last decade, recently a notable shift of live video to the Internet can be observed. To enable future live streaming scenarios with hundreds of millions of concurrent users, new approaches are required to drastically increase the efficiency and flexibility of existing content delivery mechanisms.

To this end, this doctoral thesis identifies two essential areas of research that have the potential to jointly address these future needs. General and research-area-specific requirements for delivery mechanisms are derived, a conceptual architecture is defined for the integration of mechanisms from the two areas, and two novel delivery mechanisms are proposed, each focusing on one of the identified research areas.

The first contribution is the design of Software-Defined Multicast (SDM), a cross-layer mechanism based on software-defined networking. SDM introduces network-layer multicast support for the delivery of over-the-top live video streams inside Internet service provider networks. The mechanism is shown to be efficient as well as flexible and illustrates how Internet service providers could become active players in future content delivery scenarios.

The second contribution focuses on overlay-based concepts that enable scaling live content delivery in parts of the Internet where network-layer multicast support is unavailable. A novel peer-to-peer-based hybrid streaming mechanism called Topology-Optimized Transit (TopT) is proposed. TopT effectively combines existing and new streaming mechanisms into a common architectural framework to enable transitions between mechanisms and adapt to highly dynamic streaming workloads.

**Aktueller Arbeitgeber:** TU Darmstadt, Peer-to-Peer Systems Engineering

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## 5.8 Florian Tschorsch (Björn Scheuermann, HU Berlin)

**Title:** Onions in the Queue: An Integral Networking Perspective on Anonymous Communication Systems

**Abstract:** Performance is a pivot point in the design of anonymity overlays. Due to their growing popularity, they are faced with increasing load, which makes design problems imminent. The special requirements and complex architecture of anonymity overlays renders the topic a challenging but likewise inspiring object of research.

In this work, we discuss the design of low-latency anonymous communication systems in general and the Tor network as the de-facto standard in particular. We develop solutions to a number of research questions, all collectively following the aim of enhancing and securing such networks. By doing this we create a fundamental technical understanding of networking aspects in anonymity overlays and tackle the most prevalent performance issue experienced today: network congestion.

To this end, we systematically explore the design space of data transport in anonymity overlays and reveal serious performance issues. This exploration provides insights in how (not) to design a transport protocol for anonymity overlays. In order to support future design decisions, we additionally present a methodology to measure networks in a privacy-preserving manner.

The fundamental results of this thesis include the discovery of a destructive denial of service attack and the associated design flaw of performing hop-by-hop reliability and end-to-end flow control. Moreover, we emphasize the central role of fairness. In particular, we show that gross unfairness between circuits may arise and lead to poor performance. While these kind of issues are difficult to fix, we provide respective security measures and a fully distributed scheduling algorithm that implicitly achieves global fairness.

These issues clearly demonstrate the inadequacy of currently employed congestion control in anonymity overlays. In particular, we identify a feedback “gap” between incoming and outgoing connections as the primary cause of performance issues. Aware of the requirements and the problems of anonymity overlays, we develop a tailored transport protocol. It combines congestion control with a backpressure-based flow control mechanism. The resulting overlay is able to react locally and thus rapidly to varying network conditions. It yields superior performance and a resilient overlay network.

With our work, we contribute an integral perspective on networking aspects of anonymity overlays and tackle the root cause of performance issues.

**Aktueller Arbeitgeber:** Lehrstuhl für Technische Informatik, Humboldt-Universität zu Berlin



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## 5.9 Matthias Hirth (Chair of Communication Networks, University of Würzburg)

**Title:** Modeling Crowdsourcing Platforms - A Use-Case Driven Approach

**Abstract:** Computer systems have replaced human work-force in many parts of everyday life, but there still exists a large number of tasks that cannot be automated, yet. This also includes tasks, which we consider to be rather simple like the categorization of image content or subjective ratings. Traditionally, these tasks have been completed by designated employees or outsourced to specialized companies. However, recently the crowdsourcing paradigm is more and more applied to complete such human-labor intensive tasks. Crowdsourcing aims at leveraging the huge number of Internet users all around the globe, which form a potentially highly available, low-cost, and easy accessible work-force.

To enable the distribution of work on a global scale, new web-based services emerged, so called crowdsourcing platforms, that act as mediator between employers posting tasks and workers completing tasks. However, the crowdsourcing approach, especially the large anonymous worker crowd, results in two types of challenges. On the one hand, there are technical challenges like the dimensioning of crowdsourcing platform infrastructure or the interconnection of crowdsourcing platforms and machine clouds to build hybrid services. On the other hand, there are conceptual challenges like identifying reliable workers or migrating traditional off-line work to the crowdsourcing environment.

To tackle these challenges, this PhD thesis analyzes and models current crowdsourcing systems to optimize crowdsourcing workflows and the underlying infrastructure. First, a categorization of crowdsourcing tasks and platforms is developed to derive generalizable properties. Based on this categorization and an exemplary analysis of a commercial crowdsourcing platform, models for different aspects of crowdsourcing platforms and crowdsourcing mechanisms are developed. A special focus is put on quality assurance mechanisms for crowdsourcing tasks, where the models are used to assess the suitability and costs of existing approaches for different types of tasks. Further, a novel quality assurance mechanism solely based on user-interactions is proposed and its feasibility is shown. The findings from the analysis of existing platforms, the derived models, and the developed quality assurance mechanisms are finally used to derive best practises for two crowdsourcing use-cases, crowdsourcing-based network measurements and crowdsourcing-based subjective user studies. These two exemplary use-cases cover aspects typical for a large range of crowdsourcing tasks and illustrated the potential benefits, but also resulting challenges when using crowdsourcing.

With the ongoing digitalization and globalization of the labor markets, the crowdsourcing paradigm is expected to gain even more importance in the next years. This is already evident in the currently new emerging fields of crowdsourcing, like enterprise crowdsourcing or mobile crowdsourcing. The models developed in the thesis enable platform providers to optimize their current systems and employers to optimize their workflows to increase their commercial success. Moreover, the results help to improve the general understanding of crowdsourcing systems, a

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key for identifying necessary adaptations and future improvements.

**Next steps:** Matthias Hirth is currently working at the University of Würzburg and head of the research group “Future Internet Applications” at the Chair of Communication Networks lead by Professor Phuoc Tran-Gia. His current research interests cover crowdsourcing, Quality of Experience, measurements and performance evaluation of distributed system, and subjective evaluation of systems and applications. In the context of crowdsourcing, his main research focus lies on quality control, task design, crowd-based user studies, and interdisciplinary aspects of crowdsourcing. In the field of Quality of Experience, he is mainly working on assessing and modeling the perceived quality of enterprise applications and interactive multimedia applications like games.

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## Call for Papers

### 5th GI/ITG KuVS Fachgespräch Inter-Vehicle Communication

April 6<sup>th</sup> – 7<sup>th</sup> 2017, Erlangen, Germany

#### Motivation

Inter-vehicle communication (IVC), the management and control of network connections among vehicles as well as between vehicles and existing network infrastructure, is a maturing research field that is gaining a massive momentum. First standardization efforts across all layers, by both IEEE and ETSI, have already borne fruit, allowing researchers to gain valuable insights into both the strengths and the shortcomings of current approaches. The U.S. Department of Transportation decided to introduce IVC until 2020 using IEEE 802.11p, while in Europe the decision is not met yet. The investment of European automobile manufacturers and OEMs into this idea is not only expressed in successful efforts to reserve dedicated radio spectrum harmonized across Europe, but is also reflected in numerous research ventures in cooperation with academia. However, the gathered knowledge is still fragmented, making it hard for new players to get into the game and affording even experienced groups only a restricted view on this complex field.

The goal of this year's event is to give an interdisciplinary overview on recent research activities in the area of inter-vehicle communication (IVC) including results and work in progress. One guiding theme of this 5th GI/ITG KuVS Fachgespräch Inter-Vehicle Communication is, but not limited to "Connected Mobility". Moreover, contributions addressing standardization activities, field trials, and use-cases are very welcome. We invite young researchers and their experienced colleagues to discuss about technologies, methods, and innovative mobility applications.

#### Submission/Venue

This event will take place at the Engineering Faculty of the Friedrich-Alexander-Universität Erlangen-Nuremberg. Manuscripts of 2-4 pages, formatted according to IEEE conference layout, should be submitted as PDF documents by email ([fgivc2017@i7.informatik.uni-erlangen.de](mailto:fgivc2017@i7.informatik.uni-erlangen.de)). Accepted contributions will be published in a technical report (thus, the copyright will remain with the authors).

Detailed information is available online at <http://fg-ivc.car2x.org> and at the conference website <http://www7.cs.fau.de/fgivc2017>.

#### Important Dates

Submission until: March 3<sup>th</sup>, 2017  
Notification of acceptance: March 10<sup>th</sup>, 2017  
Registration until: March 17<sup>th</sup>, 2017  
Event: April 6<sup>th</sup>-7<sup>th</sup>, 2017

#### Organizing Committee

Anatoli Djanatliev  
Kai-Steffen Hielscher  
Reinhard German  
Christoph Sommer  
David Eckhoff

For more information please visit the event website:  
<http://www7.cs.fau.de/fgivc2017>

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**Nächster Newsletter** : Juni 2017

**Einreichungsfrist für Beiträge** : 1. Mai 2017

Wir bitten dabei um Einreichungen zu den folgenden Themengebieten:

- Fachgruppe KuVS
  - Geschäftsberichte der GI – KuVS – Fachgruppe
  - ...
- Neues aus den Arbeitsgruppen
  - Abgeschlossene Promotionen
  - Preise
  - Personenbewegungen
  - Stellenmarkt
  - ...
- Neue Projekte
  - Initiativen
  - Großprojekte
  - ...
- Calls und Berichte zu Veranstaltungen
  - Konferenzberichte (Konferenzen, Fachgespräche, Dagstuhl, ...)
  - Call for Papers and Participation ( “Eigene” Konferenzen, Fachgespräche, Summer-school, ... )
  - ...

Einreichungen können per E-Mail an die Editoren gesendet werden:

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