3 Research Group on Communication and Distributed Systems

3.1 Personnel

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	M. Thoma	email: thoma@inf.unibe.ch
	L. Luceri	email: luceri@inf.unibe.ch
Guests:	B. Gill	Aalto University, Finland Trainee from 15.04 - 30.06.2015

* with financial support from a third party

3.2 Overview

The research group ”Communication and Distributed Systems” has been investigating how multimedia applications and cloud computing services with high demands on the quality, reliability and energy efficiency can be supported by mobile communication systems and networks. Moreover, we are investigating localization mechanisms for wireless devices and new Future Internet paradigms such as Information-Centric Networking.

3.3 Research Projects

SwissSenseSynergy

The SwissSenseSynergy project aims to bring together research from closely related fields, which have recently emerged due to the proliferation of wireless computing devices. In particular, the ubiquity of smart phones as well as plans to deploy large numbers of small, local-range base stations (femto cells) creates many opportunities for synergistic computation as well as numerous privacy and security concerns. At the same time, these services are much more user-centric than traditional ones. This project aims to to develop a framework for delivering secure localisation and location-based services (LBS) to users, while optimally trading off privacy requirements with user value, network performance and reliability. The following target application scenario illustrates these requirements. Application scenario: Mobility and navigation are important for a modern lifestyle. However, current navigation applications are typically limited to a few transportation modes and miss complex environmental properties or subtle user preferences. We envision an application, where information about user preferences, transportation modes, and the environment are combined into a user-oriented navigation and recommender system. Information may include real-time traffic data, public transportation, rental vehicles, air quality, weather conditions, safety ratings and user habits. The system shall suggest places to visit, transportation modes, as well as important traffic and environmental data to city officials. Users will benefit in by improved social interactions, handling mobility more sustainably and efficiently, while preserving privacy. The scenario includes several scientific challenges and research topics, which are spread across computer science and can only be met by cooperation among the consortium of SwissSenseSynergy. More precisely these include

- Localisation & prediction: Due to short range of small cell network

base stations, it is important to accurately determine the locations of mobile devices, so that handover and resource allocation can be efficiently performed in the network. Localisation can provide location-based services such as traffic prediction and is crucial to extract the semantic meaning of the location to be able to predict the mobility of the user at larger time-scales.

- Resource allocation & optimisation: Due to the trend of smaller (femto) network cells and high mobility of users, it is important to have lightweight algorithms for optimising network topology and allocating bandwidth appropriately. This heavily depends upon a good localisation model.

- User-centric location based services & crowd-sourcing: Localisation can be combined with crowd-sourcing, where mobile users supply the service with local information e.g. to create a real-time map of traffic conditions. The main challenges are to develop models for human behaviour and preferences, to ensure privacy and the accuracy of user-supplied information.

- Privacy-preservation & security: Wireless communications and crowd-sourcing raise privacy concerns, due to tracking and data collection. We aim to minimise privacy issues by developing privacy-preserving algorithms for localisation, resource allocation, prediction and crowd-sourcing. A major challenge is to combine this with mechanisms for ensuring the reliability of user-supplied information.

- Social behaviour & profile of users: The system needs to generalise the model of the user to include her environment (e.g., weather or air quality), her properties, preferences and habits, but also the other people around her. Extracting this social profile, the interconnections, and similarities between people will enable a system to adapt to the user, instead of the user adapting to the system.

Individual partners, responsible for one of the above mentioned research topics, will consider valuable knowledge from other partners to develop solutions addressing the identified problems in a collaborative way. The target application scenario will serve as a proof-of-concept and guideline for the whole project, while individual services and algorithms will be developed by each partner. The overall goal of SwissSenseSynergy is to provide a unifying framework for secure and privacy-preserving location-based services.

The CDS group is involved in the localization and tracking tasks. To design accurate indoor positioning methods based on the most popular wireless communication techniques, i.e., WiFi and LTE, we have adopted software defined radio techniques to set up a passive localization and tracking testbed for IEEE 802.11n (WiFi) signals, which use similar physical layer mechanisms (OFDM and 20MHz bandwidth) as LTE signals. Based on this testbed, we have already achieved several scientific contributions in the area of range-based indoor localization and tracking. We have investigated multipath mitigation algorithms based on channel information in OFDM system and proposed a ranging method based on non-linear regression method, which is more accurate than the commonly used log-distance path loss model. For indoor localization, we proposed an enhanced trilateration algorithm, which combines weighted centroid and constrained weighted least square algorithms (WC-CWLS). The algorithm achieves a mean positioning error of $2.4m$ for static targets and is more robust to ranging errors than linear least square algorithm. For indoor tracking, we proposed an enhanced particle filter to deal with the inaccurate likelihood estimation and moving model problems. With this enhanced particle filter, we are able to track the user with a mean error of $1.5m$.

Research staff: T. Braun, A. Hossmann, Z. Li, Z. Zhao

Financial support: Swiss National Science Foundation Sinergia project number 154458

Mobile Cloud Networking

Mobile Cloud Networking (MCN) is a EU FP7 large-scale Integrating Project (IP) funded by the European Commission, and launched in November 2012 for a period of 36 months. In total 19 partners from industry and academia perform research on MCN.

The project is primarily motivated by an ongoing transformation that drives the convergence between the mobile communication and cloud computing industry, enabled by the Internet. These observations led to a number of objectives to be investigated, implemented and evaluated over the course of the project. The top-most objectives of the MCN project are to: a) extend the concept of cloud computing beyond data centres towards the mobile end-user, b) to design an 3GPP-compliant Mobile Cloud Networking architecture that exploits and supports cloud computing, c) to enable a novel

business actor, the MCN provider, and d) to deliver and exploit the concept of an end-to-end MCN for novel applications and services. The key research and innovation issues of the MCN project are: a) how to virtualise the Radio Access Networks (RAN), b) how to design a cross-domain Infrastructure-as-a-Service (IaaS) control plane, c) how to upgrade virtualisation and cloud computing middleware to support highly demanding, real-time network applications and services, d) how to design, deploy and operate mobile communication software components to attain and fully benefit from cloud computing attributes, e) how to ensure QoE with advanced content and service migration mechanisms for mobile cloud users and f) how to support multiple cross-domain aspects that must service a multitude of business actors and stakeholders.

The CDS group is involved in the following technical work packages (WP): WP3 on Mobile Cloud Infrastructural Foundations, WP4 on Mobile Network Cloud, and WP5 on Mobile Platform. Besides, the CDS group is leading WP7 on Dissemination, Exploitation, Standardisation activities.

The scope of work within WP3 of the project is to offer a comprehensive testing framework for the LTE radio access network (RAN). In particular, the framework allows the virtualisation of base stations (running a base station in the cloud) and the development of novel algorithms for the RAN such as load balancing which can exploit the advantages of virtualisation in order to improve mobility management and service delivery. The task has delivered initial evaluations on the computational needs of LTE base stations and how running the network functions in the cloud can influence execution time. Moreover, for the management of a virtualised RAN, an architectural model was designed, consisting of entities for communication with the end users as well as orchestration of the virtual, computational and networking resources. Implementation work on the architecture was initiated and testing is currently being done.

The scope of WP4 is to develop a novel Mobile Core Cloud concept to support on-demand and dynamic deployment of mobile core networks in a cloud computing environment. In the second project year, the research activities of WP4 mainly cover the implementation and performance evaluations of Mobility and Bandwidth Prediction as a service (MOBaaS).

Mobility and Bandwidth as a service (MOBaaS) is a MCN service that generates user mobility and bandwidth prediction information to be used by any MCN defined services in order to generate triggers needed for self-adaptation procedures, e.g., optimal run-time configuration, scale-out and scale-in of service instance components, or optimal network function placement. We have successfully designed and implemented the prediction algorithms and the cloudification mechanism such that the service

can be instantiated on-demand by any other MCN services to provide prediction information. We have performed extensive performance measurements to validate the functions of MOBaaS on our in-house OpenStack cloud infrastructure. Evaluation results show that MOBaaS could provide single/group mobility and bandwidth prediction with good prediction accuracy and latency.
A key contribution of WP5 is to design and implement the follow-me cloud concept, which aims to provide cloud services and data to the mobile user as close as possible to minimize delays and improve performance. Significant contributions were made to the cloud orchestration framework, the Follow-Me Cloud concept development and the Information-Centric Networking integration into legacy and cloudified mobile networks. Such work has proven to be key in minimizing content access time and network load, while not creating relevant extra load on the cloud computing infrastructure. The work also contributed to other work packages in the project, namely to the performance evaluation carried out within Task "Real-time Performance of Infrastructure Resource Management Frameworks" and to end-to-end evaluations performed in Task "Experimentation and Evaluation".
As the project entered its third year, work on WP6 Integration has also started. In particular, definition of all interfaces and the interdependence of MCN services on each other is established. To allow for smooth integration and demonstration, common functional tests are defined, based on which performance evaluation and troubleshooting can be done.

Research staff: I. Aad, I. Alyafawi, T. Braun, A. Gomes, A. Jamakovic-Kapic, Z. Li, E. Schiller, Z. Zhao

Financial support: EU FP7 Large-scale Integrating Project (IP), contract number CNECT-ICT-318109

Network Coding Based Multimedia Streaming in Content Centric Networks

Information Centric Networking architectures (ICN) have recently gained significant attention in the research community, as they promise to revolutionize the way data is exchanged in the Internet. They move from the traditional paradigm of Internet communication using IP addresses towards using names as addresses. This is motivated by the fact that when users browse the Internet, they care only about the data content and not where

the content is stored. On the contrary, the IP model of communication focuses on where the data is located. Several problems are associated with the current IP network architecture like usability, performance, security and resilience to mobility. To cope with some of these limitations, content distribution networks (CDN) and peer-to-peer architectures have been proposed. These methods mainly deal with the scalability issue and attempt to exploit better the available network resources. CDN and P2P could be seen as a first step towards ICN. Network coding has been presented a decade ago as an efficient technique for heterogeneous both wired and wireless overlay networks to increase the throughput, decrease the delay, enhance resilience, remove the need for coordination between the network nodes etc. There are two major classes of network coding algorithms namely Linear Network Coding (LNC) and Random Linear Network Coding (RLNC). Both methods operate in finite fields. LNC decides about the coding operations centrally, although there are some decentralized designs, whereas RLNC randomly performs operations in finite fields and has only a small performance penalty compared to LNC when operations are in large finite fields. Network coding is interesting for multimedia communication. The challenge with multimedia is that data is often scalable and data delivery should respect the tight decoding deadlines.
In this project, we envisage the design of novel network coding methods that will promote the use of ICN. We are building our techniques on the Content Centric Networking (CCNx) implementation, since it has many advantages like hierarchical prefixes and being open source. Some abstract ideas regarding the use of network coding in CCN have been very recently discussed. It mainly provides some examples motivating the appropriateness of network coding for the ICN framework, rather than specific solutions. In our perspective, specific problems should be resolved prior to employing such technologies. Specifically, open challenges are: what kind of prefixes should be used, security issues, where to cache information, how one can deal with multiple concurrent sessions accessing the network, could data correlation be exploited?
In the first year of the project we developed a protocol for integrating network coding in CCN. In comparison to previous works proposing to enable network coding in CCN, our proposal permit Interest aggregation and Interest pipelining, which reduce the data retrieval times. The experimental evaluation shows that the proposed protocol leads to significant improvements in terms of content retrieval delay compared to the original CCN. Our results demonstrate that the use of network coding adds robustness to losses and permits to exploit more efficiently the available network resources. The performance gains are verified for content retrieval in various

network scenarios.
Currently we are focused on multimedia streaming applications, as it is the main source of data traffic in today's Internet. We will further target on the employment of our methods in social networks deployed when users want to share multimedia data. We believe that the ICN paradigm fits well into the framework of multimedia communication over social networks as users can take advantage of multiple interfaces to acquire the multimedia data faster and exploit efficiently the cached data as typically many users seek for the same multimedia data. We are convinced that the employment of network coding in CCN will accelerate the data delivery, improve multimedia quality, enable better the available resources, and revolutionize the caching strategies in CCN framework by considering data importance.

Research staff: E. Bourtsoulatze, T. Braun, A. Marandi, J. Saltarin

Financial support: Swiss National Science Foundation project number 149225

Algorithms, Architectures and Platforms for Enhanced Living Environments (AAPELE)

Ambient Assisted Living (AAL) is an area of research based on Information and Communication Technologies (ICT), medical research, and sociological research. AAL is based on the notion that technology and science can provide improvements in the quality of life for people in their homes, and that it can reduce the financial burden on the budgets of European healthcare providers. The concept of Enhanced Living Environments (ELE) refers to the AAL area that is more related with the Information and Communication Technologies. To design, plan, deploy and operate, an AAL system often comprehends the integration of several scientific areas. The Architectures, Algorithms and Platforms for Enhanced Living Environments (AAPELE) COST Action addresses the issues of defining software, hardware and service architectures and on studying and creating more efficient algorithms and protocols for AAL. Related CDS research activities include localization of wireless devices as well as activity detection of mobile users.

Research staff: I. Alyafawi, T. Braun, Z. Li

Financial support: European Science Foundation, COST Action IC1303

Service-Centric Networking

Content-centric network (CCN) is a new and promising networking paradigm. CCN aims at moving from the host-to-host communication style to a new paradigm that focuses on content as the building block of the future Internet architecture. However, CCN does not consider the concept of services in its architecture. We believe that services, rather than content, should be the center of focus in future network architectures. This is due to the fact that content is just a subset of services and what applies to services can easily apply to content, but not the other way around.

Service-centric network (SCN) is a new networking paradigm where services are at the heart of its architecture. SCN is an object-oriented architecture where services and contents are considered as objects. Our research aims at building the SCN architecture based on CCN with extensions regarding service naming, name resolution, service routing, and service management.

We built the NextServe framework to support the publication, invocation, and orchestration of services over CCN. The naming scheme of NextServe allows services to be invoked by name. Also service results can be cached within the CCN network improving the response time significantly.

Authentication and trust in the service are another crucial topic in SCN. Legacy authentication methods can be applied to ICN without any major issues: the owner of a content signs using his private key, and publishes both content and signature, to be used by the receiver to verify that no alterations have been made on the way.

In SCN, the content is to be ”serviced” by any service point that is not necessarily trusted, thus invalidating the signature of the original content. We are investigating authentication techniques that can be used by a receiver to validate contents even after being changed by intermediate service points, without necessarily involving the owner of the original content.

Research staff: I. Aad, T. Braun, B. Gill, D. Mansour

Financial support: Swiss National Science Foundation Project No. 146376

Aproximate Decoding of Network Codes in Wireless Sensor Network

The recent advances in the field of sensing and wireless technology have fostered the deployment of wireless sensor networks (WSN) in a wide range of monitoring applications, such as industrial process monitoring, surveillance, natural phenomena monitoring etc. The common feature of all WSNs is that they typically consist of low-cost sensing devices with limited energy and processing power that are interconnected over the unreliable wireless medium. These constraints pose new challenges in terms of communication and data gathering protocol design which must comply with the low processing power requirements and the dynamic nature of the network. In an attempt to overcome the limitations of the state-of-the-art routing protocols, a new type of data gathering algorithms for WSNs have been proposed that rely on the concept of linear network coding (LNC). In LNC, the sensor nodes linearly combine the received data before forwarding it to the next hop nodes. This simple in-network processing has been proven to increase the overall throughput of the network and to improve the robustness to packet losses. In addition, the LNC operations can be performed in a distributed manner, which is of great importance for WSN applications with rapid changes in the sensor network topology.
While significant research efforts have focused on the design of well-performing network codes, less attention has been given to the problem of approximately recovering the source data when the network coded data available at the sink node is not sufficient for perfect decoding. The problem that we study in this project is twofold. Our first goal is to establish the sufficient conditions on the number of the network coded symbols that must be available at the decoder so as to approximately reconstruct the observed sensor data with respect to some fidelity criterion. The key challenge of this analysis is to properly define and quantify the amount of additional (side)information that is available at the decoder, and derive the lower bound on the number of required network coded symbols that achieves a certain reconstruction performance, as a function of the available side information and the given network coding parameters. The result of this analysis will provide insights into the theoretical performance limits of the considered approach and will guide the design of a practical decoding method for source data recovery from an incomplete set of network coded symbols. Our second objective is to propose a decoding algorithm that is able to approximately recover the observed sensor data using prior information on the inter-sensor correlation. The key challenge is to properly exploit the side information available at the decoder in or-

der to efficiently compensate for the missing network coded symbols. We propose a novel approach for exploiting the redundancy that is present in the sensed data in order to transform the rank deficient system of linear equations into an overdetermined system. We then propose to apply methods from the theory of channel coding in order to design effective low complexity decoding algorithms.

Research staff: E. Bourtsoulatze

Financial support: Hasler Foundation (from 01.01.2015 to 30.06.2015)

Enterprise Integration of WSNs and IoT-devices

The aim of the project is to investigate new methodologies to enable interoperability between wireless sensor networks (in general various heterogeneous Internet of Thing devices (IoT) devices) and enterprise IT systems. The project assumes that the lower layers of a typical IoT/WSN protocol stack is mature and concentrates on application layer protocols, service-based integration of devices and (semantic) data content abstraction. We implemented a novel semantic overlay for IoT protocols, based on a semantic service description language (Linked USDL). The project created an Internet of Things (IoT) enterprise architecture as well as investigated two approaches for integration of semantics at a service level: First, a top-down approach downscaling an enterprise protocol towards small embedded devices. Second, a bottom-up approach where the semantic information is encoded separately from the actual service. It features an implementation of the Constrained Application Protocol (CoAP) for IBM Mote Runner, a reactive VM-based operating system, and – on top of that – the OData protocol. Furthermore, a business operations-aware sleepy nodes implementation has been developed, that allows long term sleeping of IoT-devices based upon semantic information.
Evaluation results show that the performance of the platform is very promising and the overhead imposed by the semantic overlay is reasonable compared to alternatives. OData, as one example of an enterprise-level protocol has been studied and its feasibility on an IoT-device level has been demonstrated. Furthermore, an empirical study on the challenges and opportunities of semantics in IoT has been conducted.

Research staff: T. Braun, M. Thoma

Financial support: SAP (Switzerland) Inc. (until 31.03.2015)

Scaling of Distributed Applications in Cloud Computing Environments

Cloud computing enables provisioning and distribution of highly scalable services in a reliable, on-demand and sustainable manner. Our project's aim is to model and test different virtual machine (VM) scaling policies based on both Service Level Agreements (SLAs) and application-level monitoring information. We assume that the management system will control enterprise distributed applications, which are able to scale horizontally by increasing the number of VMs allocated to running the application's services. We employ SLAs for describing the performance invariants of the distributed application and then we use the SLAs as input to the management system for scaling the number of application's VMs under varying workload conditions. We consider different SLA scaling policies, both reactive and predictive. Reactive scaling simply responds to changes in the SLA compliance level (e.g. ratio of the current value of a application metric and its maximum allowed value) by changing the number of VMs allocated to a service until the SLA ratio returns to a safe value (e.g. between 0.6 and 0.9). We also developed a SLA scaling mechanism using results from queueing theory, by controlling the number of allocated VMs based on the relation between the concurrent number of requests executed by the service and the average execution time obtained at that concurrency level. We are currently extending these mechanisms to incorporate a prediction component. We are investigating the usage of both regression and non-linear mechanisms for forecasting the values of near-future workload. The project also explores modelling of distributed applications by characterising application performance under different workload patterns. We built a statistical model of the distributed application's performance by profiling the execution times of atomic operations and inter-service network round-trip times. These statistical models are then used for constructing a simulation model of the target application in CloudSim cloud simulator. We have extended CloudSim to support simulation of multiple cloud tenants (isolated applications with different SLA contracts), accurate time-shared CPU scheduling of concurrent tasks and multiple SLA-based VM scaling managers.

We have evaluated the accuracy of workload modelling in CloudSim by comparing the execution results in both a real distributed small-scale testbed and then by replicating the same workload in our extended simula-

tor. The outcomes of evaluating the reactive and predictive scaling mechanisms are encouraging and seem to validate using them as reliable means of scaling cloud systems.

Research staff: T. Braun, A. Antonescu

Financial support: SAP (Switzerland) Inc.

Testbed for Mobile and Internet Communications

Our research group maintains its own comprehensive and heterogeneous network testbeds for various purposes. A wired testbed is used to build networks of experimental routers and end systems to be able to evaluate the behavior of new networking protocols and architectures in realistic environments. The testbed also forms a productive network of Linux PCs and provides the storage capacity and CPU power for many of our research group's projects. An educational laboratory network for students' training is also connected and has been used for teaching in the Bachelor program. Our research group also takes part in PlanetLab (http://planet-lab.org) and GpENI (https://wiki.ittc.ku.edu/gpeni/). PlanetLab is an open platform for developing, deploying, and accessing planetary-scale services. For this purpose we are hosting three PlanetLab nodes in our testbed network. GpENI is a distributed set of sites, interconnected at layer 2 (or layer 2 tunnels) to enable experimentation at layers 3 and higher. For this purpose we are hosting three GpENI nodes, two GpENI routers and one GpENI controller node in our testbed network. Moreover, we have installed three Cisco routers. Each of them is terminating a L2TP connections to provide a major European GpENI concentrator point. We are connected to the University of Kansas, the ETH Zürich and the University of Zürich.
Moreover, we deployed two powerful servers for offering virtual machines/networks in a fast and user-friendly way, one running Xen (http://xenserver.org/) and the other running OpenStack (http://www.openstack.org/). Virtualization alleviates the overhead of buying, setting up and managing virtual machines/networks, offering the users/researchers efficient and easy ways of running their experiments while reducing the financial costs and saving time, on a network that is not a simulation one.
Our research group also runs wireless testbeds. The research group owns a number of sensor nodes: Embedded Sensor Board (ESB), Modular Sensor Board (MSB), tmote SKY nodes, BTnodes, TelosB nodes, and micaZ

nodes. Some of these nodes are operated as part of the Wisebed infrastrucuture. Another testbed consisting of multiple wireless mesh nodes (17 x PCEngines WRAP, 10 x Meraki Mini, 6 x PCEngines ALIX) has been deployed throughout the building and work environment of the research group. In this testbed, multi-channel communication, multi-path routing and the management framework ADAM have been evaluated. The testbed is currently used by several Ph.D. theses and student projects.

Research staff: All members of the CDS research group

3.4 Master's Theses

- Marcel Stolz: An LTE Signal Analyser, July 2015
- Jürg Weber: Dynamic Adaptation of Transmission Modes for Opportunistic Content-Centric Networks, July 2015
- Tobias Schmid: Agent-Based Data Retrieval for Opportunistic Content-Centric Networks, July 2015
- Arnaud Durand: Distributed wideband software-defined radio receiver for heterogeneous systems, March 2015

3.5 Bachelor's Theses

- Oliver Stapleton: Service Distribution Mechanisms in Information-Centric Networking, July 2015
- Simon Kiener: Hybrid Indoor Localization Using Multiple Radio Interfaces, July 2015
- Adrian Kurt: Indoor Tracking with Kalman Filters Using Rss- Based Ranging, June 2015
- Arun Sittampalam: Content Discovery in Wireless Information-Centric Networks, May 2015
- René Gadow: Persistent Caching in Information-centric Networking, April 2015
- Nina Mujkanovic: Synchome - Synchronization Application For Mobile Content Retrieval, March 2015

- Urs Zysset: Improved Power-based Lateration via Wall Attenuation Factor, February 2015
- Lukas von Rotz: Adaptive Interest Lifetime for Content-Centric Requests, February 2015
- Konstantin Niedermann: Network Coding based Interactive Multiview Video Streaming in ICN Networks, February 2015
- Mansour Hamidi: Mobility Recognition Based on Android Sensors to Improve Indoor Localization, February 2015
- Alexander Striffeler: Raptor Coding in Mobile Content Centric Networks, August 2014

3.6 Further Activities

Memberships

Torsten Braun

- Erweitertes Leitungsgremium Fachgruppe "Kommunikation und Verteilte Systeme"', Gesellschaft für Informatik
- SWITCH Stiftungsrat
- SWITCH Stiftungsratsausschuss
- Vice President of SWITCH foundation
- Kuratorium Fritz-Kutter-Fonds
- Expert for Diploma Exams at Fachhochschule Bern
- Expert for Matura Exams at Gymnasium Köniz Lerbermatt
- Management committee member of COST Action IC 1303 Algorithms, Architectures and Platforms for Enhanced Living Environments (AAPELE)
- External Advisory Board Member of Space Internetworking Center (SPICE) at Democritus University of Thrace, Greece
- Board Member (Gesellschafter) of VGU Private Virtual Global University, Berlin, Germany

Editorial Boards

Torsten Braun

- Editorial Board Member of Informatik Spektrum, Springer
- Editorial Board Member of MDPI Journal of Sensor and Actuator Networks

Conference Chairs

Torsten Braun

- Wired/Wireless Internet Communications 2015, Steering committee, Malaga, Spain, May 25-27, 2015
- International Symposium on Quality of Service 2014, Steering committee, Portland, OR, USA, June 15 - 16 2015

Conference Program Committees

Torsten Braun

- International Conference on Distributed Computing and Networking (ICDCN 2015), BITS Pilani, January 4-7, 2015
- Leistungs-, Zuverlässigkeits- und Verlässlichkeitsbewertung von Kommunikationsnetzen und verteilten Systemen (MMBnet 2015)
- The 8th International Workshop on Communication Technologies for Vehicles, Sousse, Tunisia, May 6-8 2015
- The 6th International Congress on Ultra Modern Telecommunications and Control Systems (ICUMT 2014), Saint-Petersburg, Russia, October 6-8 2014
- The International Conference on Network and Service Management (CNSM 2014), Rio de Janeiro, Brazil, November 17-21 2014
- 7th International Workshop on Multiple Access Communications, Halmstad, Sweden, August 27-28 2014
- 3rd IEEE International Conference on Cloud Networking (CLOUDNET 2014), Luxembourg City, Luxembourg, October 8-10 2014

- The 14th NEW2AN co-located with the 7th Conference on Smart Spaces ruSMART, Saint-Petersburg, Russia, August 27 - 29, 2014
- 80th IEEE Vehicular Technology Conference (VTC2014-Fall), Vancouver, Canada, September 14—17 2014
- 12th EAI International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services, Coimbra, Portugal, July 22-–24 2015
- The Conference on Networked Systems (NetSys), Cottbus, Germany, March 09-12 2015
- The 30th ACM/SIGAPP Symposium On Applied Computing (SAC 2015), Salamanca, Spain, April 13-17, 2015
- IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2015), Boston, MA, USA, June 14-17, 2015
- The IFIP Networking 2015 Conference (Networking 2015), Toulouse, France, May 20—22, 2015
- IEEE International Workshop on Software Defined 5G Networks (Soft5G 2015), London, U.K., April 17 2015
- Workshop on Micro Aerial Vehicle Networks, Systems, and Applications for Civilian Use (DroNet 2015), Florence, Italy, May 22, 2015
- International Workshop on Quality, Reliability, and Security in Information-Centric Networking, Rhodes Island, Greece, August 20, 2014

Zhongliang Zhao

- Sensor Networks Track, IEEE ISSNIP 2015
- Pervasive Computing Track, IEEE MobiSPC 2015

Project and Person Reviewing Activities

Torsten Braun

- Research Council of Norway

- Academy of Finland
- Leibniz-Gemeinschaft
- IWT - Flemish agency for Innovation by Science and Technology

Journal Article Reviewing Activities

Torsten Braun

- Elsevier Computer Networks
- IEEE Communications Magazine
- IEEE Communications Letters
- Springer Lecture Notes in Computer Science

Carlos Anastasiades

- Elsevier Journal of Network and Computer Applications (JNCA)
- Springer Wireless Networks (WINE)

Eirina Bourtsoulatze

- IEEE Transactions on Multimedia
- IEEE Communication Letters
- IEEE Transactions on Communications
- IEEE/ACM Transactions on Networking
- KSII Transactions on Internet and Information Systems
- EURASIP Journal on Image and Video Processing

André Gomes

- IEEE Wireless Communications Magazine

Eryk Schiller

- International Journal of Ad Hoc and Ubiquitous Computing (IJAHUC)

Zhongliang Zhao

- IEEE Transactions on Multimedia
- MDPI Journal Sensors
- IEEE Transactions on Vehicular Technology

Invited Talks and Tutorials

Torsten Braun

- ”Mobile Cloud Networking”, Keynote at Latin American Computing Conference (CLEI 2014), Montevideo, September 18, 2014
- ”Telematiknetze”, Bundesamt für Bevölkerungsschutz, November 25, 2014, Schwarzenburg
- ”Communication and Distributed Systems”, COST Action IC1303, 3rd WG Meeting, Malta, May 28-29, 2015
- ”Security and Privacy in the Internet of Things”, Panel at IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks, IEEE WoWMoM, June 14-17, 2015, Boston, MA, USA
- ”Content-Centric Networking in Wireless Networks”, I-CAN Workshop and Intensive Summer School on Information-Centric Access Networks, Athens University of Economics and Business, Athens, June 2-5, 2015
- ”Service-Centric Networking”, I-CAN Workshop and Intensive Summer School on Information-Centric Access Networks, Athens University of Economics and Business, Athens, June 2-5, 2015
- ”Authentication, Authorization, Accounting, and Auditing in Wireless Mesh Networks” , University of Neuchatel, February 5, 2015

Eryk Schiller

- ”Dynamic Chain Encryption Channel for Wireless Community Networks”, E. Schiller, P. Kropf, T. Braun, Workshop Autonome Systeme 2014 (AutSys2014), 26-30 October 2014 in Cala Millor, Mallorca, Spain.
- ”Virtual Networks”, E. Schiller, Islam Alyafawi, Torsten Braun, Navid Nikaein, Lúcio Ferreira, 8th IC1004 Training School: From Hetnets to Cloud Radio Access Networks, Luxembourg, 21-23 Apr. 2015.

Zhongliang Zhao

- ”Future communication architecture for mobile cloud services”, Software Defined Networking (SDN) workshop, organized by SWITCH, University of Bern, June 11 2015

3.7 Publications

Publications submitted in the academic year 2014/2015 and appearing in the following academic year are not listed.

Book Chapters

- V. Bernardo, T. Braun, M. Curado, M. Fiedler, D. Hock, T. Hossmann, K. Hummel, P. Hurni, S. Ickin, A. Jamakovic, S. Nadjm-Tehrani, T. Trinh, E. Vergara, F. Wamser, and T. Zinner. Green wireless-energy efficiency in wireless networks. In *Large-scale Distributed Systems and Energy Efficiency: A Holistic View*, pages 81–130. March 2015. ISBN:978-1-118-86463-0

Reviewed Conference Papers

- C. Anastasiades, N. Thomos, A. Striffeler, and T. Braun. RC-NDN: Raptor codes enabled named data networking. In *IEEE International Conference on Communications (ICC)*. June 2015.

- Z. Li, T. Braun, and D. Dimitrova. A time-based passive source localization system for narrow-band signal. In *The IEEE International Conference on Communications (ICC) 2015*. June 2015.

- A. Gomes and T. Braun. Load balancing in lte mobile networks with information-centric networking. In: *IEEE ICC 2015 - Third International Workshop on Cloud Computing Systems, Networks, and Applications (CCSNA)*. June 2015.

- I. Alyafawi, E. Schiller, and T. Braun, Desislava Cvetanova Dimitrova, André Sérgio Nobre Gomes, and Navid Nikaein. Critical issues of centralized and cloudified lte-fdd radio access networks. In *IEEE ICC 2015 - Next Generation Networking Symposium (ICC'15 (07) NGN)*. June 2015.

- Z. Li, T. Braun, and D. Dimitrova. A passive wifi source localization system based on fine-grained power-based trilateration. In *IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, pages 1–9. June 2015. doi:10.1109/WoWMoM.2015.7158147

- Z. Li, T. Braun, and D. Dimitrova. Methodology for gps synchronization evaluation with high accuracy. In *The IEEE 81st Vehicular Technology Conference (VTC2015-Spring)*, pages 1–6. May 2015. doi:10.1109/VTCSpring.2015.7145929

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- L. Pimentel, D. Rosário, M. Seruffo, Z. Zhao, and T. Braun. Adaptive Beaconless Opportunistic Routing for Multimedia Distribution. In *Wired/Wireless Internet Communications. The 13th International Conference on Wired & Wireless Internet Communications.*, volume 9071 of *Lecture Notes in Computer Science*. May 2015. doi:10.1007/978-3-319-22572-2

- A. Durand, M. Gasparian, T. Rouvinez, I. Aad, T. Braun, and T. Trinh. Bitworker, a decentralized distributed computing system based on bittorrent. In *Wired/Wireless Internet Communications. The 13th International Conference on Wired & Wireless Internet Communications*, volume 9071 of *Lecture Notes in Computer Science*. May 2015. doi:10.1007/978-3-319-22572-2

- Z. Li, A. Hossmann, and T. Braun. Range-based weighted-likelihood particle filter for rss-based indoor tracking In: *Proceedings of the 1st KuVS Expert Talk on Localization*, issue AIB-2015-8 of *Aachener Informatik-Berichte*. April 2015. ISSN:0935–3232

- A. Gomes and T. Braun. Feasibility of information-centric networking integration into lte mobile networks. In *The 30th ACM/SIGAPP Symposium On Applied Computing*, pages 627–633. April 2015. doi:10.1145/2695664.2695790

- T. Taleb, M. Corici, C. Parada, A. Jamakovic, S. Ruffino, G. Karagiannis and T. Magedanz. EASE: EPC as a service to ease mobile

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- F. Dudouet, P. Harsh, S. Ruiz, A. Gomes, and T. Bohnert. A case for cdn-as-a-service in the cloud: A mobile cloud networking argument. In *International Conference on Advances in Computing, Communications and Informatics (ICACCI) 2014*. September 2014. doi:10.1109/ICACCI.2014.6968495

- Z. Zhao and T. Braun. Real-world evaluation of sensor context-aware adaptive duty-cycled opportunistic routing. In *39th Annual IEEE Conference on Local Computer Networks (IEEE LCN'14)*. September 2014. doi:10.1109/LCN.2014.6925764

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