KuVS Newsletter

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Editor Message

Dear KuVS members,

we welcome you to the 17th (and summer) edition of the KuVS newsletter.

This newsletter is providing you with all information that you need to know about the KuVS community from the last half a year.

More information and recent editions of our newsletter are available on https://www.kuvs.de/newsletter/.

We hope you enjoy reading this edition of the KuVS newsletter.

Oliver Hohlfeld
Universität Kassel

KuVS Newsletter

NetSys and ZDN 2023

Call for Participation
International Conference on Networked Systems 2023
4-7 September 2023 – Potsdam, Germany

The Conference on Networked Systems (NetSys) provides an international forum for engineers and scientists in academia, industry, and government to discuss recent innovations in networks and distributed systems. NetSys is a biennial event; in 2023, it will take place in Potsdam at the Hasso-Plattner-Institut.

More information and program: https://www.kuvs.de/netsys/2023/

Conference registration: https://hpi.de/das-hpi/registrierung/2023/netsys2023/

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Mitgliederversammlung @ NetSys

Liebe KuVS-Mitglieder,

Anlässlich der NetSys in Potsdam wird es endlich wieder eine Mitgliederversammlung der GI/ITG Fachgruppe Kommunikation und Verteilte Systeme geben. Bitte tragt euch / tragen Sie sich den Termin schon einmal ein:

Mittwoch, 6.9.2023

Dies ist die erste Mitgliederversammlung seit längerer Zeit. Ich hoffe, wir können die Gelegenheit nutzen, um über die KuVS, die Unterstützung durch die KuVS und eure / ihre Beiträge zur KuVS in aller Ruhe zu diskutieren.

Ich freue mich auf das gemeinsame Treffen!
Falko Dressler
Sprecher der GI/ITG Fachgruppe Kommunikation und Verteilte Systeme

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Movement of persons

- Prof. Dr. Boris Koldehofe accepted a full professorship on Distributed and Operating Systems at Technische Universität Ilmenau
- Prof. Dr. Marco Zimmerling accepted a full professorship on Resilient Networked Computing at TU Darmstadt
- Prof. Dr. Matthias Wählisch accepted a full professorship on Distributed and Networked Systems at TU Dresden
- Prof. Dr. Ralph Holz accepted a full professorship at University of Münster

KuVS Newsletter

Awards

KuVS-Preis für die beste Dissertation

Porträt Manisha Luthra: privat

Manisha Luthras Beiträge vereinfachen es, Kommunikationsnetze zu bauen, welche die komplexen Anforderungen von IoT-Applikationen erfüllen – zum Beispiel im sehr dynamischen Szenario einer Smart City

Verkehrsführung selbstfahrender Autos, Laststeuerung in intelligenten Stromnetzen, automatische Überwachung von Geldüberweisungen: In der Smart City beziehen sich Applikationen auf riesige Mengen an Echtzeit-Daten aus beweglichen Quellen wie Sensoren oder Smartphones. Doch wie können die Daten schnell und sinnvoll verarbeitet werden? Damit hat sich Manisha Luthra in ihrer Dissertation am Fachgebiet Multimedia Kommunikation / Kommunikationsnetze der TU Darmstadt und im Rahmen des Sonderforschungsbereichs MAKI befasst, für die sie nun mit dem KuVS-Preis ausgezeichnet wurde.

Konkret entwickelt Manisha Luthra in ihrer Dissertation mit dem Titel “Network-centric Complex Event Processing” Lösungen zu drei Problemfeldern in solchen dynamischen und Echtzeit-Kommunikationsnetzen: dies sind die Themen Adaptivität, Effizienz und Interoperabilität.

Wo im Netzwerk werden Datenströme am besten zu sinnvollen Einheiten weiterverarbeitet?

Der erste Beitrag zur Adaptivität dreht sich um die Frage, wie die benötigte Rechenleistung bestmöglich im Netzwerk verteilt werden kann und wo im Netz Datenströme am besten als

"Operatoren" zu sinnvollen Einheiten weiterverarbeitet werden – vor allem, wenn beispielsweise an einer Verkehrskreuzung neue Sensoren zum Netz hinzukommen und andere verschwinden.

Manisha Luthra hat ein intelligentes System entwickelt, das diese Dynamik im Netzwerk berücksichtigt und sich unter verschiedenen Platzierungsoptionen für die leistungsstärkste entscheidet. Der Operator wird anhand der entsprechenden Vorhersagen dann automatisch innerhalb des Netzwerks verschoben, zum Beispiel von einem Sensor zu einem Server. Das System sorgt dabei für eine nahtlose Transition ohne Leistungsverluste zwischen den Platzierungsoptionen – basierend auf dem Konzept der "Transition", mit dem im Sonderforschungsbereich "MAKI – Multi-Mechanismen-Adaption für das künftige Internet" gearbeitet wird.

Wie können die Daten schneller verarbeitet werden?

Das zweite Problem der Effizienz geht Manisha Luthra an, indem sie das Paradigma "Information-centric networking" (ICN) nutzt, um Operatoren auf programmierbaren Switches im Netzwerk auszuführen und auf diese Weise die Schnelligkeit der Datenverarbeitung zu erhöhen.

Dies garantiert eine extrem niedrige Latenz, welche bei der Verarbeitung von Datenströmen aus Sensoren immens wichtig ist, weil permanent neue Daten generiert werden und diese quasi in Echtzeit zu sinnvollen Einheiten weiterverarbeitet werden müssen.

Wie können komplexe Datenstromanwendungen unabhängig vom zugrunde liegenden System (und der Programmiersprache) entwickelt werden?

Im dritten Beitrag zum Thema Interoperabilität schlägt Manisha Luthra Methoden vor, die es möglich machen, die Schnittstellen zu verschiedenen Complex-Event-Processing (CEP)-Systemen zu vereinheitlichen und dadurch verschiedene dieser Systeme im selben Netzwerk ausführen zu können.

Hierzu macht sie sich die Prinzipien zunutze, welche dem Serverless Computing zugrunde liegen. Entwickler*innen haben dank dieser Methoden den Vorteil, dass sie CEP-Anwendungen unabhängig von der genutzten Programmiersprache, der unterliegenden Hardware und dem Betriebssystem programmieren können.

Die Dissertation wurde am Fachgebiet Multimedia Kommunikation von Prof. Ralf Steinmetz und Prof. Boris Koldehofe betreut.

Zur Person: Manisha Luthra Manisha Luthra arbeitet inzwischen als Postdoktorandin am Fachgebiet Data and AI Systems am Fachbereich Informatik der TU Darmstadt. Seit Kurzem ist sie zudem Senior Researcher im Forschungsbereich "Systemische KI für Entscheidungsunterstützung (SAIDE)" am Deutschen Forschungszentrums für Künstliche Intelligenz (DFKI) unter Leitung von Prof. Carsten Binnig.

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KuVS-Preis für die beste Masterarbeit

Foto Marvin Härdtlein: Christine Wachter/Multimedia Communications Lab

Marvin Härdtlein hat eine Methode entwickelt, Routing im Internet mithilfe eines programmierbaren, kostengünstigen Hybrid-Gerätes abzuwickeln

Eine Faszination führte Marvin Härdtlein mitten hinein ins Herz unseres Datenverkehrs. Zwischen den pulsierenden Servern eines Frankfurter Rechenzentrums, wo er als Werkstudent arbeitete, wuchs der Wunsch, genauer hinter die Fassade der schwarzgrauen Serverschränke zu schauen.

Für seine Masterarbeit mit dem Titel “Hybrid Switch: Dynamic Flow Rule Offloading on High Performance Networking Hardware” am Fachgebiet Multimedia Kommunikation / Kommunikationsnetze an der TU Darmstadt hat Marvin Härdtlein nun den Preis der Fachgruppe Kommunikation und Verteilte Systeme (KuVS) in der Gesellschaft für Informatik und der Informationstechnischen Gesellschaft im VDE e.V. für die beste Masterarbeit des Jahres 2021 zuerkannt bekommen.

Eine kosteneffiziente und flexible Lösung für Routing im Internet

Darin untersucht er die Idee, spezialisierte Netzwerk-Hardware durch ein hybrides Gerät zu ersetzen. Als Beispiel dient der Anwendungsfall des Routings im Internet. Die hierfür kommerziell verfügbaren Netzwerkgeräte sind recht teuer. Ihre Funktionen lassen sich meist nur schwer oder überhaupt nicht verändern. Marvin Härdtleins Ziel war es jedoch, Netzwerkgeräte programmierbar zu machen, um zukünftig neue Funktionen einfacher in bestehenden Netzwerken realisieren zu können.

Nun gibt es zwar Standard-Switch-Modelle, welche als Alternative zu spezialisierter Netzwerk-Hardware in Frage kommen. Diese haben allerdings einen großen Nachteil: Sie haben nicht

genug Speicherkapazität, um im Anwendungsfall des Routings im Internet ausreichend Routeninformationen halten zu können. In globalen Routingtabellen, welche als Basis dafür dienen, dass Anfragen im Internet an das richtige Ziel geleitet werden, gibt es aktuell ungefähr 850.000 Einträge.

Nötig sind ein programmierbarer Switch, ein Server und die Software P4HC

Also hat sich Marvin Härdtlein im Rahmen seiner von Ralf Kundel und Christoph Gärtner betreuten Masterarbeit ein ausgeklügeltes Konzept überlegt. Einen in der Programmiersprache P4 konfigurierbaren Switch kombiniert er mit einem Standardserver.

Dabei ergänzt der eine die Schwächen des jeweils anderen: Ein programmierbarer Switch hat nur einen überschaubaren Speicher, um Internet-Routeninformationen zu halten. Diesen kann er jedoch mit der enormen Leistung von vielen hundert Gigabit pro Sekunde abwickeln. Ein Server hingegen punktet zwar nicht mit einer solchen Performance, kann aber mit seinem großen Arbeitsspeicher sehr viele Regeln oder konkrete Routeninformationen speichern. Zudem können Standard-Serversysteme dank Software-Frameworks wie DPDK (Data Plane Development Kit) inzwischen auch größere Mengen an Netzwerkpaketen verarbeiten. So sind 100 Gigabit pro Sekunde für einen Server durchaus zu erreichen.

Um Switch und Server zu einem hybriden Gerät zu verbinden, bedarf es einer speziellen Controller-Software. Marvin Härdtlein hat hierzu die Software P4HC (P4 Hybrid Cache) programmiert. Diese verbindet beide Geräte so, dass sie nach außen hin als ein Gerät auftreten. Der Switch wird dabei zwischen den Server und die anderen Netzwerkteilnehmern platziert. Im Normalfall leitet der Switch die Pakete an den Server weiter. Dieser speichert alle Informationen, die zum Verarbeiten der Pakete notwendig sind – im Fall des Routings im Internet sind dies die 850.000 Routen der globalen Routingtabellen.

Der Switch kann den Server bei Bedarf entlasten

Ist der Server jedoch stark ausgelastet, werden Regeln in den Switch installiert. Dieser agiert dann quasi als Cache für den Server und entlastet ihn. Hierzu wertet die Software alle zehn Sekunden automatisch aus, welche der Regeln im Server den meisten Datenverkehr erzeugen. Hinter diesem Vorgehen steckt die Erkenntnis, dass manche Routen im Internet sehr intensiv genutzt werden, zum Beispiel zu Streamingdiensten wie Netflix. Konkret könne man mit ungefähr 100.000 Routen bereits 90 Prozent des kompletten Datenverkehrs abhandeln, so Marvin Härdtlein.

Dabei ist jedoch einiges zu beachten. Es kann nicht einfach jede Regel vom Server in den Switch verlagert werden. Um Probleme zu vermeiden, müssen die Regeln beim Auslagern auf den Switch zuvor auf ihre Abhängigkeiten untersucht und diese aufgelöst werden. Andernfalls könnte ein unerwartetes und somit falsches Verhalten auftreten.

Die Arbeit zeigt erstmals, wie eine voll programmierbare Netzwerk-Hardware für das Routing im Internet aussehen kann Die Grundidee, zwei Switches oder einen Hardware-Switch mit einem Software-Switch zu verbinden, war nicht neu. Die bisherigen Ansätze waren jedoch stark mit der Controller-Seite beschäftigt. Die Data Plane – also die Geräte, die aktiv die Pakete

verarbeiten – wurde dabei kaum beleuchtet.

Mit seiner Masterarbeit zeigt Marvin Härdtlein erstmals, dass es mit aktueller Hardware wie einem P4-programmierbaren Tofino-Switch und einem Standardserver möglich ist, eine Performance zu erreichen, die spezieller Netzwerk-Hardware um nichts nachsteht. Dabei ist die Lösung voll programmierbar und jederzeit flexibel, was bei spezialisierter Netzwerk-Hardware nicht der Fall ist.

KuVS Newsletter

Announcements

Traurige Nachricht zu Phuoc Tran-Gia

Leider haben wir eine sehr traurige Nachricht, einige haben es bestimmt auch schon gehört; Prof. em. Dr.-Ing. Phuoc Tran-Gia ist letzten Monat im Alter von 70 Jahren verstorben.

Viele von Ihnen werden sich an ihn von den unterschiedlichsten Tagungen, wie 2016 in Würzburg der ITC https://itc-conference.org/congresses.html oder Projekten wie G-Lab https://www.german-lab.de/ und weitere Aktivitäten erinnern können:

https://www.informatik.uni-wuerzburg.de/comnet/nachruf-des-instituts-auf-prof-tran-gia/
https://www.informatik.uni-wuerzburg.de/comnet/trauer-um-phuoc-tran-gia/

KuVS Newsletter

Finished PhD Theses

Christian Killer

University of Zurich (advisor Burkhard Stiller)

Title: Privacy and Verifiability in Decentralized Electronic Voting Systems

Abstract: Fair and secure voting is a cornerstone of democracies and, at the same time, one of the most challenging government processes. Trustworthy elections are crucial to ensure long-term stability and foster trust in the government. Historically, technology generally supported elections to ensure the correct organization and execution of electoral processes. The omnipresent digitization and emergence of the internet changed the fabric of societies and governments, naturally including voting systems. Thus, government services are increasingly digitized, and an essential effort is digitizing democratic processes, such as deploying Electronic Voting (EV) systems. A key difference and crucial aspect of voting processes is whether votes are cast in person or remotely (e.g., via the internet), i.e., Remote EV (REV) systems allow voters to remotely cast their ballot from an uncontrolled environment.

Digitizing voting processes involve complex cryptographic mechanisms because voting systems present a unique dichotomy between privacy and verifiability. The perfect balance of these properties depends heavily on the country's governmental structures (e.g., electoral system, state of digitization) and, crucially, the public's acceptance and trust in the governmental entities. In EV systems, a Public Bulletin Board (PBB) serves as a tamper-proof audit trail, i.e., as evidence of the correct execution of the voting protocol. Thus, the immutability of PBBs is a technical requirement to protect stored audit trails from tampering. Instead of relying on the honesty of governmental authorities and election officials, decentralized procedures can help mitigate centralized failures, sabotage risks, or the collusion of dishonest actors. Another fundamental challenge of publicly releasing the data stored on PBBs is ensuring that the data published, such as ballots, proofs, and logs, do not leak any privacy-sensitive data and does not impose any risks on voters. Once published, powerful adversaries can store information indefinitely and attempt to reveal the plain text of these data in the future.

Transparency is critical for voting systems and especially crucial in achieving verifiability properties. Thus, Blockchains (BC) and Distributed Ledgers (DL) emerged prominently as an instantiation of the PBB in voting systems' architectures. A DL network with a permissioned consensus is suitable for voting systems, because it directly maps the trust model to a permissioned network architecture formed by trusted governmental authorities. Based on permissioned DLs, this thesis proposes novel identity management approaches for the Swiss Remote Postal Voting (RPV) system as well as an End-to-End Verifiable (E2E-V) RPV system. Besides these systems strengthening the Swiss RPV, three REV systems are introduced, a fully decentralized voting system based on Homomorphic Encryption (HE) that achieves Receipt-Freeness and E2E-V, and fourth, its successors based on Re-Encryption Mixnets. Finally, a decentralized voting system achieving Unconditional Privacy is introduced, i.e., its privacy guarantees do not

depend on any computational hardness assumptions.

This thesis contains novel RPV and REV systems, which are evaluated quantitatively and qualitatively. Evaluations performed for these systems contained within this thesis indicate that (a) permissioned DLs are suitable PBBs for cryptographic voting schemes, and (b) performance evaluations demonstrate that these systems scale up to Swiss electorate sizes. Finally, (c) all of these systems contain explicit assumptions in terms of their respective evaluations in terms of security and trust boundaries, indicating novel threat events that emerge and their respective mitigations.

KuVS Newsletter

Daniel Merling

Universität Tübingen (advisor Michael Menth)

Title: Resilient and Scalable Forwarding for Software-Defined Networks with P4-Programmable Switches

Abstract: Traditional networking devices support only fixed features and limited configurability. Network softwarization leverages programmable software and hardware platforms to remove those limitations. In this context the concept of programmable data planes allows directly to program the packet processing pipeline of networking devices and create custom control plane algorithms. This flexibility enables the design of novel networking mechanisms where the status quo struggles to meet high demands of next-generation networks like 5G, Internet of Things, cloud computing, and industry 4.0. P4 is the most popular technology to implement programmable data planes. However, programmable data planes, and in particular, the P4 technology, emerged only recently. Thus, P4 support for some well-established networking concepts is still lacking and several issues remain unsolved due to the different characteristics of programmable data planes in comparison to traditional networking. The research of this thesis focuses on two open issues of programmable data planes. First, it develops resilient and efficient forwarding mechanisms for the P4 data plane as there are no satisfying state of the art best practices yet. Second, it enables BIER in high-performance P4 data planes. BIER is a novel, scalable, and efficient transport mechanism for IP multicast traffic which has only very limited support of high-performance forwarding platforms yet. The main results of this thesis are published as 8 peer-reviewed and one post-publication peer-reviewed publication. The results cover the development of suitable resilience mechanisms for P4 data planes, the development and implementation of resilient BIER forwarding in P4, and the extensive evaluations of all developed and implemented mechanisms. Furthermore, the results contain a comprehensive P4 literature study. Two more peer-reviewed papers contain additional content that is not directly related to the main results. They implement congestion avoidance mechanisms in P4 and develop a scheduling concept to find cost-optimized load schedules based on day-ahead forecasts.

KuVS Newsletter

Julian Zobel

TU Darmstadt (advisor Ralf Steinmetz & Christian Oberli)

Title: Aerial Network Assistance Systems for Post-Disaster Scenarios : Topology Monitoring and Communication Support in Infrastructure-Independent Networks

Abstract: Communication anytime and anywhere is necessary for our modern society to function. However, the critical network infrastructure quickly fails in the face of a disaster and leaves the affected population without means of communication. This lack can be overcome by smartphone-based emergency communication systems, based on infrastructure-independent networks like Delay-Tolerant Networks (DTNs). DTNs, however, suffer from short device-to-device link distances and, thus, require multi-hop routing or data ferries between disjunct parts of the network. In disaster scenarios, this fragmentation is particularly severe because of the highly clustered human mobility behavior. Nevertheless, aerial communication support systems can connect local network clusters by utilizing Unmanned Aerial Vehicles (UAVs) as data ferries. To facilitate situation-aware and adaptive communication support, knowledge of the network topology, the identification of missing communication links, and the constant reassessment of dynamic disasters are required. These requirements are usually neglected, despite existing approaches to aerial monitoring systems capable of detecting devices and networks.

In this dissertation, we, therefore, facilitate the coexistence of aerial topology monitoring and communications support mechanisms in an autonomous Aerial Network Assistance System for infrastructure-independent networks as our first contribution. To enable system adaptations to unknown and dynamic disaster situations, our second contribution addresses the collection, processing, and utilization of topology information. For one thing, we introduce cooperative monitoring approaches to include the DTN in the monitoring process. Furthermore, we apply novel approaches for data aggregation and network cluster estimation to facilitate the continuous assessment of topology information and an appropriate system adaptation. Based on this, we introduce an adaptive topology-aware routing approach to reroute UAVs and increase the coverage of disconnected nodes outside clusters.

We generalize our contributions by integrating them into a simulation framework, creating an evaluation platform for autonomous aerial systems as our third contribution. We further increase the expressiveness of our aerial system evaluation, by adding movement models for multicopter aircraft combined with power consumption models based on real-world measurements. Additionally, we improve the disaster simulation by generalizing civilian disaster mobility based on a real-world field test. With a prototypical system implementation, we extensively evaluate our contributions and show the significant benefits of cooperative monitoring and topology-aware routing, respectively. We highlight the importance of continuous and integrated topology monitoring for aerial communications support and demonstrate its necessity for an adaptive and long-term disaster deployment. In conclusion, the contributions of this dissertation enable the usage of autonomous Aerial Network Assistance Systems and their adaptability in dynamic disaster scenarios.

7.1 Agon Memedi

TU Berlin (advisor Falko Dressler)

Title: Vehicular Visible Light Communications for Connected Autonomous Driving

Abstract: Vehicular Visible Light Communication (V-VLC) has recently emerged as a promising technology for vehicular networking. This technology is based on the concept of using LEDs in modern cars' lighting modules for communication while preserving their illumination functionality. V-VLC has certain characteristics that can complement well RF technologies. The Line Of Sight (LOS) characteristics of VLC, the directionality of the light waves, and the confined collision domain can substantially reduce interference and improve resilience against security attacks on communication. Therefore, combining radio communications with V-VLC can provide reliable communication, as required by various vehicular networking applications. As a new technology, however, V-VLC requires further fundamental research, e.g., on the impact of automotive lighting modules on communication, multi-user interference, and medium access. To that end, in the first part of this thesis, we focus on understanding the characteristics of head- and taillights as V-VLC transmitters. We develop empirical modeling methodologies and describe the validation process based on real-world measurements. Then, we show that the V-VLC link stability is greatly impacted by the road geometry (straight and curved roads) and the cars' arrangement thereon. Additionally, we show that differences in headlights based on vehicle type, model, and lighting function (low beam or high beam) impact communication, despite adhering to the same illumination standards. In the second part of this thesis, we study medium access and address the problem of multi-user interference in V-VLC. We characterize V-VLC interference in a large-scale urban scenario and show that despite the directionality of VLC, multi-user interference presents a challenge in certain situations. To address this challenge, we design a medium access protocol that uses lighting modules as sector antennas. Using the vehicles' positions and beamforming for transmission, we are able to effectively reduce interference. We improve communication by halving the ratio of collisions and increasing the packet delivery ratio.

7.2 Dominik S. Buse

TU Berlin (advisor Falko Dressler)

Title: Towards Holistic Real-time Simulation of Cooperative Vehicles

Abstract: Wireless networking technology can enable future cars to cooperate through Vehicle-to-Everything (V2X) communication, increasing safety, comfort, and efficiency. This heralds a paradigm shift: from isolated entities, primarily interacting through their drivers, to networked elements of smart cities. But this paradigm shift requires new ways to develop and test such interconnected systems. Simulation tools of different domains need to be integrated to provide such a holistic simulation environment. But currently there is a gap between the highly-detailed, real-time testbeds like Hardware-in-the-Loop (HIL) and the large-scale, event-based network simulators for V2X. Our goal is to bridge this gap and combine tools of both domains into a co-simulation. We want to ensure real-time computation of V2X models for the inclusion of physical components or human users. And we aim to push the limits of wireless simulation on modern multi-core processors to enable running larger scenarios in real-time. We present our contributions in three parts: First, we introduce the Ego-Vehicle Interface (EVI), to bridge the gap between simulation tools of different domains into a layered co-simulation. The EVI coordinates the co-simulation and ensures that non-real-time simulators provide results far enough ahead of time for real-time components to run uninterrupted. This enables the combination of real-time systems, such as HIL setups, with large-scale traffic and event-based wireless simulation for V2X applications. Second, we investigate how V2X simulation can be ensured to run within these real-time bounds when focusing on an ego vehicle. By identifying and dynamically selecting the relevant set of neighboring vehicles, we demonstrate how to reduce the simulation to indispensable elements and limit compute time. And through simulation studies we explore the limits of the scale current hardware can process in real-time. Third, we expand these limits by improving the performance of V2X simulation through the utilization of modern multi-core processors with a new parallelization technique. As classical techniques do not perform well on the shared wireless channel, we instead focus on isolating and offloading expensive computation tasks like signal processing to background threads. In an in-depth case study using the state-of-the- art V2X simulator Veins, we describe how we identified potentials, implemented our parallelization concept, and thoroughly investigated the resulting parallel performance.

7.3 Taylan Şahin

TU Berlin (advisor Adam Wolisz)

Title: Resource Allocation for Vehicle-to-Vehicle Communications under Intermittent Cellular Coverage

Abstract: Vehicle-to-vehicle (V2V) communication is a key technology to enable safer, more efficient, and more comfortable road traffic. The stringent reliability and latency requirements of V2V messages necessitate efficient radio resource management given the scarce spectrum and the dynamic vehicular environment. Under cellular network coverage, the resource allocation can be centrally coordinated by a base station (BS), which can efficiently ensure collision-free transmissions. When out of coverage, vehicles resort to distributed mechanisms, which yet suffer from degraded communication quality due to the vehicles' limited local view. In this thesis, we propose a novel approach for V2V communications in expected, delimited out-of-coverage areas (DOCAs), whereby a centralized scheduler pre-assigns resources to the vehicles via the BSs surrounding the area, before vehicles enter it. We first explore the feasibility of this approach by exploiting the road and data traffic information available in coverage to reserve and provision the resources. While the required number of resources does not grow prohibitively with increased reliability targets, the rate of successful V2V transmissions gets highly impacted by various factors such as vehicle mobility, thus necessitating efficient means to cope with uncertainties in DOCAs. As a predictive method for resource allocation, we propose a vehicular reinforcement learning scheduler, VRLS, which is applicable to DOCAs that vary in vehicle density, mobility, wireless channel characteristics, and resource configurations. VRLS can significantly increase resource utilization efficiency by requiring fewer resources than state-of-the-art distributed scheduling solutions to support the same reliability targets. Nevertheless, considering that the performance of learning-based solutions may degrade upon parameter distributions much beyond their training environment, we propose a hybrid scheme that combines the centralized RL-based and the distributed sensing-based scheduling approaches. We show the performance benefits of such a solution under heavily congested road traffic due to an accident, as compared to either of the centralized or the distributed solutions. Finally, we shift our focus to those areas under network coverage where vehicles suffer from rather short and unpredictable coverage interruptions to the BSs. We consider an extension of our RL-based approach for this problem. The proposed solution performs better than the state-of-the-art baseline in the cases of coverage losses, especially under high traffic load and lower frequency of scheduling updates, otherwise delivering similar performance.

KuVS Newsletter

Helge Reelfs

Brandenburg University of Technology (advisor Oliver Hohlfeld)

Title: Content & user behavior in anonymous hyperlocal online platforms

Abstract: Nowadays day-to-day digital communication and social life has only fortified with the ongoing pandemic. People enjoy communication and information across various (direct) messaging platforms and accepted its ever-increasing impact on public discourse and society. While traditional platforms implement user profiles enabling social credit, the landscape also includes anonymity. Yet, a new type of application combining anonymity with a strong spatial focus, hyperlocality, emerged over recent years. To this point, platform implications of both uniquely combined design properties largely remain unknown.

In this thesis, we provide a first data-driven holistic view on Jodel that combines both properties. We leverage unbiased complete ground truth information to dissect a plethora of communities across two different countries: Germany and the Kingdom of Saudi Arabia. This work follows a platform perspective identifying four major essentially important areas revolving around the individual.

That is, we begin with a broad analysis of three User Adoption processes along three different applications. After discussing our measurements of the user base adoption of the German COVID-19 digital contact tracing application, we provide evidence of well-established platforms being re-purposed as a side channel to evade censorship in the ongoing Russo-Ukrainian hybrid war. We further showcase that the very same platform ingredients may yield vastly different outcomes on the messaging app Jodel. While any online platform builds upon User Interactions, we structurally characterize Jodel behavior across both countries. We discuss structural disparities and detail platform implications - solely induced by local user behavior. An in-depth look into the Saudi community landscape closes a research gap to platform usage in a different society, identifying differences.

Further, we discuss User Content analyzing information diffusion. Taking content to the next level, we developed a multidimensional classification scheme for intents (why) and topics (what) of social media messages and provide details of a crowdsourced campaign for Saudi Arabian contents. With neural word embeddings as a tool for making text tangible and the prevalence of emoji in social media communication, we discuss quantitative and qualitative insights to word-emoji embeddings reflecting semantics. Additionally, we make such embeddings interpretable and provide evidence that our method is well in line with human judgement.

In terms of User Management, we detail insights to distributed moderation processes and model the threat of abusive content. In the long term, platforms need to establish a sustainable, preferably growing, environment. That is, we next discuss user lifetime and possibly early churn factors, while modeling user lifetime from metadata. We finish with a blueprint of data-driven long-term quality of experience analyzes in a controlled massively multiplayer online game (MMOG) environment.

KuVS Newsletter

Project News

DAAD Network of Excellence in Advanced ICT for Tropical Medicine

Anna Förster
University of Bremen

Together with our main partner Mahidol University in Thailand, last year we started a new DAAD project in Advanced ICT for Tropical Medicine. Our main objectives are to contribute to several of the SDGs and to strengthen the role of Mahidol University as the main research hub in Tropical Medicine in South-East Asia. In this project, we develop prototypes and services for various medical and public health problems, ranging from ICT assisted dengue diagnosis and case monitoring to automatic mosquito counting for vector control. Just recently in may 2023, we held our yearly workshop and summer school in Bangkok, with guests from Thailand, Vietnam, Philippines, Kenya, Sudan, France, Germany, and Cameroon. More information about our growing network and its activities can be found here: ict-trop-med.net

ICC'2023 Workshop on Green and Sustainable Networking (GreenNet 2023) Report

Frank Loh, Tobias Hoßfeld (University of Würzburg)

The "2nd International Workshop on Green and Sustainabile Networking (GreenNet 2023)" took place in Rome on 28 May 2023 and 1 June 2023, co-located with the IEEE International Conference on Communications (ICC). The focus of GreenNet is on emerging concepts and challenges on reducing the energy consumption, improving the energy efficiency and ultimately the sustainability of communication networks and networked services.

Energy efficiency and sustainability have become of paramount importance in all human activities. Regarding ICT, it has been long recognized that its impact on helping to reduce the carbon footprint of other activities can be significant; then, it would be odd if the same principle would not apply to ICT itself. In particular, computing, communications and networking are relevant activities in this context, whose impact is non-negligible. The concept of Green Computing and Networking is currently gaining additional momentum with the growth in the number of networked applications in all vertical sectors, in the number of users and in the amount of traffic they generate. The pervasiveness of mobile networks in 5G and their evolution toward 6G, the spreading of edge computing and microdata centers and the demand in computational and data transport capacity across the edge-cloud continuum are all factors that further contribute to making energy efficiency a fundamental aspect of future networks.

The 2nd International Workshop on Green and Sustainable Networking (**GreenNet 2023**) was the second version of the successful 1st International Workshop on Network Energy Efficiency in the Softwarization Era (GreenNet 2022), which was co-located with the IEEE International Conference on Network Softwarization (NetSoft 2022) in Milan. The goal of the GreenNet Workshop was to address emerging concepts and challenges related to energy efficiency and sustainability for networked services, by pursuing sustainability in the context of ongoing developments such as Low-Power Wide Area Networking technologies like LoRaWAN, 5G, and with 6G also beyond. One core aspect was on advanced traffic and power models, as well as programmable and flexible management and control strategies. The balance between sustainability in terms of energy efficiency, performance and QoE was within the focus. Monitoring methods and metrics for power consumption, energy efficiency, as well as sustainability are key aspects. These topics have received a good deal of attention lately. However, much research work still needs to be done, especially to integrate sustainability in its different facets. A lively exchange of ideas between academia and industry during GreenNet 2023 will foster the adaption of the ideas.

The **GreenNet workshop** solicited submission of high-quality, original scientific papers presenting novel research on green and sustainable networking. In total, 53 papers were submitted and went through a single-blind review process. For all papers, at least 3 expert reviews were retrieved, on average 3.4 reviews per paper. In total, 147 reviews were obtained from the 39 TPC members and the six organizers. The TPC chairs are truly thankful for this excellent technical program committee delivering the reviews on time. As a result, 23 out of 54 full papers have been accepted for oral presentation during the workshop, leading to an acceptance rate of 44%.

The workshop took place on two days for oral presentations of the accepted papers. The program was structured into six sessions, each session starting with a keynote, expert, or industry talk. Research questions on the following topics have been answered during the workshop:

1. ***Edge computing and serverless computing for cloud deployment*:** How to split the workload among containers in an edge device to save energy and time? How to model intermittent communication and computing of battery-less edge computing? How to model the performance and energy consumption of serverless computing? How to optimize resources in multiple edge cloud networks with asynchronous computing? In particular, Simon Fletcher gave an invited expert talk on small cells and their potential and challenges in terms of energy efficiency and sustainability.
2. ***Sensor networks and the Internet of Things***: Stefan Wunderer started the session with an expert talk on sustainability discussion energy efficiency but also total energy consumption. The oral papers addressed the following questions: How to design and implement a light-based IoT node on a system-on-chip? How to place gateways in LoRaWANs considering coverage, message collision probability and energy efficiency? How to develop and parameterize a duty cycle in software defined wireless sensor networks, considering reliability and resilience? What is the energy consumption of NB-IoT and LTE-M of commercial network operators?
3. ***5G and 6G networks*:** Chiara Lombardo gave a keynote on the 6Green project. The 6Green project is one of the flagship projects researching potentials and challenges in future 6G. There, especially energy consumption and sustainability are two major topics. Afterward, the workshop paper presentations took place discussing the following questions: How to model the power consumption of 5G advanced base stations? How to analyze the power consumption in cloud-native 5G/6G ecosystems? What are sleep mode strategies for energy efficient cell-free massive MIMO in 5G deployments?
4. ***Wireless technology and networks*:** The session was opened by an expert talk of Ahmad Qidan talking about spectral and energy efficiency in 6G optical wireless communication. Then, the four technical paper presentations discussed the following research questions: Can path loss modeling be utilized to predict energy efficiency in sub-6GHz radio access networks using Kriging methods? Can power auction and bidding be successfully utilized for multiple access wireless relay communications? How to allocate resources and select relays in wireless powered FD relay networks with imperfect CSI? How to utilize the communication airtime to reduce energy consumption of WIFI access points?
5. ***Sustainability*:** The second workshop day started with a keynote talk by Esteban. The talk of the title was towards a 6G embedding sustainability, where the author presented insights on this topic

from the view of the large European 6G flagship project Hexa-X. In the session, the following research questions were discussed by the technical presentations. Can a cellular network be used in a more energy-efficient way by using renewable energy for base stations and dynamically turning them on and off? Can video streaming energy efficiency be improved by asking users to stream smaller quality? How to better allocate resources with VLC with energy harvesting?

6. ***Energy consumption and efficiency**:* The last session of the workshop started with an expert talk by Chadi Khirallah about standardization of 5G and towards 6G. The technical presentations in this session covered the following research questions. What is a reasonable way to offload computation from android devices to the edge or the cloud? What is the benefit of having a different number of ports in devices in the backbone network from a power consumption point of view? How can we compare SWIPT techniques for zero-energy RIS? Can investigate interference and energy efficiency of MIMO transmitters using beamforming and do we need to re-think old deployments in future 6G?

The GreenNet 2023 contributions have shown that the research mainly focuses on energy consumption and energy efficiency. The broader topic of sustainability is seen as important future work, and the expert talks addressed relevant aspects like lifecycle analysis. We hope to see such future work in the **next edition of the GreenNet** workshop.

Finally, we would like to thank all authors of submitted and accepted papers, the TPC members and reviewers, our keynote speakers Chiara Lombardo and Esteban Selva and the invited expert speakers Simon Fletcher, Stefan Wunderer, Ahmad Qidan, and Chadi Khirallah. Furthermore, we thank all presenters of the papers and all attendees for your efforts and interesting discussions. We also thank the ICC organization team and especially Davide Dardari, Chengjun Sun, and Angela Yingjun for the smooth workshop organization.

They all together made **GreenNet 2023 a big success**!

The GreenNet 2023 organizers Frank Loh, Franco Davoli, Hesham ElBakoury, Roberto Bruschi, Timothy O'Farrell, Tobias Hoßfeld

KuVS Newsletter

Next Newsletter - Deadline November 15th

Next newsletter : 12/2023

Deadline for submissions and contributions : 15th November 2023

We ask you for submissions in English. Topics can be from the following time frame: June 2023 - December 2023

- Fachgruppe KuVS
  - Geschäftsberichte der GI – KuVS – Fachgruppe
  - ...
- News from the working groups
  - Dissertations
  - Awards
  - News form persons
  - Open positions
  - ...
- New projects (DFG, BMBF, KMU, etc.)
  - Initiatives
  - Larger projects
  - ...
- Calls and news from events, conferences, etc.
  - Reports (Conferences, workshops, Fachgespräche, Dagstuhl, doctoral summer/winter schools, ...)
  - Call for papers and participation
    (conferences (supported by or hosted in Germany/Austria/Switzerland), Fachgespräche, Summer Schools, ...)
  - ...
- Announcements and important dates

The preferred submission format is text, e.g., using markdown language. Call for papers can also be submitted as PDFs.

Submissions should be done by sending emails to the editors:

mailto:oliver.hohlfeld@b-tu.de mailto:mathias.fischer@uni-hamburg.de

mailto:corinna.schmitt@unibw.de mailto:andreas.blenk@tum.de