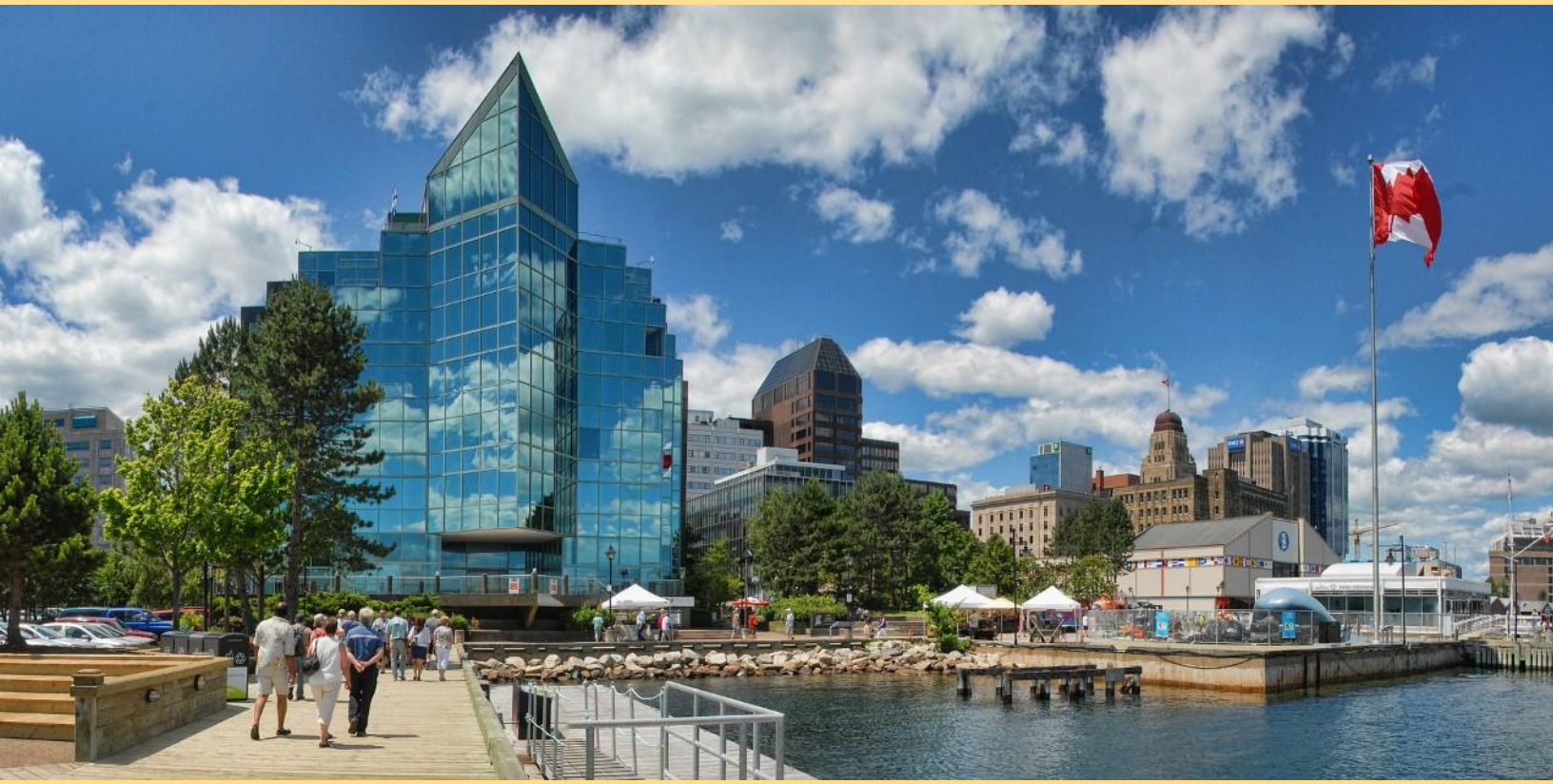
15th International Conference on Network and Service Management

Halifax, Canada // 21-25 October 2019



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8:30 - 17:00	Registration (Regency Ballroom)								
9:00 - 10:30	Big Data Event	Mini-Conference MC1	AnServApp Workshop	Tutorial 1 Cybersecurity	Welcome Speech Keynote 1 Keynote 2	Technical Session TS3	Technical Session TS6	NOMS 2020 Meeting	HipNet/SR+SFC Workshop
10:30-11:00	Coffee Break (Regency Ballroom)								
11:00-12:30	Big Data Event	Mini-Conference MC2	AnServApp Workshop	Tutorial 1 Cybersecurity	Technical Session TS1	Keynote 3 Keynote 4	Keynote 5 Keynote 6	NOMS 2020 Meeting	HipNet/SR+SFC Workshop
12:30-13:30	Lunch (Regency Ballroom)								
13:30-15:00	Big Data Event	Mini-Conference MC3	AnServApp Workshop	Tutorial 2 Blockchain	Technical Session TS2	Technical Session TS4	Technical Session TS7	NOMS 2020 Meeting	HipNet/SR+SFC Workshop
15:00-15:30	Coffee Break (Regency Ballroom)								
15:30-17:00	Big Data Event	Mini-Conference MC4	AnServApp Workshop	Tutorial 2 Blockchain	Poster Session PS1 (Regency)	Technical Session TS5	DEP + Closing Ceremony	NOMS 2020 Meeting	HipNet/SR+SFC Workshop
17:00-17:45					CNOM/IFIP WG6.6 Meeting (Britannia)				
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MESSAGE FROM GENERAL CHAIRS

We welcome you to the 15th International Conference on Network and Service Management (CNSM 2019), held on 21-25 October 2019 in Halifax, Canada. On behalf of the CNSM 2019 Organizing Committee, we would like to express to all participants our sincere and warm welcome to Halifax!

CNSM is a premier venue for the presentation of novel results and ongoing reports in all aspects of management of networks and services. CNSM 2019 is technically co-sponsored by the IEEE Communications and Computer societies, and IFIP, and is organized in cooperation with the ACM. We are grateful to our industry sponsors: 2Keys, Cisco, GoSecure, Juniper, and Moogosoft; our academic partners: Dalhousie University and the University of Western Ontario; and our partners from the federal government: MITACs, the city of Halifax and province of Nova Scotia: Digital Nova Scotia, Discover Halifax, and Murphy's.

We are proud to continue CNSM's tradition of an exciting program that starts with mini-conference papers, an exciting workshop on analytics for service and applications management, a tutorial on cybersecurity and a tutorial on blockchain on the first day, followed by three days of a single track consisting of keynotes, technical paper sessions, poster sessions, and a panel of distinguished experts. Our last day of the conference ends with a workshop on cutting edge network technology.

CNSM takes place in the Lord Nelson Hotel, which was named after England's greatest navel hero: Horatio Nelson and hosted famous guests like the Rolling Stones, Paul McCartney and Jerry Seinfeld. The downtown location is close to historical landmarks and great food.

It has been an honor serving as the CNSM 2019 General Co-chairs and being able to work with a great team of people including our TPC Co-Chairs, Nur Zincir-Heywood and Remi Badonnel; Keynote Co-Chair, Alexander Clemm; Distinguished Experts Panel Co-Chair, Rolf Stadler; Workshop Co-Chairs, Marinos Charalambides and Jin Xiao; Publicity Co-Chairs, Paulo Simoes, Young-Tak Kim, Michele Nogueira and Mohamed Faten Zhani; Publication Co-Chair, Edmundo Madeira; Technical Sponsor Co-Chair, Lisandro Zambenedetti Granville; Student Travel Grant Co-Chairs, Marc-Oliver Pahl and Noriaki Kamiyama; Patron Co-Chairs, Noura Limam and Anwar Haque; Finance Co-Chair, Anne Publicover; Local Arrangement Co-Chair, Khurram Aziz; Webmaster Co-Chair Carlos Raniery Paula dos Santo. Special thanks go to our local team from Dalhousie University, Nur Zincir-Heywood, Khurram Aziz, Anne Publicover, and all of our student volunteers.

Hanan Lutfiyya and Yixin Diao
CNSM 2019 General Co-Chairs

MESSAGE FROM TPC CHAIRS

It is our pleasure to welcome you to Halifax, Nova Scotia, Canada, for the 15th edition of the International Conference on Network and Service Management (CNSM 2019).

While this year's conference continues the CNSM tradition of being a leading single-track venue for the presentation of innovative research on all aspects related to network and service management, pervasive systems, enterprises, and cloud computing environments, CNSM 2019 also focuses on the theme "Embracing the New Wave of Artificial Intelligence". The core track is accompanied by a series of poster sessions, workshops and tutorials.

We received 127 submissions from all over the world. The papers were reviewed by an excellent program committee with 104 members drawn from industry and academia as well as many additional reviewers. All submitted papers underwent a rigorous review process with at least three reviews for every paper and a rebuttal phase. Out of the 127 papers submitted, 21 were accepted as regular papers - a very competitive acceptance ratio of 16.5%. Due to the high quality of the submitted papers, many good papers could not be selected to the main technical conference. The 19 best such papers were selected for the Mini-Conference program. In addition, 33 short papers will be presented in one poster session. Major topics covered this year include: Software Defined Networks, 5G and New Generation Networks, Data Center and Cloud Management, Performance Management and Quality of Experience, Anomaly and Change Management, Security Management, and Machine Learning and Artificial Intelligence.

The conference program also features six outstanding keynote talks from Prof. Xue Steve Liu (McGill University, Canada), Prof. Gabi Dreo Rodosek (Bundeswehr University, Germany), Prof. Jiasi Chen (University of California - Riverside, USA), Dr. Richard Li (Futurewei, USA), Prof. Alberto Leon-Garcia (University of Toronto, Canada), and Prof. Stan Matwin (Dalhousie University, Canada). The technical program ends with a Distinguished Experts Panel, organized by Prof. Rolf Stadler (KTH Royal Institute of Technology, Sweden), which will discuss the increasingly important subject “ML/AI as Enabler for Network Engineering and Operation”.

We hope that you find the program interesting and stimulating. It has been a privilege to organize this event. Enjoy CNSM 2019 and the beautiful city of Halifax 😊

Nur Zincir-Heywood and Rémi Badonnel
CNSM 2019 Technical Program Co-Chairs

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Nur Zincir-Heywood (Dalhousie University, Canada)
Thomas Zinner (TU Berlin, Germany)

KEYNOTES

Tuesday, 22 October 2019

Keynote Session 1
9:00 – 10:30 • Imperial Ballroom

Title: AI for Systems, Systems for AI
Speaker: Xue (Steve) Liu, McGill University, Montreal, Canada

***Bio**:* **Dr. Xue Liu** is a Full Professor and a William Dawson Scholar in the School of Computer Science at McGill University. He is also a VP RD, Chief Scientist, and Co-Director of the Samsung AI Montreal. Before that, he served as the Chief Scientist at Tinder Inc. from 2016 to 2019, leading the research and innovation for the world's largest dating and social discovery app valued over 10 Billion US$. Dr. Liu received his Ph.D. in Computer Science with multiple distinctions from the University of Illinois at Urbana-Champaign. His research interests are in computer systems and networks, AI and machine learning, IoT, and sustainability. He has published over 300 research papers in major peer-reviewed international journals and conference proceedings and received several best paper awards. Dr. Liu's research has been reported by news media including the New York Times, IDG/Computer World, The Register, Business Insider, Huffington Post, CBC, NewScientist, etc. Dr. Liu is a recipient of several awards including the Mitacs Award for Exceptional Leadership – Professor from MITACS, Tomlinson Science Award from McGill University, and Outstanding Young Canadian Computer Science Researcher Prizes from the Canadian Association of Computer Science. He is serving or has served on the editorial boards of ACM Transactions on Cyber-Physical Systems (TCPS), IEEE/ACM Transactions on Networking (ToN), IEEE Transactions on Parallel and Distributed Systems (TPDS), IEEE Transactions on Vehicular Technology (TVT), and IEEE Communications Surveys and Tutorials (COMST). He has severed on the organizing committees of over 40 major international conferences and workshops, including ACM/IEEE CPS-IoT Week, ACM/IEEE ICCPS, ACM e-Energy, ACM SenSys, IEEE RTSS, IEEE RTAS, IEEE INFOCOM and received several service awards.

Abstract: Recent years witnessed the successful resurgence of artificial intelligence. Deep learning and other machine learning methods have brought amazing breakthroughs in many areas, including computer vision, speech recognition, and natural language processing. Artificial intelligence has become a disruptive technology in the information era. In this talk, I will discuss the interaction of AI and system research. I will use a few recent examples to demonstrate that they are crucial in advancing each other: On the one hand, AI techniques are particularly useful to solve challenging problems in systems and network management; On the other hand, we need to improve the current system solutions and even design and build new systems to make AI more effective and efficient. Finally, I argue that the positive cycle of advancing AI and the underlying systems that support it will lead to highly autonomous and intelligence systems for the future.

Keynote Session 2
9:00 – 10:30 • Imperial Ballroom

Title: AI and Machine Learning: Taking Network and Service Management to the Next Level?
Speaker: Gabi Dreo Rodosek, Bundeswehr University Munich, Germany

***Bio**:* **Gabi Dreo Rodosek** is the Executive Director of the Research Institute CODE (Cyber Defence) and holds the Chair for Communication Systems and Network Security at the Bundeswehr University Munich. She is the coordinator of the EU project CONCORDIA, member of the Digital Council of the German Ministry of Defence, member of the the Supervisory and Advisory Board of Giesecke & Devrient GmbH, member of the Advisory Board of the BWI GmbH, member of the Advisory Board of the Siltronic AG and member of several other boards. In 2016 she was awarded the European Medal from the Bavarian Minister for European Affairs and International Relations.

Abstract: The evolvement of AI, resp. machine learning is constantly changing the dynamics of cybersecurity. AI has the potential to accelerate the volume of attacks and allow to enhance attackers' abilities to preserve anonymity. AI-enabled technology has the potential to create new opportunities for attackers to infer with critical business processes. The asymmetry of the attack -- defenders need to stop all attacks, while attackers need to exploit just one vulnerability -- needs to be changed. The keynote addresses challenges and research areas that need to be addressed with an AI-enabled technology in the area of cybersecurity to be able to master the ever-changing cyberthreat landscape.

KEYNOTES

Wednesday, 23 October 2019

Keynote Session 3
11:00 – 12:30 • Imperial Ballroom

Title: Mobile AR/VR with Edge-based Deep Learning
Speaker: Jiasi Chen, University of California, Riverside, USA

***Bio**:* **Jiasi Chen** is an Assistant Professor in the Dept. of Computer Science & Engineering at the University of California, Riverside. She received her Ph.D. from Princeton University and her B.S. from Columbia University, with work experience at AT&T Labs Research and NEC Labs America. Her research interests include edge computing, wireless/mobile networks, and multimedia networking, with a recent focus on machine learning at the network edge to aid AR/VR applications. She is a recipient of the Hellman Fellowship and the UCR Regents Faculty Fellowship.

Abstract: Augmented and virtual reality (AR/VR) are at the frontier of mobile computing. While AR/VR applications are gaining popularity today, the technologies to support these applications are far from mature. This talk will first outline the current state of mobile AR/VR platforms, including what functionality is currently available, what is needed/desired, and how edge computing can support the low latency and high bandwidth requirements of AR/VR. Next, the talk will discuss the role of deep learning to support AR/VR through two examples: object detection for AR, and user behavior prediction for VR, along with their associated systems, control, and management challenges. Finally, the talk will conclude with future directions for networked AR/VR.

Keynote Session 4
11:00 – 12:30 • Imperial Ballroom

Title: Network 2030 and New IP
Speaker: Richard Li, Futurewei, Santa Clara, USA

***Bio**:* **Dr. Richard Li** is Chief Scientist and Vice President of Network Technologies at Futurewei Technologies Inc., Huawei R&D USA. Richard also serves as the Chairman of the ITU-T FG Network 2030 and as the Vice Chairman of the European ETSI ISG NGP (Next-Generation Protocols). Prior to joining Futurewei in late 2007, he worked with Cisco and Ericsson in the field of networking technologies, standards, solutions and operating systems. Richard is extremely passionate about advances in data communications and solving problems in their entirety, thus creating a bigger and long-term impact on the networking industry. During his career, Richard spearheaded network technology innovation and development in Routing and MPLS, Mobile Backhaul, Metro and Core Networks, Data Center, Cloud and Virtualization. He holds 50+ US patents granted and 80+ US patents pending. Currently he leads a department of scientists and engineers to develop technologies for next-generation network architectures, protocols, algorithms, and systems in the support of forward-looking applications and industry verticals that are expected to bring the digital society to a higher level.

Abstract: Recent years have witnessed gradual architectural and infrastructural evolution in internetworking technology. Future applications will require advanced mechanisms such as high-precision communications and holographic type communications, which will stretch current technology beyond its limits. This talk analyzes the current Internet's constraints and limitations. It subsequently identifies new underlying design principles, defines a set of new network layer services, and outlines a new framework for a new network layer protocol that extends IP in order to evolve an essentially best-effort network to a high-precision one. This new network layer protocol will power the next wave of future networking applications and various vertical industries. The talk will also touch on related ramifications, challenges, and opportunities for network and service management.

KEYNOTES

Thursday, 24 October 2019

Keynote Session 5

11:00 – 12:30 • Imperial Ballroom

Title: The Role of Machine Learning in Network Automation
Speaker: Alberto Leon-Garcia, University of Toronto, Canada

***Bio**:* **Alberto Leon-Garcia** is Professor in Electrical and Computer Engineering at the University of Toronto. He is a Fellow of the Institute of Electronics an Electrical Engineering "For contributions to multiplexing and switching of integrated services traffic". He authored the textbooks: Probability and Random Processes for Electrical Engineering, and Communication Networks: Fundamental Concepts and Key Architecture. Leon-Garcia was Founder and CTO of AcceLight Networks in Ottawa from 1999 to 2002. He was Scientific Director of the NSERC Strategic Network for Smart Applications on Virtual Infrastructures (SAVI), and Principal Investigator of the project on Connected Vehicles and Smart Transportation. SAVI has designed and deployed a national testbed in Canada that converges cloud computing and software-defined networking. CVST has designed and deployed an application platform for smart transportation. Leon-Garcia is Founder and CEO of StreamWorx.ai which offers massive-scale real-time streaming, analytics, and machine learning for network operations and cybersecurity applications.

Abstract: The softwarization of networks provides the flexibility and agility for automating networks to deal with the complexity and to reduce the cost of delivering an increasingly complex portfolio of applications. In this talk we consider the role of machine learning in network automation. In particular, we consider the role of ML in the variety of MAPE-K loops that are required to monitor, analyze, plan, and execute resource control actions to deliver the enabling network services in support of applications. We examine the design, placement, and implementation of machine learning within these loops in network automation, and we discuss several open problems.

Keynote Session 6

11:00 – 12:30 • Imperial Ballroom

Title: Big Data in Network and Service Management: An Opportunity for Synergy
Speaker: Stan Matwin, Dalhhousie University, Canada

***Bio**:* **Stan Matwin** is the Professor and Canada Research Chair (Tier 1), and the Director of the Institute for Big Data Analytics at Dalhousie University, Canada. Internationally recognized for his work in Machine Learning and Artificial Intelligence, he has authored and co-authored more than 300 refereed papers, supervised more than 70 graduate students, and taught Data Science on four continents. He is the Coordinator for the Applications Area of the Springer Encyclopedia of Machine Learning, and one of the founders of Ocean Data Science Inc., a new Canadian start-up. He is a Fellow of the European Coordinating Committee for AI, a Fellow of the Canadian AI Society (CAIAC), and a recipient of the CAIAC Lifetime Achievement Award.

Abstract: We will present briefly the history and the major dimensions of Big Data: Volume, Velocity, Variety and Veracity. We will ground that discussion with some examples of current work at the Institute for Big Data Analytics at Dalhousie University. We will outline developments in Big Data areas particularly relevant to the theme of the conference, i.e. stream data management and data analysis of spatio-temporal data. We will then discuss examples the impactful use of Big Data and Machine Learning techniques in network operations and management (OaM), specifically in traffic prediction and resource management, including QoS management. We will illustrate some of the current advances in promising data compression methods, relevant for data sharing with privacy constraints. We will round up the talk with some early thoughts about the use of bitchain technologies in OaM and about future research opportunities at the intersection of Data Science and Network and Service Management.

DISTINGUISHED EXPERTS PANEL

Thursday, 24 October 2019

15:30 – 17:00 • Imperial Ballroom

Title: ML/AI as Enabler for Network Engineering and Operation
Speaker: Rolf Stadler, KTH Royal Institute of Technology, Sweden

***Bio**:* **Rolf Stadler** is a professor at KTH Royal Institute of Technology in Stockholm, Sweden, and head of the Division of Network and Systems Engineering. He holds an M.Sc. degree in mathematics and a Ph.D. in computer science from the University of Zurich. Before joining KTH in 2001, he held positions at the IBM Zurich Research Laboratory, Columbia University, and ETH Zürich. His group made contributions to real-time monitoring, resource management, and self-management for large-scale networked systems. His current interests include intelligent monitoring techniques and data-driven methods for network engineering and management. Rolf Stadler has been Editor-in-Chief of IEEE Transactions on Network and Service Management (TNSM) 2014-2017.

Abstract: Methods and concepts from machine learning, and artificial intelligence more generally, are being applied in an increasing number of fields from medicine to economics. The panel discusses the implications of this general trend for the topic area of this community. We will discuss questions such as “which problems in Network Engineering and Operation can we address using these methods; what are the potential drawbacks; which data can we use to create predictive models and where/how do we process the data; what standards are needed to facilitate research and development?

PANELISTS:
Jiasi Chen, University of California - Riverside, USA
Alberto Leon-Garcia, University of Toronto, Canada
Richard Li, Futurewei, USA
Stan Matwin, Dalhousie University, Canada

TUTORIALS

Monday, 21 October 2019

TUTORIAL 1: CYBERSECURITY
9:00 – 12:30 • Vanguard Room II

Title: Development of a Production Ready Data Analytics Pipeline for Real-time Threat Detection
Speaker: Jeff Schwartzentruber, 2Keys Corporation, Canada

Abstract: The increase in digitization and security threats has resulted in the increased demand for systems that are capable of handling large amounts of streaming data, with advanced analytics capabilities and low latency. Participants will first be given an introduction into the current threat landscape and modern approaches to detecting cyber-attacks. This tutorial will give viewers an understanding of the system requirements and an overview of a predominate modelling technique (anomaly detection) used in the cyber-security space. The goal of this tutorial is to provide an in-depth understanding of how to develop and implement a distributed monitoring solution, using open source software, and the theory behind anomaly detection using Bayesian methods.

Dr. Jeff Schwartzentruber holds the position of Principal Data Scientist and Research Lead at 2Keys Corporation. Dr. Schwartzentruber received his PhD in Mechanical Engineering from Ryerson University with a focus on analytical process modelling and is a fellow of the Ontario Centre of Excellence. In his role at 2Keys, Dr. Schwartzentruber is responsible for the continued development, innovation and leadership of machine learning and data science capabilities at the intersection of identity and access management, advanced threat analytics and response, and managed security services. Jeff's research interests include machine learning (particularly deep learning and boosted trees), real-time anomaly detection, and analytical/semi-empirical model development for security and business applications.

TUTORIAL 2: BLOCKCHAIN
13:30 – 17:00 • Vanguard Room II

Title: Blockchains for Industrial IoT - solutions, use-cases, and network management issues
Speakers: Pal Varga, Budapest University of Technology and Economics, Hungary
Ferenc Nandor Janky, Budapest University of Technology and Economics, Hungary

Abstract: Utilizing Blockchains within the Internet of Things (IoT) concept is quite a recent idea. There are already a number of use cases and supporting frameworks available, which shows its potential benefits for many domains. There are interesting, business-driven target areas within the Industrial IoT domain, including sectors such as supply chain (including manufacturing, transportation and logistics), maintenance, energy trading, grids, and even healthcare. When compared to consumer IoT, these systems have special requirements: certain level of real-time, security, engineering complexity, multi-stakeholder visibility, fast transaction and asset traceability. While the Distributed Ledger Technology (DLT) already addresses some areas of these (such as multi-stakeholder visibility or asset traceability), Blockchain Technology (BCT) provides additional value for security, building trust, and reducing cost while accelerating transactions of service agreements. This tutorial aims to reveal the opportunities and challenges as well as presenting real-life examples together with network management aspects. First it provides an overview and definitions the BCT universe – from Assets and Blocks through Consensus Mechanisms and Distributed Ledgers to Wallets. Next, it describes some special requirements of the Industrial IoT domain together with ideas of utilizing BCT to cover these needs. While discussing benefits, the tutorial reveals some drawbacks as well. These help us answering the questions: when is it beneficial to use BCT, when is it questionable, and when is it avoidable? Furthermore, the tutorial provides insights on various use-cases of employing BCT and smart service contracts in healthcare, electricity trading, production, asset tracking or proactive maintenance. Aside from being interesting simply because they are becoming core technologies of near-future systems, IIoT and Blockchains have a network management viewpoint as well. The IIoT end-devices need on-boarding, their data needs to be secured, authenticity needs to be checked, and trust needs to be built – all of which tasks BCT can be utilized effectively. Moreover, as part of configuration management, reliable and secure firmware distribution and upgrade can be supported inherently. Regarding implementations, instead of the well-known Blockchains that are used as cryptocurrencies (e.g. Bitcoin, Ethereum, etc.), this tutorial presents other realizations, such as IoTcoin, IOTA, or HDAC, which are targeting IIoT applications. The practical part of the tutorial will include the following parts: Implementing a simple smart-contract based distributed application to reinforce concepts learned on BlockChains and to introduce a selected distributed application framework with its programmer's interface. Creating a more complex distributed smart-contract based solution for modelling product life-cycle in IIoT setting using the framework introduced. Performing simulation by adding IIoT actors to the system and executing measurements on throughput, convergence time, latency, computational requirements on end devices etc. Analyzing the measurement results and implementing potential system tweaks for the IoT use case and verifying that with a subsequent measurement.

TUTORIALS

Pal Varga holds an associate professor position at Budapest University of Technology and Economics (BME), where he teaches various subjects, including "IoT frameworks and industrial applications", partially covering the topic of the current tutorial. Beside being active in the network and service management research community, he works on the Industrial IoT field, as well. His research covers IoT frameworks, interoperability and integrability issues, heterogeneous IoT systems, protocol translation, service oriented architectures, Industrie4.0 use-cases IoT security, IoT lifecycle management, smart service contracts, and Blockchains for IIoT. He is currently the Editor-in-Chief of the Infocommunications Journal, published by the Scientific Association for Infocommunications, Hungary (HTE), a Sister Society of IEEE.

Ferenc Nandor Janky is a PhD student at Budapest University of Technology and Economics (BME) where his thesis research topic is around process and life-cycle modelling in Industrial IoT frameworks. He graduated with a Master's in Electrical Engineering from BME with a specialization in Incofommuncation Systems in 2013. He has several years industrial experience gained at various telecommunications companies like Vodafone, AITIA International Inc., Ericsson. Beside of the PhD studies he is currently working in the financial industry developing low-latency trading applications.

TECHNICAL SESSIONS

Tuesday, 22 October 2019

TS1: Machine Learning and Artificial Intelligence

Session Chair: Alexander Clemm

11:00 – 12:30 • Imperial Ballroom

Q-DATA: Enhanced Traffic Flow Monitoring in Software-Defined Networks applying Q-learning
Trung V. Phan (Technische Universität Chemnitz, Germany); Syed Tasnimul Islam (Chemnitz University of Technology, Germany); Tri Gia Nguyen (Duy Tan University, Vietnam); Thomas Bauschert (Chemnitz University of Technology, Germany)

Flow-based Throughput Prediction using Deep Learning and Real-World Network Traffic
Christoph Hardegen, Benedikt Pfülb and Sebastian Rieger (Fulda University of Applied Sciences, Germany); Alexander Gepperth and Sven Reissmann (University of Applied Sciences Fulda, Germany)

ADAM & RAL: Adaptive Memory Learning and Reinforcement Active Learning for Network Monitoring
Sarah Wassermann (AIT Austrian Institute of Technology, France); Pedro Casas (Austrian Institute of Technology (AIT), Austria); Pavol Mulinka (Czech Technical University in Prague, Czech Republic); Thibaut Cuvelier (Orange Labs, Centrale Supelec, France)

TS2: Security Management

Session Chair: Guillaume Doyen

13:30 – 15:00 • Imperial Ballroom

Host in Danger? Detecting Network Intrusions from Authentication Logs
Haibo Bian, Tim Bai, Mohammad Ali Salahuddin, Noura Limam, Abbas Abou Daya and Raouf Boutaba (University of Waterloo, Canada)

Exploring Ethereum's blockchain anonymity using smart contract code attribution
Shlomi Linoy, Natalia Stakhanova and Alina Matyukhina (University of New Brunswick, Canada)

Exploring NAT Detection and Host Identification Using Machine Learning
Ali Safari Khatouni, Lan Zhang and Khurram Aziz (Dalhousie University, Canada); Ibrahim Zincir (Yasar University, Turkey); Nur Zincir-Heywood (Dalhousie University, Canada)

Wednesday, 23 October 2019

TS3: Anomaly and Change Management

Session Chair: Edmundo Madeira

9:00 – 10:30 • Imperial Ballroom

Towards Content-Centric Control Plane Supporting Efficient Anomaly Detection Functions
Hoang Long Mai (Montimage, France); Guillaume Doyen (Troyes University of Technology, France); Wissam Mallouli and Edgardo Montes de Oca (Montimage, France); Olivier Festor (INRIA Nancy - Grand Est, France)

Causal analysis of network logs with layered protocols and topology knowledge
Satoru Kobayashi (National Institute of Informatics, Japan); Kazuki Otomo (The University of Tokyo, Japan); Kensuke Fukuda (National Institute of Informatics, Japan)

Predicting VNF Deployment Decisions under Dynamically Changing Network Conditions
Stanislav Lange (Pohang University of Science and Technology, Korea); Heegon Kim (POSTECH, Korea); Seyeon Jeong (Pohang University of Science and Technology, Korea); Heeyoul Choi (Handong Global University, Korea); Jae-Hyoung Yoo and James W. Hong (POSTECH, Korea)

TS4: 5G and New Generation Networks

Session Chair: Liam Fallon

13:30 – 15:00 • Imperial Ballroom

Experimental Estimation of LTE-A Performance
Imane Oussakel (Université de Toulouse, CNRS & LAAS-CNRS, France); Philippe Owezarski (LAAS-CNRS, France); Pascal Berthou (CNRS/LAAS - Université de Toulouse, France)

Reliable Slicing of 5G Transport Networks with Dedicated Protection
Nashid Shahriar, Sepehr Taeb, Shihabur R. Chowdhury and Mubeen Zulfiqar (University of Waterloo, Canada); Massimo Tornatore (Politecnico di Milano & University of California, Davis, Italy); Raouf Boutaba (University of Waterloo, Canada); Jeebak Mitra and Mahdi Hemmati (Huawei Technologies Canada, Canada)

Orchestrating End-to-end Slices in 5G Networks
Davit Harutyunyan (University of Trento & FBK CREATE-NET, Italy); Riccardo Fedrizzi (FBK CREATE-NET, Italy); Nashid Shahriar and Raouf Boutaba (University of Waterloo, Canada); Roberto Riggio (FBK CREATE-NET, Italy)

TS5: Data Center and Cloud Management

Session Chair: Hanan Lutfiyya

15:30 – 17:00 • Imperial Ballroom

Efficient Learning on High-dimensional Operational Data
Forough Sahab Samani, Rolf Stadler and Hongyi Zhang (KTH Royal Institute of Technology, Sweden)

Quick Execution Time Predictions for Spark Applications
Sarah Shah (University of Calgary, Canada); Yasaman Amannejad (Mount Royal University, Canada); Diwakar Krishnamurthy and Mea Wang (University of Calgary, Canada)

Building Hybrid Virtual Network Functions with eXpress Data Path
Tu Van Nguyen, Jae-Hyoung Yoo and James W. Hong (POSTECH, Korea)

Analyzing Dynamics of MVNO Market Using Evolutionary Game
Noriaki Kamiyama (Fukuoka University, Japan) and Akihiro Nakao (The University of Tokyo, Japan) (MC)

Thursday, 24 October 2019

TS6: Performance Management and Quality of Experience

Session Chair: Pal Valga

9:00 – 10:30 • Imperial Ballroom

On Accounting for Screen Resolution in Adaptive Video Streaming: A QoE-Driven Bandwidth Sharing Framework
Othmane Belmoukadam (Côte d'Azur University & INRIA Sophia Antipolis, France); Muhammad Jawad Khokhar and Chadi Barakat (INRIA Sophia Antipolis, France)

Informed Access Network Selection: The Benefits of Socket Intents for Web Performance
Theresa Enghardt and Philipp S. Tiesel (TU Berlin, Germany); Thomas Zinner (NTNU, Norway); Anja Feldmann (Max Planck Institute for Informatics, Saarbrücken, Germany)

Enabling Emergency Flow Prioritization in SDN Networks
Jerico Moeyersons (Ghent University - imec, Belgium); Behrooz Farkiani (Amirkabir UnIversity of Technology, Iran); Bahador Bakhshi and Seyyed Ali Mirhassani (Amirkabir University of Technology, Iran); Tim Wauters (Ghent University - imec, Belgium); Bruno Volckaert (Ghent University-imec & IBBT, Belgium); Filip De Turck (Ghent University - imec, Belgium)

TS7: Software-Defined Networks

Session Chair: Mohamed Faten Zhani

13:30 – 15:00 • Imperial Ballroom

P4-BNG: Central Office Network Functions on Programmable Packet Pipelines
Ralf Kundel (TU Darmstadt, Germany); Leonhard Nobach (Deutsche Telekom & Fixed Mobile Engineering Deutschland, Germany); Jeremias Blendin (Barefoot Networks & Intel Corporation, USA); Hans-Jörg Kolbe and Georg Schyguda (Deutsche Telekom, Germany); Vladimir Gurevich (Barefoot Networks, USA); Boris Koldehofe (TU Darmstadt, Germany); Ralf Steinmetz (Technische Universität Darmstadt, Germany)

SACO: A Service Chain Aware SDN Controller-Switch Mapping Framework
Duong Tuan Nguyen (University of Quebec, Canada); Chuan Pham (Synchromedia Laboratory, Ecole de Technologie Supérieure, Université du Québec, Canada); Kim Khoa Nguyen (University of Quebec, Canada); Mohamed Cheriet (Ecole de technologie superieure (University of Quebec), Canada)

DBvLEA: A Demand-Based Approach to Virtual Link Mapping for Multi-Service Industrial Applications
Frimpong Ansah (University of Passau & Siemens AG., Germany); Hermann de Meer (University of Passau, Germany)

MINI-CONFERENCE SESSIONS

Monday, 21 October 2019

MC1: Security Management

Session Chair: Jonathan Anderson

9:00 – 10:30 • Britannia Room

Distributed Middlebox Architecture for IoT Protection
Lionel Metongnon (Universite Catholique de Louvain & Universite d'Abomey-Calavi, Belgium); Ramin Sadre (Université Catholique de Louvain, Belgium); Eugène C. Ezin (Université d'Abomey Calavi/ IMSP & IFRI, Benin)

An Access Control Implementation Targeting Resource-constrained Environments
Fan Zhang, Bernard Butler and Brendan Jennings (Waterford Institute of Technology, Ireland)

Exploring Feature Normalization and Temporal Information for Machine Learning Based Insider Threat Detection
Pedro Ferreira, Duc Le and Nur Zincir-Heywood (Dalhousie University, Canada)

MENTOR: The Design and Evaluation of a Protection Services Recommender System
Muriel Franco and Bruno Rodrigues (University of Zurich, Switzerland); Burkhard Stiller (University of Zürich, Switzerland)

MC2: Performance Management

Session Chair: Nur Zincir-Heywood

11:00 – 12:30 • Britannia Room

Scalability Evaluation of VPN Technologies for Secure Container Networking
Tom Goethals (Ghent University & imec, IDLab, Belgium); Dwight Kerkhove (Ghent University, Belgium); Bruno Volckaert (Ghent University-imec & IBBT, Belgium); Filip De Turck (Ghent University - imec, Belgium)

Concurrent Traffic Queuing Game in Smart Home
Maroua Ben Attia and Kim Khoa Nguyen (University of Quebec, Canada); Mohamed Cheriet (Ecole de technologie superieure (University of Quebec), Canada)

BANQUET: Balancing Quality of Experience and Traffic Volume in Adaptive Video Streaming
Takuto Kimura (NTT & Network Technology Laboratories, Japan); Tatsuaki Kimura (Osaka University, Japan); Arifumi Matsumoto (NTT & Service Integration Laboratories, Japan); Jun Okamoto (NTT, Japan)

Sense-Share: A Framework for Resilient Collaborative Service Performance Monitoring
Khulan Batbayar (Universitat Politecnica de Catalunya, Spain); Emmanouil Dimogerontakis, Roc Meseguer and Leandro Navarro (Universitat Politècnica de Catalunya, Spain); Ramin Sadre (Université Catholique de Louvain, Belgium)

MC3: Cloud and Distributed Systems

Session Chair: Guillaume Doyen

13:30 – 15:00 • Britannia Room

Look Ahead Distributed Planning For Application Management In Cloud
Farzin Zaker, Marin Litoiu and Mark Shtern (York University, Canada)

Inter-container Communication Aware Container Placement in Fog Computing
El Houssine Bourhim (Université du Québec à Montréal, Canada); Halima Elbiaze (University of Quebec at Montreal, Canada); Mouhamad Dieye (Université du Québec à Montréal, Canada)

Systematic Mapping on Orchestration of Container-based Applications in Fog Computing
Walter Do Espirito Santo (Federal University of Sergipe & Federal Institute of Sergipe, Brazil); Rubens S. Matos, Jr. (Federal Institute of Education, Science, and Technology of Sergipe, Brazil); Admilson de Ribamar Lima Ribeiro and Danilo Souza Silva (Federal University of Sergipe, Brazil); Reneilson Santos (Universidade Federal de Sergipe, Brazil)

Meta-Learning-Based Deep Learning Model Deployment Scheme for Edge Caching
Kyi Thar and Thant Zin Oo (Kyung Hee University, Korea); Zhu Han (University of Houston, USA); Choong Seon Hong (Kyung Hee University, Korea)

Pooling Approach for Task Allocation in the Blockchain Based Decentralized Storage Network
Iman Vakilinia (University of North Florida, USA); Shahin Vakilinia (Synchromedia & Synchromedia, Canada); Shahriar Badsha, Engin Arslan and Shamik Sengupta (University of Nevada, Reno, USA)

MC4: Programmability and Observability

Session Chair: Israat Haque

15:30 – 17:00 • Britannia Room

Adaptive Quorum-inspired SLA-Aware Consistency for Distributed ONOS Controllers
Fetia Bannour (UPEC University, France); Sami Souihi (University Paris Est UPEC, France); Abdelhamid Mellouk (UPEC, University Paris-Est Creteil Val de Marne, France)

SD-FAST: A Packet Rerouting Architecture in SDN
Ma Moyeen, Fangye Tang, Dipon Saha and Israat Haque (Dalhousie University, Canada)

Bandwidth Prediction Schemes for Defining Bitrate Levels in SDN-enabled Adaptive Streaming
Ali Alissa (University of Plymouth, United Kingdom (Great Britain)); Abdelhak Bentaleb (National University of Singapore, Singapore); Alcardo Barakabitze (University of Plymouth, United Kingdom (Great Britain)); Bogdan Ghita (University of Plymouth & Centre for Security, Communications, and Network Research, United Kingdom (Great Britain)); Thomas Zinner (NTNU, Norway)

A Study of Simple Partially-Recovered Sensor Data Imputation Methods
Christoph Sydora (University of Alberta, Canada); Johannes Jung (Technical University of Munich, Germany); Ioanis Nikolaidis (University of Alberta, Canada)

Scout: A Framework for Querying Networks
Andrew Curtis-Black, Andreas Willig and Matthias Galster (University of Canterbury, New Zealand)

POSTER SESSIONS

Tuesday, 22 October 2019

PS1: Software-Defined Networks and Deployment Management
15:30 – 17:00 • Imperial Ballroom

A Formal Model for Resiliency-Aware Deployment of SDN: A SCADA-Based Case Study
Ahm Jakaria (Tennessee Technological University, USA); Mohammad Ashiqur Rahman (Florida International University, USA); Aniruddha Gokhale (Vanderbilt University, USA)

Towards a Unified Network Slicing Model
Mohammed Chahbar (Univerité Paris 13, France); Gladys Diaz (University of Paris 13 & L2TI, Institut Galilee, France); Abdulhalim Dandoush (ESME Sudria, France)

Quantitative Analysis of Dynamically Provisioned Heterogeneous Network Services
Hadi Razzaghi Kouchaksaraei and Holger Karl (Paderborn University, Germany)

Dynamic Architecture based on Network Virtualization and Distributed Orchestration for Management of Autonomic Network
Guy Saadon and Yoram Haddad (Jerusalem College of Technology, Israel); Noëmie Simoni (Telecom-Paristech, France)

Formal Verification of Orchestration Templates for Reliable Deployment of Network Systems
Adja Ndeye Sylla and Karine Guillouard (Orange Labs, France); Frederic Klamm (Orange, France); Meryem Ouzzif (Orange Labs, France); Philippe Merle (Inria Lille - Nord Europe, France); Souha Ben Rayana and Jean-Bernard Stefani (INRIA, France)

A Composition Selection Mechanism for Chaining and Placement of Virtual Network Functions
Samuel Araújo (Universidade Federal de Minas Gerais, Brazil); Fernanda S H Souza (Federal University of São João Del-Rei, Brazil); Geraldo R Mateus (Universidade Federal de Minas Gerais, Brazil)

Janus - A Software-Defined Networking MPEG-DASH Video Streaming Load Balancer
Edenilson Jonatas Dos Passos and Adriano Fiorese (Santa Catarina State University, Brazil)

Autonomic Closed Control Loops for Management: An Idea Whose Time Has Come?
Liam Fallon, John Keeney and Ram Krishna Verma (Ericsson, Ireland)

PS2: Security Management and Services
15:30 – 17:00 • Imperial Ballroom

WASPP: Workflow Automation for Security Policy Procedures
Ren Quinn, Jacobus Van der Merwe, Nico Holguin, Ben Poster and Corey Roach (University of Utah, USA)

Trace-based Behaviour Analysis of Network Servers
Nik Sultana and Boon Thau Loo (University of Pennsylvania, USA)

Compromised Tweet Detection Using Siamese Networks and fastText Representations
Mihir Joshi, Parmeet Singh and Nur Zincir-Heywood (Dalhousie University, Canada)

Learning From Evolving Network Data for Dependable Botnet Detection
Duc Le and Nur Zincir-Heywood (Dalhousie University, Canada)

Accurate Loss Estimation Technique Utilizing Parallel Flow Monitoring
Kohei Watabe, Norinosuke Murai, Shintaro Hirakawa and Kenji Nakagawa (Nagaoka University of Technology, Japan)

TradeMap: A FINMA-compliant Anonymous Management of an End-2-end Trading Market Place
Sina Rafati Niya, Sebastian Allemann and Arik Gabay (University of Zurich, Switzerland); Burkhard Stiller (University of Zürich, Switzerland)

CapExec: towards Transparently-sandboxed Services
Mahya Soleimani Jadidi (Memorial University of Newfoundland, Canada); Mariusz Zaborski (Fudo Security Inc., Poland); Brian James Kidney (Memorial University of Newfoundland, Canada); Jonathan Anderson (Memorial University, Canada)

PS3: Machine Learning and Artificial Intelligence
15:30 – 17:00 • Imperial Ballroom

Deep Reinforcement Learning for Network Slicing with Heterogeneous Resource Requirements and Time Varying Traffic Dynamics
Veena B. Mendiratta (NOKIA Bell Labs, USA); Muntasir Raihan Rahman (Nokia Bell Labs, USA); Jaehoon Koo (Northwestern University, USA); Anwar Walid (Nokia Bell Labs, USA)

Active Learning for High-Dimensional Binary Features
Ali Vahdat, Mouloud Belbahri and Vahid Partovi Nia (Huawei Technologies, Canada)

Deep Learning Models For Aggregated Network Traffic Prediction
Aggelos Lazaris and Viktor K. Prasanna (University of Southern California, USA)

A Reinforcement Learning Based Approach for 5G Network Slicing Across Multiple Domains
Godfrey M Kibalya and Joan Serrat (Universitat Politècnica de Catalunya, Spain); Juan-Luis Gorricho (Polytechnic University of Catalonia, Spain); Rafael Pasquini (Federal University of Uberlândia - UFU, Brazil); Haipeng Yao (Beijing University of Posts and Telecommunications, P.R. China); Peiying Zhang (China University of Petroleum (East China), P.R. China)

A Framework & System for Classification of Encrypted Network Traffic using Machine Learning
Nabil Seddigh (Solana Networks, Canada); Biswajit Nandy (Solana Networks & Carleton University, Canada); Don Bennett, Yonglin Ren, Serge Dolgikh, Colin Zeidler, Juhandre Knoetze and Naveen sai Muthyala (Solana Networks, Canada)

An Architecture for Traffic Steering via Deep Learning in Challenged Edge Networks
Alessandro Gaballo (Politecnico di Torino, Italy); Matteo Flocco and Flavio Esposito (Saint Louis University, USA); Guido Marchetto (Politecnico di Torino, Italy)

PS4: Wireless and cellular networks
15:30 – 17:00 • Imperial Ballroom

Wireless Service Providers Pricing Game in Presence of Possible Sponsored Data
Patrick Maillé (IMT Atlantique, France); Bruno Tuffin (Inria Rennes - Bretagne Atlantique, France)

Low Overhead, Fine-grained End-to-end Monitoring of Wireless Networks using In-band Telemetry
Jetmir Haxhibeqiri (IDLab, Ghent University - imec, Belgium); Ingrid Moerman and Jeroen Hoebeke (Ghent University - imec, Belgium)

3-D Matching-based Resource Allocation for D2D Communications in H-CRAN Network
Pan Zhao (Henan University of Technology, P.R. China); Lei Feng (Beijing University of Posts and Telecommunications, P.R. China); Qinghui Zhang, Weidong Yang and Xiaoyang Li (Henan University of Technology, P.R. China); Fei Zheng (Guilin University of Electronic Technology, P.R. China)

Slotted TDMA Multichannel MAC for Overlapped Vehicular Networks with SDN-based Distributed System
Hyungdong Hwang (Graduate School, Yeungnam University, Korea); Young-Tak Kim (Yeungnam University, Korea)

Large- and Small-Scale Modeling of User Traffic in 5G Networks
Alberto Martínez Alba and Wolfgang Kellerer (Technische Universität München, Germany)

Energy Efficient Scheduling for Networked IoT Device Software Update
Ngoc Hai Bui (ÉTS, University of Quebec, Canada); Chuan Pham (Synchromedia Laboratory, ÉTS, Université du Québec, Canada); Kim Khoa Nguyen (University of Quebec, Canada); Mohamed Cheriet (ÉTS (University of Quebec), Canada)

Lumped Markovian Estimation for Wi-Fi Channel Utilization Prediction
Sepehr Kazemian and Ioanis Nikolaidis (University of Alberta, Canada)

PS5: Data Center and Cloud Management

15:30 – 17:00 • Imperial Ballroom

Fog-based Data Fusion for Heterogeneous IoT Sensor Networks: A Real Implementation
Fredy Valente (UFSCAR - Universidade Federal de Sao Carlos - Brazil, Brazil); Kelen Vivaldini and João Morijo (UFSCAR, Brazil); Luis Carlos Trevelin (Universidade Federal de São Carlos, Brazil)

The Softwarised Network Data Zoo
Manuel Peuster, Stefan Schneider and Holger Karl (Paderborn University, Germany)

A Scalable Color-Based Caching Scheme in Telco-CDNs
Anh-Tu N. Tran and Thanh-Dang Diep (Ho Chi Minh City University of Technology, Vietnam); Takuma Nakajima and Masato Yoshimi (TIS Inc, Japan); Nam Thoai (Ho Chi Minh City University of Technology, Vietnam)

Energy Consumption of Hybrid Data Center Networks
Joel Reginald Dodoo (Shanghai Jiao Tong University, P.R. China); Weiqiang Sun (Shanghai Jiaotong University, P.R. China); Feng Zhu (McGill University, Canada); Weisheng Hu (Shanghai Jiao Tong University, P.R. China)

Geographic Clustering Based Mobile Edge Computing Resource Allocation Optimization Mechanism
Song Kang and Linna Ruan (Beijing University of Posts and Telecommunications, P.R. China); ShaoYong Guo (Beijing University of Posts and Telecommunications & State Key Laboratory of Networking & Switching Technology, P.R. China); Wencui Li (Information & Telecommunication Co. of State Grid Henan Electric Power Company, P.R. China); Qiu Xue-song (Beijing University of Posts and Telecommunications, P.R. China)

WORKSHOPS

Monday, 21 October 2019

WS1: CNSM AnServApp 2019
The First International Workshop on Analytics for Service and Application Management

Session 1: Keynote
9:30 – 10:30 • Vanguard Room I

Title: Traffic Mining – to AI or not to AI
Speaker: Stefan Burschka, RUAG MRO Switzerland

Physicist, formation in Quantum Optics, Microwave Technology, Optical Communication, Robotic and AI. After a long industrial career in HW and custom chip design, Data Mining, IT Troubleshooting and Network Security he is now the head of "Traffic Intelligence" at Ruag MRO Switzerland. His team works in the field of Encrypted Traffic Mining, IT Troubleshooting and Network Forensic. He is a lead developer of the open source SW Tranalyzer and teaches students in analog/digital HW design and traffic mining with and without AI.

Session 2: Technical and Short Paper Presentations
11:00 – 12:30 • Vanguard Room I

Session Chair: Stefan Burschka, RUAG MRO Switzerland

Predicting Distributions of Waiting Times in Customer Service Systems using Mixture Density Networks
Majid Raeis (University of Toronto, Canada); Ali Tizghadam (TELUS & University of Toronto, Canada) and Alberto Leon-Garcia (University of Toronto, Canada)

Data-Driven Emulation of Mobile Access Networks
Ali Safari Khatouni (Dalhousie University, Canada); Martino Trevisan (Politecnico di Torino, Italy) and Danilo Giordano (Politecnico di Torino, Italy)

Communication Challenges and Solutions between Heterogeneous Industrial IoT Systems
Daniel Kozma (Budapest University of Technology and Economics, Hungary); Gabor Soos (Budapest University of Technology and Economics & Magyar Telekom Nyrt, Hungary); Daniel Ficzere (Budapest University of Technology and Economics, Hungary) and Pál Varga (Budapest University of Technology and Economics, Hungary)

Detecting Factors Responsible for Diabetes Prevalence in Nigeria using Social Media and Machine Learning
Oladapo Oyebode (Dalhousie University, Canada) and Rita Orji (Dalhousie University, Canada)

Session 3: Technical and Short Paper Presentations
13:30 – 15:00 • Vanguard Room I

Session Chair: Khurram Aziz, Dalhousie University, Canada

Can you hear me now? A call detail record based end-to-end diagnostics system for mobile networks
Anssi Tauriainen (Aalto University, Finland)

Machine Learning for Location and Orientation Fingerprinting in MIMO WLANs
Hui Xiong (Dalhousie University, Canada) and Jacek Ilow (Dalhousie University, Canada)

NFV-VIPP: Catching Internal Figures of Packet Processing for Accelerating Development and Operations of NFV-nodes
Masahiro Dodare (Nagoya Institute of Technology, Japan); Yuki Taguchi (Nagoya Institute of Technology, Japan); Ryota Kawashima (Nagoya Institute of Technology, Japan); Hiroki Nakayama (Bosco Technologies Inc., Japan); Tsunemasa Hayashi (Bosco Technologies Inc., Japan) and Hiroshi Matsuo (Nagoya Institute of Technology, Japan)

Are There Bots even in FIFA World Cup 2018 Tweets?
Moath Bagarish (Dalhousie University, Canada); Riyad Alshammari (King Saud bib Abdulaziz University for Health Science, Saudi Arabia) and Nur Zincir-Heywood (Dalhousie University, Canada)

WORKSHOPS

Friday, 25 October 2019

WS2+3: CNSM HipNet+SR/SF 2019
The Second International Workshop on High-Precision Networks Operations and Control

Session 1: Welcome and Technical Paper Presentations
9:30 – 10:30 • Vanguard Room I

Session Chair: Mohamed Faten Zhani, ÉTS Montreal, Canada

Intelligent Edge Control with Deterministic-IP based Industrial Communication in Process Automation
Amjad Badar (Chemnitz University of Technology and Huawei Munich Research Center, Germany)

A Hybrid Machine Learning/Policy Approach to Optimise Video Path Selection
Joseph McNamara (Ericsson, Ireland and Athlone Institute of Technology, Ireland); Liam Fallon (Ericsson, Ireland) and Enda Fallon (Ahlone Institute of Technology, Ireland)

Performance Evaluation of GTP-U and SRv6 Stateless Translation
Chunghan Lee (Toyota Motor Corporation, Japan); Kentaro Ebisawa (Toyota Motor Corporation, Japan); Hitoshi Kuwata (APRESIA Systems, Ltd., Japan); Miya Kohno (Cisco Systems, Japan) and Satoru Matsushima (Softbank, Japan)

Service Function Chaining Leveraging Segment Routing for 5G Network Slicing
Davide Borsatti (University of Bologna and CNIT, Italy); Walter Cerroni (University of Bologna and CNIT, Italy); Gianluca Davoli (University of Bologna and CNIT, Italy) and Franco Callegati (University of Bologna and CNIT, Italy)

Session 2: Panel
High-Precision Networking Services and Service Function Chaining: Frontier or Solution?
11:00 – 12:30 • Vanguard Room I

Panel Moderator: Alexander Clemm, Futurewei, USA

Panelists:
Raouf Boutaba, University of Waterloo, Canada
Rolf Stadler, KTH Stockholm, Sweden
Mohamed Faten Zhani, ÉTS Montreal, Canada
Nur Zincir-Heywood, Dalhousie University, Canada

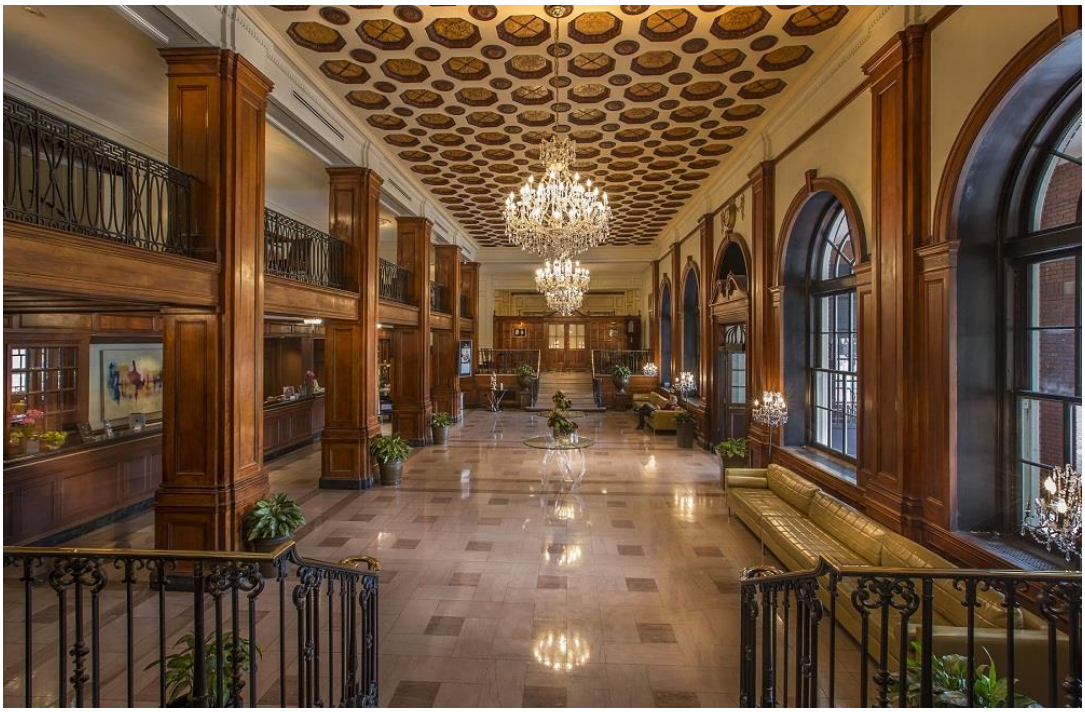
The panel will discuss viability, limitations, challenges of Service Function Chaining (SFC) with regards to providing High-Precision Networking services with hard service level guaranteees. Opportunities of SFC include the ability to generate custom chains for specific purposes, while challenges include the variations in latency and performance unpredictabilities associated with virtualization. Hence the question arises whether SFC can be a solution in the quest for High-Precision Networking services, or whether alternative solutions are needed.

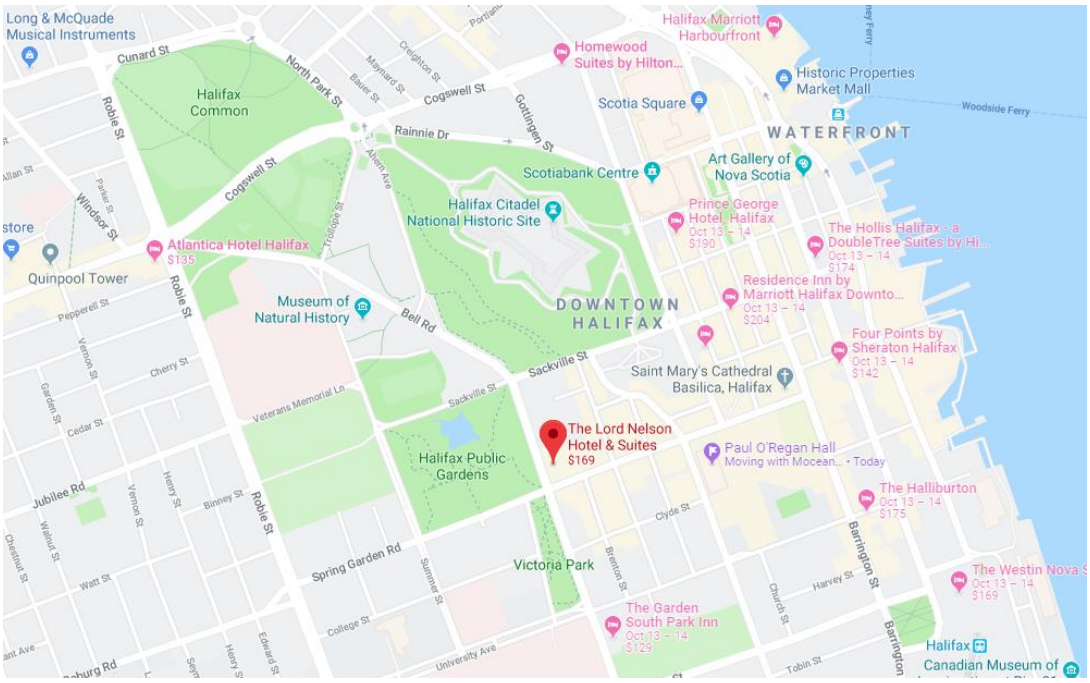
CONFERENCE VENUE

Lord Nelson Hotel & Suites

Address: 1515 South Park Street, Halifax, Nova Scotia, Canada B3J 2L2
Phone: (902) 423-6331

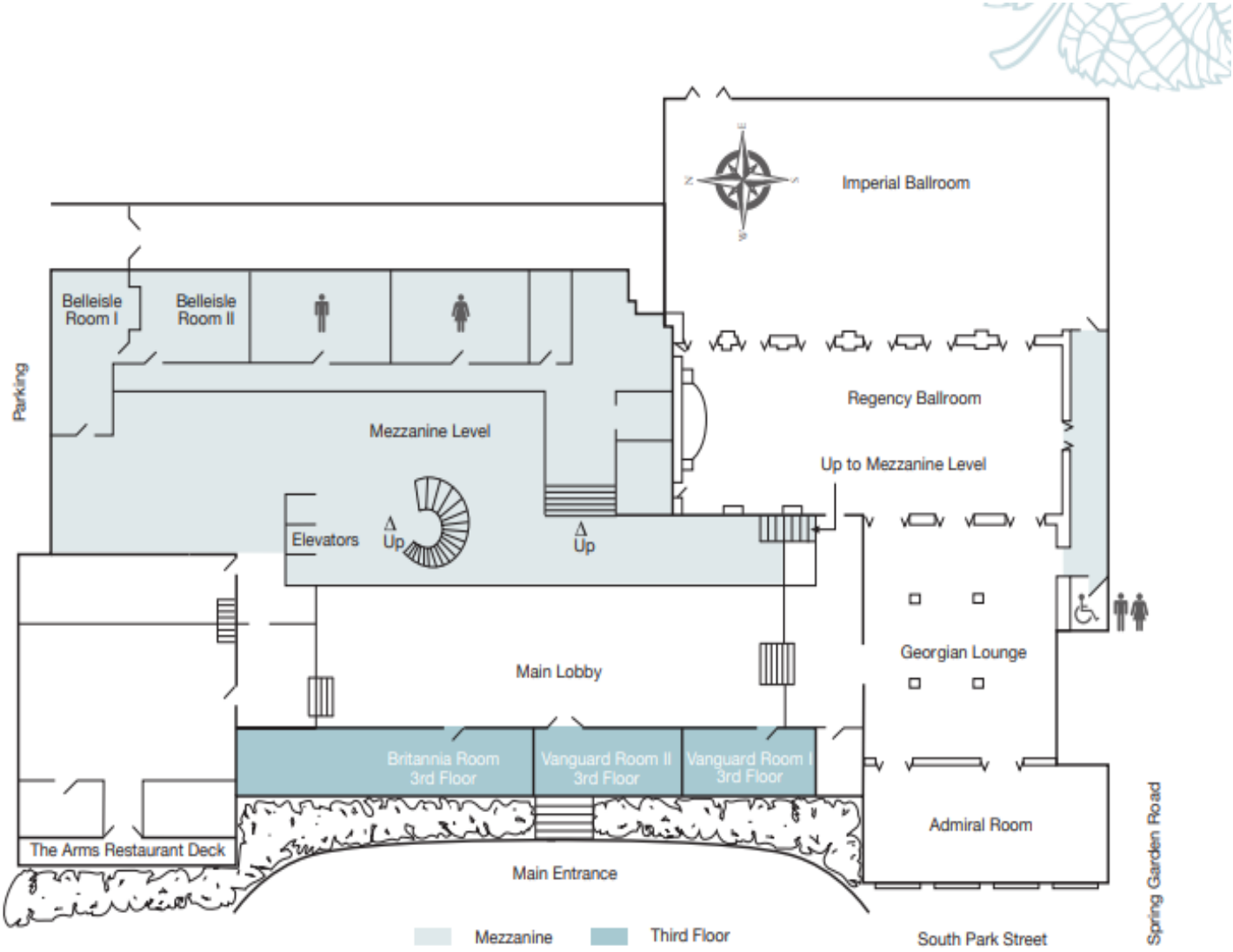
The CNSM 2019 and its co-located workshops will be held at the Lord Nelson Hotel & Suites at 1515 South Park Street in downtown Halifax, Nova Scotia, Canada.





CONFERENCE VENUE

FLOOR PLANS



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CONFERENCE EVENTS

WELCOME RECEPTION

22 October 2019 (18:30 – 20:30)

Halifax Citadel National Historic Site

Address: 5425 Sackville Street, Halifax, Nova Scotia

Citadel Hill is a hill that is a National Historic Site in Halifax, Nova Scotia, Canada. It was the large hill overlooking the easily defended harbour below that led the British military to find the town there in 1749. Among the first buildings constructed was a wooden guardhouse on top of what would eventually be called Citadel Hill, with Halifax's first settlers building their homes at the base of the hill, closer to the water. Rising majestically in the heart of the provincial capital, the Halifax Citadel National Historic site is a must-see attraction offering a fascinating step back in time. See what life was like for British soldiers in the 18th and 19th centuries while exploring the finest local spirits produced by the award-winning Compass Distillers – Halifax's only grain-to-glass distillery.

Tour Halifax Citadel Army Museum, which showcases Canadian military history, starting with the First World War and its "Road to Vimy and Beyond" exhibit through to modern-day conflict. **Sentry Change** - Every hour the Citadel is open, watch the sentry guarding the front gate be changed. **Ghost Tours** - Learn about the ghost stories and bizarre legends of the Halifax Citadel - run mid-July until late October, 8:30pm.

CONFERENCE EVENTS

BANQUET

23 October 2019 (18:30 – 21:30)

Murphy's on the Water

Address: 1751 Lower Water Street, Halifax, Nova Scotia

The CNSM 2019 Banquet will be at the Murphy's on the Water, which is located on the waterfront at the foot of George Street. Murphy's Restaurant & Patio offers a casual dining experience, and specializes in seafood dishes, local brews & fantastic views. Boasting a large indoor space, as well as a bright & airy covered patio, the restaurant sits on the edge of the longest extending wharf on the Halifax waterfront. With unobstructed views of the bustling Harbour, Georges Island, and even McNabs Island, you're sure to love that every seat at Murphy's, has a spectacular view!