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IEEE International Conference on Blockchain and Cryptocurrency

14-17 May 2019 // Seoul, South Korea

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Contents

Program-at-a-Glance

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MESSAGE FROM ICBC 2019 GENERAL CHAIR & TPC CO-CHAIRS

Welcome to the 1st IEEE International Conference on Blockchain and Cryptocurrency (ICBC 2019) being held at Supex Hall, SKT Tower, Seoul, Korea during May 14-17, 2019. IEEE ICBC 2019 is the first fully-financially sponsored conference on blockchains and cryptocurrencies by the IEEE Communications Society (ComSoc) and aims to be the top technical conference in the area of blockchain and cryptocurrency. ICBC 2019 will be the primary forum for technical exchange of the latest research results and innovations, regulations, policies, standards, and applications in this exciting and challenging area.

The theme of ICBC 2019 is *"Challenges and Opportunities of Blockchain and Cryptocurrency"*. With this theme in mind, we have prepared an excellent program consisting of three keynotes from research, industry and application communities, plenary sessions with 30 full technical papers, 5 short papers, two research and industry panels and a distinguished experts panel. We will also have 9 demonstrations of research prototypes and exhibitions showcasing the latest solutions from vendors and telecommunications operators as well as 40 posters of ongoing work by researchers. In addition, we are offering five timely tutorials on important aspects of blockchains and cryptocurrencies. ICBC 2019 received 153 paper submissions from around the world. Each paper had at least three reviews by 163 reviewers from 38 countries. We have selected 30 full papers to be presented, which is 19.6% acceptance ratio. In order to be the top conference in this area, we are operating in a single track with this highly selective excellent papers.

We have also prepared an excellent social program, including a Welcome Reception on Wednesday evening and a Banquet on Thursday with sumptuous and delicious Korean food. We will also have a performance by K-Pop stars during the Banquet.

We would like to express our deepest gratitude to all the dedicated organizing committee members from around the world and to the technical program committee members for selecting an excellent technical program. We would also like to thank our conference patrons (SKT, Sovereign Wallet, CloudFlare, Dell, IOTA, CoinOne, ICON, Penta Security) for their financial sponsorship and the supporting organizations. We would also like to thank for the support of IEEE ComSoc for trusting us with the launch of this new and exciting conference. Special thanks go to ComSoc staff (Tina Gaerlan, Nancy Sun, and Bruce Worthman) for their professional support. Last but not the least. we would like to acknowledge Hongtaek Ju, Myung-sup Kim, Mi-Jung Choi, Youngjoon Won, Gayeon Kim, Eui-Jun Baek, Ji-Won Bang, Kyungchan Ko, and Meryam Essaid for their contributions to the conference local organization. Without all of their support, ICBC 2019 would not have been possible. Thank you all!

Enjoy ICBC 2019 and Dynamic Korea!

James Won-Ki Hong
POSTECH, Korea
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U. of Waterloo, Canada
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Burkhard Stiller
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- Salil S. Kanhere, University of New South Wales
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- Thomas Locher, ETH
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- Vincent Gramoli, University of Sydney
- Volkan Dedeoglu, CSIRO
- Walid Al-Saqaf, Södertörn University
- Wangcheol Song, Jeju National University
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- Weizhi Meng, Technical University of Denmark
- Wenjuan Li, City University of Hong Kong
- Woojin Seok, KISTI
- Xueqin Liang, Xidian University, China and Aalto University
- Xuetao Wei, University of Cincinnati
- Yang Xiang, Swinburne University of Technology
- Youngjoon Won, Hanyang University
- Youngseok Lee, Chungnam National University
- Young-Tak Kim, Yeungnam University
- Yu Chen, San Jose State University
- Yunhui Zhuang, City University of Hong Kong
- Zeki Erkin, Delft University of Technology

Keynotes

Keynote 1: 10:45-11:15, Wednesday, May 15, 2019

Blockchain-based Postal Services at Korea Post

Seong Ju Kang
President, Korea Post, Korea

Abstract: Korea Post's challenge to seek for new business opportunities from blockchain technology is underway. Korea Post is reviewing to apply blockchain technology to each of its business segments: postal, savings, and insurance. For postal business, we are planning to introduce mobile e-post box system which enables a reliable transmission of e-mail by applying blockchain technology to prevent any forgery or modification. For savings business, we are planning to realize a more affordable and time-saving foreign currency remittance service by sharing real-time records through blockchain technology. For insurance business, we have implemented an automatic request and payment process for insurance premium by linking the insurer with hospitals through blockchain technology. Korea Post will continue its efforts to enhance customer reliability on blockchain technology for a further development and to create new business values as one of the leading governmental agencies in the 4th Industrial Revolution field.

Bio: Seong Ju Kang has been serving as the President of Korea Post since November 2017. Prior to the present position, he served in various public positions such as Director General of ICT Policy and R&D Bureau, Ministry of Science and ICT (April 2008 to Nov. 2017), Minister-Counselor at the Permanent Delegation of Korea to the OECD (Feb. 2011 to Mar. 2013), Assistant Secretary to the President at the Office of the President (Feb. 2007 to Feb. 2008) and Director of ICT Planning and Coordination, Ministry of Information and Communications (Dec. 1997 to Feb. 2007), mainly covering ICT policy including e-government, cyber security, economic development, government innovation and regional development. Seong Ju Kang received his MS degree from Syracuse University and PhD degree from Penn State University in public administration and MIS. He also taught at the School of Public Administration at the Catholic University of Korea and Penn State University.

Keynote 2: 10:15-11:15, Thursday, May 16, 2019

Blockchain as a Business Platform

Sachiko Yoshihama
Senior Technical Staff Member, Senior Manager at IBM Research – Tokyo

Abstract: Blockchain started as a technology to underpin bitcoin, but it has been expanding its use cases beyond cryptocurrencies. Enterprise use of blockchain is gaining wide attention both in financial and non-financial industries. For example, blockchain and smart contracts allow organizations to share not only data but also application logic and rules, which enables transformation of cross-organizational business processes. However, the blockchain is still in its early stage as a business platform, and there are many challenges that need to be addressed. This talk will review key technical challenges of blockchain, such as security, privacy, and scalability in real-world examples, and how these challenges are being addressed in Hyperledger Fabric, one of the most significant open source projects for enterprise-level blockchain platforms. At the application layer, improving the safety of smart contracts is a pressing issue. Since each smart contract is a computer program that autonomously runs on blockchain, any errors in the logic could lead to financial losses. I will introduce our

research project on automatic generation of smart contracts that allows to generate executable smart contract programs from human-understandable contract documents. Our approach is based on document templates and contract specification defined in a temporal logic-based language.

Bio: Dr. Sachiko Yoshihama is a Senior Technical Staff Member and Senior Manager at IBM Research – Tokyo. She leads a team that focuses on financial and blockchain solutions. Her research interest is to bring advanced concepts and technologies to practice and address real-world problems to transform industries. She served as a technical leader and advisor in a number of blockchain projects in Japan and Asia both in financial and non-financial industries. She joined IBM T.J. Watson Research Center in 2001, and then moved to IBM Research – Tokyo in 2003 and worked on research in information security technologies, including trusted computing, information flow control, and Web security. She served as a technology innovation leader at IBM Research Global Labs HQ in Shanghai in 2012, where she helped define research strategies for developing countries. She received Ph.D from Yokohama National University in 2010. She is a member of ACM, a senior member of Information Processing Society of Japan, and a member of IBM Academy of Technology.

Keynote 3: 10:15-11:15, Friday, May 17, 2019

Formal Design, Implementation and Verification of Blockchain Languages

Grigore Rosu
Professor, University of Illinois at Urbana-Champaign

Abstract: Many of the recent cryptocurrency bugs and exploits are due to flaws or weaknesses of the underlying blockchain programming languages or virtual machines. The usual post-mortem approach to formal language semantics and verification, where the language is firstly implemented and used in production for many years before a need for formal semantics and verification tools naturally arises, simply does not work anymore. New blockchain languages or virtual machines are proposed at an alarming rate, followed by new versions of them every few weeks, together with programs (or smart contracts) in these languages that are responsible for financial transactions of potentially significant value. Formal analysis and verification tools are therefore needed immediately for such languages and virtual machines. We present recent academic and commercial results in developing blockchain languages and virtual machines that come directly equipped with formal analysis and verification tools. The main idea is to generate all these automatically, correct-by-construction from a formal specification. We demonstrate the feasibility of the proposed approach by applying it to two blockchains, Ethereum and Cardano.

Bio: Grigore Rosu is a professor in the Department of Computer Science at the University of Illinois at Urbana-Champaign (UIUC), where he leads the Formal Systems Laboratory (FSL), and the president and CEO of Runtime Verification, Inc (RV). His research interests encompass both theoretical foundations and system development in the areas of formal methods, software engineering and programming languages. Before joining UIUC in 2002, he was a research scientist at NASA Ames. He obtained his Ph.D. at the University of California at San Diego in 2000. He was offered the CAREER award by the NSF, the Dean's award for excellence in research by the College of Engineering at UIUC in 2014, and the outstanding junior award by the Computer Science Department at UIUC in 2005. He won the ASE IEEE/ACM most influential paper award in 2016 (for an ASE 2001 paper), the Runtime Verification test of time award (for an RV 2001 paper), the ACM SIGSOFT distinguished paper awards at ASE 2008, ASE 2016, and OOPSLA 2016, and the best software science paper award at ETAPS 2002.

Research & Development Panel

14:45-16:15, Wednesday, May 15, 2019

Theme: Blockchain Beyond Cryptocurrencies: Opportunities & Challenges

Abstract: A blockchain is a distributed database that maintains a growing list of blocks which are chained to each other. Blockchsin was first proposed by Satoshi Nakamoto as the underlying technology behind Bitcoin, the first cryptocurrency. There are now over 1600 cryptocurrencies available over the Internet. In recent years, blockchain technology has attracted tremendous attention in other domains due to its salient features including auditability, immutability, security, and anonymity. This panel will examine the applications of blockchain technologies beyond cryptocurrencies and discuss the associated challenges, pitfalls and research questions. The following questions will be answered and discussed by the panelists.

1. What applications can best benefit from blockhains?
2. What are the key research challenges in adopting blockhain in these application scenarios?
3. When can we expect to see wider adoption of enterprise grade blockchain solutions? What is holding this back?
4. How do you envision blockchain technology maturing 10 years down the road?

Moderator: Salil Kanhere, UNSW Sydney, Australia

Salil Kanhere received his M.S. and Ph.D. degrees, both in Electrical Engineering from Drexel University, Philadelphia, USA. He is currently a Professor in the School of Computer Science and Engineering at UNSW Sydney, Australia. He is also a conjoint researcher at CSIRO Data61. His research interests include Internet of Things, pervasive computing, blockchain, crowdsourcing, data analytics, privacy and security. He has published over 200 peer-reviewed articles and delivered over 35 tutorials and keynote talks on these topics. His research has been featured on a number of media outlets including ABC News Australia, Forbes, IEEE Spectrum, Wired, ZDNET, Computer World, Medium, MIT Technology Review and received over 6500 citations. Salil regularly serves on the organizing committee of a number of IEEE and ACM international conferences. He is on the Editorial Board of Elsevier's Pervasive and Mobile Computing and Computer Communications. Salil is a Senior Member of both the IEEE and the ACM. He is a recipient of the Alexander von Humboldt Research Fellowship and an ACM Distinguished Speaker.

Panelist: Bhaskar Krishnamachari, Unviersity of Southern California, USA

Bhaskar Krishnamachari is Professor of Electrical and Computer Engineering at the Viterbi School of Engineering at the University of Southern California. He is Director of the USC Viterbi Center for Cyber-Physical Systems and the Internet of Things (CCI). He has expertise in wireless networks, IoT protocols and applications, distributed computing, machine learning, and blockchain technologies, spanning both theory and software systems. He has co-authored over 300 papers, collectively cited more than 24,000 times. He has received the NSF CAREER Award and the ASEE Terman Award for outstanding electrical and computer engineering educators, and several best paper awards including at ACM/IEEE IPSN and ACM MobiCom. In 2011, he was listed in MIT technology review magazine's TR-35 list of top 35 innovators under the age of 35, and in 2015 was named one of Popular Science

Panelist: Moody Alam, IOTA Foundation, Germany

Dr. Moody Alam is Director of Research at IOTA. Dr. Moody Alam is a Chartered Scientist (CSci) with the UK Science Council, and a Fellow of the Royal Statistical Society (RSS) and British Computer Society (BCS). He has been a Visiting Professor in Pakistan and was formerly a Principal Researcher at the University of Oxford. He holds a Ph.D. in Distributed Artificial Intelligence and specializes in designing decentralized protocols for intelligent systems. He has authored over 20 peer-reviewed publications in prestigious conferences and journals. His academic services also include serving on over 15 conference and programme committees and as a journal editor (Advancement in Pattern Recognition, 2018).

Panelist: Kang-Won Lee, SK Telecom, Korea

Dr. Kang-Won Lee is Head of Software R&D at SK telecom. He leads technology development for cloud computing, 5G telco VIM/SDN/NFV, AI compute infra, and blockchain platform. In the past he led a research team at IBM Watson Research Center (NY) in the area of mobile network data analytics, cloud computing, and IoT/sensor networks. He received a PhD in Computer Science from UIUC and undergrad degree from SNU. He served as OCP chair, and ON Lab board. Currently he is EEA (Enterprise Ethereum Alliance) Telco SIG chair, ACM Distinguished Scientist, and IEEE Senior Member..

Panelist: Burkhard Stiller, University of Zurich, Switzerland

Prof. Dr. Burkhard Stiller is a full professor for Communication Systems, heading the Communication Systems Group CSG, Department of Informatics IfI at the University of Zürich UZH, Switzerland. His team and he himself started to work on Bitcoins and Blockchains in early 2014 with his by then PostDoc Dr. Thomas Bocek. Besides being the coordinator of many Swiss and European industrial and research projects, Burkhard is Editor-in-Chief of Elsevier's Computer Networks journal, organized major conferences as General Chair (e.g., IFIP Networking 2018, CNSM 2013, IEEE LCN 2009 in the more recent past), chaired events as TPC Chair (e.g., WMAN 2011, ETM 2010, AIMS 2010, MUCS 2010, ICQT 2009, KiVS 2007, IFIP/IEEE NOMS 2006, IEEE LCN 2003 and 2002, and ICQT 2001), and has published within his main research interests well over 250 research papers on systems with a fully decentralized control (blockchains, clouds, peer-to-peer), network and service management (economic management), Internet-of-Things (security of constrained devices, LoRa/TTN), and telecommunication economics (charging and accounting). He is a senior advisor of modum.io, an ICO-financed start-up in the blockchain and logistics domain in Zürich, currently IFIP TC6 Chair, was Chair of the IEEE Computer Society TCCC.

Industry Panel

14:45-16:15, Thusday, May 16, 2019

Theme: Industrial Challenges and Opportunities in Blockchain and Cryptocurrency

Abstract. A token based economy is enabled by the immutabilty and programmability offereb by blockchain and their underlying programming environments (smart contract). Being a unit of value, which allows to self-govern business models and facilitate the distribution of rewards and interactions, tokens have been widely used in providing liquidity to illiquid markets, e-voting and management of digital identity. This panel will examine the pitfalls and specific use cases for tokenized economy and address challenges related to:

- How do we deal with interoperability across multiple chains and platforms?
- What are successful use cases?
- How do we measure risks?
- What security mechanisms are needed for such platforms?
- Where is regulation needed for token-based economy?

Moderator: Radu State, Head of the research group SEDAN (Service and Data Management) at SnT, Luxembourg

Radu is a graduate from both the French and the North-American research and education systems from which he obtained in 1998 the Master of Science Degree at the Johns Hopkins University (USA), followed in 2001 by a PhD degree at INRIA (France). He has an HDR (Habilitation à diriger des recherches) since 2009 from the University of Lorraine, France. Starting with 2016 he created the the research group SEDAN (Service and Data Management in Distributed Systems) at SnT at the University of Luxembourg/SnT. Before joining SnT and Luxermbourg, Radu was Professor of Computer Science in Nancy at the University of Lorraine and a senior researcher (Chargé de recherche première classe) with INRIA (Institut de Recherche en Informatique), France..

Panelist: Henry Lee, ICON Foundation, Korea

Henry Lee is currently a Director at ICON Foundation, a foundation established to oversee the development of the ICON protocol and the related technologies. Henry has extensive experience in leading various blockchain and cryptocurrency related businesses and is now responsible for managing strategy and global business development for the ICON project. Previously, Henry worked in investment banking at J.P. Morgan and Deutsche Bank where he advised a wide array of clients in the financial and technology sectors. Henry graduated with a BA from the George Washington University.

Panelist: Sachiko Yoshihama, Senior Technical Staff Member, Senior Manager, FSS & Blockchain Solutions, IBM Research – Tokyo

Dr. Sachiko Yoshihama is a senior manager at IBM Research - Tokyo, and leads a team that focuses on financial and blockchain solutions. Her research interest is to bring advanced concepts and technologies to practice and address real-world problems to transform industries. She served as a technical leader and advisor in a number of blockchain projects with clients in Japan and Asia. She joined IBM T.J. Watson Research Center in 2001, and then moved to IBM Research – Tokyo in 2003 and worked on research in information security technologies, including trusted computing, information flow control, and Web security. She served as a technology innovation leader at IBM Research Global Labs HQ in Shanghai in 2012, and helped define research strategies for developing countries. She received Ph.D. from Yokohama National University in 2010. She is a member of ACM, IEEE, and a senior member of Information Processing Society of Japan.

Panelist: Dr. Ziyuan Wang, Swinburne University of Technology, Australia

Ziyuan is a Senior Research Fellow at Swinburne University of Technology in Australia. Before joining Swinburne, she was a Research Scientist at IBM Research-Australia (2012-2018). Her recent work focuses on blockchain research and solutions across industries, including banking, insurance, and supply chain. She has published conference papers on the topic of blockchain, stream computing, and spatio-temporal data analytics. She has co-authored several patents, in the areas of Internet of Things (IoT), Artificial Intelligence (AI), and blockchain. Ziyuan has extensive teaching experience on the blockchain topics, such as guest lectures to universities, client education workshops, and executive training sessions. Prior to working in the exciting field of Blockchain technologies, Dr. Wang worked for CSIRO (2010-2012), where she was involved in environmental modeling, remote sensing data management, and scientific workflows. She holds a PhD in Computer Science from the University of Melbourne, specializing in Intelligent Transportation Systems.

Panelist: Christian Schaefer, Master Researcher, Ericsson Research

Christian is a Master Researcher in the Security research area at Ericsson Research. He joined Ericsson in 2011 and is currently focusing on different aspects of privacy enhancing technologies, mainly in a big data environment. He received a Diploma in Computer Science from University Karlsruhe (TH), Germany.

(No photo available - Christian does not wish to show his photo)

Distinguished Experts Panel

15:40-17:30, Friday, May 17, 2019

Theme: Towards a Denationalization of Money

Abstract: The emergence of crypto-currencies using blockchain technology has put on spotlight the question whether private currencies can emerge that can compete with those of central banks. Recently, JP Morgan announced their own coin and Facebook admitted that they examine the possibility to issue a currency. At the same time, central banks experiment with sandboxes of digital coins of their own in an effort to phase out paper money. Issuance of private or central bank coins pose new technology challenges to the blockchain ecosystem beyond the realm of computer engineering spilling into this of game theory, economics, democracy and regulation. The following questions will be answered and discussed by the panelists.

1. Can permissionless blockchains support millions of transactions per second to allow settlement of the global economy?
2. Is proof-of-stake a fair scheme or one where "money wins it all"?
3. Is a permissioned chain a truly decentralized system or one that a government can use to simply impose its rules?
4. Can you envision private economies competing with public government-supported economies, and how?
5. How do you envision the type of a truly decentralized stable-coin?
6. Should the moral character of blockchain cryptography be regulated and/or outlawed? Why or why not?

Moderator: Andreas Veneris, Professor, University of Toronto, Canada

Andreas is a Connaught Scholar and Professor of Electrical and Computer Engineering and Computer Science at the University of Toronto. His research interests include the development of CAD tools for the debugging, verification, synthesis and test of smart contracts, digital VLSI circuits and digital systems. He also has interest in theoretical computer science, game theoretical crypto-economics and cryptographic ledger technology. He obtained a PhD degree from the University of Illinois at Urbana-Champaign, Department of Computer Science, an MSc from the University of Southern California, Los Angeles, Department of Computer Science and an undergraduate Diploma from the University of Patras, Department of Computer Engineering and Informatics. He was a visiting faculty at the University of Illinois at Urbana-Champaign in 1998-99. He joined UofT in August 1999. He also held positions at Athens University of Economics and Business and at the University of Tokyo .

Panelist: John Milburn, CTO, HanAsset, Korea

John Milburn is an Internet user/developer/manager since 1979. After graduating as a nuclear engineer from UC Berkeley, he had works at Lawrence Berkeley Laboratory for 10 years. He was recruited by POSTECH, Korea in 1991 worked as a chief engineer building Pohang Accelerator Laboratory. He then joined Dacom in 1997 and developed KIDC (first Internet data center in Korea), BoraNet corporate Internet service, WiFi VoIP service and corporate IP-PBX service (DCS). He was an advisor to a number of companies including CJ Group, AIG, KT. He worked as a venture capital for 10 years investing in many successful startups including Gmarket. Recently, has been helping a number of blockchain projects including EOS Mainnet, SNAX, CAN, DreamChain, Coffee SC, CamFass, EOS Africa.

Panelist: Dan Kong, Head of Research, CoinOne, Korea

Dan is currently the Head of Research at Coinone. Before that, he was a senior Research Analyst at Deutsche Bank covering the telecom, media, and internet sectors. His team was highly ranked in the world's most competitive research survey, the Institutional Investor All-Asia Research Team Survey, including an Asia top 3 rank in 2016. Dan has a Bachelor of Business Administration from Korea University, and has also completed the Blockchain Strategy Programme executive education at Saïd Business School, University of Oxford. Dan holds professional designations including CAIA (Chartered Alternative Investment Analyst), Certified Research Analyst, and Registered Fund Manager..

Panelist: Grigore Rosu, Professor, Univ. of Illinois Urbana-Champaign, USA

Grigore Rosu is a professor in the Department of Computer Science at the University of Illinois at Urbana-Champaign (UIUC), where he leads the Formal Systems Laboratory (FSL), and the president and CEO of Runtime Verification, Inc (RV). His research interests encompass both theoretical foundations and system development in the areas of formal methods, software engineering and programming languages. Before joining UIUC in 2002, he was a research scientist at NASA Ames. He obtained his Ph.D. at the University of California at San Diego in 2000. He was offered the CAREER award by the NSF, the Dean's award for excellence in research by the College of Engineering at UIUC in 2014, and the outstanding junior award by the Computer Science Department at UIUC in 2005. He won the ASE IEEE/ACM most influential paper award in 2016 (for an ASE 2001 paper), the Runtime Verification test of time award (for an RV 2001 paper), the ACM SIGSOFT distinguished paper awards at ASE 2008, ASE 2016, and OOPSLA 2016, and the best software science paper award at ETAPS 2002.

Panelist: Raouf Boutaba, Professor, University of Waterloo, Canada

Raouf Boutaba is a University Chair Professor of Computer Science and Associate Dean Research of the faculty of Mathematics at the University of Waterloo. He also holds an INRIA International Chair in France. He is the founding Editor in Chief of the IEEE Transactions on Network and Service Management (2007-2010), and the current Editor-in-Chief of the IEEE Journal on Selected Areas in Communications. He served as the general or technical program chair for a number of international conferences including IM, NOMS and CNSM. His research interests are in the areas of network and service management. He has published extensively in these areas and received several journal and conference Best Paper Awards such as the IEEE 2008 Fred W. Ellersick Prize Paper Award. He also received other recognitions, including the Premier's Research Excellence Award, Industry research excellence Awards, fellowships of the Faculty of Mathematics, of the David R. Cheriton School of Computer Science and several outstanding performance awards at the University of Waterloo. He is fellow of the IEEE, a fellow of the Engineering Institute of Canada and a fellow of the Canadian Academy of Engineering..

Tutorials

Tutorial #1
9:00-10:30, Tuesday May 14, 2019

Blockchain and Smart Contracts – From Theory to Practice

Bruno Rodrigues, Eder John Scheid, Roman Blum, Thomas Bocek, and Burkhard Stiller
University of Zurich and HSR Hochschule für Technik Rapperswil, Switzerland

Abstract: Blockchains and Smart Contracts are key concepts helping to build the foundation of a truly distributed digital society. As blockchain-based applications evolve beyond the financial market, many challenges toward its effective integration into existing systems are emerging. This tutorial will provide insights on two challenges in the development of blockchain-based applications. While the first is related to decisions concerning which application areas and use cases blockchains do provide an advantage beyond distributed databases and decentralized systems, the second is related to practical security considerations in the development of Smart Contracts. The audience will be guided through key characteristics that may influence the decision of adoption as well as how to manage on-chain and off-chain information. Then, use cases will be discussed exemplifying how to strike a balance between application requirements and blockchain characteristics. At the end of the tutorial, the audience will have gained insight on when and how to use blockchain and also on fundamental security considerations in the development of Smart Contracts.

Tutorial #2
10:45-12:15, Tuesday May 14, 2019

Enterprise Blockchain Solutions for Financial Services: Techniques and Challenges

Ziyuan Wang, Donghai Liu and Yang Xiang
Swinburne University of Technology, Australia

Abstract: The fundamental of the financial services industry is to facilitate trusted transactions of value between multiple untrusted parties. Lately many financial institutions are considering using blockchain to enable more efficient cross-organizational collaboration in a distributed fashion, by eliminating costly intermediaries, manual processes, and error-prone actions.Based on our industrial experience with Tier 1 banking and insurance clients, in this tutorial, we will provide an overview and hands-on knowledge sharing of enterprise blockchain solutions including shared KYC (Know Your Customer), bank guarantee, trade finance, and real-time insurance. We will demonstrate state-of-the-art techniques, highlight challenges, emerging trends, and share key lessons learned. In addition, we will provide overview in several popular blockchain platforms, and explain how they are applicable in developing enterprise-grade solutions for the financial services industry.

Tutorial #3
13:15-14:45, Tuesday May 14, 2019

Lightning network: off-chain transactions & the future of decentralised value transfer

Mariusz Nowostawski and Rene Pickhardt
Norwegian University of Science and Technology, Norway

Abstract: Blockchain and related technologies have enabled new and interesting ways to facilitate value transfer. Most notably, through direct, potentially privacy-preserving, peer-to-peer exchange of value. The value transfer is one of the key components of Bitcoin. There are two fundamental aspects related to value transfer: scalability (throughput, latency, participants), and privacy. We will focus on one specific technology that addresses both for value transfer: Lightning network]. Similarly to decentralised blockchain systems, Lightning Network consists of the protocol layer (Lightning protocol), as well as the network of nodes (Lightning network). In contrast to other decentralized blockchain systems the Lightning protocol stack operates as Layer 2 on top of an existing blockchain protocol, such as Bitcoin. The concept of payment channels and off-chain transactions

have been in the conceptual development since the first implementation of the Bitcoin protocol itself. Its origin can be traced to the concept of payment channels from Bitcoin 0.1. In recent years, the concepts have been refined and the off-chain payments have been not only in active development, but have been actually deployed in the Bitcoin mainnet. The motivation for this workshop is to explain the fundamental problems, as well as the current state of the art in solving those problems. It is to bring a better understanding of what Lightning is and how it works, what is the current state of the protocol development and deployment, and what work is still to be conducted.

Tutorial #4

15:00-16:30, Tuesday May 14, 2019

Interledger: Theory and Practice

Santeri Paavolainen and Pekka Nikander,
Aalto University, Finland

Abstract: With the spread of pragmatic approaches to blockchains and distributed ledger technologies (DLTs), the need to operate securely across multiple DLTs has become apparent. The class of operations that span two or more DLTs is generally referred to as interledger. Various interledger approaches have been proposed, researched and taken into use, including for example, atomic cross-chain transactions, sidechains, bridging approaches, ledger-of-ledger structures, and layered value transfer protocols, such as the W3C Interledger Protocol (ILP). In this tutorial, we first provide a cohesive backdrop for understanding the motives behind interledger approaches, such as crossing across global DLTs or more locally bridging ledgers more suited for IoT integration with a public ledger. After that, we outline the different types of interledger approaches and their advantages and disadvantages, and describe different use cases and examples where different interledger approaches are applicable.

Tutorial #5

16:45-18:15, Tuesday May 14, 2019

Blockchain for Cyberphysical Systems: Applications, Opportunities and Challenges.

Salil Kanhere, Raja Jurdak, Ali Dorri
UNSW Sydney and Data61 CSIRO, Australia

Abstract: In a cyber-physical system (CPS), computing elements coordinate and communicate with sensors, which monitor cyber and physical indicators, and actuators, which modify the cyber and physical environment where they are run. Current CPS ecosystems rely on centralised, brokered communication models, otherwise known as the client-server paradigm. All devices are identified, authenticated and connected through cloud servers and the data collected by the devices is stored in the cloud for further processing. While this model has connected generic computing devices for decades and will continue to support small-scale CPS networks as we see them today, it will not be able to respond to the growing needs of the large-scale CPS ecosystems of tomorrow with billions of connected devices. Cloud servers will remain a bottleneck and point of failure that can disrupt the entire network. This is especially important as critical services and infrastructure such as healthcare, electric grids, logistics, transportation become dependent on CPS. The current stove-piped architecture has also created isolated data silos, where users have limited control over their data and how it is used. Users have to trust the cloud and application providers and have no choice but to rely on their promises of security and availability. In this tutorial we will explore how Blockchain (BC) technology has the potential to overcome the aforementioned challenges. BC is an immutable timestamp ledger of blocks that is used for storing and sharing data in a distributed manner. The stored data might be payment history, e.g. Bitcoin, or a smart contract or even personal data. In recent years, BC has attracted tremendous attention from practitioners and academics in different disciplines (including law, finance, and computer science) due to its salient features which include distributed structure, immutability and security and privacy. The tutorial will specifically consider four key aspects of CPS which include: (i) Internet of Things; (ii) Intelligent Transportation; (iii) Supply Chain; and (iv) Smart Grids. We will explain relevant concepts, review the state-of-the-art, present representative solutions that have been proposed and discuss open challenges.

Demos

▶ Tuesday, May 15, 10:30 AM – 4:45 PM (Lobby)

D1: Rewarding device-to-device content dissemination using Proof-of-Prestige

Michał Król, Sergi, Reñé, Arnold Cheung, Ioannis Psaras
University College London, United Kingdom

D2: Simulating a Blockchain Network with SimBlock

Ryohei Banno, Kazuyuki Shudo
Tokyo Institute of Technology, Japan

D3: BlockZoom: Large-Scale Blockchain Testbed

Wazen M. shbair[1], Mathis Steichen[1], Jérôme François[2], Radu State[1]
University of Luxembourg, Luxembourg1, INRIA Nancy Grand Est, France2

D4: Interledger Demo: IoT Integration

Santeri Paavolainen, Pekka Nikander
Aalto University, Finland

D5: Demo: Blockchain for the Simplification and Automation of KYC Result Sharing

Robert Norvill, Mathis Steichen, Wazen M. Shbair, Radu State
University of Luxembourg, Luxembourg

D6: A Platform-independent, Generic-purpose, and Blockchain-based Supply Chain Tracking

Sina Rafati Niya, Danijel Dordevic, Atif Ghulam Nabi, Tanbir Mann, Burkhard Stiller
University of Zürich, Switzerland

D7: EUREKA – A Minimal Operational Prototype of a Blockchain-based Rating and Publishing System

Andreas Schaufelbühl[1], Sina Rafati Niya[1], Lucas Pelloni[1], Severin Wullschleger[1], Thomas Bocek[2], Lawrence Rajendran[3], Burkhard Stiller[1]
University of Zürich, Switzerland[1], HSR University of Applied Sciences Rapperswil, Switzerland[2], King's College London, United Kingdom[3]

D8: Adaptation of Proof-of-Stake-based Blockchains for IoT Data Streams

Sina Rafati Niya[1], Eryk Schiller[1], Ile Cepilov[1], Fabio Maddaloni[1], Kürsat Aydinli[1], Timo Surbeck[1], Thomas Bocek[2], Burkhard Stiller[1]
University of Zürich, Switzerland[1], HSR University of Applied Sciences Rapperswil, Switzerland[2]

D9: SDPP: Streaming Data Payment Protocol for Data Economy

Rahul Radhakrishnan, Gowri Sankar Ramachandran, Bhaskar Krishnamachari
University of Southern California, USA

Technical, Short Paper & Poster Sessions

▶ Wednesday, May 15, 2019

TS: Technical Session, PS: Poster Session
SPS: Short Paper session

08:30AM – 09:45AM (Main Hall)	**TS1: Blockchain-based Network Services** *Chair: Sandip Chakraborty, IIT Kharagpur, India*
	RouteChain: Towards Blockchain-based Secure and Efficient BGP Routing Muhammad Saad, Afsah Anwar, Ashar Ahmad, Hisham Alasmary, Murat Yuksel, Aziz Mohaisen University of Central Florida, USA
	BlockONS: Blockchain based Object Name Service Wondeuk Yoon[1], Indal Choi[2], Daeyoung Kim[1] KAIST, Republic of Korea[1] LG Electronics, Republic of Korea[2]
	Trinity: A Byzantine Fault-Tolerant Distributed Publish-Subscribe System with Immutable Blockchain-based Persistence Gowri Sankar Ramachandran[1], Kwame-Lante Wright[1], Licheng Zheng[1], Pavas Navaney[1], Muhammad Naveed[1], Bhaskar Krishnamachari[1], Jagjit Dhaliwal[2] University of Southern California, USA[1] County of Los Angeles, USA[2]
9:45AM – 10:15PM (Lobby)	**PS1:** *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*
	Energy-recycling Blockchain with Proof-of-Deep-Learning Changhao Chenli, Boyang Li, Yiyu Shi, Taeho Jung University of Notre Dame, USA
	CaIV: Cast-as-Intended Verifiability in Blockchain-based Voting Raphael Matile, Bruno Rodrigues, Eder Scheid, Burkhard Stiller University of Zurich UZH, Switzerland
	Increasing Trust in Tor Node List Using Blockchain Luk´aˇs Hellebrandt, Ivan Homoliak, Kamil Malinka, Petr Han´aˇcek Brno University of Technology, Czech Republic
	A Fault Resilient Consensus Protocol for Large Permissioned Blockchain Networks Chander G[1], Pralhad Deshpande[2], Sandip Chakraborty[3] IBM Research, India[1] Anquan Capital, Singapore[2] IIT Kharagpur, India[3]
	Towards Human-readable Smart Contracts Felix Franz[1], Tobias Fertig[1], Andreas E. Sch¨utz[1], Henry Vu[2] University of Applied Sciences W¨urzburg-Schweinfurt, Germany[1] PENTASYS AG, Germany[2]
11:15AM – 12:45PM (Main Hall)	**TS2: Blockchain Platforms** *Chair: Kihyung Kim, Ajou University, Korea*
	Incentives in Ethereum's Hybrid Casper Protocol Vitalik Buterin[1], Daniel Reijsbergen[2], Stefanos Leonardos[2], Georgios Piliouras[2] Ethereum Foundation, Switzerland[1] Singapore University, Singapore[2]
	Quantum Bitcoin: An Anonymous, Distributed, and Secure Currency Secured by the No-Cloning Theorem of Quantum Mechanics Jonathan Jogenfors, Linköping University, Sweden.
	A Solution for the Risk of Non-deterministic Transactions in Hyperledger FabricInsun Jang, Shenbin Zhang[1], Ence Zhou[1], Bingfeng Pi[1], Jun Sun[1], Kazuhiro Yamashita[2], Yoshihide Nomura[2] Fujitsu Reasearch & Development Center Co., Ltd, P.R. China[1] Fujitsu Laboratories, Japan[2]

1:30PM – 2:45PM (Main Hall)	**TS3: Decentralized Trust** *Chair: Andreas Veneris, University of Toronto, Canada*
	Solving the Buyer and Seller's Dilemma: A Dual-Deposit Escrow Smart Contract for Provably Cheat-Proof Delivery and Payment for a Digital Good without a Trusted Mediator Aditya Asgaonkar, Bhaskar Krishnamachari University of Southern California, USA
	BANKLAVES: Concept for a Trustworthy Decentralized Payment Service for Bitcoin Matthias Grundmann, Marc Leinweber, Hannes Hartenstein Karlsruhe Institute of Technology, Germany
	A Scalable Blockchain Approach for Trusted Computation and Verifiable Simulation in Multi-Party Collaborations Ravi Kiran Raman[1 2], Roman Vaculin[2], Michael Hind[2], Sekou L. Remy[3], Eleftheria K. Pissadaki[2], Nelson Kibichii Bore[3], Roozbeh Daneshvar[2], Biplav Srivastava[2], Kush R. Varshney[2] University of Illinois at Urbana-Champaign, USA[1] IBM Research, USA[2] IBM Research, Kenya[3]
4:15PM – 4:45PM (Main Hall)	**PS2:** *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*
	MTFS: Merkle-Tree-Based File System Jia Kan, Kyeong Soo Kim Xi'an Jiaotong-Liverpool University, China
	A Payment Channel Based Hybrid Decentralized Ethereum Token Exchange Xuan Luo[1], Wei Cai[2], Zehua Wang[1], Xiuhua Li[1], Victor C. M. Leung[1] University of British Columbia, Canada[1] The Chinese University of Hong Kong, Shenzhen, China[2]
	Improving Vendor-managed Inventory Strategy Based on Internet of Things (IoT) Applications and Blockchain Technology Tom Dasaklis, Fran Casino University of Piraeus, Greece
	Permissionless Blockchains and Secure Logging Chunpeng Ge[1], Siwei Sun[2], Pawel Szalachowski[1] Singapore University of Technology and Design, Singapore[1] Data Assurance and Communication Security Research Center, China[2]
	Peer-to-Peer EngergyTrade: A Distributed Private Energy Trading Platform Ali Dorri[1 2], Ambrose Hill[1 2], Salil Kanhere[1], Raja Jurdak[2], Fengji Luo[3], Zhao Yang Dong[1] UNSW, Australia[1] DATA61 CSIRO, Australia[2] University of Sydney, Australia[3]
	Transparent Logging with Hyperledger Fabric Christian Schaefer, Christine Edman Ericsson AB, Sweden
4:45PM – 6:00PM (Main Hall)	**TS4: Security** *Chair: Christopher Harris, University of Northern Colorado, USA*
	Mempool Optimization for Defending Against DDoS Attacks in PoW-based Blockchain Systems Muhammad Saad[1], Laurent Njilla[2], Charles Kamhoua[3], Joongheon Kim[4], DaeHun Nyang[5], Aziz Mohaisen[1] University of Central Florida, USA[1] Air Force Research Laboratory, USA[2] Army Research Laboratory, USA[3] Chung-Ang University, Republic of Korea[4] Inha University, Republic of Korea[5]
	Proof-of-Prestige: A Useful Work Reward System for Unverifiable Tasks Michał Król, Alberto Sonnino, Mustafa Al-Bassam, Argyrios Tasiopoulos, Ioannis Psaras University College London, United Kingdom

	An Evaluation of Bitcoin Address Classification based on Transaction History Summarization Yu-Jing Lin[1], Po-Wei Wu[1], Cheng-Han Hsu[1], I-Ping Tu[2], Shih-wei Liao[1] National Taiwan University, Republic of China[1] Academia Sinica, Taiwan[2]
6:00PM – 8:00PM (Main Hall)	**PS3**: *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*
	Detection of Tampered Images Using Blockchain Technology Nour Jnoub, Wolfgang Klas University of Vienna, Austria
	Digitizing Invoice and Managing VAT Payment Using Blockchain Smart Contract Van-Cam NGUYEN[1], Hoai-Luan PHAM[2], Thi-Hong TRAN[2], Huu-Thuan HUYNH[1], Yasuhiko AKASHIMA[2] Vietnam National University, Vietnam[1] Nara Institute of Science and Technology, Japan[2]
	Lottery DApp from Multi-Randomness Extraction Yu-Chi Chen, Song-Yi Hsu, Ting-Wei Chang, Ting-Wei Wu Yuan Ze University, Taiwan
	Towards Blockchain Interoperability: Improving Video Games Data Exchange Léo Besançon, Catarina Ferreira Da Silva, Parisa Ghodous Université Claude Bernard Lyon 1, France
	FPGALedger: FPGA based Decentralized Ledger for Enterprise Applications Han-Yee Kim[1], Lei Xu[2], Weidong Shi[3], Taeweon Suh[1] Korea University, Republic of Korea[1] Conduent Technology Innovation, USA[2]
	The Design of a Mobile Number Portability System on a Permissioned Private Blockchain Platform Dilip Krishnaswamy, Kanchan Chauhan, Aayush Bhatnagar, Shailesh Jha, Shobhit Srivastava, Dipender Bhamrah, Manish Prasad Reliance Jio Infocomm, India

▶ Thursday, May 16, 2019

8:30AM – 9:45AM Short Papers (Main Hall)	**SPS**: **Blockchain & Cryptocurrency** *Chair: Mariusz Nowostawski, Norwegian University of Science and Technology, Norway*
	Enhancing Engagement in Token-Curated Registries via an Inflationary Mechanism Yi Lucy Wang, Bhaskar Krishnamachari, Gowri Ramachandran University of Southern California, USA
	Standardising smart contracts: Automatically inferring ERC standards Robert Norvill[1], Beltran Borja Fiz Pontiveros[1], Radu State[1], Andrea Cullen[2] University of Luxembourg, Luxemburg[1] University of Bradford, United Kingdom[2]
	Proof of Delivery in a Trustless Network Kyle Park[1], Kideok Cho[1], Dookyoon Han[1], Ted Taekyoung Kwon[2], Sangheon Pack[3] Network Defines, Inc., Republic of Korea[1] Seoul National University, Republic of Korea[2] Korea University, Republic of Korea[3]
	Formal Verification of Token Economy Models O.Letychevskyi[1], M.Poltoratzkyi[2], V.Peschanenko[1], P.Kovalenko[3], V.Radchenko[1], S.Mogylko[3] Garuda AI B.V., Netherlands[1] Kherson State University, Ukraine[2] Skillonomy, Ukraine[3]
	Elasticoin: Low-Volatility Cryptocurrency with Proofs of Sequential Work Yuhao Dong, Raouf Boutaba University of Waterloo, Canada

9:45AM – 10:15AM (Lobby)	**PS4:** *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*
	Sora: A Decentralized Autonomous Economy Makoto Takemiya Soramitsu Co., Ltd., Japan
	Blockchain based Proxy Re-Encryption Scheme for Secure IoT Data Sharing Ahsan Manzoor[1], Madhsanka Liyanage[1 2], An Braeken[3], Salil S. Kanhere[4], Mika Ylianttila[1] University of Oulu, Finland[1] University College Dublin, Ireland[2] Vrije Universiteit Brussel, Belgium[3] University of New South Wales, Australia[4]
	The Risks and Challenges of Implementing Ethereum Smart Contracts Christopher G. Harris University of Northern Colorado, USA
	Security Management and Visualization in a Blockchain-based Collaborative Defense Christian Killer, Bruno Rodrigues, Burkhard Stiller University of Zurich UZH, Switzerland
	On Using Blockchain Based Workflows Nelson Bore, Andrew Kinai, Juliet Mutahi, David Kaguma, Fred Otieno, Sekou L. Remy, Komminist Weldemariam IBM Research, Kenya
	Blockchain Explorer based on RPC-based Monitoring System Chaehyeon Lee, Heegon Kim, Sajan Maharjan, Kyungchan Ko, James Won-Ki Hong POSTECH, Republic of Korea
11:15AM – 12:30PM (Main Hall)	**TS5: Information Sharing Applications** *Chair: Gowri Ramachandran, University of Southern California, USA*
	Promoting Distributed Trust in Machine Learning and Computational Simulation Nelson Kibichii Bore[1], Ravi Kiran Raman[2 3], Isaac M. Markus[1], Sekou L. Remy[1], Oliver Bent[1 4], Michael Hind[2], Eleftheria K. Pissadaki[2], Biplav Srivastava[2], Roman Vaculin[2] IBM Research, Kenya[1] IBM Research, USA[2] University of Illinois at Urbana-Champaign, USA[3] University of Oxford, United Kingdom[4]
	A Response to the United Nations CITES Blockchain Challenge: Incremental and Integrative PoA-based Permit Exchange Anselm Busse[1], Jacob Eberhardt[1], Sebastian Frost[1], Dong-Ha Kim[1], Thore Weilbier[1], Lukas Renner[1], Matthias Roth[2], Stefan Tai[1] Technische Universität Berlin, Germany[1] Adesso Schweiz AG, Switzerland[2]
	A Blockchain-based Scientific Publishing Platform Sina Rafati Niya[1], Lucas Pelloni[1], Severin Wullschleger[1], Andreas Schaufelbühl[1], Thomas Bocek[2], Lawrence Rajendran[3], Burkhard Stiller[1] University of Zurich UZH, Switzerland[1] HSR Hochschule für Technik Rapperswil, Switzerland[2] Kings College London, United Kingdom[3]
1:30PM – 2:45PM (Main Hall)	**TS6: Access Control Application** *Chair: Laurie Lau, APATAS, Hong Kong*
	On Public Decentralized Ledger Oracles via a Paired-Question Protocol Marco Merlini, Neil Veira, Ryan Berryhill, Andreas Veneris University of Toronto, Canada
	DAcc: Decentralized Ledger based Access Control for Enterprise Applications Isaac Markus, Lei Xu, Subhod I, Nikhil Nayab Conduent Technology Innovation, USA

	Logging mechanism for cross-organizational collaborations using Hyperledger Fabric Laurens Van Hoye, Pieter-Jan Maenhaut, Tim Wauters, Bruno Volckaert, Filip De Turck Ghent University, Belgium
4:15PM – 4:45PM (Lobby)	**PS5**: *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*
	Integration of Fog Computing and Blockchain Technology Using the Plasma Framework Michael Herbert Ziegler, Marcel Großmann, Udo R. Krieger University of Bamberg, Germany
	Distributed Ledger Witness Selection in Bounded Width Directed Acyclic Graphs Andrew Gorczyca, Audrey Decker Air Force Research Lab, USA
	Measuring ICO Performance Indicators: An Empirical Study Via White Papers Charlotte, Shiao-Han Wu, Huang-Chih Sung, Tsung-Chi Cheng National Chengchi University, Taiwan
	BlockSIM: A practical simulation tool for optimal network design, stability and planning Santosh Pandey[1], Gopal Ojha[1], Bikesh Shrestha[1], Rohit Kumar[2] Rosebay Consulting, Nepal[1] Rosebay Group, Nepal[2]
	Empirical Performance Evaluation and Mathematical Analysis of the EOS.IO Blockchain Protocol Zachary Cole[1], Bhaskar Krishanmachari[2] Whiteblock, Inc, USA[1] USC Viterbi School of Engineering, USA[2]
	Visualising Bitcoins Dynamic P2P Network Topology and Performance Meryam Essaid, Sejin Park, Hongteak Ju Keimyung University, Republic of Korea
4:45PM – 6:00PM (Main Hall)	**TS7**: **Distributed Consensus** *Chair: Thomas Bocek, HSR Hochschule für Technik Rapperswil, Switzerland*
	Scalable BFT Consensus Mechanism Through Aggregated Signature Gossip Jieyi Long, Ribao Wei Theta Labs, Inc, USA
	Enforcing Fairness in Blockchain Transaction Ordering Ariel Orda, Ori Rottenstreich Technion and Orbs, Israel
	Weighted Voting on the Blockchain: Improving Consensus in Proof of Stake Protocols Stefanos Leonardos, Daniel Reijsbergen, Georgios Piliouras Singapore University of Technology and Design, Singapore

▶ Friday, May 17, 2019

8:30AM – 9:45AM (Main Hall)	**TS8**: **Security Application** *Chair: Wei Cai, The Chinese University of Hong Kong, Shenzhen, China*
	Design of Trusted B2B Market Platforms using Permissioned Blockchains and Game Theory Shivika Narang[1], Megha Byali[1], Pankaj Dayama[2], Vinayaka Pandit[2], Yadati Narahari[1] Indian Institute of Science, India[1] IBM Research, India[2]
	Unleashing the Full Potential of Blockchain Technology for Security-Sensitive Business Applications Alexander Marsalek[1], Christian Kollmann[2], Thomas Zefferer[2], Peter Teufl[2] Graz University of Technology, Austria[1] A-SIT Plus GmbH, Austria[2]

9:45AM – 10:15AM (Lobby)	**PS6:** *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*
	Achieving Fairness in the Tangle through an Adaptive Rate Control Algorithm Luigi Vigneri, Wolfgang Welz, Alon Gal, Vassil Dimitrov IOTA Foundation, Germany
	Usability and Security Analysis of the KeepKey Wallet Emad Almutairi[1], Shiroq Al-Megren[2] King Abdulaziz City for Science and Technology, Saudi Arabia[1] King Saud University, Saudi Arabia[2]
	Identification of Darknet Markets' Bitcoin Addresses by Voting Per-address Classification Results Kota Kanemura, Kentaroh Toyoda, Tomoaki Ohtsuki Keio University, Japan
	Mint Centrality: A Centrality Measure for the Bitcoin Transaction Graph Beltran Borja Fiz Pontiveros, Mathis Steichen, Radu State University of Luxembourg, Luxemburg
	Various Perspectives in New Blockchain Design by Using Theory of Inventive Problem Solving Song-Kyoo Kim[1], Chan Yeob Yeun[1], Ernesto Damiani[1], Yousef Al-Hammadi[2] Khalifa University, UAE[1] UAE University, UAE[2]
	A Landscape of Cryptocurrencies Zhaofang Li[1], Qinghua Lu[2], Shiping Chen[2], Yue Liu[1], Xiwei Xu[2] China University of Petroleum, China[1] Data61, CSIRO, Australia[2]
11:15AM – 12:30PM (Main Hall)	**TS9: Smart Contracts** *Chair: Raja Jurdak, CSIRO, Australia*
	Probabilistic Smart Contracts: Secure Randomness on the Blockchain Krishnendu Chatterjee[1], Amir Kafshdar Goharshady[1], Arash Pourdamghani[2] IST Austria, Austria[1] Sharif University of Technology, Iran[2]
	Verifiable Smart Contract Portability Martin Westerkamp Technical University of Berlin, Germany
	Dispute Resolution for Smart Contract-based Two-Party Protocols Eric Wagner, Achim Völker, Frederik Fuhrmann, Roman Matzutt, Klaus Wehrle RWTH Aachen University, Germany
1:30PM – 3:10PM (Main Hall)	**TS10: Performance** *Chair: Sejin Park, Keimyung University, Korea*
	Churn in the Bitcoin Network: Characterization and Impact Muhammad Anas Imtiaz, David Starobinski, Ari Trachtenberg, Nabeel Younis Boston University, USA
	Private Transaction Retrieval for Lightweight Bitcoin Client Yankai Xie[1 2], Chi Zhang[1], Lingbo Wei[1 2], Yukun Niu[1], Faxing Wang[1] University of Science and Technology of China, P. R. China[1] Chinese Academy of Sciences, P. R. China[2]
	Velocity: Scalability Improvements in Block Propagation Through Rateless Erasure Coding Nakul Chawla, Hans Walter Behrens, Darren Tapp, Dragan Boscovic, K. Selçuk Candan Arizona State University, USA
	FastFabric: Scaling Hyperledger Fabric to 20,000 Transactions per Second Christian Gorenflo[1], Stephen Lee[2], Lukasz Golab[1], Srinivasan Keshav[1] University of Waterloo, Canada[1] University of Massachusetts, USA[2]
	PS7: *Chairs: KyungChan Ko, POSTECH, Korea & Meryam Essaid, Keimyung University, Korea*

	Hermes: An Open and Transparent Marketplace for IoT Sensor Data over Distributed Ledgers Pavlos Tzianos, Georgios Pipelidis, Nikos Tsiamitros Technical University of Munich, Germany
	A Conceptual Blockchain-Based Architecture for Data Markets José Parra Moyano, Karl Schmedders University of Zurich, Switzerland
	Blockchain-Based Solution to Prevent Postage Stamps Fraud Darya Korepanova[1 2], Stanislav Kruglik[3], Yash Madhwal[3], Timur Myaldzin[4 5], Ivan Prokhorov[1 5], Igor Shiyanov[4], Sergey Vorobyov[1 2], Yury Yanovich[1 3 6] Bitfury, Netherland[1] National Research University Higher School of Economics, Russia[2] Skolkovo Institute of Science and Technology, Russia[3] Russian Post, Russia[4] Lomonosov Moscow State University, Russia[5] Institute for Information Transmission Problems (IITP RAS), Russia[6]
	On the specification and verification of atomic swap smart contracts Ron van der Meyden UNSW Sydney, Australia
3:10PM – 3:40PM	On the Effectiveness of Multi-Token Economies Sean Kang[1], Kideok Cho[2], Kyle Park[2] SK Telecom, Republic of Korea[1] Network Defines, Republic of Korea[2]
(Lobby)	Punishment not Reward: Disincentivising Blockchain Application Misbehaviour Richard Banach University of Manchester, United Kingdom

Registration Hours

* All attendees and accompanying guests must register and receive a conference badge in order to participate in conference activities. Photo ID is required. Individuals are responsible for picking up their own registration packages. No attendee will be allowed to pick up registration for their colleagues.

* Local registration hours for the conference in SKT-Tower Seoul:

DATE	Location	TIME
May 14	Supex Hall Registration Desk 4th floor, SKT Tower	08:00 – 18:00
May 15-17	Supex Hall Registration Desk 4th floor, SKT Tower	07:30 – 18:00

Venue

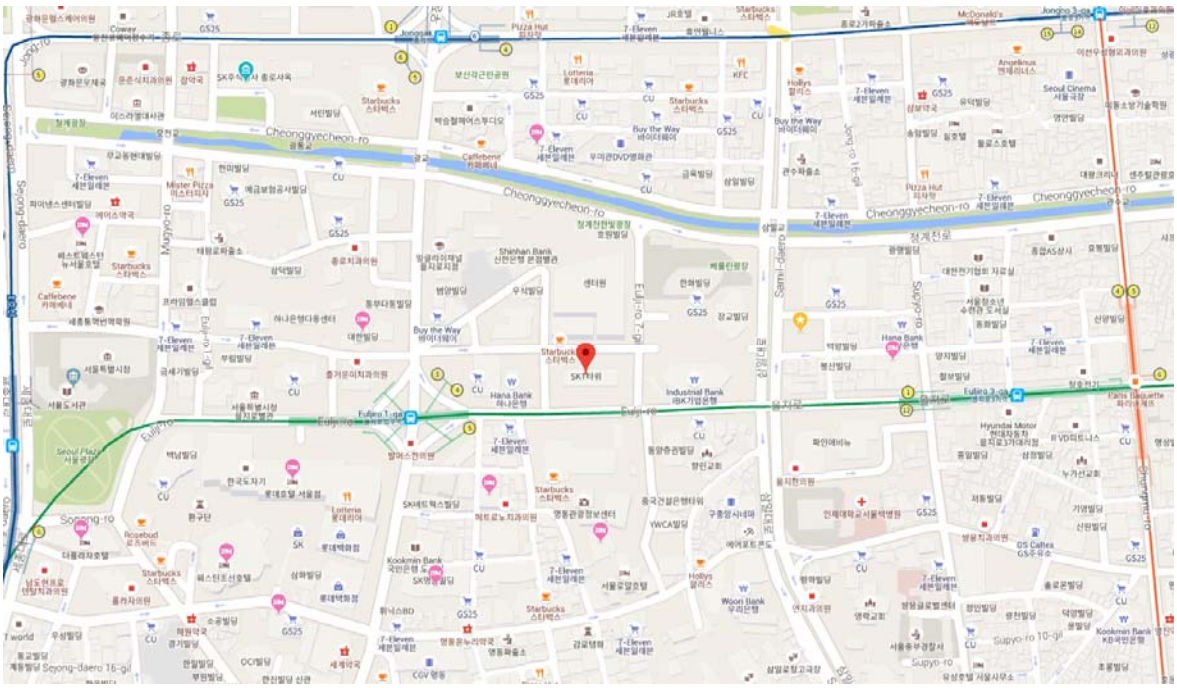
2019 IEEE International Conference on Blockchain and Cryptocurrency will be held at:

Supex Hall, 4th Floor, SKT Tower

65 Eulji-ro, Myeong-dong, Jung-gu,
Seoul, Korea

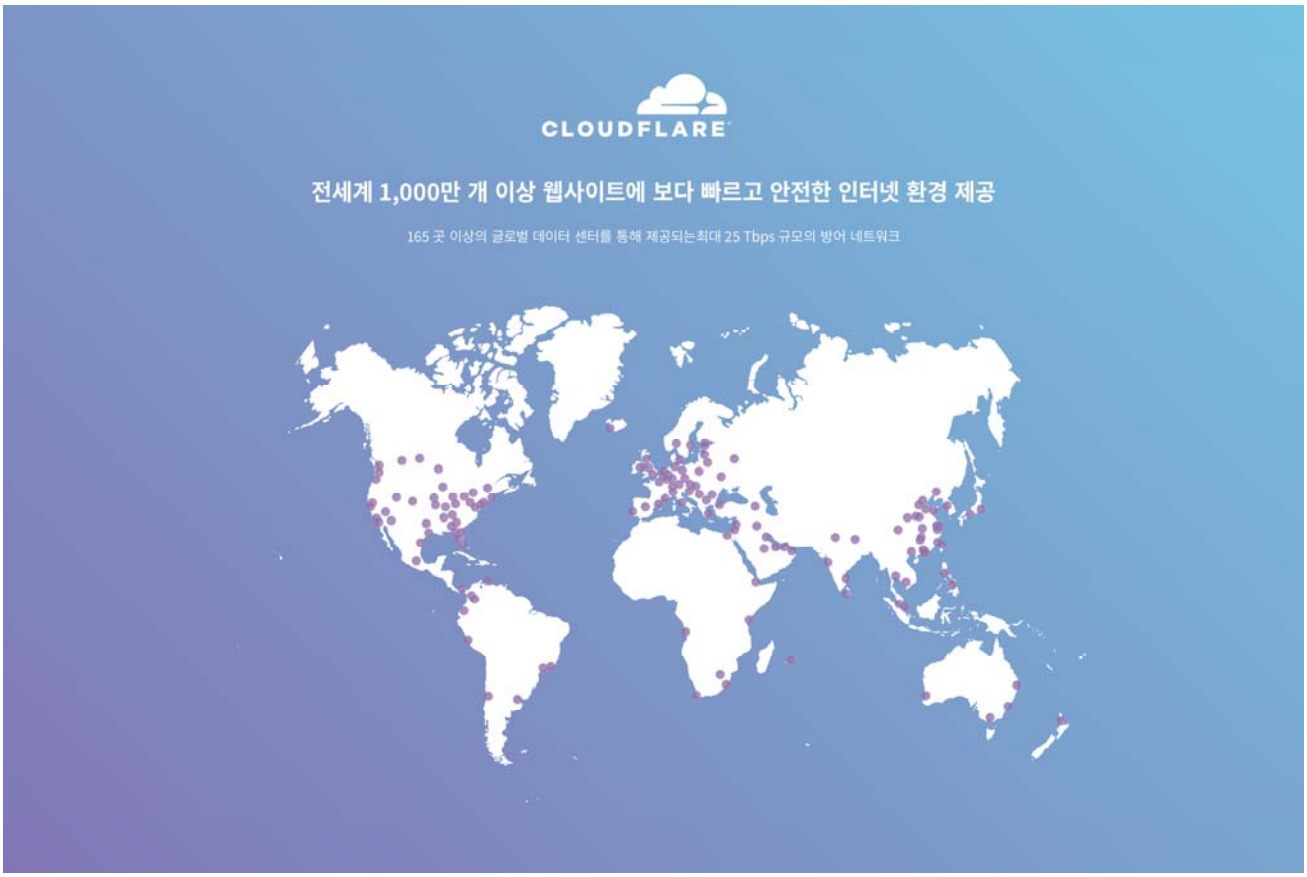
The ICBC 2019 is using Supex Hall which is located on the 4th floor of SKT Tower building, the headquarter of SKTelcom. SKT Tower is located in a core downtown area of Seoul, where Seoul City Hall and Palaces from Chosun Dynasty as well as many tourist attractions are nearby. It is located between Euljiro-1ga of Subway Line 2 and Euljiro-3ga of Subway Line 3.

SKT Tower is located near the Seoul City Hall




SK telecom
시대, 생활이 되다


SKT 5GX


CLOUDFLARE
전세계 1,000만 개 이상 웹사이트에 보다 빠르고 안전한 인터넷 환경 제공
165 곳 이상의 글로벌 데이터 센터를 통해 제공되는최대 25 Tbps 규모의 방어 네트워크

MUI META-BLOCKCHAIN

● New Coin Minting ● Token to Coin Coversion ● Coin Pegging

The SovereignWallet Network plans to create a genesis block of MUI Meta-blockchain and to launch the mainnet exactly 12 years after Bitcoin genesis block creation. This will realize Hayek's vision.

MUI Meta-blockchain is the first crypto money to complete Satoshi's vision. It is a stable coin based on Algorithmic Central Bank system, that combines the decentralized cryptocurrency technology with the technology of digital currency of the central banks.

MUI Meta-blockchain is a programmable blockchain that will be able to support multiple cryptocurrencies in a single blockchain

SOVEREIGNWALLET NETWORK

총상금 100만 ICX
ICON TX CHALLENGE에 참여하세요!

— 참가팀 국내/외 공모

아이콘 재단이 블록체인 생태계 발전을
도모하고 블록체인 개발자를 유치 및 지원하기 위해
다음과 같은 내용을 전세계 공모합니다.

참가대상

전 세계 모든 Blockchain & Cryptocurrency 예비 전문가

참가방법

1. ICON Protocol을 이용해 Smart Contract(SCORE)를 제작
2. 제작한 SCORE를 이용해 TX을 발생시키는 서비스
   (DApp 혹은 Web page)제작
3. TX을 발생시켜 TX상금을 수령하고 DApp 및 서비스를
   발전시켜 최종시상 상금 수령

상세방법

1. ICON Event Page에 들어가 이벤트 상세 내용 및 개발 관련 팁을
   정독한다.
2. ICON Protocol을 이용하여 Block Chain Smart Contract
   (SCORE)를 제작한다.
3. 제작된 SCORE를 MainNet에 Deploy 신청한다.
4. SCORE를 사용하여 TX가 일어나는 서비스 (DApp 혹은
   Web page)를 제작한다.
5. Audit을 통과한 SCORE(Smart Contract) 주소, DApp 혹은 서비스
   Web Page 링크, 시비스에 대한 간단한소개(UI 사용법 등)와 함께
   이름, 이메일, 연락처를 기재하여 참가신청을 완료한다.
6. SCORE를 통해 매일 TX를 발생시켜 TX Reward를 받고,
   DApp 혹은 서비스를 발전시켜 최종 시상 대상팀에 선정된다.

이벤트기간

참가신청 시작일	TX count 시작일	참가 신청 및 TX count 마감일
5월 2일	6월 3일	7월 31일

시상내역

구 분	팀 수	시상금
총상금	-	100만 ICX
참가상금	최대 250팀	200 ICX
TX Reward	제한 없음	60만 ICX
최종시상	6팀	5만 ICX

수상 및 특전

총상금 100만 ICX

참가상금 5만 ICX : SCORE Audit 승인 후 참가가 확정 된 팀에게는
참기상금 200 ICX 지급

TX Reward 60만 ICX : 이벤트 기간 동안 1TX 당 0.01 ICX 지급.
일별 정산하며 하루 최대 2만 TX 인정

- 지깁 1개당 하루 최대 200 TX 인정
- 이벤트 기간 동안 일별 200 ICX 수령 가능

최종 시상 30만 ICX : 이벤트 종료 시점의 DApp의 완성도, 사업성, 기술성,
블록체인 효용성의 심사 기준에 따라 아이콘 재단 자체
심의를 통해 6팀 선정

- 이벤트 종료 후 2주이내 선정 및 시상
- 선정된 6팀에게 각각 5만 ICX 시상
- 종료 후 특전 : ICON 한국 office 채용 가산점 혹은 Internship 기회
  제공, 참가팀에 대해 투자유치 검토

※ Contest Contribution reward 5만 ICX : 상세 내용 추후 공지
250팀 이상 참가신청 완료시 참가상금 지급 자동종료 : 참가신청은 계속 가능
TX Reward 60만 ICX 소진 시 Reward 지급 자동종료

※ 이벤트 진행 및 상금, Reward 지급 기준 관련 상세내용은 접수 및 신청 전에 아래 이벤트
웹페이지의 공지사항에서 필히 확인하시기 바랍니다

참가신청 및 문의

챌린지 참가 신청 : https://forms.gle/KkMLXNC9AT3EWWz66
문의 : support@iconloop.com