

The 37th International Conference on Information Networking (ICOIN 2023)

January 11 (Wed.) - 14 (Sat.), 2023
Bangkok, Kingdom of Thailand & Virtual Conference



Conference Program

Organized by



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Organizing Committee Members.....	4
Technical Program Committee Members	5
Message from the ICOIN 2023 General Co-Chairs	8
Message from the ICOIN 2023 TPC Co-Chairs	9
ICOIN 2023 Program at a Glance.....	10
Keynote Speeches.....	12
Tutorials	15
Oral Sessions.....	17
Poster Sessions.....	23
Conference Room Map	27
Venue	28
Travel Information	30

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Message from the ICOIN 2023 General Co-Chairs

On behalf of the whole organizing committee members, we welcome you to the 37th International Conference on Information Networking (ICOIN 2023). We are very grateful to have many talented and very well responsible people involved in the process of submitting papers, chairing sessions, reviewing papers, and organizing the conference.

This event is a product of the hardship of many committee members who have worked beyond deadlines for the perfect conference and performed the tedious task of advertisement in the best of manners. The conference is an amalgam of high-quality submissions brought forward by thorough research to meet the high standard required, as of today's world.

We are also pleased to let you know that, this year, ICOIN has reached its 37th event. ICOIN 2023 is ready to serve you with ever heightened quality of technical programs. You will find the technical sessions organized in 3 days interesting, informative and inspiring.

Even though we have seen the ending of the pandemic and building back better, substantial uncertainties still remain on safety and feasibility of activities and events worldwide. ICOIN 2023 has therefore taken the decision to invite the participants in the on-site venue of Bangkok, and at the same time, we have decided to put our best energy in organizing a hybrid event, which supports the on-line conference.

We thank all the participants who continue to collaborate with ICOIN 2023, and to reassure all of you that ICOIN 2023 is fully committed to creating a hybrid event up to the highest standards of computer communications and network technology.

Again, we would like to express our sincere gratitude to the committee members and referees who made tremendous contributions to this event.

Our special thanks are due to Profs. Seokjoo Shin, Minho Park, Joohyun Lee, David (Bong Jun) Choi, Haeyoung Lee, Mikio Hasegawa, and Nurul Sarkar: the Program Committee Chair, Prof. Haneul Ko, and Dongkyun Kim: the Finance Chair, Profs. JungRyun Lee, Joohyun Lee, Sungoh Kwon, Carlos Becker Westphall, Yasuo Okabe, and Jyh-Cheng Chen: Publicity Co-chairs, Profs. Sangoh Park and HyungJune Lee: Publication chair, Profs. Woongsoo Na, Changhee Joo, Taeyoon Kim: Registration Chair, Profs. Joongheon Kim, Junbeom Hur, Guan-Hsiung Liaw, and Katsuyoshi Iida: Workshop Chair, Prof. Laihyuk Park: Internet Media Chair, Profs. Hyosu Kim, Yongseok Son, Yeunwoong Kyung, Jaehwan Lee: Local Arrangement Chair and all other Chairs.

We wish your participation in ICOIN 2023 being a memorable one with both valuable technical exchanges and wonderful cultural and outdoor experiences.



Yongtae Shin
Soongsil University, South Korea



Sang-Chul Kim
Kookmin University, South Korea



Somnuk Keretho
Kasetsart University, Thailand



Tomoki Yoshihisa
Osaka University, Japan



Nen-Fu (Fred) Huang
National Tsing Hua University, Taiwan



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The University of Electro-Communications, Japan



Panjai Tantatsanawong
Silpakorn University, Thailand



Hiroyuki Ohsaki
Kwansei Gakuin University, Japan



Giacomo Morabito
University of Catania, Italy



Sinchai Kamolphiwong
Prince of Songkla University, Thailand

General Co-Chairs, ICOIN 2023

Message from the ICOIN 2023 TPC Co-Chairs

It is our great pleasure to welcome all of you to Bangkok, Kingdom of Thailand for the 37th International Conference on Information Networking (ICOIN). With its 37 years of rich history, ICOIN 2023 has been an exciting conference covering many recent advances in computer communications and network technologies in both academic and practical aspects.

In particular, the conference will be highlighted by keynote speeches and tutorials from world-renowned researchers from around the world. Our prestige invited speakers will share their views and experiences about Smart City in Thailand, Semantic Communication, Metaverse over 6G, AI+Energy, Deep Intelligence on Embedded Systems, and Data-driven Strategies for Sustainable IoT.

In addition, for this year's conference, we received 235 paper submissions from 31 countries, and all papers were rigorously reviewed by at least three independent reviewers. Among them, 90 papers have been accepted for oral presentations and 67 papers for poster presentations. There will be 18 technical sessions for oral presentations, held in 3 parallel tracks, and 6 poster sessions for poster presentations. The program covers a wide range of latest advancements in Computer Communication and Networking including Edge Computing, Security, Machine Learning, SDN, IoT, Privacy, Resource Allocation, Energy, Health, and Wireless Communications.

We appreciate all authors who submitted papers to this conference and all reviewers who spent their precious time and carefully reviewed papers. We also thank the technical program committee members for their endless commitment and dedication for preparation of this conference. Also, we would like to thank our sponsors, KIISE, IEEE, IEEE Computer Society, IEICE, and KICS, for their generous support. We express our deepest gratitude to the general co-chairs, Prof. Yongtae Shin, Prof. Sang-Chul Kim, Prof. Somnuk Keretho, Prof. Tomoki Yoshihisa, Prof. Nen-Fu (Fred) Huang, Prof. Takeo Fujii, Prof. Panjai Tantatsanawong, Prof. Hiroyuki Ohsaki, Prof. Giacomo Morabito, and Prof. Sinchai Kamolphiwong for their strong support and guidance.

We hope all of you enjoy the fantastic program of ICOIN 2023 as well as the attractions of Bangkok.



Seokjoo Shin
Chosun University, South Korea



Minho Park
Soongsil University, South Korea



Joohyun Lee
Hanyang University, South Korea



David(Bong Jun) Choi
Soongsil University, South Korea



Haeyoung Lee
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Mikio Hasegawa
Tokyo Univ. of Science, Japan



Nurul Sarkar
Auckland University of Technology, New Zealand

Technical Program Committee Co-Chairs, ICOIN 2023

ICOIN 2023 Program at a Glance

TIME	Sukhumvit II(3F)	Manhattan Studio(2F)	Ploenchit III(3F)
January 10, 2023 (Tuesday)			
15:00-18:00	Organizing Committee (OC) Meeting	Steering Committee (SC) Meeting	
January 11, 2023 (Wednesday)			
10:00-10:40	Opening, TPC Report, and Award (Chair: Prof. Bong Jun Choi, Soongsil University, Korea)		
10:40-11:40	Keynote Speech 1: "AI+Energy: AI Techniques towards the Carbon Neutral Era" Prof. Chongkwon Kim, Korea Institute of Energy Technology (KENTECH), Korea (Chair: Prof. Sang-Chul Kim, Kookmin University, Korea)		
11:40-13:00	Lunch Break		
13:00-14:40	Session A-1 Wireless 1 (Chair: Dr. Eunil Seo, Umeo University, Sweden)	Session B-1 Edge Computing 1 (Chair: Dr. Ram Narayan Yadav, IITRAM, India)	Session O-1 Security 1 (Chair: Dr. Ashutosh Bhatia, BITS Pilani, India)
14:40-15:00	Coffee Break		
15:00-16:40	Session A-2 Wireless 2 (Chair: Prof. Jeong Gon Kim, Tech University of Korea)	Session B-2 Edge Computing 2 (Chair: Prof. Kwangsue Chung, Kwangwoon University., Korea)	Session O-2 Security 2 (Chair: Prof. Yasuo Okabe, Kyoto University)
16:40-17:00	Coffee Break		
17:00-18:20	Session Poster-1 (Chair: Prof. Tangina Sultana, Kyung Hee University, Korea)	Session Poster-2 (Chair: Prof. Hui-Chun Hung, National Central University, Taiwan)	Session Poster-3 (Chair: Prof. Apostolos Gkamas, University Ecclesiastical Academy of Vella of Ioannina, Greece)
January 12, 2023 (Thursday)			
09:30-10:30	Keynote Speech 2: "Toward Smart City Thailand" Komsan Maleeese, Acting President, KMITL (Chair: Prof. Insoo Sohn, Dongguk University, Korea)		
10:30-11:30	Keynote Speech 3: "Towards an Immersive Metaverse over Wireless 6G Networks" Prof. Walid Saad, Virginia Tech, USA (Chair: Prof. Choong Seon Hong, Kyung Hee University, Korea)		
11:30-13:00	Lunch Break		
13:00-14:40	Session A-3 Wireless 3 (Chair: Dr. Muhammad Usman Sheikh, Aalto Uni., Finland)	Session B-3 Internet of Things 1 (Chair: Prof. Md. Delowar Hossain, Kyung Hee University, Korea)	Session O-3 Privacy (Chair: Prof. Seokjoo Shin, Chosun University, Korea)
14:40-15:00	Coffee Break		

ICOIN 2023 Program at a Glance

TIME	Sukhumvit II(3F)	Manhattan Studio(2F)	Ploenchit III(3F)
15:00-16:40	Session A-4 Machine Learning 1 (Chair: Dr. Seon Ho Kim, USC, USA)	Session B-4 SDN (Chair: Prof. Joohyun Lee, Hanyang University, Korea)	Session O-4 Internet of Things 2 (Chair: Prof. Nurul I Sarkar, Auckland University of Technology, New Zealand)
16:40-17:00	Coffee Break		
17:00-18:20	Session Poster-4 (Chair: Prof. Jaeyoung Choi, Soongsil University, Korea)	Session Poster-5 (Chair: Prof. Jongsun Choi, Soongsil University, Korea)	Session Poster-6 (Chair: Prof. Miinho Park, Soongsil University, Korea)
18:30-21:00	Banquet (3F Sukhumvit View)		
January 13, 2023 (Friday)			
09:30-10:30	Keynote Speech 4: “VisionX: Semantic communication Meets System2 ML” Prof. Mehdi Bennis, University of Oulu, Finland (Chair: Prof. Takeo Fujii, The University of Electro-Communications, Japan)		
10:30-11:30	Tutorial 1: “Enabling Deep Intelligence on Embedded Systems” Prof. Seulki Lee, UNIST, Korea (Chair: Prof. Mikio Hasegawa, Tokyo University of Science, Japan)		
11:30-13:00	Lunch Break		
13:00-14:00	Tutorial 2: “Data-driven strategies for sustainable IoT” Prof. Swades De, IITD, India (Chair: Prof. Sangheon Pack, Korea University, Korea)		
14:00-15:40	Session A-5 Machine Learning 2 (Chair: Prof. Kamlesh Tiwari, BITS Pilani, India)	Session B-5 Resource Allocation 1 (CChair: Prof. Ram Narayan Yadav, IITRAM, India)	Session O-5 Energy (Chair: Prof. Joongheon Kim, Korea University)
15:40-16:00	Coffee Break		
16:00-17:40	Session A-6 Machine Learning 3 (Chair: Prof. Ching-seh (Mike) Wu, San Jose State University, USA)	Session B-6 Resource Allocation 2 (Chair: Prof. Nattapong Kitsuan, The University of Electro-Communications, Japan)	Session O-6 Health (Chair: Prof. Hrishikesh Dutta, Michigan State University, USA)
January 14, 2023 (Saturday)			
10:00-11:40	Organizing Committee (OC) Meeting	Steering Committee (SC) Meeting	

January 11, 2023 (Wednesday)

10:40-11:40

KEYNOTE #1

“AI+Energy: AI Techniques towards the Carbon Neutral Era”

Speaker: Prof. Chongkwon Kim, Korea Institute of Energy Technology (KENTECH), Korea

Abstract

Environmental damages and climate abnormalities due to the CO₂ emissions have been the center of concern for the last several years and many countries aim to achieve carbon neutrality by year 2050. Electrification has emerged as the sole solution that can accomplish the target. Electrification of energy requires an astronomical amount of investment on renewable energy sources such as photovoltaics, wind turbines, and etc. In addition, to provision the stable energy supply, various energy conversion and energy storage devices are required. The total energy system is too large and complex and it requires light speed monitoring and control mechanisms. Several prior studies have shown that various AI techniques enhance the efficiency of the energy systems. However, the optimal control problem for holistic energy systems is still remained as an untrodden research area. We will discuss the endeavors towards the carbon neutral era emphasizing the integration of AI and energy technologies.



Biography

Dr. Chong-Kwon Kim received his Ph.D degree from the University of Illinois at Urbana-Champaign at 1987. He is currently a Distinguished Professor at Korea Institute of Energy Technology (KENTECH). He is serving on a Director of Research Institute of Energy AI at KENTECH, focusing on the integration of AI technology into various problems in energy area. Before KENTECH, he has worked as an MTS at Bell Communications

Research from 1987 to 1991 and as a professor at the Seoul National University from 1991 to 2021. During his 30 plus more career, he published more than 100 research papers in the field of computer network, performance analysis, machine learning and data mining. He has served on a president of Korea Institute of Information Scientists and Engineers during 2014 and 2015 and has been serving on steering committee of several international conferences. His research interests include machine learning and its applications to energy systems.

January 12, 2023 (Thursday)

09:30-10:30

KEYNOTE #2

“Toward Smart City Thailand”

Speaker: Komsan Maleesee, Acting President, KMITL

Abstract

Designing future smart cities is an art of balancing between technologies and demographic culture for each region with citizens' health, wellbeing, and security as main objectives. While most smart cities use technology to improve all aspects of it, from governance to management and design and planning, people-centered design is essential to make a city “smart”, sustainable, and provide the best quality of life to its citizens. In this talk, we will explore various aspect of designing a future smart city from Thailand's seven criteria: smart mobility, smart people, smart economy, smart living, smart energy, smart environment, and smart governance. Successful case studies of

Thailand smart city implementations are presented to highlight the use of technologies to its fullest potentials while keeping the wellbeing of its citizen at heart. Public-private partnership business model is used to ensure the sustainability of each solution implemented. Lessons learned from current smart cities case studies and recommendations for future implementations will also be presented.



Biography

Komsan Maleesee received the B.S. degree in construction engineering from King Mongkut's Institute of Technology, in 1993 and the M.S. and Sc.D. degrees in Civil Engineering from Tokai University, in 2001 and 2005, respectively. From 2005 to 2020, he was 39th president of The Council of Engineering Deans of Thailand and Dean of faculty of engineering in King Mongkut's Institute of Technology Ladkrabang. From 2020, he has been an acting president in KMITL, senior executive vice president for University Resources and Services (Acting) in KMITL, and KOSEN-KMITL Acting President.

January 12, 2023 (Thursday)

10:30-11:30

KEYNOTE #3

"Towards an Immersive Metaverse over Wireless 6G Networks"

Speaker: Prof. Walid Saad, Virginia Tech, USA

Abstract

By merging the virtual, digital, and physical worlds, the metaverse will transform the way in which people interact, communicate, conduct business, travel, and remotely control devices within immersive, connected, multi-sensory holographic societies. The metaverse will usher in a new society, dubbed Society 5.0, in which a high integration between cyber and physical spaces is necessary to balance economic advancement with the resolution of current and emerging social challenges. However, in order to deploy the metaverse at scale, a confluence of various technologies, ranging from wireless communication systems to digital twins, extended reality, and artificial intelligence (AI) is needed. In this talk, we explore the synergistic integration of these technologies, and its role in enabling a harmonious metaverse operation. We first focus on the at-scale deployment of the metaverse over wireless 6G systems, and we study whether 6G (with terahertz bands) can deliver the stringent rate, reliability, and latency needed to deliver the quality of physical experience needed to connect the virtual worlds of the metaverse. We then introduce a novel framework for modeling, analyzing, and optimizing the metaverse while taking into account all of its key components including digital twins. Then, we explore the new paradigm of semantic communications that creates AI native, reasoning wireless systems that can seamlessly and autonomously grow and evolve with their data so as to meet the stringent quality-of-experience (QoE) needs of metaverse applications and systems. We discuss specifically what fundamentals are needed to design realistic semantic communication systems, and how those can contribute to the metaverse. Subsequently, we discuss the role of continual AI in synchronizing the operation of digital twins within the metaverse. We conclude with an overview on future research in this exciting area.



Biography

Dr Mehdi Bennis is a full (tenured) Professor at the Centre for Wireless Communications, University of Oulu, Finland and head of the intelligent connectivity and networks/systems group (ICON). His main research interests are in radio resource management, game theory and distributed AI in 5G/6G networks. He has published more than 200 research papers in international conferences, journals and book chapters. He

has been the recipient of several prestigious awards including the 2015 Fred W. Ellersick Prize from the IEEE Communications Society, the 2016 Best Tutorial Prize from the IEEE Communications Society, the 2017 EURASIP Best paper Award for the Journal of Wireless Communications and Networks, the all-University of Oulu award for research, the 2019 IEEE ComSoc Radio Communications Committee Early Achievement Award, the 2020 Clarivate Highly Cited Researcher by the Web of Science and the 2022 Fred W. Ellersick Prize from the IEEE Communications Society. Dr Bennis is an editor of IEEE TCOM and Specialty Chief Editor for Data Science for Communications in the Frontiers in Communications and Networks journal. Dr Bennis is an IEEE Fellow.

January 13, 2023 (Friday)

09:30-10:30

KEYNOTE #4

“VisionX: Semantic communication Meets System2 ML”

Speaker: Prof. Mehdi Bennis, University of Oulu, Finland

Abstract

This keynote talk will first provide a brief introduction of VisionX sitting at the intersection of machine learning and communication in terms of enablers and mathematical tools, while contrasting it with current efforts in the area. Then, recent results in semantics-native communication and learning communication protocols from data will be presented.



Biography

Dr Mehdi Bennis is a full (tenured) Professor at the Centre for Wireless Communications, University of Oulu, Finland and head of the intelligent connectivity and networks/systems group (ICON). His main research interests are in radio resource management, game theory and distributed AI in 5G/6G networks. He has published more than 200 research papers in international conferences, journals and book chapters. He

has been the recipient of several prestigious awards including the 2015 Fred W. Ellersick Prize from the IEEE Communications Society, the 2016 Best Tutorial Prize from the IEEE Communications Society, the 2017 EURASIP Best paper Award for the Journal of Wireless Communications and Networks, the all-University of Oulu award for research, the 2019 IEEE ComSoc Radio Communications Committee Early Achievement Award, the 2020 Clarivate Highly Cited Researcher by the Web of Science and the 2022 Fred W. Ellersick Prize from the IEEE Communications Society. Dr Bennis is an editor of IEEE TCOM and Specialty Chief Editor for Data Science for Communications in the Frontiers in Communications and Networks journal. Dr Bennis is an IEEE Fellow.

January 13, 2023 (Friday)

10:30-11:30

TUTORIAL #1

“Enabling Deep Intelligence on Embedded Systems”

Speaker: Prof. Seulki Lee, UNIST, Korea

Abstract

As deep learning for resource-constrained systems become more popular, we see an increased number of intelligent embedded systems such as IoT devices, robots, autonomous vehicles, and the plethora of portable, wearable, and mobile devices that are feature-packed with a wide variety of machine learning tasks. However, the performance of DNNs (deep neural networks) running on an embedded system is significantly limited by the platform’s CPU, memory, and battery size; and their scope is usually limited to simplistic inference tasks only. This tutorial introduces on-device deep learning algorithms and supporting systems designs, which enable embedded systems to efficiently perform deep intelligent tasks, deep neural networks in particular, beyond their limited computing resources. We name such on-device deep intelligence on embedded systems as Embedded Deep Intelligence. Specifically, we propose resource-aware learning strategies devised to overcome the fundamental constraints of embedded systems. Once deployed in the field with the proposed resource-aware learning strategies, embedded systems are not only able to perform deep inference tasks on sensor data but also update and re-train their learning models at run-time without requiring any help from any external system. Such an on-device learning capability of Embedded Deep Intelligence makes an embedded intelligent system real-time, privacy-aware, secure, autonomous, untethered, responsive, and adaptive without concern for its limited resources.



Biography

Dr. Seulki Lee is an assistant professor at the Department of Computer Science and Engineering (CSE) and Artificial Intelligence Graduate School (AIGS) at UNIST (Ulsan National Institute of Science and Technology), where he leads EAI Lab (Embedded Artificial Intelligence Lab). He earned his Ph.D. and M.S degrees in Computer Science at the University of North Carolina at Chapel Hill (UNC). His research aims to make resource-constrained real-time and embedded sensing systems capable of learning, adapting, and evolving. He published many peer-reviewed papers at international conferences in the fields of embedded systems and AI, including ACM MobiSys, ACM SenSys, ACM IPSN, ACM UbiComp (IMWUT), IEEE RTAS, and IEEE DCOSS. He received the best paper award in ACM AIoTChallenge (2020) and the best presentation award in ACM UbiComp (2020). Since 2019, he has served as a Technical Program Committee and Reviewer of several international conferences and journals, including AAAI, ACM SenSys, ACM CSCW, ACM IMWUT, IEEE PerCOM, ACM/IEEE CHASE, IEEE TC, IEEE TMC, and IEEE TETC.

January 13, 2023 (Friday)

13:00 - 14:00

TUTORIAL #2

“Data-driven strategies for sustainable IoT”

Speaker: Prof. Swades De, IITD, India

Abstract

In most of the research studies of communication systems, stationarity of traffic is assumed, and the associated processes are approximated to some known "standard" distributions. While such assumptions are indeed necessary for developing tractable analytical frameworks for performance evaluation, at times such assumptions are far from reality. Moreover, in modern-day IoT communications, for resource efficiency more precise optimizations are necessary, where the assumed stationarity and traffic distributions prove to be quite strong and do not necessarily result in predicting accurate performance trends. Therefore, more and more researchers are resorting to data-driven dynamic system characterization and optimization strategies. In this context, in this discourse we will present data-driven approach to performance optimization of communication systems. Through a few examples, which include cognitive radio spectrum access, smart power grid monitoring, smart sensing IoT systems, we will demonstrate how data-driven, context-aware light-weight machine learning based, and edge computing aided approaches are utilized in more accurate system performance characterization and optimization leading to communication and storage resource efficiency and energy sustainability of the IoT nodes. We will share our experiences from field experiments, proof-of-concept implementations, and deployments, and will highlight the possibilities of learning-aided networking optimizations for various multidisciplinary-disciplinary applications.



Biography

Dr. Swades De is a Professor in the Department of Electrical Engineering and an Institute Chair Professor at Indian Institute of Technology Delhi. Before moving to IIT Delhi in 2007, he was a tenure-track Assistant Professor of Electrical and Computer Engineering at New Jersey Institute of Technology (2004-2007). He worked as a post-doctoral researcher at ISTI-CNR, Pisa, Italy (2004), and has nearly 5 years industry experience in India on communication hardware and software development (1993-1997, 1999). He received his PhD in Electrical Engineering from the State University of New York at Buffalo, MTech in Optoelectronics and Optical Communications from Indian Institute of Technology Delhi, and BTech in Radiophysics and Electronics from University of Calcutta.

Dr. De's research interests are broadly in communication networks, with emphasis on performance modeling and analysis. Current directions include resource optimization, energy harvesting, wireless energy transfer, sustainable and green communications, spectrum sharing, smart grid networks, and IoT communications. To date, he has published over 220 articles in top journals and well-known conferences, a few book chapters, an edited book, 1 US/EU/WO patent, and filed 9 Indian patents and 6 US/EU patents.

Dr. De currently serves as an Area Editor for IEEE Communications Letters and Elsevier Computer Communication, and Editor for IEEE Transactions on Vehicular Technology, IEEE Wireless Communications Letters, and IEEE Wireless Communications Magazine. He is a Fellow of Indian National Academy of Engineering, National Academy of Sciences, India, Institute of Engineers, India, and Institution of Engineering and Technology, UK. Dr. De is a recipient of Abdul Kalam Technology Innovation National Fellowship and an IEEE Vehicular Technology Society Distinguished Lecturer.

January 11, 2023 (Wednesday)

Session A-1: Wireless 1

13:00-14:40

Chair: Dr. Eunil Seo, Umeo University, Sweden

- [A-1-1] **Height Pattern Estimation Method Using the Combination of Radio Map and 3D Map for Spectrum Sharing**
Sunao Miyamoto, Shota Yamada and Takeo Fujii (The University of Electro-Communications, Japan)
- [A-1-2] **Beam Pattern Estimation of 5G Millimeter-Wave Base Station Based on Radio Map and Multi-Beam Antenna Model at 28GHz**
Shougo Matsuo, Sunao Miyamoto, Hirofumi Nakajo and Takeo Fujii (The University of Electro-Communications, Japan)
- [A-1-3] **Network-Assisted Full-Duplex Millimeter-Wave Cell-Free Massive MIMO with Localization-Aided Inter-User Channel Estimation**
Shuto Fukue (The University of Electro-Communications, Japan); Giuseppe Thadeu Freitas de Abreu (Jacobs University Bremen, Germany); Koji Ishibashi (The University of Electro-Communications, Japan)
- [A-1-4] **An Artificial Intelligence Framework for Holographic Beamforming: Coexistence of Holographic MIMO and Intelligent Omni-Surface**
Apurba Adhikary, Md. Shirajum Munir, Avi Deb Raha, Yu Qiao, Sang Hoon Hong, Eui-Nam Huh and Choong Seon Hong (Kyung Hee University, Korea (South))
- [A-1-5] **A Design of Service Mesh Based 5G Core Network Using Cilium**
Binh Van Duong and younghun Kim (Soongsil University, Korea (South))

Session B-1: Edge Computing 1

13:00-14:40

Chair: Dr. Ram Narayan Yadav, IITRAM, India

- [B-1-1] **Scene Identification Using Visual Semantic Segmentation and Supplementary Classifier for Resource-Constrained Edge Systems**
Chungjae Choe and Sungwook Jung (Korea Electronics Technology Institute (KETI), Korea (South)); Nak-Myoung Sung (Korea Electronics Technology Institute, Korea (South)); Seokjun Lee (Korea Electronics Technology Institute (KETI), Korea (South))
- [B-1-2] **Advances in Distributed Load Orchestration for Vision Computing in 5G-MEC Environments**
Ricardo N Boing and Hugo Sampaio (Federal University of Santa Catarina, Brazil); Fernando Koch (Korea University, Brazil); Wesley Bezerra (UFSC, Brazil); René Nolio Santa Cruz and Carlos Becker Westphall (Federal University of Santa Catarina, Brazil)

- [B-1-3] **Offloading Visual SLAM Processing to the Edge: An Energy Perspective**
Peter Sossalla (Technische Universität Dresden, Germany); Johannes Hofer (Technische Universität Dresden, Germany); Christian Leonard Vielhaus and Justus Rischke (Technische Universität Dresden, Germany); Frank H.P. Fitzek (Technische Universität Dresden & ComNets - Communication Networks Group, Germany)
- [B-1-4] **Dynamic Edge Server Placement for Computation Offloading in Vehicular Edge Computing**
Dhruv Nakrani and Jayesh Khuman (Institute of Infrastructure, Technology, Research and Management, India); Ram Narayan Yadav (Institute of Infrastructure Technology Research And Management, Ahmedabad, India)
- [B-1-5] **Blockchain-Based Service Migration for Multi-Access Edge Computing**
Shuyang Ren and Choonhwa Lee (Hanyang University, Korea (South))

Session O-1: Security 1

13:00-14:40

Chair: Dr. Ashutosh Bhatia, BITS Pilani, India

- [O-1-1] **Signal Strength Balanced Scheduling for Secure Ambient Backscatter Networks**
Yeonah An (Korea University, Korea (South)); Hoorin Park (Seoul Women's University, Korea (South)); Wonjun Lee (Korea University, Korea (South))
- [O-1-2] **Towards Generating Semi-Synthetic Datasets for Network Intrusion Detection System**
Ngoc-Truong Nguyen, Ton-Nhan Le, Le Kim-Hung and Khanh-Hoi Le Minh (University of Information Technology, Vietnam)
- [O-1-3] **An Experimentation on CoAP Multi Factor Authentication Mechanism with Reputation for Internet of Things Constrained Devices and Low Power Wide Area Network**
Wesley Bezerra (UFSC, Brazil); Ricardo N Boing (Federal University of Santa Catarina, Brazil); Cristiano Antonio de Souza (UFSC - Federal University of Santa Catarina, Brazil); Carlos Becker Westphall (Federal University of Santa Catarina, Brazil)
- [O-1-4] **Development of WLAN Topology Display System**
Olam Wongwirat (King Mongkut's Institute of Technology Ladkrabang, Thailand); Supannada Chotipant (Faculty of Information Technology, King Mongkut's Institute of Technology Ladkrabang, Thailand); Tadchapon Hongtong and Nattawat Suttijumnong (KMUTL, Thailand)
- [O-1-5] **Relay Selection, Eavesdropper-Aware Relaying, PHY-Secrecy Capacity Analysis of Cooperative Wireless System over Hybrid Fading Channels**
Tarun Jain (Birla Institute of Technology and Science Pilani, India); B. Sainath (BITS Pilani, India); Ashutosh Bhatia (Birla Institute of Technology and Science, Pilani, India)

Session A-2: Wireless 2

15:00-16:40

Chair: Prof. Jeong Gon Kim, Tech Univ of Korea

- [A-2-1] **Measurement of Sub-GHz Band LPWA Radiowave Propagation on Each Floor in Indoor Environment**
Taro Miyamoto and Shusuke Narieda (Mie University, Japan); Takeo Fujii (The University of Electro-Communications, Japan); Hiroshi Naruse (Mie University, Japan)
- [A-2-2] **Considerations on Tradeoff Between Downlink NOMA and Beamforming in Mobile Systems**
Kentaro Yoda, Takumi Yasaka and Kohei Miyashita (Kogakuin University, Japan); Satoshi Suyama (NTT DOCOMO, INC., Japan); Hiroyuki Otsuka (Kogakuin University, Japan)
- [A-2-3] **Lower Bound for the Number of Accommodable End-Devices in LPWAN with Multiple Interferences**
Daisuke Kumamoto and Shusuke Narieda (Mie University, Japan); Takeo Fujii (The University of Electro-Communications, Japan); Hiroshi Naruse (Mie University, Japan)
- [A-2-4] **Measurement-Based Spectrum Database for Non-Terrestrial Networks**
Yusuke Itayama, Hirofumi Nakajo, Shougo Matsuo and Takeo Fujii (The University of Electro-Communications, Japan)
- [A-2-5] **An Evaluation of Time-Series Anomaly Detection in Computer Networks**
Hong Nguyen, Arash Hajisafi, Alireza Abdoli, Seon H Kim and Cyrus Shahabi (University of Southern California, USA)

Session B-2: Edge Computing 2

15:00-16:40

Chair: Prof. Kwangsue Chung, Kwangwoon Univ., Korea

- [B-2-1] **Collaborative Computation Offloading Scheme Based on DRL**
Jinho Park and Kwangsue Chung (Kwangwoon University, Korea (South))
- [B-2-2] **Edge-Assisted Attention-Based Federated Learning for Multi-Step EVSE-Enabled Prosumer Energy Demand Prediction**
Luyao Zou, Chu Myaet Thwal, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))
- [B-2-3] **Accelerating Convergence in Wireless Federated Learning by Sharing Marginal Data**
Eunil Seo (Computing Science, Sweden & Umea University, Sweden); Vinh Cong Pham (Sungkyunkwan University & Hippo T&C, Korea (South)); Erik Elmroth (Umeå University and Elastisys, Sweden)
- [B-2-4] **Adaptive Streaming Scheme with Reinforcement Learning in Edge Computing Environments**
Jeongho Kang and Kwangsue Chung (Kwangwoon University, Korea (South))

[B-2-5] A Framework for Multi-Prototype Based Federated Learning: Towards the Edge Intelligence

Yu Qiao, Md. Shirajum Munir, Apurba Adhikary, Avi Deb Raha, Sang Hoon Hong and Choong Seon Hong (Kyung Hee University, Korea (South))

Session O-2: Security 2

15:00-16:40

Chair: Prof. Yasuo Okabe, Kyoto University

- [O-2-1] **T-PASS: A Blockchain-Based NFT Enabled Property Management and Exchange System**
Hari M K (Veda Ayurvedic, India); Ankit Agrawal and Ritika Bhatia (BITS Pilani, India); Ashutosh Bhatia (Birla Institute of Technology and Science, Pilani, India); Kamlesh Tiwari (BITS Pilani, India)
- [O-2-2] **Post Quantum Cryptography: A Review of Techniques, Challenges and Standardizations**
Ritik Rohit Bavdekar and Eashan Chopde (BITS Pilani, Pilani Campus, India); Ankit Agrawal (BITS Pilani, India); Ashutosh Bhatia (Birla Institute of Technology and Science, Pilani, India); Kamlesh Tiwari (BITS Pilani, India)
- [O-2-3] **Secure, Dynamic and Uncomplicated Licensing of Movies on a Blockchain Infrastructure**
João Santos (University of Porto, Portugal); Ivone Amorim (Polytechnic of Porto, Portugal); Alexandre Ulisses (MOG Technologies, Portugal); João Correia Lopes (INESC TEC, Portugal); Vasco Filipe (MOG Technologies, Portugal)
- [O-2-4] **Introduction to MITRE ATT&CK: Concepts and Use Cases**
Seok Bin Son, Soohyun Park and Haemin Lee (Korea University, Korea (South)); Youngkee Kim (Korea University, Korea (South)); Dongwan Kim (Dong-A University, Korea (South)); Joongheon Kim (Korea University, Korea (South))
- [O-2-5] **Android Malware Category and Family Classification Using Static Analysis**
Cong-Danh Nguyen (University of Information Technology & VNU-HCM, Vietnam); Nghi Hoang Khoa (University of Information Technology, VNU-HCM, Vietnam); Khoa Nguyen-Dang Doan (University of Information Technology & Vietnam National University Ho Chi Minh City, Vietnam); Nguyen Tan Cam (University of Information Technology & Vietnam National University HoChiMinh City, Vietnam)

January 12, 2023 (Thursday)

Session A-3: Wireless 3

13:00-14:40

Chair: Dr. Muhammad Usman Sheikh, Aalto Uni., Finland

- [A-3-1] **Performance Analysis of Uplink IM-OFDMA Systems in the Presence of CFO and Rx-IQI**
Ozgur Alaca (Texas A&M University, USA); Saud Althunibat (Al-Hussein Bin Talal University, USA); Serhan Yarkan (Istanbul Commerce University, Turkey); Scott Miller (Texas A&M University, USA); Khalid A. Qaraqe (Texas A&M University at Qatar, USA)
- [A-3-2] **Selective Competition for NOMA-Capable Devices Using RIS**
Yoon Min-Seok, Kyoung Min Kim and Tae-Jin Lee (Sungkyunkwan University, Korea (South))
- [A-3-3] **Channel Characterization at Sub-THz Band with Measurements and Ray Tracing in Indoor Case**
Muhammad Usman Sheikh (Aalto University, Finland); Muhsin Ali and Guillermo Carpintero (Universidad Carlos III de Madrid, Spain); Kalle Ruttik, Edward Mutafungwa and Riku Jäntti (Aalto University, Finland)
- [A-3-4] **THL2H-Ex: An Improved Neighbor Discovery Approach for Wireless Sensor Networks**
Raudel Suarez and Amiya Nayak (University of Ottawa, Canada)
- [A-3-5] **IEEE 802.11ac WLAN Analysis in 160Mhz Channel**
Samad Salehi Kolahi (Unitec Institute of Technology, New Zealand); Tahany Shaheen, Elijah Anderson, Rahaf Aljadani and Asma Ceyddique (Unitec, New Zealand)

Session B-3: Internet of Things 1

13:00-14:40

Chair: Prof. Md. Delowar Hossain, Kyung Hee Uni., Korea

- [B-3-1] **Node-Centric Random Walk for Fast Index-Free Personalized PageRank**
Kohei Tsuchida, Naoki Matsumoto and Kunitake Kaneko (Keio University, Japan)
- [B-3-2] **The More the Merrier: Reconstruction of Twitter Firehose**
Seyed Ali Alhosseini (University of Potsdam, Germany); Christoph Meinel (Hasso-Plattner-Institute, Germany)
- [B-3-3] **Joint Association and Power Allocation for Data Collection in HAP-LEO-Assisted IoT Networks**
Nway Nway Ei, Pyae Sone Aung, Seong-Bae Park, Eui-Nam Huh and Choong Seon Hong (Kyung Hee University, Korea (South))
- [B-3-4] **Development of Activity Management System to Watch over Children**
Ichio Inoue and Kayoko Yamamoto (The University of Electro-Communications, Japan)
- [B-3-5] **Traffic Reduction for Out-Of-Band Network Management over LPWA**

Kodai Tanabe and Go Hasegawa (Tohoku University, Japan); Gen Kitagata (Morioka University, Japan)

Session O-3: Privacy

13:00-14:40

Chair: Prof. Seokjoo Shin, Chosun University, Korea

- [O-3-1] **Perceptual Encryption-Based Privacy-Preserving Deep Learning for Medical Image Analysis**
Ijaz Ahmad and Seokjoo Shin (Chosun University, Korea (South))
- [O-3-2] **Towards Decentralized Autonomous Digital Signatures Using Smart Contracts**
Kazumasa Omote (University of Tsukuba, Japan)
- [O-3-3] **Privacy Data Protection Scheme of Industrial Field Equipment Based on Fully Homomorphic Encryption**
Feng Xiao (Chongqing University of Posts and Telecommunications, China); Jin Wang (State Grid Hubei Electric Power Research Institute, China); Min Wei (Chongqing University of Posts and Telecommunications, China); Chang Liu (State Grid Hubei Electric Power Research Institute, China); Vanqui Le (Chongqing University of Posts and Telecommunications, China); Jiangpei Xu (State Grid Hubei Electric Power Research Institute, China)
- [O-3-4] **Generative Data Augmentation Applied to Face Recognition**
Marwa Jabberi (ISITCom & REsearch Groups in Intelligent Machines, Tunisia)
- [O-3-5] **Privacy-Preserving Traffic Flow Prediction: A Split Learning Approach**
Nam Phuong Tran (Chung-Ang University, Korea (South)); Nhu-Ngoc Dao (Sejong University, Korea (South)); Quang Tuan Do, The Vi Nguyen and Sungrae Cho (Chung-Ang University, Korea (South))

Session A-4: Machine Learning 1

15:00-16:40

Chair: Dr. Seon Ho Kim, USC, USA

- [A-4-1] **Topology Design for Data Center Networks Using Deep Reinforcement Learning**
Haoran Qi and Zhan Shu (University of Alberta, Canada); Xiaomin Chen (Northumbria University, United Kingdom (Great Britain))
- [A-4-2] **Design of a 3D Scene Reconstruction Network Robust to High-Frequency Areas Based on 2.5D Sketches and Encoders**
Changdae Lee (Kwangwoon University, Korea (South)); Jaeseok Yoo (LG Electronics, Korea (South)); Kwanghyun Park (Kwangwoon University, Korea (South))
- [A-4-3] **VNDN-Fuzzy - A Strategy to Mitigate the Forwarding Interests Broadcast Storm Problem in VNDN Networks**
Ilane Karise (UECE, Brazil); Joaquim Celestino Júnior (State University of Ceará, Brazil); Marcial P Fernandez (Universidade Estadual do Ceará, Brazil); Maxwell E. Monteiro (Federal Institute of Espírito Santo - IFES & Federal University of Espírito Santo)

Santo - UFES, Brazil; Ahmed Patel (Computer Networks and Security Laboratory (LARCES) State University of Ceara (UECE), Brazil & Faculty of Computer Science & Information System, United Kingdom (Great Britain))

- [A-4-4] **ETANet: An Efficient Triple-Attention Network for Salient Object Detection**

Ngo Thien Thu, Eui-Nam Huh and Choong Seon Hong (Kyung Hee University, Korea (South))

- [A-4-5] **Robust Federated Learning with Local Mixed Co-Teaching**

Girum Fithamlak Ejigu, Choong Seon Hong and Sang Hoon Hong (Kyung Hee University, Korea (South))

Session B-4: SDN

15:00-16:40

Chair: Prof. Joohyun Lee, Hanyang Uni., Korea

- [B-4-1] **Deep Reinforcement Learning Driven Aggregate Flow Entries Eviction in Software-Defined Networking**

JunHan Zang (Sungkyunkwan University, Korea (South)); Syed Muhammad Raza (Sungkyunkwan University, Korea (South)); Gyurin Byun (Sungkyunkwan University, Korea (South)); Moonseong Kim (Seoul Theological University, Korea (South)); Hyunseung Choo (Sungkyunkwan University, Korea (South))

- [B-4-2] **A QoS-Aware Routing Mechanism for SDN-Based Integrated Networks**

Yu Zhang and Mengze Cui (University of Muenster, Germany); Mina Abadeer (University of Münster, Germany); Sergei Gorlatch (University of Munster, Germany)

- [B-4-3] **Forecasting SDN End-To-End Latency Using Graph Neural Network**

Zhun Ge, Jiacheng Hou and Amiya Nayak (University of Ottawa, Canada)

- [B-4-4] **A Software-Defined Networks Approach for Cyber Physical Systems**

Jumana Khrais, Mariam Al-Issa, Reham Al-Omari and Ahmad T. Al-Hammouri (Jordan University of Science and Technology, Jordan)

- [B-4-5] **Optimising Forensic Data Availability and Retention of SDN Forensic Logs by Using Bloom Filter**

Varun Sharma (International Institute of Information Technology, India); Shatrunjay Rawat (IIIT Hyderabad, India)

Session O-4: Internet of Things 2

15:00-16:40

Chair: Prof. Nurul I Sarkar, Auckland University of Technology, New Zealand

- [O-4-1] **Privacy Enhanced Federated Learning Utilizing Differential Privacy and IPFS**

Hyowon Kim and Inshil Doh (Ewha Womans University, Korea (South))

- [O-4-2] **Establishing Trustworthy Rational Friendships in Social Internet of Things**

Raza Ul Mustafa (Munster Technological University, Ireland); Alan McGibney and Susan Rea (Nimbus Research Centre, Ireland)

- [O-4-3] **Indirect Bluetooth Low Energy Connection Detection**

Ondřej Hujňák, Kamil Malinka and Petr Hanacek (Brno University of Technology, Czech Republic)

- [O-4-4] **IoT Gateways Network Communication Analysis**

Jan Zbořil, Ondřej Hujňák and Kamil Malinka (Brno University of Technology, Czech Republic)

- [O-4-5] **Applying of Websocket and WebRTC for Video Calling in Telemedicine During COVID-19 Pandemic**

Khanista Namee (King Mongkut's University of Technology North Bangkok, Thailand); Areej Meny (King Saud bin Abdulaziz University for Health Sciences, Saudi Arabia); Siwalai Chinchua (King Mongkut's University of Technology North Bangkok, Thailand); Supeeti Kulchan (King Mongkut's University of Technology North Bangkok & Faculty of Industrial Technology and Management, Thailand)

January 13, 2023 (Friday)

Session A-5: Machine Learning 2

14:00-15:40

Chair: Prof. Kamlesh Tiwari, BITS Pilani, India

- [A-5-1] **Integrating Machine Learning for Network Threat Detection with SmartX Multi-Sec Framework**

Talaya Farasat (Gwangju Institute of Science and Technology, Korea (South)); Muhammad Ahmad Rathore (Gwangju Institute of Science & Technology (GIST), Korea (South)); JongWon Kim (Gwangju Institute of Science & Technology, Korea (South))

- [A-5-2] **An Artificial Intelligent-Driven Semantic Communication Framework for Connected Autonomous Vehicular Network**

Avi Deb Raha, Md. Shirajum Munir, Apurba Adhikary, Yu Qiao, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))

- [A-5-3] **Is Puzzle-Based CAPTCHA Secure Against Attacks Based on CNN?**

Kenta Terada and Yasuo Okabe (Kyoto University, Japan); Yoshinori Matsumoto (Capy Japan Inc., Japan)

- [A-5-4] **LSTM-Based PdM Platform for Automobile SCU Inspection Equipment**

Sung Hyun Oh (Tech University of Korea, Korea (South)); Jeong Gon Kim (Korea Polytechnic University, Korea (South))

- [A-5-5] **Coreset Construction for Extra Binomial Variation in Binomial Regression**

Faqiang Zhang and Nuttanan Wichitaksorn (Auckland University of Technology, New Zealand); Bhargab Chattopadhyay (Indian Institute of Management Visakhapatnam, India)

Session B-5: Resource Allocation 1

14:00-15:40

Chair: Prof. Ram Narayan Yadav, IITRAM, India

- [B-5-1] **Multi-Armed Bandit Learning for TDMA Transmission Slot Scheduling and Defragmentation for Improved Bandwidth Usage**
Hrishikesh Dutta, Amit Kumar Bhuyan and Subir Biswas (Michigan State University, USA)
- [B-5-2] **UAV Trajectory Planning for Improved Content Availability in Infrastructure-Less Wireless Networks**
Amit Kumar Bhuyan, Hrishikesh Dutta and Subir Biswas (Michigan State University, USA)
- [B-5-3] **Resource Allocation and User Association Using Reinforcement Learning via Curriculum in a Wireless Network with High User Mobility**
Dong Uk Kim (Kyung Hee & Networking Intelligence, Korea (South)); Choong Seon Hong, Seong-Bae Park and Eui-Nam Huh (Kyung Hee University, Korea (South))
- [B-5-4] **Reinforcement Learning Approach for Resource Allocation in 5G HetNets**
Fivos Allagiots, Christos J Bouras and Vasileios Kokkinos (University of Patras, Greece); Apostolos Gkamas (University Ecclesiastical Academy of Vella of Ioannina, Greece); Philippos Pouyioutas (University of Nicosia, Cyprus)
- [B-5-5] **Cache Node Placement Scheme Considering Maximum Traffic in Content-Centric Networks**
Prapphan Pavarangkoon (King Mongkut's Institute of Technology Ladkrabang, Thailand); Shohei Nakajima and Nattapong Kitsuan (The University of Electro-Communications, Japan)

Session O-5: Energy

14:00-15:40

Chair: Prof. Joongheon Kim, Korea University

- [O-5-1] **Characteristics of FRET-Based Molecular Communication**
Minh Duong and Sungoh Kwon (University of Ulsan, Korea (South))
- [O-5-2] **UAV-Based Data Collection and Wireless Power Transfer System with Deep Reinforcement Learning**
Jaewook Lee (Electronics and Telecommunications Research Institute, Korea (South)); Sangwon Seo (Korea University, Korea (South)); Haneul Ko (Kyunghee University, Korea (South))
- [O-5-3] **ABEP Analysis of Coded and Uncoded Mixed RF/FSO Communication System SWIPT-Based**
Souad Labghough (ENSIAS - Mohammed V University in Rabat, Morocco); Fouad Ayoub (CRMEF Kenitra, Morocco); Faissal El Bouanani (ENSIAS, Mohammed V University in Rabat, Morocco); Mostafa Belkasm (ENSIAS - Mohammed V University in Rabat, Morocco); Khalid A. Qaraqe (Texas A&M University at Qatar, USA)
- [O-5-4] **Secrecy Performance of Energy Harvesting Based D2D Communications in Spectrum-Sharing Networks**

Ajay Singh (Indian Institute of Technology Jammu, India); Surjeet Kumar (Indian Institute of Technology Delhi, India); Shilpa Thakur (Indian Institute of Technology, India)

- [O-5-5] **Security of Energy Harvesting Based D2D Communications in Cognitive Cellular Network**

Ajay Singh and Koduru Sree Venkateswara Rao (Indian Institute of Technology Jammu, India)

Session A-6: Machine Learning 3

16:00-17:40

Chair: Prof. Ching-seh (Mike) Wu, San Jose State Uni., USA

- [A-6-1] **Small Object Detection Technology Using Multi-Modal Data Based on Deep Learning**
Chi-Won Park, Yuri Seo, Teh-Jen Sun, Ga-Won Lee and Eui-Nam Huh (Kyung Hee University, Korea (South))
- [A-6-2] **RNN-Based Text Summarization for Communication Cost Reduction: Toward a Semantic Communication**
Sumit Kumar Dam, Md. Shirajum Munir, Avi Deb Raha, Apurba Adhikary, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))
- [A-6-3] **The Emerged Artificial Intelligence Protocol for Hierarchical Information Network**
Caesar Wu and Pascal Bouvry (University of Luxembourg, Luxembourg)
- [A-6-4] **Machine Learning Assisted Approach for Water Leaks Detection**
Sara H Badar (Texas A&M University Qatar, Qatar); Souad Labghough (ENSIAS - Mohammed V University in Rabat, Morocco); Almaha Al-Abdulghani (Texas AM University at Qatar, Qatar); Eiman Mohammed (Texas University at Qatar Doha, Qatar); Othmane Bouhali (Texas A&M University at Qatar, Qatar); Khalid A. Qaraqe (Texas A&M University at Qatar, USA)
- [A-6-5] **An Heuristic Intrusion Detection Approach Using Deep Learning Model**
Ching-Seh Wu and Sam Chen (San Jose State University, USA)

Session B-6: Resource Allocation 2

16:00-17:40

Chair: Prof. Nattapong Kitsuan, The University of Electro-Communications, Japan

- [B-6-1] **Seamless and Efficient Resources Allocation in 6G Satellite Networks Servicing Remote User Equipments**
Sheikh Salman Hassan, Yu Min Park, Ki Tae Kim, Sang Hoon Hong and Choong Seon Hong (Kyung Hee University, Korea (South))
- [B-6-2] **Kuramoto-Inspired Wireless Resource Allocation for Weighted Networks**
Kimcheang Chhea, Sengly Muy and Jung Ryun Lee (Chung-Ang University, Korea (South))
- [B-6-3] **Robustness to Digital Power Adjustment in Transmit Power Allocation for Poor Conditioned LPWA End Devices**

Shusuke Narieda (Mie University, Japan); Takeo Fujii (The University of Electro-Communications, Japan)

[B-6-4] A Collaborative UAV Routing Algorithm for Time Sensitive Surveillance Tasks

Yang Yu and Sanghwan Lee (Kookmin University, Korea (South))

[B-6-5] Scalable Channel Allocation in Downlink NOMA Using Parallel Array of Laser Chaos Decision-Maker

Masaki Sugiyama (Tokyo University of Science, Japan); Aohan Li (The University of Electro-Communications, Japan); Makoto Naruse (The University of Tokyo, Japan); Mikio Hasegawa (Tokyo University of Science, Japan)

Session O-6: Health

16:00-17:40

Chair: Prof. Hrishikesh Dutta, Michigan State Uni., USA

[O-6-1] ResNet-TCN: A Joint Model for ECG Heartbeat Classification with High Accuracy

Shaogang Hu (University of Electronic Science and Technology of China, China); Renwei Li and Qiang Hu (Chongqing University of Posts and Telecommunications, China); Guanchao Qiao (University of Electronic Science and Technology of China, China)

[O-6-2] Histopathological Classification of Colorectal Polyps Using Deep Learning

May Phu Paing (School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand & King Mongkut's Institute of Technology, Thailand); Jae-Wan Cho (KMUTL (King Mongkut's Institute of Technology Ladkrabang, Thailand), Thailand)

[O-6-3] Link-Level Assessment of NOMA Aided Multi-Hop DECT-2020 New Radio for mMTC Applications

Sandhya Soni (LNMIIT, India); Rahul Makkar (The LNM Institute of Information Technology Jaipur, India); Divyang Rawal (LNMIIT, India); Nikhil Sharma (The LNM Institute of Information Technology, Jaipur, India)

[O-6-4] A New Chapter for Medical Image Generation: The Stable Diffusion Method

Loc X. Nguyen, Pyae Sone Aung, Huy Q. Le, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))

[O-6-5] Heimdall: Blockchain-Based Consent Management Framework

Bruno Lopes Alcantara Batista (Universidade de Fortaleza, Brazil); Francisco Mardonio Vieira Filho (State University of Ceará (UECE), Brazil); Joaquim Celestino Júnior (State University of Ceará, Brazil); Jose N de Souza (UFC, Brazil)

January 11, 2023 (Wednesday)

Session Poster-1

17:00-18:20

Chair: Prof. Tangina Sultana, Kyung Hee Uni., Korea

- [P-1-1] **Classification Performance Evaluation of Latent Vector in Encoder-Decoder Model**
Kyuchang Kang (Kunsan National University, Korea (South)); Changseok Bae (Daejeon University, Korea (South))
- [P-1-2] **Transformers with Attentive Federated Aggregation for Time Series Stock Forecasting**
Chu Myaet Thwal, Ye Lin Tun, Ki Tae Kim, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-1-3] **Seamless and Intelligent Resource Allocation in 6G Maritime Networks Framework via Deep Reinforcement Learning**
Sheikh Salman Hassan, Seong-Bae Park, Eui-Nam Huh and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-1-4] **Advanced Signal Processing of Photo-Excited Current Spectroscopy Based on Trap State Distribution for Photo-Sensor Applications**
Dongwook Kim, Jung-Hyok Kwon, Eui-Jik Kim, Jaehoon Park, Hyunju Lee and Bokyoung Kim (Hallym University, Korea (South))
- [P-1-5] **Resource Allocation Reinforcement Learning for Quality of Service Maintenance in Cloud-Based Services**
Dupyo Hong, DongWan Kim and Yongtae Shin (Soongsil University, Korea (South))
- [P-1-6] **Segmentation of Cerebral Hemorrhage CT Images Using Swin Transformer and HarDNet**
Zhegao Piao, Yeong Hyeon Gu, Seong Joon Yoo and Myounggho Seong (Sejong University, Korea (South))
- [P-1-7] **Layer-Wise Knowledge Distillation for Cross-Device Federated Learning**
Huy Q. Le, Loc X. Nguyen, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-1-8] **Vehicle Platooning Algorithm for Improving Following Control**
Yujie Li and Sang-Chul Kim (Kookmin University, Korea (South))
- [P-1-9] **A Review on Rate-Splitting Multiple Access-Assisted Downlink Networks: Rate Optimizations**
Anh-Tien Tran, Demeke Shumeye, Thien Duc Hua and Quang Tuan Do (Chung-Ang University, Korea (South)); Nhu-Ngoc Dao (Sejong University, Korea (South)); Sungrae Cho (Chung-Ang University, Korea (South))
- [P-1-10] **A Research on Low Latency Motion Control System Using Real-Time Scheduling in Edge Server**
Jaeho Jeon (Electronics and Telecommunications Research Institute, Korea (South)); Dongbeom Ko and Sungjoo Kang (Electronics and Telecommunications Research Institute (ETRI), Korea (South))

- [P-1-11] **Noise Reduction Caused by External Events in Wireless Sensor Network**
Trinh Lai-Thuc and Myungsik Yoo (Soongsil University, Korea (South)); Jaehyuk Cho (Jeonbuk national university, Korea (South))

Session Poster-2

17:00-18:20

Chair: Prof. Hui-Chun Hung, National Central University, Taiwan

- [P-2-1] **Integrated Optimization in Training Process for Binary Neural Network**
Hieu Quang Vo, Sang Hoon Hong, LokWon Kim and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-2-2] **Semantic Communication for AR-Based Services in 5G and Beyond**
Tri Nguyen Dang, Loc X. Nguyen, Huy Q. Le, Ki Tae Kim, S. M. Ahsan Kazmi, Seong-Bae Park, Eui-Nam Huh and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-2-3] **Sustainable Auctions for Electricity Markets**
Abrar Ahmed and Bong Jun David Choi (Soongsil University, Korea (South)); Bizzat Hussain Zaidi (Tate Engineering Inc, Canada); Abdul Samad (Istanbul Technical University, Turkey)
- [P-2-4] **The Performance of Graph Neural Network in Detecting Fake News from Social Media Feeds**
Iftekhharul Islam Shovon and Seokjoo Shin (Chosun University, Korea (South))
- [P-2-5] **Hand Bone X-Rays Segmentation and Congregation for Age Assessment Using Deep Learning**
Kyunghee Jung, Toan Duc Nguyen, Duc Tai Le, Junghyun Bum, Simon S. Woo and Hyunseung Choo (Sungkyunkwan University, Korea (South))
- [P-2-6] **Spectral Efficiency Maximization for V2V Communication Underlaid Cellular Uplink Using Deep Neural Networks**
Dara Ron, EunJeong Han and Jung Ryun Lee (Chung-Ang University, Korea (South))
- [P-2-7] **Applying Deep Knowledge Tracing Model for University Students' Programming Learning**
Hui-Chun Hung and Ping-Han Lee (National Central University, Taiwan)
- [P-2-8] **A Data Plane Approach for Detecting Malware in IoT Networks**
K Haribabu and Mrunal Hareshwar Gaikar (BITS Pilani, India)
- [P-2-9] **Cooperative User Relaying with RSMA for 6G Networks: Overview, Research Challenges and Future Trends**
Cuong Ho and The Vi Nguyen (Chung-Ang University, Korea (South)); Chunghyun Lee (Chun-Ang University, Korea (South)); Thi My Tuyen Nguyen and Sungrae Cho (Chung-Ang University, Korea (South))
- [P-2-10] **Phase-Compensating-Circuit Design Utilizing Linear-Nonlinear Joint Optimizations**
Tian-Bo Deng (Toho University, Japan)

- [P-2-11] **AI BOX: Artificial Intelligence-Based Autonomous Abnormal Network Traffic Response Mechanism**
Jiann-Liang Chen (National Taiwan University of Science and Technology, Taiwan); Zheng-Zhun Chen, Youg-Sheng Chang, Ching-lang Li and Tien-I Kao (Industrial Technology Research Institute, Taiwan); Yu-Ting Lin, Yu-Yi Xiao and Jian-Fu Qiu (National Taiwan University of Science and Technology, Taiwan)

Session Poster-3

17:00-18:20

Chair: Prof. Apostolos Gkamas, University Ecclesiastical Academy of Vella of Ioannina, Greece

- [P-3-1] **Trajectory Optimization of Multi-UAM for Reliable Communications with Integrated Space-Air-Ground Network**
Yu Min Park, Ki Tae Kim, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-3-2] **A PSK-Based Multi-Hop Authentication for Home Network and Its Implementation Using PUCC Protocol**
Takeshi Kato (GMS Laboratory, Komazawa University); Norihiro Ishikawa (Komazawa University, Japan)
- [P-3-3] **UAVs Reformation Approach Based on Packet Loss in GPS-Denied Environments**
Issaree Srisomboon and Sanghwan Lee (Kookmin University, Korea (South))
- [P-3-4] **A Brief Review on Network Identity-Based Moving Target Defense**
Nico Saputro (Florida International University, USA & Parahyangan Catholic University, Indonesia)
- [P-3-5] **FedBeam: Federated Learning Based Privacy Preserved Localization for Mass-Beamforming in 5GB**
Deepti Sharma and Ramesh Babu Battula (Malaviya National Institute of Technology Jaipur, India)
- [P-3-6] **Controlling and Simulation System for Hydraulic Valve Testing Based on Qt**
Chen Zhang (Jiangsu Advanced Construction Machinery Innovation Center LTD., China)
- [P-3-7] **ParaNet: A Single Blocked Network for Mobile Edge Computing Devices**
Sharmen Akhter, Md. Imtiaz Hossain, Md. Delowar Hossain, Choong Seon Hong and Eui-Nam Huh (Kyung Hee University, Korea (South))
- [P-3-8] **State of the Art Analysis of Resource Allocation Techniques in 5G MIMO Networks**
Christos J Bouras (University of Patras, Greece); Ioannis Caragiannis (Aarhus University, Denmark); Apostolos Gkamas (University Ecclesiastical Academy of Vella of Ioannina, Greece); Nicos Protopapas, Kyriakos Sgarbas and Tasos Sardelis (University of Patras, Greece)

- [P-3-9] **A Review on Satellite-Terrestrial Integrated Wireless Networks: Challenges and Open Research Issues**
Demeke Shumeye, Anh-Tien Tran and Arooj Masood (Chung-Ang University, Korea (South)); Nhu-Ngoc Dao (Sejong University, Korea (South)); Sungrae Cho (Chung-Ang University, Korea (South))

- [P-3-10] **Implementation of Edge Servers on an Open 5G Core Network**

Pisit Vanichchanunt (King Mongkut's University of Technology North Bangkok, Thailand); Ittipon Yamyuan (KMUTNB, Thailand); Pruk Sasithong (Chulalongkorn University, Thailand); Lunchakorn Wuttisittikulkij (Chulalongkorn University (CU), Thailand); Sukritta Paripurana (King Mongkut's University of Technology North Bangkok, Thailand)

- [P-3-11] **A Long Distance Low Bandwidth Firmware Update Process for LPWAN - Taking LoRaP2P+ as Example**
Yu-Zhe Xie, Jia-Cheng Zhang, Daniel Ho Teck Khieng and Nen-Fu Huang (National Tsing Hua University, Taiwan)

January 12, 2023 (Thursday)

Session Poster-4

17:00-18:20

Chair: Prof. Jaeyoung Choi, Soongsil Uni., Korea

- [P-4-1] **A Survey on Mobile Edge Computing for Deep Learning**
Pyeongjun Choi and Jeongho Kwak (DGIST, Korea (South))
- [P-4-2] **Hybrid MAC for Military UAV Networks**
Gyu Seon Kim (Inha University, Korea (South)); Hyunsoo Lee and Chanyoung Park (Korea University, Korea (South)); Soyi Jung (Ajou University, Korea (South)); Jae-Hyun Kim (Ajou University, South Korea, Korea (South)); Joongheon Kim (Korea University, Korea (South))
- [P-4-3] **DCGit: Decentralized Internet Hosting for Software Development**
Pratham Gupta, Kunjan Shah, Ankit Agrawal and Ritika Bhatia (BITS Pilani, India); Ashutosh Bhatia (Birla Institute of Technology and Science, Pilani, India); Kamlesh Tiwari (BITS Pilani, India)
- [P-4-4] **More General Discussions on Information Transfer of the Centralized Network System with Coupled Oscillations and Random Matrices**
Takako Hoshiyama (The University of Tokyo & Research Center, Japan); Hironori Shimoyama (Professional of Computational Science and Education, Japan)
- [P-4-5] **A Review on Reinforcement Learning Enabled Cooperative Spectrum Sensing**
Thi Thu Hien Pham and Sungrae Cho (Chung-Ang University, Korea (South))

- [P-4-6] **Multi-Person 3D Pose Estimation in Mobile Edge Computing Devices for Real-Time Applications**
Md. Imtiaz Hossain, Sharmen Akhter, Md. Delowar Hossain, Choong Seon Hong and Eui-Nam Huh (Kyung Hee University, Korea (South))
- [P-4-7] **The Study on TAVR Medical Twin Method Based on Real World Data(RWD)**
Se-Min Hyun and KangYoon Lee (Gachon University, Korea (South))
- [P-4-8] **GDFed: Dynamic Federated Learning for Heterogenous Device Using Graph Neural Network**
Yoon Ji Su, Sun Moo Kang, Seong-Bae Park and Choong Seon Hong (Kyung Hee University, Korea (South))
- [P-4-9] **A Study on the Cluster-Wise Regression Model for Bead Width in the Automatic GMA Welding**
Bo Ram Lee and Won Bin Oh (Mokpo National University, Korea (South)); Hak Hyoung Kim and Yeong Jae Jeong (Jeonnam Technopark, Korea (South)); Jae Seung Yoon (Dongyoung Machinery, Korea (South)); Ill Soo Kim (Mokpo National University, Korea (South))
- [P-4-10] **A Dynamic Scheduling Technique to Optimize Energy Consumption by Ductless-Split ACs**
Keshav Kaushik and Prabhutva Agrawal (BITS Pilani, India); Vinayak Naik (BITS Pilani, Goa, India)
- [P-4-11] **A Study on the Derivation of Essential Security Elements Through Analysis of Non-Face-To-Face Telehealth Service Model**
Jungha Jin and SangSeon Park (KOREA University, Korea (South)); Inhye Lee (Korea University, Korea (South))
- [P-5-5] **A Survey on Fuzzy Logic for Cluster Head Selection in Wireless Sensor Networks**
Geeranuch Woraphonbenjakul (Chung Ang University, Korea (South)); Arooj Masood and Sungrae Cho (Chung-Ang University, Korea (South))
- [P-5-6] **A Review on Recent Approaches in mmWave UAV-Aided Communication Networks and Open Issues**
Quang Tuan Do, Demeke Shumeye, Anh-Tien Tran, Thien Duc Hua and Sungrae Cho (Chung-Ang University, Korea (South))
- [P-5-7] **The Application of Distributed Ledger Technology in Agribusiness**
Zheyu Chen (University of Michigan, USA)
- [P-5-8] **Hand Written Digits Recognition Based on Concatenated LSTMs**
Noriaki Kaneko and Masakatsu Ogawa (Sophia University, Japan)
- [P-5-9] **Abnormal Client Detection Federated Learning Using Image Vectors**
JinSeon Park (Kyung Hee University, Korea(South)); Seong-Bae Park, Choong Seon Hong and Ki Tae Kim (Kyung Hee University, Korea (South))
- [P-5-10] **Neural Architectural Nonlinear Pre-Processing for mmWave Radar-Based Human Gesture Perception**
Hankyul Baek, Yoo Jeong Ha and Minjae Yoo (Korea University, Korea (South)); Soyi Jung (Ajou University, Korea (South)); Joongheon Kim (Korea University, Korea (South))
- [P-5-11] **Modern Trends in Quantum AI: Distributed and High-Definition Computation**
Jae Pyoung Kim, Won Joon Yun, Hankyul Baek and Joongheon Kim (Korea University, Korea (South))

Session Poster-5

17:00-18:20

Chair: Prof. Jongsun Choi, Soongsil Uni., Korea

- [P-5-1] **Techno-Economic Analysis of IoT Networks in 5G**
Christos J Bouras, Charalampos Chatzigeorgiou and Anastasia Kollia (University of Patras, Greece); Philippos Pouyioutas (University of Nicosia, Cyprus)
- [P-5-2] **Hands-Up-Go: Development of Gas Efficient Blockchain Event DApp**
Aeri Kim, Meryam Essaid, Junhyeong Ryu and Hongtaek Ju (Keimyung University, Korea (South))
- [P-5-3] **A Review on Congestion Control for Internet of Deep Space Things Communication**
Arooj Masood, Taeyun Ha and Demeke Shumeye (Chung-Ang University, Korea (South)); Nhu-Ngoc Dao (Sejong University, Korea (South)); Thien Duc Hua (Chung-Ang University, Korea (South)); Geeranuch Woraphonbenjakul (Chung Ang University, Korea (South)); Sungrae Cho (Chung-Ang University, Korea (South))
- [P-5-4] **Key Generation and Management Method Using AI Generated Rubik's Cube States**
Jungha Jin and SangSeon Park (KOREA University, Korea (South))

Session Poster-6

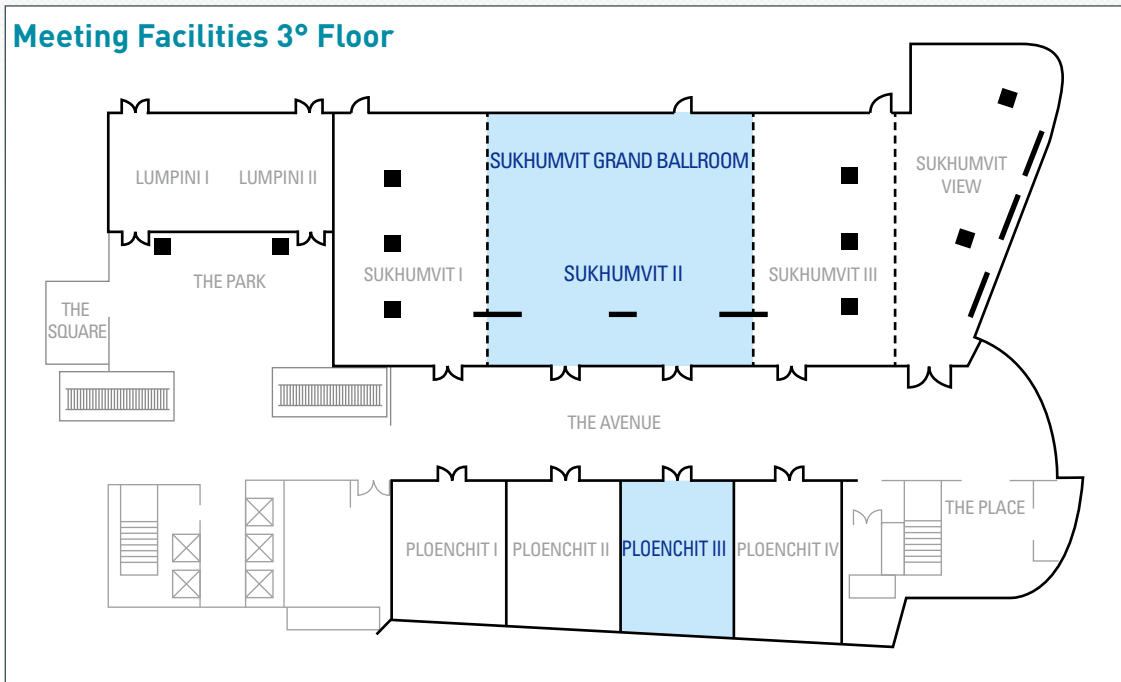
17:00-18:20

Chair: Prof. Miinho Park, Soongsil Uni., Korea

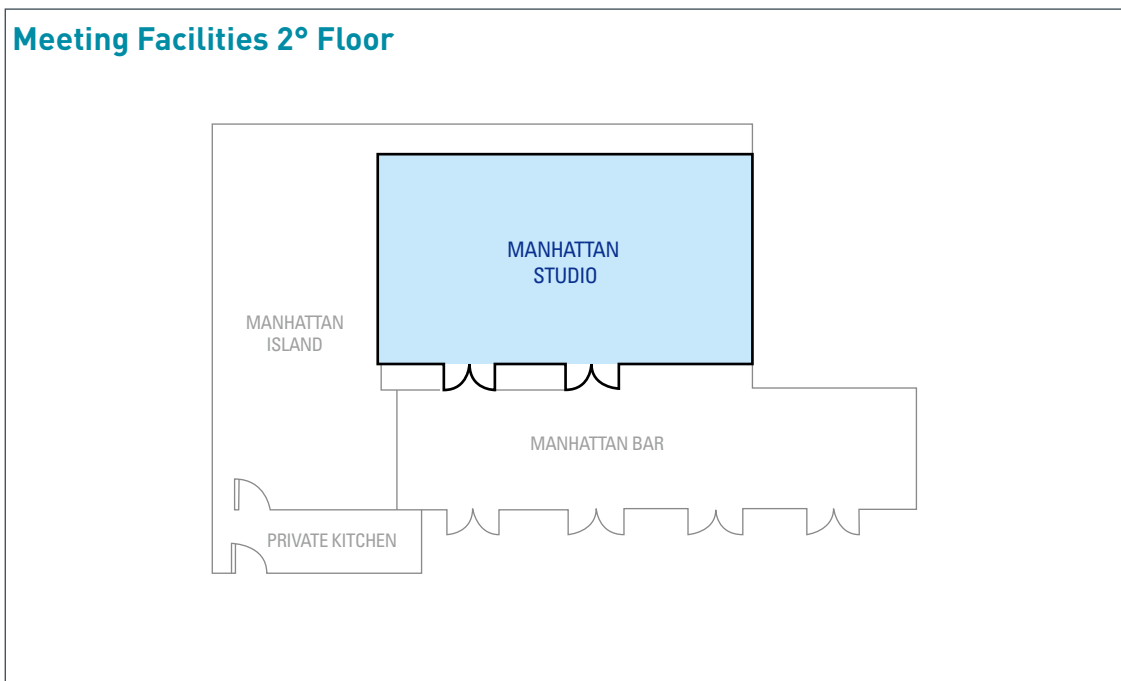
- [P-6-1] **Design and Analysis of 29 GHz Millimeter-Waves Phased Array Antenna with Reduced Mutual Coupling**
Ashfaq Ahmad (Chosun University, Republic of Korea, Korea (South)); Dong-You Choi, Yun Hwang Lee, Geun OK Lee and Hyeon Jung Kim (Chosun University, Korea (South))
- [P-6-2] **A Review on Matching-Based Models for Distributed Computation Offloading in Fog-Enabled IoT Systems**
Tran Hoa and Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))
- [P-6-3] **Contents Delivering Network on Constellation Satellite Using THz: Latency Minimization and Energy Optimization**
Min Seok Kim, Choong Seon Hong and Sang Hoon Hong (Kyung Hee University, Korea (South))

- [P-6-4] **Computation Offloading Strategy Based on Multi-Armed Bandit Learning in Microservice-Enabled Vehicular Edge Computing Networks**
Md. Delowar Hossain, Tangina Sultana, Sharmen Akhter, Md. Imtiaz Hossain, Ga-Won Lee, Choong Seon Hong and Eui-Nam Huh (Kyung Hee University, Korea (South))
- [P-6-5] **Sionna: Introduction to Embedded Open-Source Semantic Communication Platforms**
Ju-Hyung Lee (University of Southern California, USA); Joongheon Kim (Korea University, Korea (South))
- [P-6-6] **Exaggerated Advertisement Inspection System for Judging the Suitability of Advertisements in Social Media Environment**
Yohan Park and Yongjin Kim (Soongsil University, Korea (South)); Jonghyeok Mun (Soongsil University, Korea (South)); Jongsun Choi and Jaeyoung Choi (Soongsil University, Korea (South)); Yongyun Cho (Sunchon National University, Korea (South))
- [P-6-7] **Abnormal Human Behavior Detection Based on VAE-LSTM Hybrid Model in WiFi CSI with PCA**
Yong-Hwan Kim and Sang-Chul Kim (Kookmin University, Korea (South))
- [P-6-8] **A Reference Architecture for Activities-As-Asset Distributed Ledger with Secure Private Computation**
Chen-Fu Chiang (SUNY Polytechnic Institute, USA); Ali Tekeoglu (Johns Hopkins University Applied Physics Laboratory, USA); Saumendra Sengupta (SUNY Polytechnic Institute, USA); Aaron Gregory and Tzu-Chieh Wei (Stony Brook University, USA); Dilip Kusumtla (State University of New York Polytechnic Institute, USA)
- [P-6-9] **Multi-Keyword Based Information Routing in Peer-To-Peer Networks**
Iling Yen (University of Texas at Dallas, USA); Hieu Tran (The University of Texas at Dallas, USA); Miao Miao (UTD, USA); Farokh Bastani (The University of Texas at Dallas, USA)
- [P-6-10] **Deep Learning for 2D-MIMO Scheme Based on Optical Camera Communication**
Huy Nguyen, Van Linh Nguyen, Duc Hoang Tran and Yeong Min Jang (Kookmin University, Korea (South))
- [P-6-11] **A V2X Access Authorization Mechanism Based on DID and VC Using Blockchain**
Jiho Lim, Ki-Hyung Kim, Hansu Oh, Sun-young Kim and Kichun Sim (Ajou University, Korea (South))
- [P-6-12] **A Pactical HMM-Based Map-Matching Method for Pedestrian Navigation**
Shengjie Ma and Hyukjoon Lee (Kwangwoon University, Korea (South))

Meeting Facilities 3rd Floor



Meeting Facilities 2nd Floor



JW Marriott Hotel Bangkok

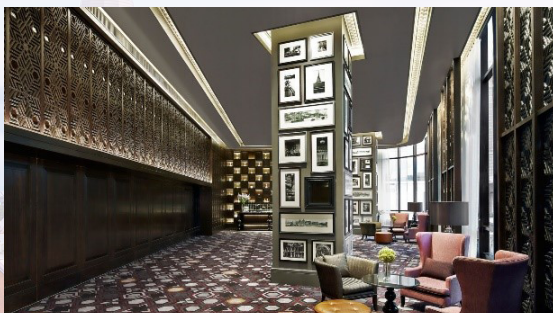
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A New Era of Elegance



Transportation to and from Hotel

The experience begins the moment the travelers arrive. The spacious lobby has been enriched with stylish design details and unique objects d'art that emulate the rich culture of its location. Dark and light wood tones are accentuated by pops of color from the orange leather soft seating, vibrant floral arrangements, and the Thai-inspired geometric design of the plush carpet underfoot. Multiple intimate spaces allow for a quiet place to work or unwind with a favorite beverage. The new room design also seamlessly balances traditional Thai elements and modern architectural ideologies. Some unique features in the rooms provide intriguing insights into Thai history and culture.

Prime Location on Sukhumvit Road

With its prime location in the Central Business District on Sukhumvit Road, JW Marriott Hotel Bangkok is perfect for business and pleasure. Just only a 2-minute walk to the Ploenchit or Nana BTS Skytrain station, the hotels is easily connected to major business and shopping areas in the city such as Siam Paragon Mall, MBK shopping Mall, Central World and Central Embassy. With direct access to and from the Suvarnabhumi Airport via the expressway.

Nourish Your Mind and Body

JW Marriott Hotel Bangkok is a haven designed to let you focus on feeling whole. Fully embrace the here and now and focus on what matters most. With an array of special services and treatments that will help you reconnect with yourself and what really matters.

Getting JW Marriott Hotel Bangkok

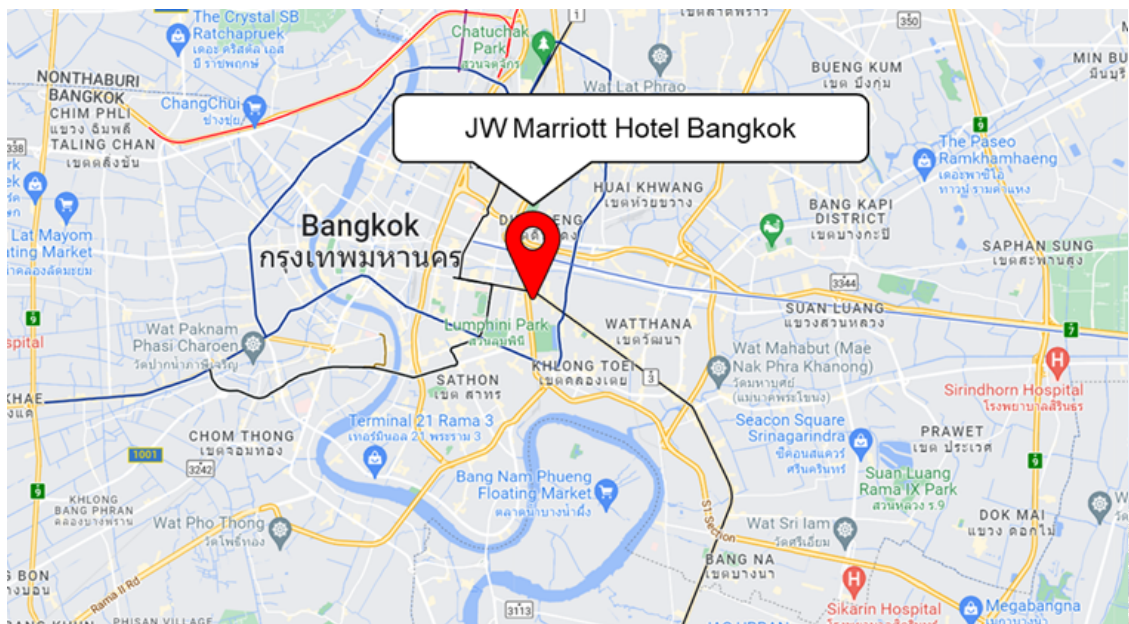
4 Sukhumvit Road, Soi 2, Bangkok, Thailand, 10110

Tel: +66 2-6567700

- From Suvarnabhumi Airport
Distance from Property: 26.2 KM / Phone Number: +66 213-21888
- From Don Mueang International Airport
Distance from Property: 24.4 KM / Phone Number: +66 253-51111
- Nearby

Subway Station: Ploenchit BTS SkyTrain Station / Sukhumvit MRT Subway Stations

Train Station: Hua Lamphong Railway Station





Grand Palace & Wat Prakeaw

The Grand Palace and Wat Prakeaw command respect from all who have walked in their sacred grounds. Built in 1782, and for 150 years the home of Thai Kings and the Royal court, the Grand Palace continues to have visitors in awe with its beautiful architecture and intricate detail. Wat Pra Kaew enshrines Phra Kaew Morakot (the Emerald Buddha), the sacred Buddha image meticulously carved from a single block of emerald.



Wat Arun (The Temple of Dawn)

The impressive silhouette of Wat Arun's towering spires is one of the most recognised in Southeast Asia. Constructed during the first half of the 19th century in the ancient Khmer style, the stupa showcasing ornate floral pattern decked out in glazed porcelain is stunning up close. Apart from its beauty, Wat Arun symbolises the birth of the Rattanakosin Period and the founding of the new capital after Ayutthaya fell.



Floating Market

The pioneer of all floating markets, Damnoen Saduak continues to offer an authentic experience despite its increasingly touristy atmosphere. Imagine dozens of wooden row boats floating by, each laden to the brim with farm-fresh fruits, vegetables or flowers. Food vendors fill their vessels with cauldrons and charcoal grills, ready to whip up a bowl of 'boat noodle' or seafood skewers upon request.



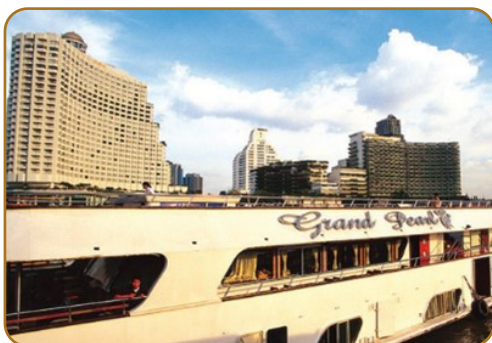
China Town (Yaowarat)

Chinatown is a colourful, exotic and pleasingly chaotic area, packed with market stalls and probably the highest concentration of gold shops in the city. During major festivities like Chinese New Year and the Vegetarian Festival, the dynamism and spirit of celebration spreads across town like wildfire, and if you happen to be around, don't miss an opportunity to witness Bangkok Chinatown at its best.



Wat Pho

There's more to Wat Pho than the gigantic reclining Buddha and traditional Thai massage. Wat Pho harbours a fascinating collection of murals, inscriptions and sculptures that delve into various subjects, from warfare to astronomy to archaeology. The vast temple complex contains a landscaped garden with stone sculptures, stupas adorned with glazed porcelain, a souvenir shop and the College of Traditional Medicine.



Chao Phraya River & Waterways

One of the most scenic areas, the riverside reflects a constantly changing scene day and night: water-taxis and heavily laden rice barges chugging upstream, set against a backdrop of glittering temples and luxury hotels. The areas from Wat Arun to Phra Sumeru Fortress are home to some of the oldest settlements in Bangkok, particularly Bangkok Noi and its charming ambience of stilt houses flanking the complex waterways.



Chatuchak Weekend Market

Once only popular among wholesalers and traders, Chatuchak Weekend Market has reached a landmark status as a must-visit place for tourists. Its sheer size and diverse collections of merchandise will bring any seasoned shoppers to their knees. The market is home to more than 8,000 market stalls. On a typical weekend, more than 200,000 visitors come here to sift through the goods on offer.



Khao San Road

If Bangkok is a city where East greets West, then Khao San Road is the scene of their collision, the place where they jostle for superiority and poke one another in the eye. With travellers from every corner of the modern world, sleek clubs playing sophisticated sounds, eclectic market stalls, converted VW cocktail bars, and foods tamed to suit the Western palate, it may seem clear who won the fight.

