APNOMS 2021

The 22nd Asia-Pacific Network Operations and Management Symposium

Networking Data and Intelligent Management in the Post-COVID19 Era

Sep. 8-10, 2021, Taiwan

Advanced Program

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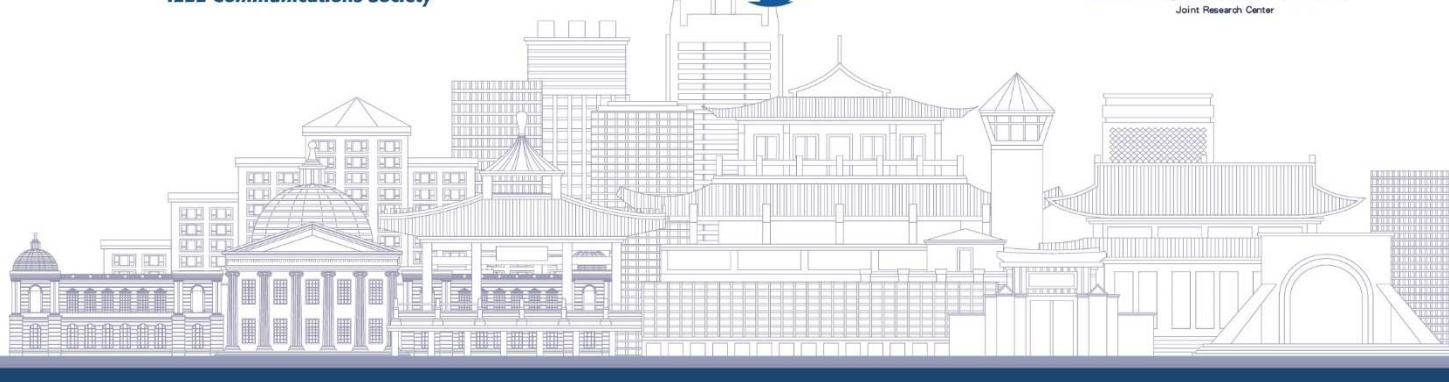


Chunghwa Telecom

*Chunghwa Telecom is **the largest integrated telecom service provider in Taiwan**. The goal of the company is to be a value-creating and trustworthy company in providing Information, Communication and Technology, or ICT, services.*

"We are pleased with Chunghwa's remarkable achievements in the second quarter," said Mr. Chi-Mau Sheih, Chairman and CEO of Chunghwa Telecom. "We maintained our leading market position in the mobile business sector, and I would like to express my personal gratitude to all of our employees navigating the challenging operating environment in the quarter. Our accumulated number of 5G sign-ups exceeded 1 million at the end of the quarter, ahead of schedule, and we expect to reach 2 million sign-ups by the end of this year. To upgrade the quality of 5G services, we accelerated our 5G deployment and accumulated more than 8,000 base stations by quarter end, expecting to approach 12,000 base stations by the end of this year. Moreover, we are proud to have won the distinction of "Fastest 5G" and "Best Mobile Coverage" in Q1-Q2 2021, according to the Taiwan 5G Speedtest AwardTM report in July. Given our significant progress in 5G adoption and development, as well as market approval and endorsement, we are optimistic about our growth and strive to maintain our leading status in Taiwan's mobile market."
"The trends that fueled our growth during the quarter, such as "work from anywhere", "video everywhere", and the democratization of content creation, have all accelerated. As customer demands continue to grow and our market opportunities expand, we are delighted to see an ongoing increase in fixed broadband services, as subscriber numbers for our MOD/IPTV platform and Hami video continued to grow. In July, we broadcasted the Tokyo Olympic Games with 4K quality on the MOD platform and exclusively delivered the first-ever VR simulation on Hami Video. In addition, overall ICT project revenue in the second quarter continued to increase. We will continue to enhance our ICT technology capabilities to cater to more emerging digital opportunities and remain selective to further increase project profit margin."
Mr. Sheih concluded, "Looking ahead, we will continue to invest in our capabilities, improve the quality of our product and service offerings, and accelerate innovation, as we address the changing needs of our clients."

Mr. Chi-Mau Sheih
Chairman and CEO

Taiwan's Telecom Leader / Strong Market Positions (a)

Q2 2021 Consolidated Revenue: NT$49.60 bn

- Domestic Fixed
  - #1 Local
    - 91.9% share by subs (9.81 mn subs)
    - 83.1% share by minutes
  - #1 DLD
    - 82.1% share by minutes
  - #1 Broadband access
    - 64.4% share by subs (b)(c) (4.35 mn subs)
- Mobile
  - #1 Mobile revenue
    - 38.8% market share (d)
  - #1 Mobile subscribers
    - 36.0% market share (10.63 mn subs)(e)
- Internet
  - #1 ISP
    - 61.5% share by subs (3.95 mn subs)
- International Fixed
  - #1 ILD
    - 45.0% share by minutes

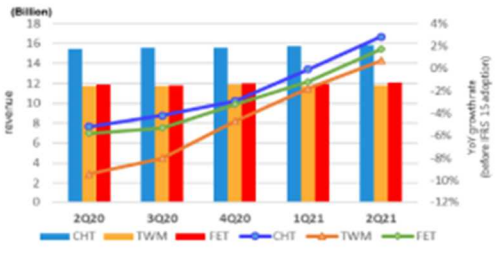
Source: Company data, MOTC, and NCC statistics
a) Market share as of May 2021
b) CHT access circuits were not included
c) Excluding PWLAN subscriber numbers
d) Revenues are based on T-IFRSs
e) 040 subscribers excluded

DIFFERENTIATING FACTORS

- Leading Position in Customer Access
- Extensive Product Portfolio with High Quality Services
- Branding & Scale Advantages
- Advanced Network & Technology Capabilities
- Financial Strengths

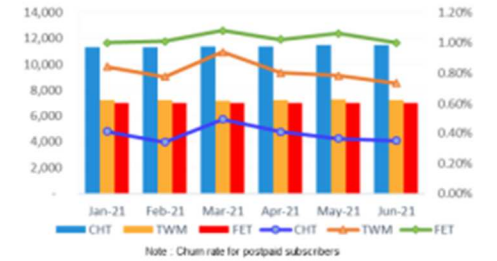
Leading Position in Mobile Market

Better Performance in Mobile Service Revenue



Note : For TWM and FET, mobile service revenue is derived from mobile ARPU under Residual Value Method times the average subscriber number

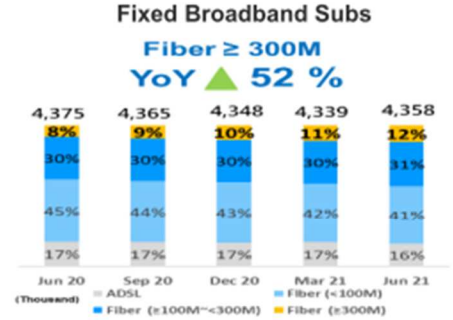
Highest Subs & Lowest Churn



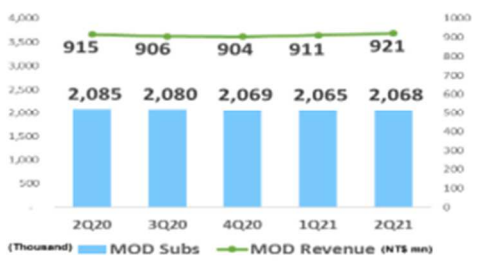
Note : Churn rate for postpaid subscribers

#1 Broadband Provider

Fixed Broadband Subs



MOD Revenue and Subs



中華電信股份有限公司
Chunghwa Telecom Co., Ltd.
For more information visit:
www.cht.com.tw/ir

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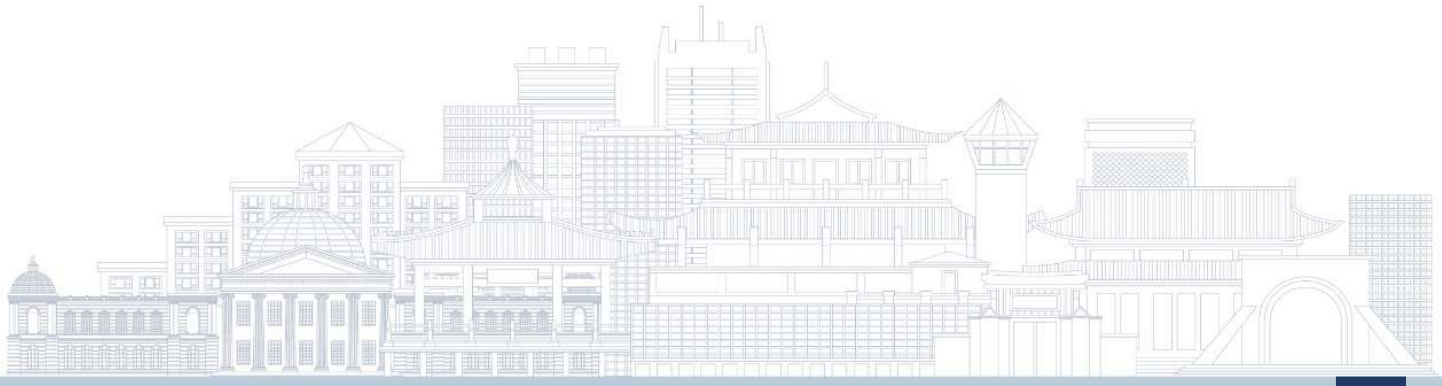

Welcome to APNOMS 2021

The 22nd Asia-Pacific Network Operations and Management Symposium

"Networking Data and Intelligent Management in the Post-COVID19 Era"

Sep. 8-10, 2021, Tainan, Taiwan

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Supported by: Chunghwa Telecom and National Chiao Tung University/Okinawa Open Laboratory Joint Research Center

APNOMS (Asia-Pacific Network Operations and Management Symposium) has been a premier conference on network operations and management in the Asia Pacific region. APNOMS meets almost every year, typically during September and boasts a rich history of success. APNOMS 2021, taking place in Tainan, Taiwan, marks the 22nd anniversary, following the successful APNOMS'97 (Seoul) to APNOMS 2020 (Daegu). APNOMS 2021 is sponsored by IEICE Technical Committee on Information and Communication Management (ICM), the KICS Technical Committee on Korean Network Operations and Management (KNOM), National Yang Ming Chiao Tung University (NYCU), and Ministry of Science and Technology (MOST), Taiwan. APNOMS 2021 includes a full three-day program of keynotes, tutorials, technical sessions, panel discussions, demo and poster sessions, and exhibitions.

The most significant impact on social life and economics worldwide since 2020 is definitely the COIVD-19 pandemic. The pandemic also affects various aspects of development, management, and application of telecom network and communications. To this end, the main theme of APNOMS 2021 is set to networking data and intelligent management in the post-COVID19 era. We shall have several experts and researchers gathered together to discuss technologies for post-Covid19 era in the data and network management aspect, sharing their experience and challenges in various academia, industries and governments. The diverse topics cover virtual desktop infrastructure for telework, optimizing pandemic containment by social network analysis, roles of supercomputer in overcoming COVID-19, learning human behavior in the COVID-19 pandemic time, and many others.

Another important trend of topics is about 5G. We have three keynotes covering the opportunities and challenges in the 5G era, the open-source movement in the 5G MEC, and the challenge for automated operation toward future 5G and cloud-native environment.

Of course, APNOMS 2021 also offers technical, poster, innovation, demo, and special sessions with topics on the operation and management of networks spanning from telecommunications to computer networks. This year, we have a special arrangement for poster, demo, and exhibitions. The virtual venue provides a way for participants to interact in real time yet keep the social distance. This emerging way of interaction exactly demonstrates

how the community can adapt to the COVID-19 pandemic.

Finally, we would like to express our sincere thanks to the authors, reviewers, committee members, volunteers, and participants, who make a great effort to the success of APNOMS 2021. We are looking forward to seeing you in this event.

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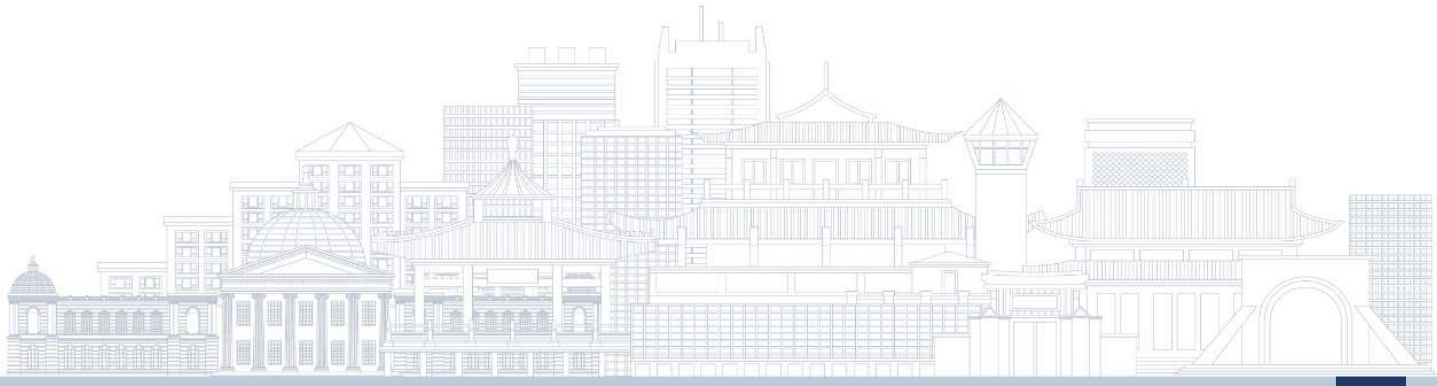

Program at a Glance

Wednesday, September 8, 2021

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(90 min)</td><td>Tutorial 1 (T1)
Federated Learning for Internet of Vehicles
Celimuge Wu
Chair: Guey-Yun Chang</td><td>Tutorial 2 (T2)
Edge Learning: Enabling Distributed Machine Learning in Cloud-Edge Environment
Peng Li
Chair: Sangheon Pack</td><td></td></tr>
<tr><td>10:30 ~ 10:45
(15 min)</td><td colspan="3">Break</td></tr>
<tr><td>10:45 ~ 11:30
(45 min)</td><td colspan="3">Welcome Address &
Keynote Speech 1 (K1)
The Opportunities and Challenges in the 5G Era
Hey-Chyi Young (VP, Telecommunication Lab, Chunghwa Telecom Co. Ltd.)
Chair: Li-Hsing Yen</td></tr>
<tr><td>11:30 ~ 12:40
(70 min)</td><td colspan="3">Break</td></tr>
<tr><td>12:40 ~ 14:10
(90 min)</td><td>Tutorial 3 (T3)
Trajectory Design in Wireless Drone Networks: Moving from Offline Optimization to Online Learning
Yu-Jia Chen
Chair: Guey-Yun Chang</td><td>Tutorial 4 (T4)
Human Behavior in the Time of COVID-19 Pandemic: Learning from Data Science
Jinyoung Han
Chair: Sangheon Pack</td><td></td></tr>
<tr><td>14:10 ~ 14:30
(20 min)</td><td colspan="2">Break</td><td rowspan="2">Exhibitions
(Main Hall in gather.town)</td></tr>
<tr><td>14:30 ~ 15:30
(60 min)</td><td colspan="2">Poster Session 1 (PS1)
(Poster 1 Room in gather.town)
Chair: You-Chiun Wang</td></tr>
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(100 min)</td><td>Technical Session 1 (TS1)
Internet of Things and Wireless Sensor Networks
Chair: Jen-Jee Chen</td><td>Technical Session 2 (TS2)
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Chair: Hiroki Nakayama</td><td></td></tr>
</table>

Thursday, September 9, 2021

Time	Track I	Track II	Track III
09:00 ~ 9:30 (30 min)	**Keynote Speech 2 (K2)** **The Opensource Movement in the 5G MEC** Sungwon Lee (Kyung Hee University) **Chair**: Woojin Seok		
09:30 ~ 09:50 (20 min)	Break		
09:50 ~ 11:30 (100 min)	**Technical Session 3 (TS3)** **Edge/Fog Computing** **Chair**: Kyungbaek Kim	**Technical Session 4 (TS4)** **5G Network** **Chair**: Huai-Sheng Huang	**Special Session (SS)** Bruce Lan (Palo Alto Networks) Tomohiro Otani, (KDDI) Hiroaki Harai (NICT) Dongkyun Kim (KISTI) **Chair**: Chi-Lin Tsai
11:30 ~ 12:40 (70 min)	Break		
12:40 ~ 14:20 (100 min)	**Technical Session 5 (TS5)** **Configuration and Fault Management** **Chair**: Haneul Ko	**Technical Session 6 (TS6)** **Intelligent Network Management** **Chair**: Yan-Ann Chen	**Innovation Session 1 (IS1)** **Intelligent Network Operations and Management in a New Era** **Chair**: Chien-Chi Kao (CHT, Taiwan)
14:20 ~ 14:40 (20 min)	Break		**Exhibitions** (Main Hall in gather.town)
14:40 ~ 15:40 (60 min)	**Poster Session 2 (PS2)** (Poster 2 Room in gather.town) **Chair**: Hiroki Nakayama		
15:40 ~ 17:20 (100 min)	**Technical Session 7 (TS7)** **SDN** **Chair**: Ryo Yamamoto	**Technical Session 8 (TS8)** **Heterogeneous Networks** **Chair**: Ting-Hui Chiang	

Friday, September 10, 2021

Time	Track I	Track II	Track III
09:00 ~ 9:30 (30 min)	**Keynote Speech 3 (K3)** **The Challenge for Automated Operation Toward Future 5G and Cloud-Native Environment** Masanori Miyazawa (KDDI) **Chair**: Kazuhiko Kinoshita		
09:30 ~ 09:50 (20 min)	Break		
09:50 ~ 11:30 (100 min)	**Technical Session 9 (TS9)** **Network Monitoring and Measurements** **Chair**: Cheng Zhang	**Technical Session 10 (TS10)** **NFV** **Chair**: Choi Mi-Jung	**Innovation Session 2 (IS2)** **Intelligent & Secure Networking Services** **Chair**: Dr. Wootae Kim (KT, Korea)
11:30 ~ 12:40 (70 min)	Break		
12:40 ~ 13:40 (60 min)	**Poster Session 3 (PS3) + Exhibitions** (Poster 3 Room in gather.town) **Chair**: Haneul Ko		**Demo Session (DS)** (Main Hall in gather.town)
13:40 ~ 13:50 (10 min)	Break		
13:50 ~ 15:45 (115 min)	**Distinguished Experts Panel (DEP)** **Technologies for Post-Covid19 era in the data and network management aspect: Sharing experiences and challenges in various academia, industries and governments** Magnus Ewerbring (Ericsson Asia-Pacific) / Shinji Yamashita (Fujitsu, Japan) / De-Nian Yang (Sinica, Taiwan) / Ping-Yu Hsu (National Central University, Taiwan) / Sangjae Seo (KISTI, Korea)/ **Chair**: Yi-Cheng Chen (National Central University, Taiwan)		
15:45 ~ 15:50 (5 min)	Break		
15:50 ~ 16:20 (30 min)	**Paper Award and Closing**		

Keynotes

Keynote 1

The Opportunities and Challenges in the 5G Era

Time & Date: 11:00 ~ 11:30, Sept. 8, 2021

Chair: Li-Hsing Yen

Speaker: Ms. Hey-Chyi Young

(VP, Telecommunication Lab, Chunghwa Telecom Co. Ltd.)

Madam Hey-Chyi Young joined Chunghwa Telecom 31 years ago. She has been Vice President of Telecommunication Laboratories since Nov. 2017. Before that, she served as Director of Network Management Lab and Director of Cloud Computing Lab in TL. Madam Young has rich experience in telecommunication management. She and her team were the pioneers for developing OSS (operations supporting systems) with the capabilities of service auto-provision involving a large-scale heterogeneous network. These OSS have been applied in Chunghwa Telecom's broadband services, including ADSL, FTTx, HiNet, Wi-Fi, MOD, and made a tremendous and positive impact on the high broadband penetration rate in Taiwan. Her team also developed the cloud management system to provide Chunghwa Telecom on-demand cloud services in the market. Facing the 5G era, she currently dedicates herself to advanced technologies like telco cloud, autonomous network, intelligent orchestration and operations, as well as the integration of multi-domain technologies for innovative services and digital transformation.

Summary of Presentation

5G outlines a beautiful vision, and countries around the world likewise attach strategic importance to 5G. This speech will present the 5G vision, the essence of 5G technologies and applications, the status quo of 5G deployment and penetration worldwide, and the new opportunities brought by 5G. This speech will also point out the challenges we must face and overcome to achieve the 5G vision in the real world. In addition, the speaker will share Chunghwa Telecom's relevant activities and achievements in response to the 5G new era.

Keynote 2

The Opensource Movement in the 5G MEC

Time & Date: 09:00 ~ 09:30, Sept. 9, 2021

Chair: Woojin Seok

Speaker: Prof. Sungwon Lee

Sungwon Lee received the B.S., M.S., and Ph.D. degrees in Computer Engineering from Kyung Hee University, Korea, in 1994, 1996, and 1998, respectively. From 1999-2008, he joined Samsung Electronics research and business groups on radio access network and core network development of cdma2000 1X, cdma200 1xEV-DO, WCDMA, HSPA, WiBro/Mobile-WiMAX, and IP Multimedia Subsystem (IMS). He worked as a project leader for several trial innovative system developments. And, he was a senior engineer for system architecture, system design, and traffic engineering for several commercial product developments. He has published more than 100+ patents according to mobile broadband networks, including more than 30 registered U.S. patents. He is currently a Professor of Faculty with the Department of Software Convergence, Kyung Hee University, Korea. His current research interests are mobile broadband wireless networks, cellular communications, data center networking, and open-source software & hardware based networking technologies.

Summary of Presentation

Open source is widely used in 5G networks. These trends are not limited to operating systems and include networking protocols, virtualization, cloud computing, and container technologies. Linux Forum and CNCF are some of the most important participants of the 5G ecosystem. In this keynote, we will survey the key ideas and enablers of MEC in 5G networks and explains the role and position of opensource software in this movement.

Keynote 3

The Challenge for Automated Operation Toward Future 5G and Cloud-Native Environment

Time & Date: 09:00 ~ 09:30, Sept. 10, 2021

Chair: Kazuhiko Kinoshita

Speaker: Mr. Masanori Miyazawa (KDDI)

Masanori Miyazawa received the B.E and M.E degrees in electronic engineering from Tokyo University of Science, Japan, in 2000, 2002 respectively. He joined KDDI corporation in 2002. Since 2004, he has been engaged in research on optical networking (e.g., GMPLS), and autoamted operation management using AI/ML. From 2019, He moved to operation division and is currently developing the operation management system (OSS) for automation in commercial mobile and fixed network.

Summary of Presentation

Telecom operators are expecting a dramatic transformation in network management and operation using an automation by starting into 5G era. In reality, several problems still remain for efficient automated operation, especially in hybrid network (combination with traditional network and new virtualized network such as 5G-NSA). In this session, we will talk about introduction of several problems in network operation and future technologies for advanced automation toward beyond 5G.

Distinguished Experts Panel

Friday, September 10, 2021, 13:50-15:45

Theme: Technologies for Post-Covid19 era in the data and network management aspect: Sharing experiences and challenges in various academia, industries and governments

Chair: Prof. Yi-Cheng Chen (National Central University, Taiwan)

Speaker 1

Enterprise potential with 5G connectivity

Speaker: Dr. Magnus Ewerbring (Ericsson)

As Chief Technology Officer (CTO) for Asia-Pacific, Magnus Ewerbring is responsible for driving technology alignment as well as long term technology strategies for Ericsson in Asia-Pacific. Magnus has been with Ericsson for more than 30 years and has held several senior executive positions within Ericsson Research, Development, Business Units, as well as in customer accounts. Magnus holds a Master of Science in Electrical Engineering from Chalmers University of Technology (Gothenburg, Sweden) and a Ph.D. in Electrical Engineering from Cornell University (Ithaca, N.Y., USA). Magnus is based in Hong Kong.

Summary of Presentation

5G is rapidly being deployed throughout the World. Both consumer and enterprises are increasingly reaping the benefits of 5G services. For enterprises, the possibilities are plenty as they digitalize. Be increasingly becoming data driven, higher values can be derived increasing performance and energy efficiency and safety in manufacturing plants. In our talk, we will exemplify recent advancement of 5G-based connectivity in enterprise environments.

Speaker 2

VDI Service Quality Analysis System

- Experiences and Challenges towards Post COVID-19 Era -

Speaker: Mr. Shinji Yamashita (Fujitsu Ltd.)

Shinji Yamashita received the B.E. and M.E. degrees in Electrical Engineering from the University of Tokyo, Tokyo, Japan, in 1996 and 1998, respectively. In 1998, he joined Fujitsu Laboratories Ltd. and has been engaged in research and development of optical modules & ICs, MEMS devices, software-defined networking (SDN) and AI-based network operation & management systems. From 2021, he moved to Fujitsu Ltd., where he is working on future society and technology based on 6G networks. From 2008 to 2009, he was a visiting scholar in the Department of Electrical Engineering, Stanford University, CA, USA, where he was engaged in the research on packet/optical integrated networks based on OpenFlow/SDN. He was also active in Open Networking Foundation (ONF) activities and was awarded for Outstanding Technical Contributor from ONF in 2014. Mr. Yamashita is a Senior Member of IEEE.

Summary of Presentation

Due to the influence of recent COVID-19 virus, telework has been penetrated rapidly and regarded as a standard workstyle in new-normal era. Especially, Virtual Desktop Infrastructure (VDI) attracts lot of attention as it enables secured telework with thin client. On the other hand, with the explosive increase of telework users, VDI users are facing such difficulties as taking much time for login, not being able to start applications. In this talk, I will introduce VDI Quality analysis system that analyzes network capture data among users, cloud and VDI systems. By this system, VDI operators can detect anomalies from login time of users and analyze the load of cloud service. I will also share some lessons learnt from experiences to deal with sudden increase of telework traffic and introduce activities & challenges in Fujitsu towards post COVID-19 era.

Speaker 3

Optimizing Pandemic Containment for COVID-19 by Social Network Analysis

Speaker: Dr. De-Nian Yang (Sinica, Taiwan)

De-Nian Yang is now a research fellow in the Institute of Information Science, Academia Sinica. His research interests include the optimization and analysis of various networks with data mining and machine learning. He received Best Paper Nominate in IEEE GLOBECOM, PAKDD Best Paper Running-Up Award, Best In-Session Presentation Award of IEEE INFOCOM, Best Student Paper Award of IEEE ICME, Best Paper Honorable Mention Award in ACM CHI, and Emerging Technologies Prize in ACM SIGGRAPH Asia. His research on network analysis and optimization was featured by MIT Technology Review, ACM Tech News, and Phys.org. His research on analysis and intervention of social networks was invited for Microsoft MSRA Faculty Summit. He has served in DASFAA, IEEE GLOBECOM, MDM, WWW, and INFORMS as various chairs (co-chairs) and participated in Senior PC of AAAI and IJCAI. He is the vice chair of IEEE Social Networks Technical Committee and the chair (co-chair) of Meeting and Conference Committee and Information Services Committee in IEEE COMSOC Asia Pacific Board. He is the associate editor of IEEE Trans. on Parallel and Distributed Systems, feature-topic editor of IEEE Communications Magazine, and guest editor of IEEE Trans. on Computational Social Systems. He is a senior member in IEEE and distinguished member of ACM.

Summary of Presentation

Epidemics and pandemics can have a significant impact on not only public health but also the economy. In most countries, Non-Pharmaceutical Interventions (NPIs), aiming to limit exposure of viruses to uninfected people, are the primary mitigation strategy to contain epidemics and pandemics. However, strict containment operations may cause severe recessions, which have been observed in many countries. Therefore, finding the best containment operations of NPIs that also sustain the economy is a matter of great urgency. In this talk, we will present the problem of Economy-aware Containment Operation through NPIs (ECON) that maximizes economic productivity while containing the epidemic by analyzing social contact networks built by Bluetooth, whereas Google and Apple has leveraged Bluetooth to construct social contact networks with user privacy and security in the core design. We prove the hardness and inapproximability of ECON. To solve ECON, we design an approximation algorithm, namely NPI Selection and Scheduling (NPISS), to determine the particular time to implement an appropriate NPI in a region. NPISS first ensures the Risky Regions that

have many infections and may cause many people to be severely ailing to be restricted by an appropriate NPI while other regions can be lifted from restrictions to gain more economic productivity. Then, NPISS further schedules the implementation of NPIs to early stop the regions from becoming the epicenter. Experiments on real social contact networks demonstrate that NPISS outperforms the existing approaches in public health and the state-of-the-art algorithms for containment.

Speaker 4

Distinguishing Customer Satisfactions with Tones of Voices

Speaker: Prof. Ping-Yu Hsu (National Central University, Taiwan)

Dr. Ping-Yu Hsu graduated from the CSIE department of National Taiwan University in 1987, got his master degree from the Computer Science Department of New York University in 1991, and Ph.D. degree from the Computer Science Department of UCLA in 1995. He is a distinguished professor in the Business Administration department of National Central University and the secretary-in-chief of the Chinese ERP Society. He is currently the Dean of School of Management at National Central University. His research interest focuses in the business data related applications, including Business Analytics, Data mining, Business Intelligence, and Adoption issues of Enterprise Systems. He has published more than 100 Journal and conference articles. His papers have been published in Decision Support Systems, European Journal of Information Systems, IEEE Transactions, Applied Soft Computing, Information Sciences, Tourism Management, Electronic Markets, and various other journals.

Summary of Presentation

The outbreak of Covid-19 leads customers to shop online. However, sustainable business growth comes from customer satisfactions, which leads to repurchase behavior and the degree of customer satisfaction impacts both sales performance and enterprise growth, according to marketing theories. On the other hand, customer satisfaction is cognitive states that have to be enquired through post-purchase questionnaire survey when in-person contact cannot be conducted. The inconvenience of collecting the data causes low survey response rates. Recently, ASR (Automatic Speech Recognition) based methods are proposed to translate dialogs between agents and customers to text corpora and conduct sentiment analysis on the corpus to tell customer satisfactions. These approaches face two issues, namely, lacking the association of customer satisfaction and positive sentiment of corpus analysis and

oriental customers tending to utter mild and polite words during conversations.

A study is conducted to establish methods to extract features from customers' voices to distinguish their satisfaction without resorting to ASR. With the lab data, we are able to confirm that the voice collected indeed is related to the analysis of satisfaction questionnaires. A primary study is also conducted to investigate if the predicted satisfaction can lead to customer repurchase. The discussed studies show only a tip of the ice burg of the challenge faced with digital transformation. Companies in deed have collected tons of data with their operations. Data driven analysis methods indeed can come up with some analysis results. The main issue is how to integrate the outcome with traditional marketing and customer service theories so that companies can incorporate the analysis into their business operations and enhance their decisions. This study only serves as a very tiny step toward the goal. Much more effort is needed to substantiate the tide of digital transformation.

Speaker 5

Roles of Supercomputer in Overcoming COVID-19

Speaker: Dr. Sangjae Seo

(Korea Institute of Science and Technology Information, Korea)

Sangjae Seo is a researcher in the Center for Supercomputing Applications at Korea Institute of Science and Technology Information (KISTI). He received his Ph.D. in Nano science and technology from Sungkyunkwan University in 2015, and B.S. degree in mechanical engineering from the same university in 2009. Before joining KISTI, he was a postdoctoral researcher at Nagoya University. His research interests include parallel computing, computational biophysics, molecular modeling and simulation.

Summary of Presentation

The novel coronavirus infection (COVID-19), first identified in 2019, has rapidly spread around the world and continues to threaten our lives until these days. To cope with COVID-19, countries are devoting various efforts, such as developing effective treatments and vaccines. In this regards, supercomputers have been widely used to understand the coronavirus and reveal its interactions with drugs. In this talk, I would like to introduce examples of use of supercomputers to overcome COVID-19, and discuss the importance of supercomputers to prepare for future pandemics.

Special Session

Thursday, September 9, 2021, 09:50-11:30

Theme: 1. Cloud Native in Telecom Network Infrastructure
2. Artificial Intelligence/Machine Learning for Network Management

Chair: Chi-Lin Tsai (Telecom Technology Center, Taiwan)

Speaker 1: Bruce Lan (Palo Alto Networks)

Bruce Lan serves as a system engineer of Palo Alto Networks Taiwan since September 2010. In his role as a solution consultant, he supports market development in major industries and delivers overall solution for companies in Taiwan. With over 15 years' experience as a technical consultant, Bruce's experience spans senior technical roles in several system integration service provider. He was previously a security solution architect of system and networking Disti company in Taiwan, too.

Summary of Presentation

5G promises transformative mobility and creates disruptive business opportunities by revolutionizing enterprise connectivity. 5G networks and cloud integration enable new enterprise use cases not previously possible, allowing for industrial-scale IoT networks with ultra-low latency, mission-critical reliability and a high degree of mobility. With 5G networks comes a greater reliance on cloud and edge compute, creating a highly distributed environment that spans multi-vendor and multi-cloud infrastructures.

An increasingly hyper-connected world will also open up new security vulnerabilities and threat vectors. To tap into the 5G business opportunities with minimal risk of being exploited by malicious actors, we need comprehensive, context-driven and automated security at scale across your 5G infrastructure.

Speaker 2: Tomohiro Otani (KDDI)

Tomohiro Otani is an executive director of KDDI Research, Inc., where is responsible for R&D activities related to IoT, connected car, big data platforms, and associated operational technologies. Prior to his role as Executive Director, Otani served as general manager of Operation Support System Development Department of Operations Sector at KDDI Corporation. Here, he was responsible for developing operational support systems (OSS) for fixed and mobile networks. He has been a member of the technical programming committee of international technical conferences and was a co-chair of TPC of MPLS2007 and iPOP2017. He is one of the authors of IETF RFCs (3471, 5146, 6825, 7025).

Summary of Presentation

This presentation reviews the rapid transition of telecom network infrastructure from PNF to CNF through NFV these days. The corresponding change of network operation is also introduced by network automation as well as AI/ML, by referring to recent research results on top of NFV/CNF.

Speaker 3: Hiroaki Harai (NICT)

HIROAKI HARAI received the Ph.D. in information and computer sciences from Osaka University, Osaka, in 1998. He has been appointed to Director General of Network Research Institute at the National Institute of Information and Communications Technology, Tokyo, since 2021, where he has engaged in R&D and promotion in the field of networking technologies such as network architecture and optical/wireless/space networking.

Summary of Presentation

The speaker overviews automatic network control and management supported by artificial intelligence. He introduces AI application for resource monitoring and reconfiguration to meet QoS requirement on the service network platform built on cloud-native networking environment.

Speaker 4: Dongkyun Kim (KISTI)

Dongkyun Kim is a principal researcher who has been working for advanced research networking for over 20 years at Korea Institute of Science and Technology Information (KISTI). He received the Ph.D. degree in Computer Science from Chungnam National University, Korea in 2005, becoming a member of Joint Institute of Computational Science (JICS) of University of Tennessee and Oak Ridge National Laboratory in the United States as a visiting scholar from 2006 to 2007. He is the pioneer of the KREONET-S project to achieve network softwarization for the national research network in Korea (KREONET, Korea Research Environment Open Network), based on SDN/NFV and various open networking technologies. He has been leading KREONET-S project since 2015, making diverse efforts to realize SDN-based virtual dedicated networking, network automation and orchestration, and network intelligence over KREONET Infrastructure. He also serves as chairs of Future Infrastructure WG of Future Internet Forum and ONOS/CORD WG of SDN/NFV Forum in Korea.

Summary of Presentation

KREONET is the national research network in Korea, being softwarized to come up with the innovative networking services such as virtualized network slicing, network orchestration, network intelligence in association with fixed/mobile wireless networks (e.g., WiFi6 and 5G+). This talk will focus on the KREONET softwarization (KREONET-S) project to develop and deploy a de-facto R&E wide-area SDN infrastructure in Korea for the advanced services above, as well as the status and direction of network intelligence for KREONET-S in particular.

Tutorials

Date & Time: 09:00 ~ 10:30, Sept. 8, 2021.
Chair: Prof. Guey-Yun Chang (National Central University, Taiwan)

Tutorial 1
Federated Learning for Internet of Vehicles
Speaker: Dr. Celimuge Wu (Associate Professor, The University of Electro-Communications, Japan)

Celimuge Wu received his PhD degree from The University of Electro-Communications, Japan in 2010. He has been an associate professor of The University of Electro-Communications since 2015. His research interests include Vehicular Networks, Edge Computing, IoT, Intelligent Transport Systems, and Application of Machine Learning in Wireless Networking and Computing. He serves as an associate editor of IEEE Transactions on Network Science and Engineering, IEEE Transactions on Green Communications and Networking, IEEE Open Journal of the Computer Society, Wireless Networks, and IEICE Transactions on Communications. He also has been a guest editor of IEEE Transaction on Intelligent Transportation Systems, IEEE Transactions on Emerging Topics in Computational Intelligence, IEEE Computational Intelligence Magazine etc. He is the chair of IEEE TCGCC Special Interest Group on Green Internet of Vehicles and IEEE TCBD Special Interest Group on Big Data with Computational Intelligence. He is a recipient of 2021 IEEE Communications Society Outstanding Paper Award, and IEEE Computer Society 2019 Best Paper Award Runner-Up. He is a senior member of IEEE.

Summary of Presentation

In order to support advanced vehicular Internet-of-Vehicles (IoV) applications, information exchanges among different vehicles are required to find efficient solutions for catering to different application requirements in complex and dynamic vehicular environments. Federated learning (FL), which is a type of distributed learning technology, has been attracting great interest in recent years as it performs knowledge exchange among different network entities without a violation of user privacy. This talk will focus on the applications of FL in vehicular environments in order to facilitate emerging vehicular IoV applications.

Date & Time: 09:00 ~ 10:30, Sept. 8, 2021.
Chair: Prof. Sangheon Pack (Korea University, Korea)

Tutorial 2

Edge Learning: Enabling Distributed Machine Learning in Cloud-Edge Environment

Speaker: Dr. Peng Li (Associate Professor, The University of Aizu, Japan)

Peng Li received his BS degree from Huazhong University of Science and Technology, China, in 2007, the MS and PhD degrees from the University of Aizu, Japan, in 2009 and 2012, respectively. Dr. Li is currently an Associate Professor in the University of Aizu, Japan. His research interests mainly focus on cloud computing, Internet-of-Things, big data systems, as well as related wired and wireless networking problems. Dr. Li has published over 100 technical papers on prestigious journals and conferences. He won the Young Author Award of IEEE Computer Society Japan Chapter in 2014. He won the Best Paper Award of IEEE TrustCom 2016. He supervised students to win the First Prize of IEEE ComSoc Student Competition in 2016. Dr. Li is the editor of IEICE Transactions on Communications. He is a member of IEEE.

Summary of Presentation

Machine learning has demonstrated great promises in various fields, e.g., finance, self-driving and healthcare. The success of deep learning stems from the availability of big training data and massive computation power. However, in many applications, training data are generated by distributed devices owned by individuals, who hesitate to share their data that expose privacy. Moreover, it becomes difficult to aggregate these data to a single computing site for centralized training due to the increasing data size. In this talk, we will present a paradigm complementary to the cloud-based methods for machine learning in the cloud-edge environment. It is proposed and developed for moving the training and inference to the edge environment to serve the delay-sensitive and privacy-sensitive applications, of which the data cannot be gathered to the cloud. While edge learning has great potential for many intelligent applications, e.g., smart cities and self-driving cars, it is quite challenging to realize it in an efficient and secure manner due to the inherent characteristics of the cloud-edge environment. We will present the opportunities, open challenges and possible solutions of edge learning in this talk.

Date & Time: 12:40 ~ 14:10, Sept. 8, 2021.
Chair: Prof. Guey-Yun Chang (National Central University, Taiwan)

Tutorial 3
Trajectory Design in Wireless Drone Networks: Moving from Offline Optimization to Online Learning
Speaker: Dr. Yu-Jia Chen (Assistant Professor, National Central University)

Yu-Jia Chen received the B.S. degree and Ph.D. degree in electrical engineering from National Yang Ming Chiao Tung University, Taiwan, in 2010 and 2015, respectively. From 2015 to 2018, he was a postdoctoral research fellow with National Yang Ming Chiao Tung University, Taiwan, and he was a postdoctoral research fellow with Harvard University from 2018 to 2019. In 2019, he joined National Central University, Taiwan, where he is currently an assistant professor at the department of communication engineering. His research interests include AI-enabled communication networks, wireless sensing, and network security. Dr. Chen has published more than 30 articles in peer-reviewed international journal and conference papers. He is holding four US patents and four ROC patents. Dr. Chen has been serving as Technical Organizing Committee and Symposium Cochair for many international conferences and symposia, including Globecom, VTC, and PIMRC. He is also co-founder of the IEEE workshop SPSCS, focusing on security and privacy in smart and connected systems. Prof. Chen has experience with tutorials at academic conferences such as Globecom and VTC.

Summary of Presentation

Unmanned aerial vehicles (UAVs) have recently gained wide popularity in various wireless applications due to their agility and high mobility features. In this talk, we will first review the trajectory design problem of cellular-connected UAVs. We will discuss some examples of UAV trajectory design taking into account the communication performance of the entire trajectory. Then we will look into the nature of graph theory based approaches and introduce a low-complexity method to solve the unconstrained problem by finding the shortest trajectory in an undirected weighted graph. Next, we introduce a novel imitation augmented deep reinforcement learning approach to solve the challenging connectivity- constrained problem. Finally, we provide some results from both simulated and real experiments to illustrate the effectiveness of the proposed method.

Date & Time: 12:40 ~ 14:10, Sept. 8, 2021.
Chair: Prof. Sangheon Pack (Korea University, Korea)

Tutorial 4
Human Behavior in the Time of COVID-19 Pandemic: Learning from Data Science
Speaker: Dr. Jinyoung Han (Assistant Professor, Sungkyunkwan University)

Jinyoung Han is Assistant Professor in the Department of Applied Artificial Intelligence at Sungkyunkwan University (SKKU), where he leads the Data Science and Artificial Intelligence Lab (DSAIL). Before joining SKKU, he was Assistant Professor at Hanyang University (ERICA). He was a postdoctoral researcher at University of California, Davis, and Seoul National University. He received his Ph.D. in computer science and engineering from Seoul National University in 2013, and B.S. degree in computer science from KAIST in 2007. His research interests generally lie in data mining, network science, machine learning, and social computing.

Summary of Presentation

The outbreak of COVID-19 has a significant impact on individual mental health and human behavior. As the use of social media has become a part of daily life, the posts about COVID-related stress, symptoms, and emotions could be easily observed in social media. In this talk, we will show how COVID-19 pandemic affects mental status such as emotions and suicidal ideation using social media data and NLP techniques. Also, as the COVID-19 pandemic progresses, the uncertainty of the unprecedented crisis stimulates the proliferation of fake news. This talk introduces how to detect fake news on COVID-19 using graph learning and NLP models.

Technical Sessions

Technical Session 1 (TS1)

Wednesday, September 8, 2021, 15:30-17:10, Track I

Theme: Internet of Things and Wireless Sensor Networks

Chair: Jen-Jee Chen (National Yang Ming Chiao Tung Univ., Taiwan)

No.	Title and Authors
TS1-1	**Efficient Path and Charge (P&C) Scheduling for a Mobile Charger to Improve Survivability and Throughput of Sensors with Adaptive Sensing Rates** You-Chiun Wang, Yu-Cheng Bai (National Sun Yat-sen University, Taiwan)
TS1-2	**Friendly Jamming in Wireless Networks: A Stackelberg Game** Shilpa Rao, Rohit Tripathi (Indian Institute of Information Technology Guwahati, India)
TS1-3	**Secrecy Outage Probability of Reconfigurable Intelligent Surface-Aided Cooperative Underlay Cognitive Radio Network Communications** Anh-Tu Le*, Munyaradzi Munochiveyi** (*Van Lang University, Vietnam, **University of Zimbabwe, China & Asia University, Taiwan)
TS1-4	**SSAE - DeepCNN Model for Network Intrusion Detection** Jonghwa Lee, Jong-wouk Kim, Mi-Jung Choi (Kangwon National University, Korea)

Technical Session 2 (TS2)

Wednesday, September 8, 2021, 15:30-17:10, Track II

Theme: Mobile and Wireless Network

Chair: Hiroki Nakayama (BOSCO Technologies, Japan)

No.	Title and Authors
TS2-1	**Radio Resource Allocation for RIS-Aided D2D Communication Based on Greedy Hypergraph-With-Weight Coloring** Tang Liu, Lei Feng, Li Wenjing, Zhixiang Yang (Beijing University of Posts and Telecommunications, China)
TS2-2	**Joint Power Control and Passive Beamforming in Intelligent Reflecting Surface Assisted Multi-Cell Uplink Communications** Kunyi Xie*, Yang Yang*, Lei Feng*, Li Wenjing*, Jing Shen** (*Beijing University of Posts and Telecommunications, China, **State Grid Henan Electric Power Company Information and Communication Company, China)
TS2-3	**Power Control and Evolutionary Strategy Based Slicing Resource Allocation for V2V Communication** Yan Liang*, Xin Chen*, Teng Ma*, Shengcheng Ma**, Libo Jiao* (*Beijing Information Science and Technology University, China, **Beihang University, China)
TS2-4	**Cognitive Collision Resolution for Enhanced Performance in C-V2X Sidelink Mode 4** Moin Ali, Young-Tak Kim (Yeungnam University, Korea)

Technical Session 3 (TS3)

Thursday, September 9, 2021, 09:50-11:30, Track I

Theme: Edge/Fog Computing

Chair: Kyungbaek Kim (Chonnam National University, Korea)

No.	Title and Authors
TS3-1	**Edge Computing and Networking Resource Management for Decomposable Deep Learning: An Auction-Based Approach** Ya-Ting Yang, Hung-Yu Wei (National Taiwan University, Taiwan)
TS3-2	**Text-To-Speech with Model Compression on Edge Devices** Wai-Wan Koc, Yung-Ting Chang, Jian-Yu Yu, Tsì-Uí Ík (National Yang Ming Chiao Tung University, Taiwan)
TS3-3	**Business Demand-Oriented Intelligent Orchestration of Network Slices Based on Core-Edge Collaboration** Naling Li, Ying Wang, Li Wenjing, Ke Chen (Beijing University of Posts and Telecommunications, China)
TS3-4	**Incentive-Stable Matching Protocol for Service Chain Placement in Multi-Operator Edge System** Jen-Yu Wang, Li-Hsing Yen, Juliana Liman (National Yang Ming Chiao Tung University, Taiwan)

Technical Session 4 (TS4)

Thursday, September 9, 2021, 09:50-11:30, Track II

Theme: 5G Network

Chair: Huai-Sheng Huang (National Taipei Univ., Taiwan)

No.	Title and Authors
TS4-1	**Robotic Assistance Operation for Effective On-Site Network Maintenance Works** Takayuki Warabino, Yusuke Suzuki, Tomohiro Otani (KDDI Research, Inc., Japan)
TS4-2	**Design of a Network Management System for 5G Open RAN** Tse-Han Wang*, Yen-Cheng Chen**, Sin-Jie Huang*, Kai-Sheng Hsu*, Chung-Hua Hu* (*ChungHwa Telecom, Taiwan, **National Chi Nan University, Taiwan)
TS4-3	**Cost-Effective Policy for Deployment of Dense 5G RAN with Fiber and Wireless Backhaul Link** Arobindo Hore*, Ayan Paul**, Madhubanti Maitra* (*Jadavpur University, India, **BSNL, India)
TS4-4	**Network Data Analytics Function for IBN-Based Ne\twork Slice Lifecycle Management** Khizar Abbas, Talha Ahmed Khan, Afaq Muhammad, Javier Jose Diaz Rivera, Wang-Cheol Song (Jeju National University, Korea)

Technical Session 5 (TS5)

Thursday, September 9, 2021, 12:40-14:20, Track I

Theme: Configuration and Fault Management

Chair: Haneul Ko (Korea Univ., Korea)

No.	Title and Authors
TS5-1	**History Data Management Method of API Request Order Using Bitemporal Data Model for Application Layer Recovery** K Takahashi, S Kanemaru, T Toyoshima, Yukitsugu Sasaki (NTT, Japan)
TS5-2	**Multiple-Layer-Topology Discovery Method Using Traffic Information** Mizuto Nakamura, Naoki Hayashi, Atsushi Takada, Toshihiko Seki, Kyoko Yamagoe (NTT, Japan)
TS5-3	**Orchestrator for Automating Failure Response in Telecom Carriers** Yuichi Suto, Ryosuke Sato, Yuichiro Ishizuka, Kosuke Sakata, Yoshikazu Hagiwara, Tsuyoshi Furukawa (NTT, Japan)
TS5-4	**Bayesian Network Equipped Workflow Engine to Coordinate Artificial Intelligence for Automating Network Operation** Ryosuke Sato, Mizuto Nakamura, Atsushi Takada, Kyoko Yamagoe (NTT, Japan)

Technical Session 6 (TS6)

Thursday, September 9, 2021, 12:40-14:20, Track II

Theme: Intelligent Network Management

Chair: Yan-Ann Chen (Yuan Ze Univ., Taiwan)

No.	Title and Authors
TS6-1	**Detection of Hypergiants in AS-Level Topology Using Machine Learning** Michiko Harayama, Takuro Kudoh (Gifu University, Japan)
TS6-2	**Automating Web-Based Infrastructure Management via Contextual Imitation Learning** Jieyu Lin, Hongxiang Geng, Alberto Leon-Garcia (University of Toronto, Canada)
TS6-3	**Time-Aware Stream Reservation for Distributed TSN** Ching-Chih Chuang*, Yuan-Yao Shih**, Jian-Cheng Chen***, Ai-Chun Pang*** (*National Pingtung University, Taiwan, **National Chung Cheng University, Taiwan, ***National Taiwan University, Taiwan)
TS6-4	**Distilling Knowledge in Federated Learning** Huy Q. Le, Jong Hoon Shin, Minh N. H. Nguyen, Choong Seon Hong (Kyung Hee University, Korea)

Technical Session 7 (TS7)

Thursday, September 9, 2021, 15:40-17:20, Track I

Theme: SDN

Chair: Ryo Yamamoto (The University of Electro-Communications, Japan)

No.	Title and Authors
TS7-1	**Proposal and Evaluation of Automatic Registration Method of Service Information by Distribution from Deployment System to Maintenance System** R Katayanagi, K Takahashi, Satoshi Kondoh (NTT, Japan)
TS7-2	**P4MT: Designing and Evaluating Multi-Tenant Services for P4 Switches** Buck Chung*, Chien Chen*, Chien-Chao Tseng*, Jim Chen**, Joel Mambretti** (*National Yang Ming Chiao Tung University, Taiwan, **Northwestern University, USA)
TS7-3	**Design of a Network Scan Defense Method by Combining an SDN-Based MTD and IPS** Shoya Chiba*, Luis Guillen*, Satoru Izumi**, Toru Abe*, Takuo Suganuma* (*Tohoku University, Japan, **National Institute of Technology, Sendai College, Japan)
TS7-4	**Virtual Machine Failure Prediction Using Log Analysis** Sukhyun Nam, Jibum Hong, Jae-Hyoung Yoo, James Won-Ki Hong (Pohang University of Science and Technology, Korea)

Technical Session 8 (TS8)

Thursday, September 9, 2021, 15:40-17:20, Track II

Theme: Heterogeneous Networks

Chair: Ting-Hui Chiang (Feng Chia Univ., Taiwan)

No.	Title and Authors
TS8-1	**A Resilient Mechanism for Multi-Controller Failure in Hybrid SDN-Based Networks** Luis Guillen*, Satoru Izumi**, Toru Abe*, Takuo Suganuma* (*Tohoku University, Japan, **Sendai College, Japan)
TS8-2	**An Intelligent Fault Location Approach Using Fuzzy Logic for Improving Autonomous Network** Kuan-Yu Nie, Chih-Wei Chang, Chien-Chi Kao, Jung Pei (Chunghwa Telecom, Taiwan)
TS8-3	**Evaluation of Resource Sharing Framework for Heterogeneous Network Services** Haruo Oishi*, Kyoko Yamori**, Cheng Zhang***, Yoshiaki Tanaka* (*Waseda University, Japan, **Asahi University, Japan, ***Ibaraki University, Japan)
TS8-4	**Cos-CBDC: Design and Implementation of CBDC on Cosmos Blockchain** Jungsu Han, Jeongheon Kim, Jongsoo Woo, James Won-Ki Hong (Pohang University of Science and Technology, Korea)

Technical Session 9 (TS9)

Friday, September 10, 2021, 09:50-11:30, Track I

Theme: Network Monitoring and Measurements

Chair: Cheng Zhang (Ibaraki University, Japan)

No.	Title and Authors
TS9-1	**Discovery of Ethereum Topology Through Active Probing Approach** Soo Hoon Maeng, Meryam Essaid, Park Sejin, Hong Taek Ju (Keimyung University, Korea)
TS9-2	**Analysis of Compact Block Propagation Delay in Bitcoin Network** Aeri Kim, Jungyeon Kim, Meryam Essaid, Park Sejin, Hong Taek Ju (Keimyung University, Korea)
TS9-3	**FullSight: A Deep Learning Based Collaborated Failure Detection Framework of Service Function Chain** Kuo Guo, Jia Chen, Ping Dong, Yu Zhao, Deyun Gao, Shang Liu (Beijing Jiaotong University, China)
TS9-4	**Performance Evaluation of Ethereum Private and Testnet Networks Using Hyperledger Caliper** Wonseok Choi, James Won-Ki Hong (POSTECH, Korea)

Technical Session 10 (TS10)

Friday, September 10, 2021, 09:50-11:30, Track II

Theme: NFV

Chair: Choi Mi-Jung (Kangwon National Univ., Korea)

No.	Title and Authors
TS10-1	**Security-Oriented Network Slice Backup Method** Ke Chen, Ying Wang, Peng Yu, Naling Li (Beijing University of Posts and Telecommunications, China)
TS10-2	**On-Demand Service Function Chain Based on IPv6 Segment Routing** Chia Wei Wu, Chia-Wei Tseng, Wei Yu Chen, Li-Fan Wu, Shih-Chun Hsu, Sheng -Wang Yu (ChungHwa Telecom, Taiwan)
TS10-3	**A Flexible vCPE Framework to Enable Dynamic Service Function Chaining Using P4 Switches** Muthuraman Elangovan, Chien Chen, Jyh-Cheng Chen (National Yang Ming Chiao Tung University, Taiwan)
TS10-4	**Energy-Efficient VNF Deployment for Graph-Structured SFC Based on Graph Neural Network and Constrained Deep Reinforcement Learning** Siyu Qi*, Shuopeng Li*, Shaofu Lin*, Mohand Yazid Saidi**, Ken Chen** (*Beijing University of Technology, China, **University of Paris 13, France)

Poster Sessions

Poster Session 1 (PS1)
Wednesday, September 8, 2021, 14:30-15:30, gather.town
Chair: You-Chiun Wang (National Sun Yat-sen University, Taiwan)

No.	Title and Authors
PS1-1	**Enhanced Quality of Service Measurement Mechanism of Container-Based Cloud Network Architecture** Jhih-Dao Jhan, Yung-Chang Lai, Yong-Ling Chen, Fei-Hua Kuo (Chunghwa Telecom, Taiwan)
PS1-2	**NFV-Enabled Vertical Scalability for IoT Slices** Hafizhuddin Zul Fahm, Fuchun Joseph Lin (National Yang Ming Chiao Thung University, Taiwan)
PS1-3	**New Multi-Access Network Transmission Technology to Enhance Edge Computing** Pang-Chen Liu, Huai-En Tseng, Shun-Kai Yang, Fei-Hua Kuo (Chunghwa Telecom, Taiwan)
PS1-4	**A Road-Aware Approach for Hierarchical Routing in IoV Based on Intents and Q-Values** Asif Mehmood, Talha Ahmed Khan, Javier Jose Diaz Rivera, Afaq Muhammad, Wang-Cheol Song (Jeju National University, Korea)
PS1-5	**Measurement-Based IoT Server Selection for Mobile Edge Computing** Nuntanut Bhooanusas, Sok-Ian Sou (National Cheng Kung University, Taiwan)
PS1-6	**Model-Based Anomaly Detection in Response Delay in Communication Through LTE Network** Kohei Yamamoto*, Naoki Wakamiya*, Ryo Nakano**, Ryosuke Fujiwara** (*Osaka University, Japan, **Hitachi Ltd., Japan)
PS1-7	**BRAS Syslog Pattern Generation Method: A Preliminary Experiment on Clustering Algorithms** Yun-Jie Li, Jhao-Yin Li (Chunghwa Telecom, Taiwan)
PS1-8	**Relation Between Warning Error and Vehicle Speed in Vehicle-To-Pedestrian Warning System** Takahiro Suzuki*, Kyoko Yamori**, Cheng Zhang***, Takumi Miyoshi****, Yoshiaki Tanaka* (*Waseda University, Japan, **Asahi University, Japan, ***Ibaraki University, Japan, ****Shibaura Institute of Technology, Japan)
PS1-9	**Design and Analysis of a Real-Time Multicast Routing Algorithm in Inter-Blockchain Networks** Tzu-Lun Huang*, Jason Huang** (*St. John University, Taiwan, **Advanced Financial Engineering LLC, USA)
PS1-10	**Lightweight Blockchain to Solve Forgery and Privacy Issues of Vehicle Image Data** Dongjun Na, Sejin Park (Keimyung University, Korea)
PS1-11	**A Dynamic Selection Algorithm of Tor Relay Based on Client Bias** Yun Zhang, Yamei Xia (Beijing University of Posts and Telecommunications, China)
PS1-12	**Design and Implementation of Automatic Generation Method for API Adapter Test Code** Sho Kanemaru, Yukitsugu Sasaki, Kensuke Takahashi, Tsuyoshi Toyoshima (NTT Corporation, Japan)
PS1-13	**Docker Container Networking Based Apache Storm and Flink Benchmark Test** Tao Liu*, Zhihong Yang**, Yuzhong Sun*** (*China University of Mining and Technology, China, **China University of Geoscience, China, ***Chinese Academy of Sciences, China)
PS1-14	**Performance Analysis of Applying Deep Learning for Virtual Background of WebRTC-Based Video Conferencing System** Sangwoo Ryu, Kyungchan Ko, James Won-Ki Hong (POSTECH, Korea)
PS1-15	**A Survey on Public Blockchain-Based Networks: Structural Differences and Address Clustering Methods** Hye-Yeong Shin, Meryam Essaid, Sejin Park, Hongtaek Ju (Keimyung University, Korea)

Poster Session 2 (PS2)
Thursday, September 9, 2021, 14:40-15:40, gather. Town
Chair: Hiroki Nakayama (BOSCO Technologies, Japan)

No.	Title and Authors
PS2-1	**An SDN Controller Enabled Architecture for 5G Backhaul Networks** Hao-Ze Fang, Hsing-Chen Chi, Min-Chi Tseng, Yu-Ping Yu (Chunghwa Telecom, Taiwan)
PS2-2	**Study of Contention Window Adjustment for CSMA/CA by Using Machine Learning** Yen-Wen Chen, Kuo-Che Kao (National Central University, Taiwan)
PS2-3	**Development of Reference Model for Enterprise Architecture Leveraging TM Forum Assets** Miwaka Ohtani, Shingo Omata, Ken Kanishima (NTT Corporation, Japan)
PS2-4	**Method of Constructing Petri Net Service Model Using Distributed Trace Data of Microservices** Masaru Sakai, Kensuke Takahashi, Satoshi Kondoh (NTT Corporation, Japan)
PS2-5	**An API-Based In-Service Surveillance Approach for Enterprise PBX** Chen-Hung Chu, Gong-Da Fan, Yi-Kai Chiang, Chao-Chun Huang, Chung-Shih Tang (Chunghwa Telecom, Taiwan)
PS2-6	**Learning for Prediction of Maritime Collision Avoidance Behavior from AIS Network** Po-Ruey Lei*, Pei-Rong Yu**, Wen-Chih Peng** (*ROC Naval Academy, Taiwan, **National Yang Ming Chiao Tung University, Taiwan)
PS2-7	**A Multi-Objective Approach for Optimizing Content Delivery Network System Configuration** Hoang-Loc La, Thanh Le Hai Hoang, Nam Thoai (Ho Chi Minh City University of Technology, Vietnam)
PS2-8	**SPENT+: A Category- and Region-Aware Successive POI Recommendation Model** Hsu-Chao Lai*, Yi-Shu Lu*, Mu-Fan Wang*, Yi-Cheng Chen**, Wen-Yueh Shih*, Jiun-Long Huang* (*National Yang Ming Chiao Tung University, Taiwan, ** National Central University, Taiwan)
PS2-9	**The Design and Implementation of a Blockchain-Based Logistics Platform for International Trade** Yen-Yu Chen, Hsu-Chao Lai, Jiun-Long Huang, Ming-Jiu Hwang (National Yang Ming Chiao Tung University, Taiwan)
PS2-10	**Encrypted Network Traffic Identification Based on 2D-CNN Model** Yan Zhou*, Huiling Shi**, Yuhan Zhao*, Wei Gao*, Wei Zhang* (*Qilu University of Technology, China, ** Shandong Computer Science Center, China)
PS2-11	**Dynamic Network Provisioning with Reinforcement Learning Based on Link Stability** Hong-Nam Quach, Sungwoong Yoem, Kyungbaek Kim (Chonnam National University, Korea)
PS2-12	**Graph Convolutional Network Based Link State Prediction** Sungwoong Yeom, Chulwoong Choi, Shivani Sanjay Kolekar, Kyungbaek Kim (Chonnam National University, Korea)
PS2-13	**Machine Learning-Based Cache Optimization on MEC Platform** Waleed Akbar, Afaq Muhammad, Javier Jose Diaz Rivera, Wang-Cheol Song (Jeju National University, Korea)
PS2-14	**Applying RouteNet and LSTM to Achieve Network Automation: An Intent-Based Networking Approach** Talha Ahmed Khan, Khizar Abbas, Javier Jose Diaz Rivera, Afaq Muhammad, Wang-Cheol Song (Jeju National University, Korea)
PS2-15	**A Flexible P4-Based Pin-Point In-Band Network Monitoring** Toshihiro Sato, Toshio Hirotsu (Hosei University, Japan)

Poster Session 3 (PS3)
Friday, September 10, 2021, 12:40-13:40, gather.town
Chair: Haneul Ko (Korea University, Korea)

No.	Title and Authors
PS3-1	**In-Band Network Telemetry Task Orchestration Based on Multi-Objective Optimization** Zhenyi Zhang, Wei Su, Lizhuang Tan (Beijing Jiaotong University, China)
PS3-2	**On Detecting Cloud Container Failures from Computing Utility Sequences** Yu-Shao Liu*, Hsu-Chao Lai*, Jiun-Long Huang*, August F. Y. Chao** (*National Yang Ming Chiao Tung University, Taiwan, **Taiwan Web Service Corporation, Taiwan)
PS3-3	**On the Performance of NOMA with Bi-Directional in Weibull-Channel** Hung-Anh Tong, Anh-Tu Le (Van Lang University, Vietnam)
PS3-4	**5G Radio Frequency Conformance Test Based on Polymorphic Adaptation** Zhen Wei*, Ying Wang*, Hongbin Yang** (*Beijing University of Posts and Telecommunications, China, **Beijing Smart Testing Technology Co. Ltd., China)
PS3-5	**Design and Implementation of a DNS Server with Geolocation Capability** Ta-Li Lai, Meng-Hsun Tsai (National Cheng Kung University, Taiwan)
PS3-6	**Mitigating SYN Flooding and UDP Flooding in P4-Based SDN** Zi-Yang Shen, Ming-Wei Su, Yun-Zhan Cai, Meng-Hsun Tasi (National Cheng Kung University, Taiwan)
PS3-7	**Real-Time License Plate Recognition and Vehicle Tracking System Based on Deep Learning** Guan-Wen Chen, Chun-Min Yang, Tsi-Ui Ik (National Yang Ming Chiao Tung University, Taiwan)
PS3-8	**An Association Control Method in LAA/Wi-Fi Coexistent Networks Considering Uplink/Downlink Communications** Yoshiki Morimoto, Kazuhiko Kinoshita (Tokushima University, Japan)
PS3-9	**On-Demand MEC Empowered UAV Deployment for 6G Time-Sensitive Maritime Internet of Things** Sheikh Salman Hassan, Yu Min Park, Choong Seon Hong (Kyung Hee University, Korea)
PS3-10	**An Efficient Resource Sharing Model for Multi-UAV-Assisted Wireless Networks** Yan Kyaw Tun, Kitae Kim, Pyae Sone Aung, Madyan Alsenwi, Choong Seon Hong (Kyung Hee University, Korea)
PS3-11	**Decentralized Collaborative Caching-Based Virtual Reality for 5G and Beyond** Tri Nguyen Dang, Jeong Min Jeon, Latif U. Khan, Aunas Manzoor, Choong Seon Hong (Kyung Hee University, Korea)
PS3-12	**Intelligent Grid Shepherd: Towards a Resilient Distributed Energy Resources Control System** Md. Shirajum Munir, Do Hyeon Kim, Seok Won Kang, Luyao Zou, Choong Seon Hong (Kyung Hee University, Korea)
PS3-13	**Study on the Online Charging System in B5G Era** Wei-Lun Lin*, Chien-Hsuan Chen*, Huai-Sheng Huang** (*Fu Jen Catholic University, Taiwan, **National Taipei University, Taiwan)
PS3-14	**WITSE: A Testbed for Performance Evaluation of TaiSEIA 101 over Wireless Protocols** Yan-Ann Chen, Shao-Yi Chen (Yuan Ze University, Taiwan)
PS3-15	**Adaptive Wireless Multi-Hop Routing Less Affected by Processing Delay** Hiroshi Katada*, Taku Yamazaki**, Takumi Miyoshi**, Shigeru Shimamoto*, Yoshiaki Tanaka* (*Waseda University, Japan, **Shibaura Institute of Technology)

Innovation Sessions

Innovation Session 1 (IS1)

Thursday, September 9, 2021, 12:40-14:20, Track III

Theme: Intelligent Network Operations and Management in a New Era

Chair: Dr. Chien-Chi Kao (CHT, Taiwan)

No.	Title and Authors
IS1-1	**Design and Implementation of Private 5G Networks Monitoring Systems** Yu-Ying Hsu, Pin Kao, Yu-Chen Lin, Chia-Hao Yu (Chunghwa Telecom Laboratories, Taiwan)
IS1-2	**A 5G Crosshaul Network Speed Inspection and Obstacle Location Method** Ting-Che Chuang, Hsien-Tsung Lin, Chuan Yin, Yong-Zen Haung (Chunghwa Telecom Laboratories, Taiwan)
IS1-3	**Applicability of Schema Matching to Adapter Development for Orchestrator** Naoki Take, Yoshifumi Kato, Miwaka Otani, Kiyotaka Saito, Satoshi Kondo, Yu Miyoshi (NTT, Japan)
IS1-4	**Study on Automating Decision-Making by Learning Optimal Processes from PC Work** Misa Fukai, Masashi Tadokoro, Haruo Oishi (NTT, Japan)
IS1-5	**IP RAN Hybrid Provisioning in 5G Backhaul Network** Che-Chun Teng, Po-Hsiang Huang, Mei-Chun Chen, Hong-Jie Chen, Min-Han Hung, Chin-Ping Chuang (Chunghwa Telecom Laboratories, Taiwan)

Innovation Session 2 (IS2)

Friday, September 10, 2021, 9:50-11:30, Track III

Theme: Intelligent & Secure Networking Services

Chair: Dr. Wootae Kim (KT, Korea)

No.	Title and Authors
IS2-1	**Building Commercial IoT/AI Applications with IOTtalk** Yi-Bing Lin (National Yang Ming Chiao Tung University, Taiwan)
IS2-2	**Securing Smart IoT Devices from Edge Computing System** Chi-Yu Li (National Yang Ming Chiao Tung University, Taiwan)
IS2-3	**FrameTalk: AN IoT Application for interaction Between Smartphone and Digital Picture Frame** Hsiang-Chyn Li, Chang-Chieh Cheng (National Yang Ming Chiao Tung University, Taiwan)
IS2-4	**Telco Cloud Management for Virtual Serving and Packet Gateway with CUPS Architecture** Ming-Yen Wu, Chun-Han Chou, Yuan-Mao Hung, Chien-Hua Lee, Shih-Che Chien (Chunghwa Telecom Laboratories, Taiwan), Yu-Sheng Lin (Quanta Cloud Technology, Taiwan)
IS2-5	**Evaluation of User Experience in AR Based QoS Visualization for Wireless LAN User Navigation** Ryusuke Sakamaki (Waseda University, Japan), Kyoko Yamori (Asahi University, Japan), Cheng Zhang (Ibaraki University, Japan), Yoshiaki Tanaka (Waseda University, Japan)

Demo Session

Friday, September 10, 2021, 12:40-13:40, Main Hall in gather.town

Chair: Li-Hsing Yen (National Yang Ming Chiao Tung University, Taiwan)

No.	Title and Authors
DS1	**FrameTalk: AN IoT Application for interaction Between Smartphone and Digital Picture Frame** Hsiang-Chyn Li, Chang-Chieh Cheng (National Yang Ming Chiao Tung University, Taiwan)
DS2	**Securing Smart IoT Devices from Edge Computing System** Chi-Yu Li (National Yang Ming Chiao Tung University, Taiwan)
DS3	**Building Commercial IoT/AI Applications with IOTtalk** Yi-Bing Lin (National Yang Ming Chiao Tung University, Taiwan)

Exhibitions

Chunghwa Telecom: EyeSee – Service Assurance System for Enterprise Private 5G Network	
中華電信 Chunghwa Telecom	Chunghwa Telecom (CHT) announces private 5G network solutions to provide safe, fast, and reliable mobile networks for enterprises by setting up dedicated base stations and MEC (Multi-Access Edge Computing) infra in enterprises' filed. EyeSee, a self-developed system of CHT, is a self-management platform used to monitor enterprises' various ICT services and infrastructure proactively. To ensure service quality of private 5G networks, Chunghwa Telecom extends EyeSee monitoring scope from ICT infrastructure to mobile network elements, including UE, RAN, MEC. EyeSee collects and analyzes performance metrics into meaningful information through visualized graphs and historical reports. Besides, EyeSee sends notification to users based on flexible rule combination created by administrator. With features described above, enterprise customers can log on to the unified web-based service portal and master their private 5G networks.

Chunghwa Telecom: EyeLAN – Zero Trust Network Access Solution	
中華電信 Chunghwa Telecom	EyeLAN is independently developed by Chunghwa Telecom Research Institute and has been used in Chunghwa Telecom's corporate network. Introducing EyeLAN, an easy-to-use, and affordable network provision & monitoring solution. It adopts Zero Trust Network Access (ZTNA) technologies, also known as the software-defined perimeter (SDP), that operates on an adaptive trust model. It monitors network devices such as PC, Printers, Notebook, IP camera, storage devices, and everything that has IP and is connected to the network. EyeLAN continuously monitors the network and provides an in-depth visibility and access control. In case of a fault, you can easily drill down to the root cause and eliminate it before operations are affected.