http://www.apnoms.org/2017/

The 19th Asia-Pacific Network Operations and Management Symposium

APNOMS 2017

"Managing a World of Things"

Sep. 27-29, 2017 in Seoul, Korea

Final Program

Sponsored by IEICE ICM

Technically Co-Sponsored by IEEE IEEE ComSoc IEEE Communications Society

Patron ATTO Research, INSOFT, Chunghwa Telecom, BOSCO Technology

Proceedings of APNOMS2017 were published on Sep. 27, 2017 in USB flash drive format. The proceedings(*) are also published in IEEE Xplore.
* Except papers of Innovation Sessions, Special Sessions and Tutorials.

APNOMS 2017

Table of Contents

APNOMS 2017 Sponsors & Supporters

Sponsored by

IEICE ICM

Technically Co-Sponsored by

IEEE IEEE ComSoc IEEE Communications Society

Patron

ATTORESEARCH, INSOFT, 中華電信 Chunghwa Telecom, BOSCO Technologies

APNOMS 2017

Welcome Message

The 19th Asia-Pacific Network Operations and Management Symposium
"Managing a World of Things"

APNOMS (Asia Pacific Network Operations and Management Symposium) has been a premier conference on network operations and management in the Asia Pacific region. APNOMS 2017 is sponsored by IEICE Technical Committee on Information and Communication Management (ICM) and the KICS Technical Committee on Korean Network Operations and Management (KNOM), and technically co-sponsored by the IEEE Communication Society (IEEE ComSoc). APNOMS meets every year, typically during September but specially in August in this year and boasts a rich history of successes. It includes a full three-day program of keynotes, tutorials, technical sessions, panel discussions, poster sessions, and exhibits that focus on managing networks that span the computing and telecommunications areas including IoT, Cloud and Big data issues.

APNOMS 2017 is the 19th in the series, following the successful APNOMS'97 (Seoul), APNOMS'98 (Sendai), APNOMS'99 (Kyongju), APNOMS 2000 (Nara), APNOMS 2001 (Sydney), APNOMS 2002 (Jeju), APNOMS 2003 (Fukuoka), APNOMS 2005 (Okinawa), APNOMS 2006 (Busan), APNOMS 2007 (Sapporo), APNOMS 2008 (Beijing), APNOMS 2009 (Jeju), APNOMS 2011 (Taipei), APNOMS 2012 (Seoul), APNOMS 2013 (Hiroshima), APNOMS 2014 (Hsinchu), APNOMS 2015 (Busan) and APNOMS2016 (Kanazawa)

We are cordially inviting you to submit papers for technical session, poster session, innovation session, and special session. Also, we invite you to submit tutorial proposal on recently advanced topics. We are looking forward to seeing you in Seoul.

Finally, we would like to express our sincere thanks to the authors, reviewers, committee members, volunteers, and participants, whose great efforts have made the success of APNOMS 2017

General Chair

Taesang Choi
ETRI,
Korea

Vice Co-Chairs

Hong-Taek Ju
Keimyung Univ.,
Korea

Kiyohito Yoshihara
KDDI Research,
Japan

Chih-Wei Yi
NCTU,
Taiwan

TPC Co-Chairs

Myung-Sup KIM
Korea Univ.,
Korea

Haruo Oishi
NTT,
Japan

Jiun-Long Huang
NCTU,
Taiwan

APNOMS 2017

Organizing Committee

General Chair	Taesang Choi (ETRI, Korea)
Vice Co-Chairs	Hong-Taek Ju (Keimyung Univ., Korea)
	Kiyohito Yoshihara (KDDI Research, Japan)
	Chih-Wei Yi (National Chiao Tung University, Taiwan)
TPC Co-Chairs	Myung-Sup Kim (Korea Univ., Korea)
	Haruo Oishi (NTT, Japan)
	Jiun-Long Huang (National Chiao Tung University, Taiwan)
Poster Co-Chairs	Ki-hyung Kim (Ajou University, Korea)
	Yoshiaki Kitaguchi (Tokyo Institute of Technology, Japan)
	Cheng-Hsin Hsu (National Tsing Hua University, Taiwan)
Innovation Session Co-Chairs	Soo-Hyun Park (Kookmin University, Korea)
	Kenichi Nishikawa (AWS, Japan)
	Chung-Hua Hu (CHT, Taiwan)
Special Session Co-Chairs	Jincheol Kim (SKT, Korea)
	Dai Kashiwa (NTT Communications, Japan)
	Hung-Yu Wei (National Taiwan University, Taiwan)
Tutorial Co-Chairs	SeongYong Park (Yeonsei University & Kulcloud, Korea)
	Takuya Asaka (Tokyo Metropolitan University, Japan)
	Kate Ching-Ju Lin (National Chiao Tung University, Taiwan)
DEP Co-Chairs	Jong-Moon Chung (Yonsei University, Korea)
	Yuji Nomura (Fujitsu Laboratories, Japan)
	Yu-Huang Chu (CHT, Taiwan)
Exhibitoin Co-Chairs	Kisang Ok (KT, Korea)
	Hiroki Nakayama (BOSCO Technologies, Japan)
	Chen-Min Hsu (CHT, Taiwan)
Publicity Co-Chairs	Sangheon Pack (Korea University, Korea)
	Takuya Kuwahara (NEC, Japan)
	Wen-Chih Peng (National Chiao Tung University, Taiwan)
Finance Co-Chairs	Mi-Jung Choi (Kangwon Nat'l Univ., Korea)
	Kyoko Yamori (Asahi Univ., Japan)
	Jenq-Shiou Leu (National Taiwan University of Science and Technology)
Publication Co-Chairs	Yoonhee Kim (Sookmyung Women's University, Korea)
	Ryo Yamamoto (The University of Electro-Communications, Japan)
	Min-Te Sun (National Central University, Taiwan)
Local Arragnement Co-Chairs	Hyunggon Park (Ewha Womans University, Korea)
Secretaries	Buseung Cho (KISTI, Korea)
	Yuncheng Zhu (Hitachi Ltd., Japan)
	Lien-Wu Chen (Feng Chia University, Taiwan)

APNOMS 2017

Organizing Committee

Steering Committee	Yu-Chee Tseng (National Chiao Tung University, Taiwan)
	Chien Chen (National Chiao Tung University, Taiwan)
	Wang-Cheol Song (Jeju National University, Korea)
	Young-Tak Kim (Yeungnam University, Korea)
	Shingo Ata (Osaka City University, Japan)
	Makoto Takano (Osaka University, Japan)
	Yoshiaki Kiriha (NEC, Japan)
	Choong Seon Hong (Kyung Hee University, Korea)
	Young-Woo Lee (KT, Korea)
Advisory Board	Seong-Beom Kim (Korea)
	Masayoshi Ejiri (Japan)
	Nobuo Fujii (Cyber Creative Institute, Japan)
	Yoshiaki Tanaka (Waseda Univ., Japan)
	James Won-Ki Hong (POSTECH, Korea)
	Doug Zuckerman (Applied Communication Sciences, USA)
	Kyung-Hyu Lee (ETRI, Korea)
International Liaison	USA: Deep Medhi (Univ. of Missouri-Kansas City, USA)
	Latin America: Carlos Westphall (UFSC, Brazil)
	Europe: Marcus Brunner (Swisscom, Switzerland)
	China: John Jiahai Yang (Tsinghua Univ., China)
	Hong Kong: Rocky K. C. Chang (Hong Kong Polytechnic Univ., China)
	Thailand: Teerapat Sanguankotchakorn (AIT, Thailand)
	Australia: Rajan Shankaran (Macquarie Univ., Australia)
	Canada: Raouf Boutaba (Univ. of Waterloo, Canada)

APNOMS 2017

Technical Program Committee

TPC Co-Chairs	Myung-Sup Kim (Korea Univ., Korea)
	Haruo Oishi (NTT, Japan)
	Jiun-Long Huang (National Chiao Tung University, Taiwan)
Members	Abdelkader Lahmadi (University of Lorraine)
	Adarsh Sethi (University of Delaware)
	Ahmed Elmesiry (Universidad Tecnica Federico Santa Maria)
	Ai-Chun Pang (National Taiwan University)
	Alex Galis (University College London)
	Alexander Keller (IBM Global Technology Services)
	Ana Pont (Universidad Politecnica de Valencia)
	Baek-Young Choi (University of Missouri-Kansas City)
	Barbara Martini (CNIT)
	Bo Gu (Kogakuin University)
	Brendan Jennings (TSSG, Waterford Institute of Technology)
	Brigitte Kervella (LIP6)
	Buseong Cho (KISTI)
	Byungchul Park (University of Toronto)
	Carlos Juiz (University of Balearic Islands)
	Carlos Kamienski (Universidade Federal do ABC (UFABC))
	Carlos Westphall (Federal Uiversity of Santa Catarina)
	Catalin Meirosu (Ericsson Research)
	Chao-Chun Chen (National Cheng Kung University)
	Chen Whai-En (National Ilan University)
	Chen Yeong-Sheng (National Taipei University of Education)
	Chen Yuh-Shyan (National Taipei University)
	Cheng Zhang (Waseda University)
	Cheng-Hsin Hsu (National Tsing Hua University)
	Chi-Fu Hwang (National Chung Cheng University)
	Chi-Shih Chao (Feng Chia University)
	Chia-Wei Chang (Chiao Tung University)
	Chien Chen (NCTU)
	Chien-Chao Tseng (National Chiao Tung University)
	Chih-Lin Hu (National Central University)
	Chih-Wei Yi (NCTU)
	Ching-Hsien Hsu (Chung-Hua University)
	Ching-Ju Lin (National Chiao Tung University)
	Choong Seon Hong (Kyung Hee University)
	Chu-Sing Yang (National Cheng Kung University)
	Clarissa Marquezan (Huawei Technologies)
	Corinna Schmitt (University of Zurich)

Technical Program Committee

Members	Cynthia Hood (Illinois Institute of Technology)
	Daniel W. Hong (KT)
	Deok-Jae Choi (Chonnam Univ.)
	Eiichi Horiuchi (Mitsubishi Electric)
	Eiji Takahashi (NEC)
	Ernst Leiss (University of Houston)
	Eun Kyoung Paik (KT)
	Filip De Turck (Ghent University - iMinds)
	Gabi Dreo Rodosek (University of Federal Armed Forces, Munich)
	Giovane C. M. Moura (SIDN Labs)
	Guilherme Sperb Machado (University of Zurich)
	Haiquan Chen (Valdosta State University)
	Hammi Badis (Telecom ParisTech)
	Hanan Lutfiyya (University of Western Ontario)
	Haruo Oishi (NTT)
	Hector Cancela (Universidad de la Republica)
	Hiroki Nakayama (BOSCO Technologies Inc.)
	Hongtaek Ju (Keimyung University)
	Hsi-Lu Chao (National Chiao Tung University)
	Hsu Jenq-Muh (National Chiayi University)
	Hu Chia-Cheng (Naval Academy)
	Huang-Chen Lee (National Chung Cheng University)
	Hugo Scolnik (FCEyN, Universidad de Buenos Aires)
	Hung Yu Wei (National Taiwan University)
	Hwa-Chun Lin (National Tsing Hua University)
	Hyunchul Kim (Sangmyung University)
	Hyunggon Park (Ewha Womans Univ.)
	Irene Loiseau (Universidad Buenos Aires)
	Iwona Pozniak-Koszalka (Wroclaw University of Technology)
	Jae-Oh Lee (Korea Univ. of Technology and Education)
	James Hong (POSTECH)
	Jerome Francois (INRIA Nancy Grand Est)
	Jeferson Campos Nobre (Universidade do Vale do Rio do Sinos (Unisinos))
	Jehn-Ruey Jiang (National Central University)
	Jen-Yi Pan (National Chung Cheng University)
	Jenq-Shiou Leu (National Taiwan University of Science and Technology)
	Jeroen Famaey (University of Antwerp - iMinds)
	Jeu-Yih Jeng (Chunghwa Telecom Labs)
	Jia-Ming Liang (Chang Gung University)
	Jiahai Yang (Tsinghua University)

APNOMS 2017

Technical Program Committee

Members	Jilong Wang (Tsinghua University)
	Jiun-Long Huang (National Chiao-Tung University)
	Jiyeon Son (Electronics and Telelcommunications Research Institute)
	Joaquim Celestino Junior (State university of Ceara - UECE)
	Joon-Myung Kang (Hewlett Packard Labs)
	Jose De Souza (UFC)
	Jun Bi (Tsinghua University)
	Karima Boudaoud (I3S-CNRS Laboratory, University of Nice Sophia Antipolis)
	Katya Gilly de la Sierra (Universidad Miguel Hernandez)
	Kazuhiko Kinoshita (The University of Tokushima)
	Kazunori Ueda (Kochi University of Technology)
	Keisuke Ishibashi (NTT)
	Kenichi Nishikawa (AWS)
	Ki-Hyung Kim (Ajou Univ.)
	Kiminori Sugauchi (Hitachi Ltd.)
	Kisang Ok (KT)
	Kiyohito Yoshihara (KDDI R&D Laboratories Inc.)
	Kuo-Feng Ssu (National Cheng Kung University)
	Kyoko Yamori (Asahi University)
	Kyung-Hyu Lee (ETRI)
	Kyungbaek Kim (Chonnam National University)
	Li-Der Chou (National Central University)
	Li-Hsing Yen (National Chiao Tung University)
	Lin-huang Chang (National Taichung University of Education)
	Ling-Jyh Chen (Academia Sinica)
	Lisandro Zambenedetti Granville (UFRGS)
	Makoto Takano (Osaka Univ.)
	Manabu Nakagawa (NTT Communications)
	Marat Zhanikeev (Tokyo University of Science)
	Maryam Barshan (Ghent University-iMindS)
	Mauro Tortonesi (University of Ferrara)
	Meng-Hsun Tsai (National Cheng Kung University)
	Mi-Jung Choi (Kangwon National University)
	Michele Nogueira (Universidade Federal do Parana)
	Min-Te Sun (National Central University)
	Myung-Sup Kim (Korea University)
	Nakjung Choi (Bell Labs)
	Nazim Agoulmine (University of Evry)
	Nen-Fu Huang (National Tsing Hua University)
	Noriaki Kamiyama (NTT Network Technology Laboratories)

Technical Program Committee

Members	Olivier Festor (INRIA Nancy - Grand Est)
	Olivier Fourmaux (Sorbonne Universités, UPMC Univ Paris 6, CNRS, LIP6 UMR 766)
	Osamu Mizuno (Kogakuin University)
	Paulo Carvalho (Centro Algoritmi, Universidade do Minho)
	Ping-Fan Ho (National Chiao Tung University)
	Prosper Chemouil (Orange Labs)
	Rafael Brundo Uriarte (IMT Institute for Advanced Studies Lucca)
	Rajan Shankaran (Macquarie University)
	Ramin Sadre (Université Catholique de Louvain)
	Ramon Puigjaner (Universitat de les Illes Balears)
	Rashid Mijumbi (Waterford Institute of Technology)
	Remi Badonnel (LORIA - INRIA)
	Ren-Hung Hwang (National Chung Cheng University)
	Ricardo Schmidt (University of Twente)
	Rossitza Goleva (Technical University of Sofia)
	Ruei-Hau Hsu (Singapore University of Technology and Design)
	Ruibiao Qiu (F5 Networks Inc.)
	Sangheon Pack (Korea University)
	Satoshi Ohzahata (University of Electro-Communications)
	Seung-Joon Seok (Kyungnam University)
	Shiann-Tsong Sheu (National Central University)
	Shiao-Li Tsao (National Chiao Tung University)
	Shigeo Urushidani (National Institute of Informatics)
	Shinji Sugawara (Chiba Institute of Technology)
	Shou-Chih Lo (National Dong Hwa University)
	Sidath Handurukande (Ericsson Ireland)
	Sonja Filiposka (Ss. Cyril and Methodius University in Skopje)
	Soo-Hyun Park (Kookmin Univ.)
	Sven van der Meer (Ericsson)
	Tadafumi Oke (KYOWA EXEO Corporation)
	Tae Oh (Rochester Institute of Technology)
	Takeshi Ikenaga (kyushu institute of technology)
	Takeshi Kinoshita (NTT Corporation)
	Taku Yamazaki (Waseda University)
	Takuya Asaka (Tokyo Metropolitan University)
	Teerapat Sa-nguankotchakorn (AIT)
	Thomas Vanhove (Ghent University)
	Toshio Tonouchi (NEC)
	Toshiro Nunome (Nagoya Institute of Technology)
	Tsan-Chang Kuo (Chunghwa Telecom Laboratories)

Technical Program Committee

Members	Tsunemasa Hayashi (BOSCO Technologies Inc.)
	Wang-Cheol Song (Jeju National University)
	Wonyong Yoon (Dong-A University)
	Woojin Seok (Korea Institute of Science and Technology information)
	Yan Ma (Beijing Univ. of Posts and Telecomm.)
	Yaohui Jin (Shanghai Jiao Tong University)
	Yaw-Chung Chen (National Chiao Tung University)
	Yen-Cheng Chen (National Chi Nan University)
	Yen-Wen Chen (National Central University)
	Yezid Donoso (Universidad de los Andes)
	Yi Ren (National Chiao Tung University)
	Yi-Ta Chuang (University of California, Berkeley)
	Yoji Ozawa (Hitachi, Ltd.)
	Yoonhee Kim (Sookmyung Women's Univ.)
	Yoshiaki Kiriha (The University of Tokyo)
	Young Choi (Regent University)
	Young-Tak Kim (Yeungnam University)
	Young-Woo Lee (KT)
	Youngjoon Won (Hanyang University)
	YoungJun Lee (Korea National University of Education)
	Youngseok Lee (Chungnam National University)
	Yousef-Awwad Daraghmi (Palestine Technical University)
	Yu-Huang Chu (Chunghwa Telecom Labs)
	Yuji Nomura (Fujitsu Labs)
	Yuka Kato (Tokyo Woman's Christian University)
	Yuncheng Zhu (Hitachi, Ltd.)

APNOMS 2017

Program at a Glance

Wednesday, 27 September 2017			
	Room A	**Room B**	**Lobby**
08:00 ~			Registration
09:00 ~ 10:30 (90 min)	Tutorial 1 A Distributed SDN Controller - ONOS Technical Tutorial Speaker : Dr. Jian Li	Tutorial 2 Managing mobile sensor networks in an underground pipe Speaker : Prof. Susumu Ishihara	Exhibition Preparation
10:30 ~ 10:45 (15 min)	Coffee Break @ Lobby		
10:45 ~ 12:15 (90 min)	Tutorial 3 Security and Privacy in Large-Scale RFID Systems Speaker : Prof. Min-Te Sun	Tutorial 4 Containerized IoT-Cloud Services over SmartX Playgrounds and their Sustained/Secured Orchestration Speaker : Prof. JongWon Kim	
12:15 ~ 13:15 (60 min)	Lunch @ Four Seasons (1st Floor)		
13:15 ~ 13:55 (40 min)	Welcome Address by General Chairs Keynote Speech 1 SKT's Vision and Plan for Next-Gen OSS in 5G Era Speaker : Mr. Jin-Hyo Park		
13:55 ~ 14:25 (30 min)	Coffee Break @ Lobby		Exhibition Demos
14:25 ~ 16:05 (100 min)	Technical Session 1 Vehicular and Maritime	Technical Session 2 Traffic Analysis and QoS	
16:05 ~ 16:35 (30 min)	Coffee Break @ Lobby		
16:35 ~ 18:15 (100 min)	Technical Session 3 SDN and NFV	Innovation Session 1 Service Management and Systems	

APNOMS 2017

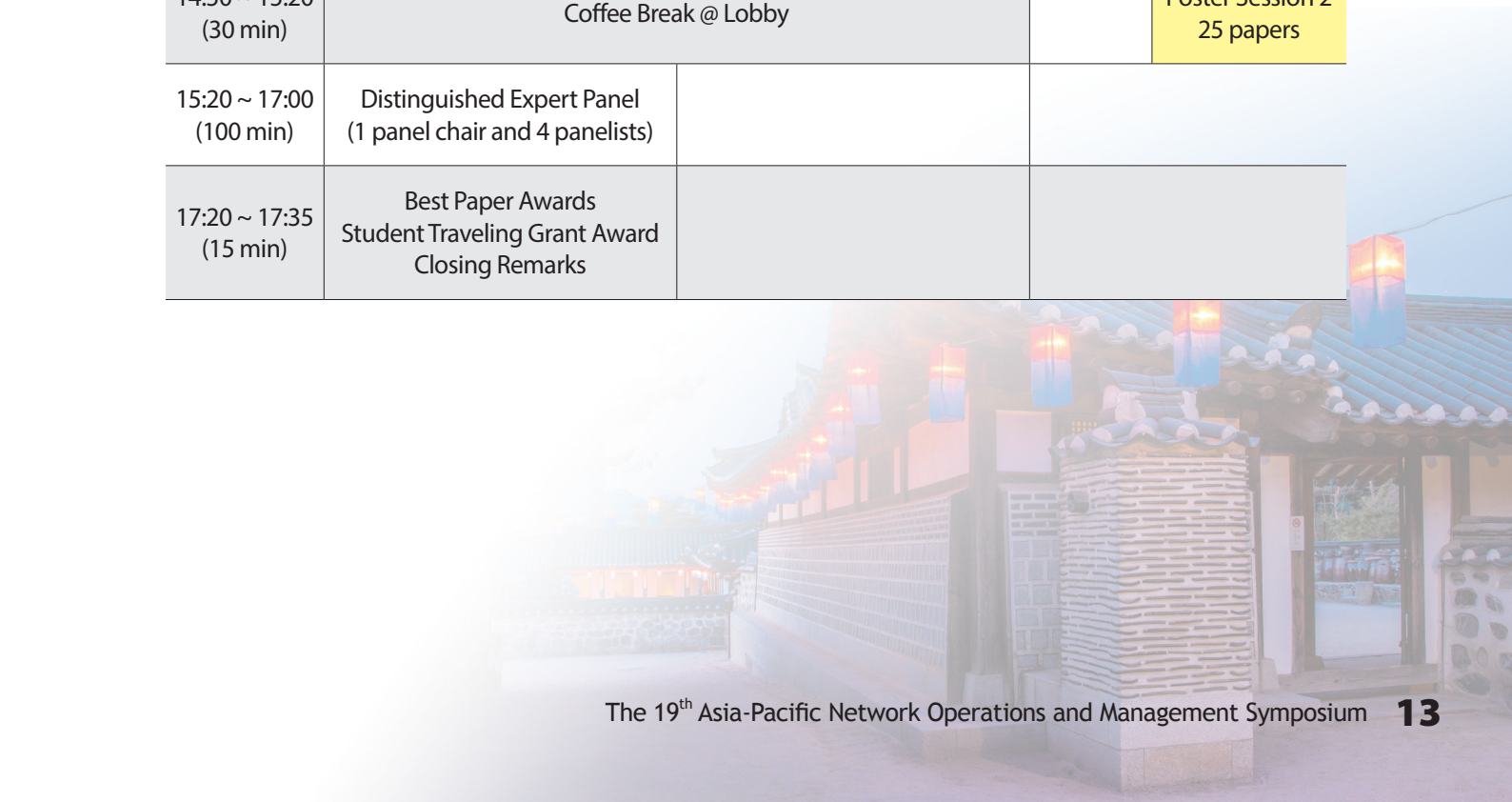
Program at a Glance

Thursday, 28 September 2017				
	Room A	Room B	Lobby	
08:00 ~			Registration	
09:00 ~ 10:00 (60min)	Keynote Speech 2 Softwarization of 5G Core Networks Speaker : Prof. Jyh Cheng Chen Keynote Speech 3 IT management for IoT era Speaker : Mr. Tsunemasa Hayashi			
10:00 ~ 10:30 (30 min)	Coffee Break @ Lobby		Exhibition Demos	Poster Session 1 26 papers
10:30 ~ 12:10 (100 min)	Technical Session 4 SDN and Fault Management	Technical Session 5 SDN and Service Managment		
12:10 ~ 13:10 (60 min)	Lunch @ Geomungo Hall C (3rd Floor)			
13:10 ~ 14:50 (100 min)	Special Session 1 Network intelligence in the age of IoT with SDN and NFV	Technical Session 6 Security		
14:50 ~ 15:20 (30 min)	Coffee Break @ Lobby			Poster Session 1 26 papers
15:20 ~ 17:00 (100 min)	Innovation Session 2 Architecture and Business Management	Technical Session 7 Cloud and Fog Computing		
18:00~ 20:00 (120 min)	Symposium Banquet @ Geomungo Hall C (3rd Floor)			

APNOMS 2017

Program at a Glance

Friday, 29 September 2017				
	Room A	Room B	Lobby	
08:00 ~			Registration	
09:00 ~ 10:00 (60min)	Keynote Speech 4 The first 5G system PoC in conjunction with the PyeongChang winter Olympics Speaker : Dr. Hyung Kyu Chung Keynote Speech 5 Network slicing - open issues Speaker : Prof. Slawomir Kukliński			
10:00 ~ 10:30 (30 min)	Coffee Break @ Lobby		Exhibition Demos	Poster Session 2 25 papers
10:30 ~ 12:10 (100 min)	Technical Session 8 IoT and WLAN	Technical Session 9 Wireless Network and CDN		
12:10 ~ 13:10 (60 min)	Lunch @ Geomungo Hall A (3rd Floor)			
13:10 ~ 14:50 (100 min)	Special Session 2 Mobile Edge Computing and V2X for Autonomous Driving			
14:50 ~ 15:20 (30 min)	Coffee Break @ Lobby			Poster Session 2 25 papers
15:20 ~ 17:00 (100 min)	Distinguished Expert Panel (1 panel chair and 4 panelists)			
17:20 ~ 17:35 (15 min)	Best Paper Awards Student Traveling Grant Award Closing Remarks			



Keynotes

Keynote 1: SKT's Vision and Plan for Next-Gen OSS in 5G Era

Date : Wed. Sep. 27, 13:15~13:55(40 min), Room A

Mr. Jin-Hyo Park
Senior Vice President of Network Technology R&D Center, SK Telecom, Korea

He joined SK Telecom at 1997, and worked for the IRIDIUM project and 3GPP standardization. From 2004, he has not only contributed commercialization of WCDMA and HSDPA/HSUPA, but also took a responsibility for the R&D strategy of SK Telecom. Since 2009, he has successfully led the Korea-first LTE launch, the world-first multi-carrier deployment, the world-first nation-wide HD Voice (VoLTE) commercialization, the world-first LTE-A (Carrier Aggregation) commercialization, and directing LTE evolution and beyond LTE-A of SK Telecom as head of Access Network Lab.

He became head of Network Technology R&D Center as Senior Vice President in 2013. His current interest mainly focuses on developing new growth ICT like big data, security, autonomous driving as well as next generation communication technology like LTE-A, 5G, SON/SDN/NFV.

He received a Bachelor degree in the department of Mathematics and a Master degree in the Information & Communication Engineering at Korea University.

Keynote 2: Softwarization of 5G Core Networks

Date : Thu. Sep. 28, 09:00~09:30(30 min), Room A

Prof. Jyh Cheng Chen
National Chiao Tung University, Taiwan

Jyh-Cheng Chen has been a Faculty Member with National Chiao Tung University (NCTU), Hsinchu, Taiwan since 2010. Prior to that, he was with Bellcore/Telcordia Technologies in New Jersey, USA, and National Tsing Hua University (NTHU), Hsinchu, Taiwan. He is also now serving as the Convener, Computer Science Program, Ministry of Science and Technology, Taiwan. Dr. Chen received numerous awards, including the Outstanding Teaching Awards from both NCTU and NTHU, the Outstanding Research Award from the Ministry of Science and Technology, the Outstanding I. T. Elite Award, Taiwan, the K. T. Li Breakthrough Award from the Institute of Information and Computing Machinery, and the Telcordia CEO Award. He is a Fellow of the IEEE and a Distinguished Member of the ACM. He was a member of the Fellows Evaluation Committee, IEEE Computer Society.

Keynotes

Keynote 3: IT management for IoT era (A real Web of Things and Intelligent management for network career)

Date : Thu. Sep. 28, 09:30~10:00(30 min), Room A

Mr. Tsunemasa Hayashi
CEO/President of BOSCO Technologies Inc, Japan

Tsunemasa Hayashi was born in 1968. He received the M.E. degree from the Tokyo Institute of Technologies in 1994. He completed the Slone Program of Executive-Management of Technologies with the Massachusetts Institute of Technologies in 2006. He was with NTT Laboratories from 1994 to 2006. He has been the CEO/President of BOSCO Technologies Inc., since 2012. His technology interest areas are network operation/management, network virtualization, and high-speed parallel operation. He has engaged in many SDN/NFV projects for network careers. He was a recipient of the Best Paper Award from APDAC'97.

Keynote 4: The first 5G system PoC in conjunction with the PyeongChang winter Olympics

Date : Fri. Sep. 29, 09:00~09:30(30 min), Room A

Dr. Hyung Kyu Chung
vice president of ETRI, Korea

Dr. Hyun Kyu Chung is a vice president of ETRI(Electronics and Telecommunications Research Institute) and head of 5G Giga-Service Research Laboratory. He is responsible for mobile communication R&D and CPND(Contents, Platform, Network and Device) technologies for the Giga-Korea Project in ETRI. He received B.S. degree from Seoul National University in 1985 and his master degree on electrical engineering from KAIST in 1988. He joined to KT(Korea Telecom) in 1988 as a researcher. After moving his career to SK Telecom in 1993, he had served as a researcher for deploying world-first CDMA commercial networks in Korea, the head of SK Telecom U.S. R&D Center at Fairfield, New Jersey. In U.S. he pursued Ph.D. degree in electrical engineering in Polytechnic institute of NYU, Brooklyn, New York, where he majored wave propagation for mobile communications. After his doctoral degree in 2000, he joined to Lucent Technologies in New Jersey as a member of technical staff and then joined ETRI in 2001.

Keynotes

Keynote 5: Network slicing - open issues

Date : Fri. Sep. 29, 09:30~10:00(30 min), Room A

Dr. Slawomir Kukliński
Orange Polska, Poland

Sławomir Kukliński received Ph.D. with honors from Warsaw University of Technology (94') and since then he is Assistant Professor there. He is teaching about mobile and wireless systems. From 2003 he is also working for Orange Polska as research expert focused on mobile and wireless systems with emphasis to self-managed solutions. At present he is interested in application of cognitive techniques to control, management and orchestration of SDN and 5G networks. He led many national research projects as principal investigator and was involved in many international projects, including FP6 MIDAS, FP7 EFIPSANS, FP7 4WARD, FP7 ProSense, Celtic COMMUNE, he coordinated Polish-Luxembourgish project on Cognitive SDN (CoSDN). At present he is involved EU-Japan project 5G!Pagoda. He was working on SDN standardization in ITU-T (Study Group 13) and now is involved in IETF activities on network slicing. Slawomir Kukliński has published more than 50 conference and journal papers, served as a member of TPC of many conferences and gave several invited keynotes.

Tutorial

Tutorial 1: A Distributed SDN Controller - ONOS Technical Tutorial

Date : Wed. Sep. 27, 09:00~10:30(90 min), Room A

Dr. Jian Li
POSTECH, Korea

In this tutorial, we will cover in-depth technical details of Open Network Operating System (ONOS). ONOS is an open source distributed SDN controller project, started in 2013 at Open Networking Laboratory (ON.LAB), open sourced in 2014, and hosted by Linux Foundation. The objective of this project is to deliver a network OS to fulfill service providers' stringent requirements. ONOS aims to provide scalability, high availability, high performance and abstracted APIs to allow ONOS application developer easily develop their application and service that control the traffic in the network. Today the platform is based on a solid architecture written in Java, and has quickly matured to be feature rich and production ready. This talk will have a technical focus discussing the different aspects of the ONOS architecture, network state distribution, northbound APIs, southbound protocols integration, performances, multiple use-cases and applications. A live demo will also be shown during the talk.

Tutorial 2: Managing mobile sensor networks in an underground pipe

Date : Wed. Sep. 27, 09:00~10:30(90 min), Room B

Prof. Susumu Ishihara
Shizuoka University, Japan

In this tutorial, design and management technology of a mobile sensor network for underground pipes, sewer systems, is introduced. Old sewer pipes have to be examined for maintenance. The cost of sewer survey is, however, very high and bring pressures on local governments. A sewer survey system we have been developing uses multiple small sensor/camera nodes like baseballs to sense the pipe condition and record video of the pipe wall and transmit the data to a server via wireless communication.

What the workers need to do with this system is just to open some manholes to attach access points on the manholes and put sensor/camera nodes into the pipe. The range of wireless radio communication in small pipes is very limited, and it makes difficult to deliver sensor/camera data to access points. This tutorial introduces our work on designing camera/sensor nodes and experiments of radio communication in small underground sewer pipes and discusses the management of such a sensor network system.

Tutorial

Tutorial 3: Security and Privacy in Large-Scale RFID Systems

Date : Wed. Sep. 27, 10:45~12:15(90 min), Room A

Prof. Min-Te Sun
National Central University, Taoyuan, Taiwan

Radio Frequency IDentificaiton (RFID) technologies enable a tremendous amount of applications, such as supply chain management, electric transportation payment, and warehouse operations. In these applications, the administrator manages and monitors a large number of objects by reading passive RF tags attached to the objects with an RF reader. Objects and their owners are automatically identified by an attached RF tag, which causes the security and privacy threat to individuals and organizations. Thus, security and privacy protection are the primary concern when RFID applications are deployed in our daily lives. In this tutorial, we investigate a number of security and privacy issues in large-scale RFID systems, and discuss possible solutions to each of these issues.

Tutorial 4: Containerized IoT-Cloud Services over SmartX Playgrounds and their Sustained/Secured Orchestration

Date : Wed. Sep. 27, 10:45~12:15(90 min), Room B

Prof. JongWon Kim
GIST, Korea

Recently we are in the middle of fundamental changes toward software-defined infrastructure (SDI), which gradually transform the silo-based legacy infrastructure into composable one by integrating IoT-based smart things, SDN/NFV-assisted inter-connected edges, and data-rich Cloud core. This user-driven SDI transformation is being supported by diverse open-source software/hardware projects from Linux Foundation, OpenStack Foundation, Open Compute Project (OCP), and others. Thus, in this talk, aligned with this on-going transformation, the prototyping experience of containerized IoT-Cloud services is discussed by showcasing API-driven service function chaining over SmartX playgrounds (i.e., testbeds). That is, by focusing on the futuristic abstraction of "Inter-connected container-based functions over distributed pools of box-style resources", IoT-Cloud service prototyping is explained over hyper-converged (i.e., computing/networking/storage combined) and accelerated SmartX Boxes. Also, by leveraging DevOps-based automation with provisioning/visibility/orchestration/intelligence capabilities, the sustained/secured operation for targeted IoT-Cloud services is discussed by taking example service scenarios.

Special Sessions

Special Session1 : Network intelligence in the age of IoT with SDN and NFV

Date : Thur. Sep. 28, 13:10 ~ 14:50 (100min), Room A
Chair: Dr. Jincheol Kim (SKT, Korea)

Finding the Right Way for High-Performance NFV

Prof. Ryota Kawashima (Nagoya Institute of Technology, Japan)

Abstract : The trend for softwarizing network functions has reached to the area of core networks where tremendous amount of traffic is flowing on. Fast packet processing frameworks like DPDK are now integral part of NFV-nodes for high-performance networking. However, our study has revealed that further performance advances are necessary even for the cutting-edge NFV-nodes. In this presentation, future research directions in regard to NFV-node performance is given based on our thorough performance analysis results.

Bio : He received his M.S. degree from Iwate Prefectural University (Japan) in 2007 and also received a Ph.D. degree from The Graduate University for Advanced Studies (SOKENDAI, Japan) in 2010. He has worked as a software engineer at ACCESS CO., LTD. and Stratosphere, Inc. In 2013 he became an assistant professor at Nagoya Institute of Technology (Japan). His research interest is performance aspect of SDN/NFV, and related papers have been accepted for top level journals and conferences, such as IEEE TNSM and IEEE NetSoft. He received the best paper award for 2016 IEICE Communications Society.

Network Intelligence in the age of IoT with SDN and NFV

Dr. Sangho Shin (Manager, SK Telecom, Korea)

Abstract : In the era of IoT, Big Data, and AI, SKT has been trying to transform to ICT and Data company. As one of the various efforts, we have been gathering data from telco network infrastructure creating data lake system, and we are utilizing the data for operation intelligence through big data analysis. In this talk, I am going to describe how we collect and analyze the data, focusing on servers and switches in telco cloud infrastructure. We have developed T-CORE for cloud server monitoring and TINA for network monitoring, which collect logs, statistics, and events and store them in TSDB and allow users to analyze the data providing various analysis UIs and tools. Recently, we are working on anomaly detection for recommendation and self-healing, using machine learning and deep learning technologies. The analysis results are transferred to our control plane in real time or periodically. We have developed SDN based network controller for virtual and physical network, SONA and SONA Fabric, respectively. SONA is the ONOS based carrier grade multi-tenancy virtual network solution, and SONA fabric is the leaf-spine fabric solution. In this talk, I will also explain how effectively we can manage data center network using SONA and SONA Fabric, integrating with T-CORE and TINA.

Bio : Sangho Shin received B.S from Korea University and received his master's degree in 2002 and Ph.D in 2008, both from Columbia University in City of New York. He has done research on VoIP on Wireless Network in IRT Lab with Prof. Henning Schulzrinne.

He worked at LG for three years and Samsung for six years as a principal researcher. He also worked at ON.Lab (now ONF) as a visiting scholar and contributed to developing ONOS and Segment Routing use case (CORD Fabric), which was shown at ONS '15. Now, he is working for SK Telecom in Korea and leading the SDN projects at R&D center.

His interests are Wireless Networking, SDN, and Home Networking. He published many papers on top conferences and journals, including IEEE INFOCOMM, GLOBECOM, and TMC.

Special Sessions

RECO : An Open-Source Reconfigurable Core Network

Prof. Jyh Cheng Chen (National Chiao Tung University, Taiwan)

Abstract : It is envisioned in the future that not only smartphones will connect to cellular networks, but also all kinds of different wearable devices, sensors, vehicles, etc. However, since the characteristics of different devices differ largely, people argue that future 5G communication systems should be designed to elastically accommodate these different scenarios. We propose a reconfigurable core network to achieve the NGMN vision of slicing the mobile networks to suit for different types of users. We also built a prototype based on openair-cn to demonstrate the architecture we proposed. The source code is open to anyone freely.

Bio : Jyh-Cheng Chen has been a Faculty Member with National Chiao Tung University (NCTU), Hsinchu, Taiwan since 2010. Prior to that, he was with Bellcore/Telcordia Technologies in New Jersey, USA, and National Tsing Hua University (NTHU), Hsinchu, Taiwan. He is also now serving as the Convener, Computer Science Program, Ministry of Science and Technology, Taiwan. Dr. Chen received numerous awards, including the Outstanding Teaching Awards from both NCTU and NTHU, the Outstanding Research Award from the Ministry of Science and Technology, the Outstanding I. T. Elite Award, Taiwan, the K. T. Li Breakthrough Award from the Institute of Information and Computing Machinery, and the Telcordia CEO Award. He is a Fellow of the IEEE and a Distinguished Member of the ACM. He was a member of the Fellows Evaluation Committee, IEEE Computer Society.

Towards a distributed SDN controller - ONOS

Dr. Jian Li (POSTECH, Korea)

Abstract : In this talk, a summary of Open Networking Operating System (ONOS) will be given. ONOS is an open source distributed SDN controller project, started in 2013 at Open Networking Laboratory (ON.LAB), open sourced in 2014, and hosted by Linux Foundation. The objective of this project is to deliver a network OS to fulfill service providers' stringent requirements. ONOS aims to provide scalability, high availability, high performance and abstracted APIs to allow ONOS application developer easily develop their application and service that control the traffic in the network. Today the platform is based on a solid architecture written in Java, and has quickly matured to be feature rich and production ready. This talk will have a technical focus discussing the different aspects of the ONOS architecture, network state distribution, northbound APIs, southbound protocols integration and applications.

Bio : Jian Li is a member of Ambassador Steering Team of Open Networking Foundation (ONF), mainly in charge of governing ONF Ambassador program. Jian Li is also currently serving as a chair of ONOS/CORD Working Group under SDN/NFV forum in Korea. He participates several ONOS brigade's activities including performance and security brigade, SDN teaching brigade and localization brigade; and leads gRPC northbound interface brigade. Jian Li is a SDN/NFV enthusiast, mainly focuses on promoting open source SDN/NFV project (e.g., ONO and CORD) to Korea open networking academia and industry. He received his Ph.D degree from POSTECH in 2016. His research is in the area of Software-Defined Networks (SDN), mainly focuses on control plane management and Locator/Identifier Separation Protocol (LISP) design and implementation. Jian is an active ONOS developer, contributed code in various areas including Control Plane Manager (CPMan), northbound interfaces (e.g., REST, gRPC), and southbound interfaces (e.g., OpenFlow, LISP).

Special Sessions

Special Session2 : Mobile Edge Computing and V2X for Autonomous Driving

Date : Fri. Sep. 29, 13:10 ~ 14:50 (100min), Room A
Chair : TBD

Fog/Edge computing Platform : Enabling Low-Latency Application in Next Generation Network

Dr. Yuan-Yao Shih (Academia Sinica, Taiwan)

Abstract : Recently, with the ubiquitously connected smart devices, the Internet of Things (IoT) has received tremendous attentions and is considered as a promising architecture for many applications. With the diversity of the IoT applications, such as wearable computing, smart metering, smart home/city, vehicles and health monitoring, a large amount of dense, distributed, and mostly mobile IoT devices are expected for deployment shortly. In addition, many applications (such as augmented/virtual reality and vehicle automation) are demanding in terms of high bandwidth and low latency. These applications need intensive computations to accomplish object tracking, content analytics and intelligent decision for better accuracy, performance and user experiences. Current networking infrastructure, including radio access and backhaul, encounter difficulties in dealing with the increasing IoT traffics; thus, to fulfill the service requirements of those IoT applications, cloud computing is considered as a promising architecture, which can provide elastic resources to applications on the resource-limited IoT devices. However, many challenges remain unsolved, such as mobility support, location-awareness and ultra-low latency requirements due to possible long network delay in traversing the time-sensitive data traffics through the Internet backbone.

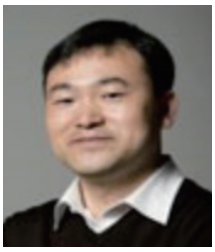
A new paradigm, called fog/edge computing, is emerging. It is an architecture by extending cloud computing to the edge of the network. Fog/edge computing has the potential to fulfill the ultra-low latency requirements for new rising machine-type communication (MTC) applications (such as tactile Internet, mobile augmented reality, and vehicle automation) by joint powerful computing of multiple fog/edge nodes and near-range communications at the edge. Since many emerging IoT applications require ultra-low latency, in addition to computing latency, communication latency also cannot be neglected. The location of fog/edge nodes and users be considered as a major factor when deciding which nodes supply resource to which users. The success of the fog/edge computing platform relies on the efficiency and sustainability of the platform. This talk will discuss how the fog/edge computing platform can enable ultra-low latency applications for next generation networks and the challenges to realize a successful fog/edge computing platform.

Bio : Yuan-Yao Shih is currently a Postdoctoral Research Fellow at Research Center for Information Technology Innovation, Academia Sinica. He received his B.S. degree in Computer Science from National Tsing Hua University, Taiwan, in 2008, M.S. and Ph.D. degrees in Computer Science and Information Engineering from National Taiwan University, Taiwan, in 2010 and 2015 respectively. His Ph.D. thesis was awarded IICM Best Ph.D. Dissertation Award. He was a visiting student in the Department of Electrical Engineering at the Princeton University in 2015 and a visiting scholar in the Department of Computer Science at University of Minnesota from 2016 to 2017.

Special Sessions

Cooperative safety with V2X for automated driving systems and some ADAS applications : use cases and technologies

Dr. Si Bok Yu (Korea Automotive Technology Institute (KATECH), Korea)



Abstract : In this presentation, the current development status of vehicle automation systems in Korea is shortly summarized. The system use cases and test case for C-FVCWS (Cooperative-Forward Vehicle Collision Warning Systems) is discussed. C-FVCWS is the V2V based system which provides the warning service for drivers when there is a risk of collision with the forward vehicle on the same path with the ego vehicle. The presentation also includes the development of the system standard for C-PADS(Cooperative - Partially Automated In-Lane Driving Systems) and the test cases for C-PADS. The C-PADS is the system which the longitudinal control of the automated vehicle is activated by the wireless communication from the road infrastructure. The development project for C-FVCWS was finished in 2015, and the C-PADS is now in the 3rd year development phase.

Bio : Si-bok Yu, Ph.D., is the Director of Vehicle Autonomous Technology R&D Center in Korea Automotive Technology Institute(KATECH). He received the M.S. and Ph.D. from Aerospace Engineering department at Old Dominion University in Virginia.

His is currently focusing on the cooperative automated vehicle research. The research includes the longitudinal control of the automated vehicle based on the wireless communication with the road infrastructure.

He has been working in KATECH since 2003. In 2015, he received the Ministry Award from MSIP (Ministry of Science, ICT and Future Planning). He has been working in ISO TC204 WG14 'Vehicle Active Control & Warning Systems' since 2006, and he is now the Korean representative of the WG. He was the project leader for ISO 11067 'CSWS (Curve Speed Warning Systems), and he is now the project leader for ISO/NP 20901 'EEBL (Emergency Electronic Brake Light Systems).

App-Specific Edge Computing and In-Network Deep Learning

Prof. Akihiro Nakao (University of Tokyo, Japan)

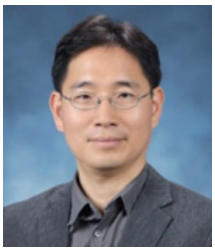
Abstract : Network softwarization and network slicing are considered essential concepts for building 5G mobile networks and beyond to flexibly accommodating applications and services with a wide spectrum of diverse requirements. Mobile/Multi-access Edge Computing is also emerging technology to deal with ultra-reliable and low-latency applications. In this presentation, we introduce our research on application specific network slicing enabling edge computing for a target application utilizing flexible network infrastructure brought by network softwarization. We apply deep machine learning within networks to identify applications from given flows of traffic to create slices per application and to enable execution environments for edge computing per application.

Bio : Akihiro Nakao received his BS in Physics and ME in Information Engineering from the University of Tokyo. He worked at IBM Yamato Laboratory, Tokyo Research Laboratory, and IBM Texas Austin. He received his MS and PhD in Computer Science from Princeton University. Since 2005, he has been an Associate Professor and is now a Professor in Applied Computer Science at the Interfaculty Initiative in Information (III) Studies, Graduate School of Interdisciplinary Information Studies, University of Tokyo. He has been appointed as Chairperson of Department in III. He has also been appointed Chairman of the 5G Mobile Network Promotion Forum (5GMF) Network Architecture Committee by Japanese government.

Special Sessions

Wireless Information-Centric Networking with Edge Computing for Vehicular Applications

Prof. Byung-Seo Kim (Hongik University, Korea)



Abstract : Future connected vehicular systems will be able to obtain massive driving environment data in real time and by analyzing such a massive information, vehicle itself will drive to a destination with avoiding upcoming hazards. To realize the system, the high computation capability, the low latency communication, and the more flexible distributed communication model are required. In regard to the computing capability, Cloud computing might be solution since it offers storage, computation and software services on demand in the Cloud. However, it might not meet the required latency because it locates way far from the vehicular system. Therefore, instead of Cloud computing, to provide both of high computing capability and low latency, Mobile Edge Computing (MEC) or Fog Computing might be a solution since this paradigm offers computation, data, and application services in close proximity of end users. Regarding the more flexible distributed communication model, Information-centric networking (ICN) might be an alternative since it provides non-host centralized network, non-IP-based data publish/subscribe mechanism, broadcasting-based transmissions, etc. In this talk, ICN approach with Mobile Edge computing (MEC) for vehicular communications are discussed. This talk will cover the fundamentals of ICN and MEC/Fog computing, use cases of vehicular applications over ICN with Edge Computing, issues for ICN over MEC, and wireless networks adopting ICN/MEC concepts.

Bio : Byung-Seo Kim is an Associate Professor at the Department of Computer and Information Communication Engineering in Hongik University-Sejong Campus. He received his B.S. degree in Electrical Engineering from In-Ha University, Korea in 1998 and his M.S. and Ph.D. degrees in Electrical and Computer Engineering from the University of Florida in 2001 and 2004, respectively. From January 2005 to August 2007, he worked for Motorola Inc., Illinois and his researches in Motorola Inc. were about wireless broadband mission critical communications. He served as Guest Editors of special issues of International Journal of Distributed Sensor Networks, IEEE Access, and Journal of the Institute of Electrics and Information Engineers, and served as General Chair and TPC members for international conferences. He is IEEE Senior Member. His research interests include the design and development of efficient wireless/wired networks including link-adaptable/cross-layer-based protocols, wireless CCNs/NDNs, Mobile Edge Computing, physical layer for broadband PLC, and resource allocation algorithms. His works have appeared in around 141 publications and 22 patents.

Distinguished Expert Panel

DEP Session : Managing a World of Things

Date : Fri. Sep. 29, 15:20 ~ 17:00 (100min) Room A

Chairs	Jong-Moon Chung (Yonsei University, Korea) Yuji Nomura (Fujitsu Laboratories, Japan) Yu-Huang Chu (CHT, Taiwan)
Pannelist	**Prof. Li-Chun Wang** **National Chiao Tung University, Taiwan**

Abstract : A significant change in wireless networks recently is that much more data are collected from various sources, including channels, locations, radio access options, social networks, network state and management. The availability of this large amount and various types of data can potentially help a traditional knowledge-driven mobile network be transformed into a more powerful data-driven cognitive network (D2CN) with the help of machine learning, data mining, artificial intelligence, and statistical reasoning. Hence, from the holistic aspects of signal processing, network planning, and user customization, the performance of D2CN can be significantly improved.

In this talk, we first introduce what data science (or data-driven research) is. Next, we take power control issues of ultra-dense small cells (UDSC) as an example to illustrate how a data-driven approach can empower self-organizing network (SON) to enhance the throughput and energy efficiency of UDSC, and provide application-aware flow QoS control. Last, we highlight some important data-driven wireless network research directions in the future.

Bio : Dr. Li-Chun Wang (M'96 -- SM'06 -- F'11) received Ph. D. degree from the Georgia Institute of Technology, Atlanta, in 1996. From 1996 to 2000, he was with AT&T Laboratories, where he was a Senior Technical Staff Member in the Wireless Communications Research Department. Since August 2000, he has joined the Department of Electrical and Computer Engineering of National Chiao Tung University in Taiwan and is the current Chairman of the same department. Dr. Wang won the Distinguished Research Award of National Science Council, Taiwan in 2012, and was elected to the IEEE Fellow grade in 2011 for his contributions to cellular architectures and radio resource management in wireless networks. He was the co-recipient of 2015 IEEE Communications Society Asia-Pacific Board Best Award. He also won the 2013 Y. Z. Hsu Scientific Paper Award, and was the co-recipient of the 1997 IEEE Jack Neubauer Best Paper Award.

His current research interests are in the areas of radio resource management and cross-layer optimization techniques for wireless systems, heterogeneous wireless network design, and cloud computing for mobile applications. He is holding 10 US patents and editing a book, "Emerging Technologies for 5G Wireless Systems," with Cambridge University Press.

Distinguished Expert Panel

Pannelist	**Mr. Satoru Matsushima** **Softbank Corp., Japan**
	Bio : Satoru Matsushima is a Deputy Director in SoftBank's Network Division of Technology Unit. He has experience in the telecommunication industry in design, planning and deploying networks and services. His expertise in IP based technologies, such as MPLS, IPv6, SDN and other related protocols. He participates regularly in IETF standardization meetings, and co-authors Request For Comment (RFC) documents and Internet Drafts to standardize protocols. He is currently working to develop new mobile network architecture and solutions with software defined infrastructures and virtualization technology. The goal of his work is to simplify current networks and is able to provide programmability for 5G applications.

Pannelist	**Dr. Jian Li,** **Ambassador, Open Networking Foundation (ONF), SDN&NFV**
	Abstract : The presentation of Dr. Jian Li will cover the following contents. 1. New ONF - Open Innovation Pipelines to Build Integrated Solutions - Software Defined Standards 2. Open Source vs. Standardization - ONF Open Innovation Pipeline - New ONF's Scope - New ONF – Restructuring for the Open Source Era - Linux Foundation's View 3. Why Open Source for Orchestrator? Bio : Jian Li is a member of Ambassador Steering Team of Open Networking Foundation (ONF), mainly in charge of governing ONF Ambassador program. Jian Li is also currently serving as a chair of ONOS/CORD Working Group under SDN/NFV forum in Korea. He participates several ONOS brigade's activities including performance and security brigade, SDN teaching brigade and localization brigade; and leads gRPC northbound interface brigade. Jian Li is a SDN/NFV enthusiast, mainly focuses on promoting open source SDN/NFV project (e.g., ONO and CORD) to Korea open networking academia and industry. He received his Ph.D degree from POSTECH in 2016. His research is in the area of Software-Defined Networks (SDN), mainly focuses on control plane management and Locator/Identifier Separation Protocol (LISP) design and implementation. Jian is an active ONOS developer, contributed code in various areas including Control Plane Manager (CPMan), northbound interfaces (e.g., REST, gRPC), and southbound interfaces (e.g., OpenFlow, LISP).

Technical Session

Technical Session 1: Vehicular and Maritime

Date : Wed. Sep. 27, 14:25~16:05(100 min), Room A

Chair: Dr. Woojin Seok (KISTI, Korea)

1-1	A Framework for Discovering Maritime Traffic Conflict from AIS Network *Po-Ruey Lei*, Tzu-Hao Tsai**, Yu-Ting Wen**, and Wen-Chih Peng** (*ROC Naval Academy, Zuoying, Taiwan, **National Chiao Tung University, Hsinchu, Taiwan)*
1-2	Adaptive Shipborne Base Station Sleeping Control for Dynamic Broadband Maritime Communications *Ailing Xiao, Ning Ge, Liuguo Yin, Chuan'ao Jiang, and Shaohua Zhao (Tsinghua National Laboratory for Information Science and Technology, Beijing, China)*
1-3	Scalable TDMA Cluster-based MAC (STCM) for Multichannel Vehicular Networks *Nurullah Shahin and Young-Tak Kim (Yeungnam University, Korea)*
1-4	Collaborative Security Attack Detection in Software-Defined Vehicular Networks *Myeongsu Kim, Insun Jang, Sukjin Choo, Jungwoo Koo, and Sangheon Pack (Korea University, Seoul, Korea)*

Technical Session 2: Traffic Analysis and QoS

Date : Wed. Sep. 27, 14:25~16:05(100 min), Room B

Chair: Prof. Byung-Seo Kim, (Hongik University. Korea)

2-1	A QoS-based ONU Group Planning Algorithm for Smart Grid Communication Network *Jun-Hai Lu*, Fan-Bo Meng*, Dong Guo**, Ying Li***, Si-Ya Xu***, and Xing-Yu Chen*** (*State Grid Liaoning Electric Power Company,Shenyang, China, **Beijing Guodiantong Network Technical Co. LTd.,Beijing, China, ***Beijing University of Posts and Telecommunications, Beijing, China)*
2-2	Emerging Network Technologies and Network Neutrality Conformance *Ramneek*†, Patrick Hosein**, Woojin Seok*†, Jai-Seung Kwak†, and Alexandr Ni*† (*Korea University of Science and Technology, Daejeon, Korea, †KISTI, Daejeon, Korea, **The University of the West Indies, Trinidad and Tobago)*
2-3	Building IP Geolocation Database from Online Used Market Articles *Hyunsu Mun and Youngseok Lee (Chungnam National University, Korea)*
2-4	Identification of User Behavior from Flow Statistics *Shingo Ata*, Yusuke Iemura*, Nobuyuki Nakamuray**, and Ikuo Oka* (*Osaka City University, Osaka, Japan, **Oki Electric Industry Co., Ltd., Osaka, Japan)*

Technical Session 3: SDN and NFV

Date : Wed. Sep. 27, 16:35~18:15(100 min), Room A

Chair: Prof. Po-Ruey Lei, (ROC Naval Academy, Taiwan)

3-1	Regional Fault Tolerant Recovery Mechanism for Multilayer Networks *Xiaomei Wang, Lanlan Rui, Xuesong Qiu, Ying Li, and Siya Xu (Beijing University of Posts and Telecommunications, Beijing, China)*
3-2	Knowledge-Defined Networking using In-band Network Telemetry *Jonghwan Hyun and James Won-Ki Hong (POSTECH, Pohang, Korea)*
3-3	Enabling Network Function Virtualization over Heterogeneous Resources *Thomas Lin, Naif Tarafdar, Byungchul Park, Paul Chow, and Alberto Leon-Garcia (University of Toronto, ON, Canada)*
3-4	A Novel vCPE Framework for Enabling Virtual Network Functions with Multiple Flow Tables Architecture in SDN Switches *Nen-Fu Huang, Chi-Hsuan Li, Chia-Chi Chen, I-Hsien Hsu, Che-Chuan Li, and Ching-Hsuan Chen (National Tsing Hua University, Hsinchu, Taiwan)*

Technical Session

Technical Session 4: SDN and Fault Management

Date : Thu. Sep. 28, 10:30~12:10(100 min), Room A

Chair: Dr. Haruo Oishi (NTT, Japan)

4-1	Service Failure Diagnosis in Service Function Chain *Shilei Zhang, Ying Wang, Wenjing Li, and Xuesong Qiu (Beijing University of Posts and Telecommunications, Beijing, China)*
4-2	Towards ONOS-based SDN Monitoring using In-band Network Telemetry *Nguyen Van Tu, Jonghwan Hyun, and James Won-Ki Hong (POSTECH, Pohang, Korea)*
4-3	Towards Comprehensive Protection for OpenFlow Controllers *Shengzhi Zhang* , Xiaoqi Jia**, and Weijuan Zhang*** (*Florida Institute of Technology, USA, **CAS, Beijing, China, ***University of Chinese Academy of Science, Beijing, China)*
4-4	Design of Optical Aggregation Network with Carrier Edge Functions Virtualization *Takashi Miyamura*, Akira Misawa*, and Jun-ichi Kani** (*NTT Corporation, Tokyo, Japan, **NTT Corporation, Kanagawa, Japan)*

Technical Session 5: SDN and Service Managment

Date : Thu. Sep. 28, 10:30~12:10(100 min), Room B

Chair: Prof. Young-Tak Kim (Yeungnam University, Korea)

5-1	OpenAPI-based Message Router for Mashup Service Development *Doyoung Lee, Seyeon Jeong, and James Won-Ki Hong (POSTECH, Pohang, Korea)*
5-2	A Survivability-based Backup Approach for Controllers in Multi-controller SDN against Failures *Lingyu Zhang, Ying Wang, Wenjing Li, Xuesong Qiu, and Qinghong Zhong (Beijing University of Posts and Telecommunications, Beijing, China)*
5-3	Enforcing Users'Constraints In Dynamic, Software-Defined Networks Of Devices *Pierre Peloso, Dinh Thai Bui, and Mathieu Boussard (Centre de Paris-Saclay, Nozay, France)*
5-4	IO Visor-based Packet Tracing and Collection over Distributed SmartX Server-Switch Boxes *Jungi Lee, Taekho Nam, Aris Cahyadi Risdianto, and JongWon Kim (Gwangju Institute of Science and Technology, Gwangju, Korea)*

Technical Session 6: Security

Date : Thu. Sep. 28, 13:10~14:50(100 min), Room B

Chair: Prof. Kyungbaek Kim (Chonnam National University, Korea)

6-1	An Integrated Security Monitoring System for Digital Service Network Devices *Wen-Lin Cheng, Ting-Che Chuang, Chien-Wen Yang, Yueh-Hsien Lin, Min Liu, and Chuan Yin (Chunghwa Telecom Laboratories Co., Ltd., Taoyuan, Taiwan)*
6-2	Firmware over the Air for Home Cybersecurity in the Internet of Things *Che-Chun Teng, Jia-Wei Gong, Ya-Shian Wang, Chin-Ping Chuang, and Mei-Chun Chen (Chunghwa Telecom Laboratories Co., Ltd., Taoyuan, Taiwan)*
6-3	Design and Implementation of Security System for Cloud Storage *Ju-Shu Chueh and Min-Te Sun (National Central University, Taoyuan, Taiwan)*
6-4	Threshold Estimation in Self-Destructing Scheme Using Regression Analysis *Young Ki Kim and Choong Seon Hong (Kyung Hee University, Korea)*

Technical Session

Technical Session 7: Cloud and Fog Computing

Date : Thu. Sep. 28, 15:20~17:00(100 min), Room B

Chair: Prof. Kazuhiko Kinoshita (Tokushima University, Japan)

7-1	Multi-stage Stackelberg Game Approach for Colocation Datacenter Demand Response *Minh N. H. Nguyen, DoHyeon Kim, Nguyen H. Tran, and Choong Seon Hong (Kyung Hee University, Korea)*
7-2	Distributed Analytics in Fog Computing Platforms Using TensorFlow and Kubernetes *Pei-Hsuan Tsai, Hua-Jun Hong, An-Chieh Cheng, and Cheng-Hsin Hsu (National Tsing Hua University, Hsin-Chu, Taiwan)*
7-3	Queueing Theoretic Approach to Job Assignment Strategy Considering Various Inter-arrival of Job in Fog Computing *Tomoya Mori, Yoichi Utsunomiya, Xuejun Tian, and Takashi Okuda (Aichi Prefectural University, Aichi, Japan)*
7-4	iSDF: an Integrated Software-defined Computing Framework for Scientific Experiments *Seoyoung Kim*, Julim Ahn*, Heewon Kim*, Yoonhee Kim*, and Jieun Choi** (*Sookmyung Women's University, Seoul, Korea, **KISTI, Daejeon, Korea)*

Technical Session 8: IoT and WLAN

Date : Fri. Sep. 29, 10:30~12:10(100 min), Room A

Chair: Prof. Guey-Yun Chang (National Central University, Taiwan)

8-1	Traffic Management using Value Function-based Regulation *Yuncheng Zhu*, Hideki Okita** (*Research & Development Group, Hitachi, Ltd, Japan, **Future Investment Division, Hitachi, Ltd., Japan)*
8-2	A Plug and Play Generic Sensor Platform based on MQTT Protocol *Wen-Cong Chin and Yaw-Chung Chen (National Chiao Tung University, Hsinchu, Taiwan)*
8-3	Backhaul Virtualization for Multiple Services in Public WLANs *Kazuki Ginnan*, Keita Kawano** , Kazuhiko Kinoshita***, Hiroki Nakayama****, Tsunemasa Hayashi****, and Takashi Watanabe* (*Osaka University, Japan, **Okayama University, Japan, ***Tokushima University, Japan, ****BOSCO Technologies Inc., Japan)*
8-4	Ruin Theory Based Modeling of Fair Spectrum Management in LTE-U *Aunas Manzoor, Nguyen H. Tran, and Choog Seon Hong (Kyung Hee University, Korea)*

Technical Session 9: Wireless Network and CDN

Date : Fri. Sep. 29, 10:30~12:10(100 min), Room B

Chair: Prof. Sangheon Pack (Korea University, Korea)

9-1	A Hybrid Pull-Push Protocol in Hybrid CDN-P2P Mesh-based Architecture for Live Video Streaming *Teerapat Sanguankotchakorn and Nonpawich Krueakampliw (Asian Institute of Technology, Pathumthani, Thailand)*
9-2	D2D Communications under LTE-U System: QoS and Co-existence Issues are Incorporated *Anupam Kumar Bairagi and Choong Seon Hong (Kyung Hee University, Korea)*
9-3	Layered Video Communication in ICN Enabled Cellular Network with D2D Communication *Saeed Ullah, Tuan LeAnh, Anselme Ndikumana, Md. Golam Rabiul Alam, and Choong Seon Hong (Kyung Hee University, Korea)*
9-4	Performance Measurements of 360◦ Video Streaming to Head-Mounted Displays Over Live 4G Cellular Networks *Wen-Chih Lo, Ching-Ling Fan, Shou-Cheng Yen, and Cheng-Hsin Hsu (National Tsing Hua University, Hsin-Chu, Taiwan)*

Poster Session

Poster Session 1

Date : Thu. Sep. 28, 10:00~10:30(30 min)/ 14:50~15:20(30 min), Lobby

Chair: Prof. Cheng-Hsin Hsu (National Tsing Hua University, Taiwan)

1-1	The Exploration of Machine Learning for Abnormal Prediction Model of Telecom Business Support System *Jen-Hao Chen, Chao-Wen Huang, and Chia-Chun Shih (Chunghwa Telecom Co., Ltd., Taiwan)*
1-2	Using Kernel Density Estimation to Target Customer Complaint Handling Service *Hsin-Chieh Chao, Kai-An Tang, Yin-Hsin Liu, and Chang-Yu Hsu (Chunghwa Telecom Laboratories, Taoyuan, Taiwan)*
1-3	Orchestration of NFV Virtual Applications Based on TOSCA Data Models *Yuan-Mao Hung, Shih-Che Chien, and Yung-Yi Hsu (Chunghwa Telecom Laboratories, Taoyuan, Taiwan)*
1-4	Effect of the penalty on the QoS received by multihomed clients *Rohit Tripathi (Indian Institute of Information Technology Guwahati, Guwahati, India)*
1-5	Load Balancing for Multiple Controllers in SDN Based on Switches Group *Yaning Zhou, Ying Wang, Jinke Yu, Junhua Ba, and Shilei Zhang (Beijing University of Posts and Telecommunications, Beijing, China)*
1-6	Classification-Based Elephant Flow Detection Method using Application Round on SDN Environments *Yuan-Hao Huang, Wen-Yueh Shih, and Jiun-Long Huang (National Chiao Tung University, Hsinchu, Taiwan)*
1-7	Design and Implement a Mobile Badminton Stroke Classification System *Juyi Lin, Chia-Wei Chang, Chih-Hao Wang, Hong-Chuan Chi, Chih-Wei Yi, Yu-Chee Tseng, and Chih-Chuan Wang (National Chiao Tung University, Taiwan)*
1-8	Location-aware Dynamic Network Provisioning *Van-Quyet Nguyen, Sinh-Ngoc Nguyen, Deokjai Choi, and Kyungbaek Kim (Chonnam National University, Gwangju, Korea)*
1-9	Suspicious Traffic Detection Based on Edge Gateway Sampling Method *Sinh-Ngoc Nguyen, Jintae Choi, and Kyungbaek Kim (Chonnam National University, Gwangju, Korea)*
1-10	Could We Beat A New Mimicking Attack? *Degang Sun*†‡, Kun Yang†‡, Bin Lv†‡, and Zhixin Shiy† (*Beijing University, Beijing, China, †Chinese Academy of Sciences, Beijing, China, ‡University of Chinese Academy of Sciences, Beijing, China)*
1-11	File Transfer Framework with Multipath Transfer in Heterogeneous Networks for Disaster Recovery *Kyu-Hwan Lee, Dong-Hyuk Jang, and Sung-Jae Lee (Agency for Defense Development, DaeJeon, Korea)*
1-12	Evaluating Scheduling Strategies in LOD Based Application *Usman Akhtar, Muhammad Bilal Amin‡, and Sungyoung Lee (Kyung Hee University, Korea, ‡Korea Research Foundation (KRF) and UCLab, Kyung Hee University)*
1-13	Sky-Scope : Skype Application Traffic Identification System *Sung-Ho Lee, Young-Hoon Goo, Jee-Tae Park, Se-Hyun Ji, and Myung-Sup Kim (Korea University, Sejong, Korea)*
1-14	High-Reliable WDM Optical Access Network Expanding by Double Fiber-Tangent-Ring Topology *Qi Shao*, Yu Shao**, Ying Li***, and Si-Ya Xu*** (*Henan electric power corporation,Henan, China, **Zhengzhou power supply company,Henan, China, ***Beijing University of Posts and Telecommunications, Beijing, China)*
1-15	Experimental evaluation of a path switching function to avoid delay spikes in wireless LANs *Kazumasa Goto, Kazuya Okuda, Ryohei Nakamura, and Hisaya Hadama (National Defense Academy of Japan, Japan)*

Poster Session

1-16	Survey on Network Protocol Reverse Engineering Approaches, Methods and Tools *Baraka D. Sija* , Young-Hoon Goo*, Kyu-Seok-Shim*, Sungyun Kim**, Mi-Jung Choi**, and Myung-Sup Kim* (*Korea University, Sejong, Korea, **Kangwon National University, Chuncheon, Korea)*
1-17	Feasibility Study for Simulating Community Based Content Caching on CCN Network Using ndnSIM Simulator *Suman Pandey*†, Yang-Sae Moon† and Mi-Jung Choi† (*Daegu Catholic University, Korea, †Kangwon National University, Chuncheon, Korea)*
1-18	Design and Implementation of a Service-Oriented Network Provisioning System for Network as a Service *Tse-Han Wang*, Yen-Cheng Chen**, Chen-Min Hsu*, Kai-Sheng Hsu*, and Hey-Chyi Young* (*Chunghwa Telecom Laboratories, Taoyuan, Taiwan, **National Chi Nan University, Taiwan)*
1-19	Topology Design for Multihop Cellular Network *Jyh-Shyan Huang* and Yao-Nan Lien** (*Chunghwa Telecom Laboratories, Taipei, Taiwan, **National Asia University, Taipei, Taiwan)*
1-20	Dynamic Reordering Bloom Filter *Da-Chung Chang, Chien Chen, and Mahadevan Thanavel (National Chiao Tung University, Hsinchu, Taiwan)*
1-21	Sliced NFV Service Chaining in Mobile Edge Clouds *Sooeun Song and Jong-Moon Chung (Yonsei University, Seoul, Korea)*
1-22	The Implementation and Evaluation for Automatic Platform Failure Test System Using CMDB From Automation Script *Shinsaku Numata, Norimasa Kamiya, Shoji Hashimoto, and Dai Kashiwa (NTT Communications Corporations Technology Development, Tokyo, Japan)*
1-23	Forwarding Path Discovery with Software Defined Networking *Chih-Chieh Chen*, Yi-Ren Chen*†, Shi-Chun Tsai*, and Ming-Chuan Yang† (*National Chiao Tung University, Hsinchu, Taiwan, †Academia Sinica, Taipei, Taiwan)*
1-24	FERA: A Caching Scheme in CCN using File-Extension and Regression Analysis *Jin Won Lee and Choong Seon Hong (Kyung Hee University, Korea)*
1-25	iToy: A LEGO-like Solution for Small Scale IoT Applications *Yi Ren, Muhammad Alfiansyah, Nyoto Arif Wibowo, Cheng-Wei Wu, JieFu Geng, and Yu-Chee Tseng (National Chiao Tung University, Hsinchu, Taiwan)*
1-26	A3N: Agile Application-Awareness in Software-Defined Networks *He Cai, Jun Deng*, Yuhua Zhang*, and Xiaofei Wang*, Sangheon Pack** (*Tianjin University, Tianjin, China, **Korea University, Seoul, Korea)*

Poster Session 2

Date : Fri. Sep. 29, 10:00~10:30(30 min)/ 14:50~15:20(30 min), Lobby

Chair: Prof. Hong-Taek Ju (Keimyung University, Korea)

2-1	Application-aware Traffic Engineering in Software-Defined Network *Seyeon Jeong, Doyoung Lee, Jonghwan Hyun, Jian Li, and James Won-Ki Hong (POSTECH, Pohang, Korea)*
2-2	Reliable Vehicle Selection Algorithm with Dynamic Mobility of Vehicle in Vehicular Cloud System *Sukjin Choo, Insun Jang, Jungwoo Koo, Joonwoo Kim, and Sangheon Pack (Korea University, Seoul, Korea)*
2-3	Performance Analysis of H.264, H.265, VP9 and AV1 Video Encoders *Md Abu Layek, Ngo Quang Thai, Md Alamgir Hossain, Ngo Thien Thu, Le Pham Tuyen, Ashis Talukder, TaeChoong Chung and Eui-Nam Huh (Kyung Hee University, Korea)*

Poster Session

2-4	Structured Whitelist Generation in SCADA Network using PrefixSpan Algorithm *Woo-Suk Jung*, Jeong-Han Yun**, Sin-Kyu Kim**, Kyu-Seok Shim*, and Myung-Sup Kim (*Korea University, Sejong, Korea, **National Security Research Institute, Daejeon, Korea)*
2-5	Enhancing Service Resiliency in the Next Generation EPC System *Zaw Htike and Yoshinori Kitatsuji (KDDI Research Inc., Japan)*
2-6	Parallel and Local Diagnostic Algorithm for Wireless Sensor Networks *Lidan Wang*, Xiaofei Zhang*, Yu-Chee Tsengy**, and Cheng-Kuan Lin* (*Soochow University, Suzhou, China, **National Chiao-Tung University, Hsinchu, Taiwan)*
2-7	A Hybrid Live Streaming Model for a Reliable Service *Dongho Son, Doyoung Lee, Taeyeol Jeong, and James Won-Ki Hong (POSTECH, Pohang, Korea)*
2-8	User Clustering based on Correlation in 5G using Semidefinite Programming *Chit Wutyee Zaw, Yan Kyaw Tun, and Choong Seon Hong (Kyung Hee University, Korea)*
2-9	Downlink Power Allocation in Virtualized Wireless Networks *Yan Kyaw Tun, Chit Wutyee Zaw, and Choong Seon Hong (Kyung Hee University, Korea)*
2-10	SigManager: Automatic Payload Signature Management System for the Classification of Dynamically Changing Internet Applications *Kyu-Seok Shim*, Young-Hoon Goo*, Sungyun Kim**, Mi-Jung Choi**, and Myung-Sup Kim* (*Korea University, Sejong, Korea, **Kangwon National University, Chuncheon, Korea)*
2-11	An Approach of Cost Optimized Influence Maximization in Social Networks *Ashis Talukder, Md. Golam Rabiul Alam, Anupam Kumar Bairagi, Sarder Fakhrul Abedin, Md Abu Layek, Hoang T. Nguyen, and Choong Seon Hong (Kyung Hee University, Korea)*
2-12	Browser's "search form" issues and countermeasures *Yuji Suga (Internet Initiative Japan Inc., Japan)*
2-13	Access Point Selection Algorithm for Providing Optimal AP in SDN-based Wireless Network *DongKyu Lee and Choong Seon Hong (Kyung Hee University, Korea)*
2-14	Collaborative Cache Allocation and Computation Offloading in Mobile Edge Computing *Anselme Ndikumana, Saeed Ullah, Tuan LeAnh, Nguyen H. Tran, and Choong Seon Hong (Kyung Hee University, Korea)*
2-15	Infrastructure-assisted Hybrid Road-aware Routing and QoS Provisioning in VANETs *Muhammad Tahir Abbas and Wang-Cheol Song (Jeju National University, Jeju, Korea)*
2-16	Mobile charger billing system using lightweight Blockchain *Nam Ho Kim, Sun Moo Kang, and Choong Seon Hong (Kyung Hee University, Korea)*
2-17	Reliable Smart Energy IoT-Cloud Service Operation with Container Orchestration *Seungryong Kim, Chorwon Kim, and JongWon Kim (Gwangju Institute of Science and Technology, Gwangju, Korea)*
2-18	Probabilistic k-Weighted Coverage Placement in Wireless Sensor Networks *Guey-Yun Chang*, Chih-Wei Charng*, Jang-Ping Sheu**, and Liang Ruei-Yuan* (*National Central University, Jhongli, Taiwan, **National Tsing Hua University, Hsinchu, Taiwan)*
2-19	A Traffic Grouping Method using the Correlation Model of Network Flow *Young-Hoon Goo*, Sung-Ho Lee*, Seongyun Choi**, Mi-Jung Choi**, and Myung-Sup Kim* (*Korea University, Sejong, Korea, **Kangwon National University, Chuncheon, Korea)*
2-20	Classification of Application Traffic Using Tensorflow Machine Learning *Jee-Tae Park, Kyu-Seok Shim, Sung-Ho Lee, and Myung-Sup Kim (Korea University, Sejong, Korea)*
2-21	Power Allocation Games for Cooperative Coordinated Multipoint Transmission Scheme *Seunghyun Jung and Hyunggon Park (Ewha Womans University, Seoul, Korea)*

Poster Session

2-22	Information Fusion based Agile Streaming Telemetry for Intelligent Traffic Analytics of Softwarized Network *Taesang Choi, Sangsik Yoon, and Sejun Song (ETRI, Daejeon, Korea)*
2-23	An Ontology-based Hybrid Approach for Accurate Context Reasoning *Muhammad Asif Razzaq, Muhammad Bilal Amin and Sungyoung Lee (Kyung Hee University, Korea)*
2-24	Application Identification System for SDN QoS based on Machine Learning and DNS Responses *Nen-Fu Huang*, Che-Chuan Li*, Chi-Hsuan Li*, Chia-Chi Chen*, Ching-Hsuan Chen**, and I-Hsien Hsu* (*National Tsing Hua University, Hsinchu, Taiwan, **National Tsing Hua University, Hsinchu, Taiwan)*
2-25	The Unique Reliable Identity System of Enabling Lightweight Device Management in NMS Mechanism for the U-IoT *Khamdamboy Urunov, Soo-Young Shin, and Soo-Hyun Park (Kookmin University, Seoul, Korea)*

Innovation Session

Innovation Session 1: Service Management and Systems

Date : Wed. Sep. 27, 16:35~18:15(100 min), Room B

Chair: Prof. Soo-Hyun Park (Kookmin University, Korea)

1-1	A Smart Rolling Update Methodology adopt Intelligent DevOps workflow Take Large Cloud Project as Use Case *Kai-Wei Kuo, Yen-Cheng Lin, Chih-Lung Liao, and Chia-Chen Chu (Chunghwa Telecom Laboratories, Taiwan)*
1-2	An Automatic Internationalization and Localization Mechanism for Web Applications *Che-Jen Chang, Wei-Chen Liao, Kai-Wei Kuo, Hsiao-Lin Peng, and Chia-Chen Chu (Chunghwa Telecom Laboratories, Taiwan)*
1-3	A Novel Template-based Architecture for the Heterogeneous ICT Infrastructure Monitoring System with Customizable Widgets *Chia-Hao Yu, An-Jung Cheng, Hsiu-Kuei Chiang, and I Han Liu (Chunghwa Telecom Laboratories, Taiwan)*
1-4	Design and Implementation of Automatic System for Network Testing with Quality Degradation *Junichi Kawasaki, Megumi Shibuya, Atsuo Tachibana, Masanori Miyazawa, and Teruyuki Hasegawa (KDDI Research, Inc., Japan)*

Innovation Session 2: Architecture and Business Management

Date : Thu. Sep. 28, 15:20 ~ 17:00(100 min), Room A

Chair: Prof. Youngjoon Won (Hanyang University, Korea)

2-1	A multiple cloud solution on OpenStack in practice *Jui-Hao Yang, Yen-Cheng Lin, Chih-Lung Liao, and Chia-Chen Chu (Chunghwa Telecom Laboratories, Taiwan)*
2-2	Network Resource Management Architecture with Unified Information Models *Shingo Horiuchi, Kazuaki Akashi, Masataka Sato, and Tadashi Kotani (NTT, Japan)*
2-3	OSS Architecture and Order Mapping Function for Providing Various Services *Kazuaki Akashi, Masataka Sato, Shingo Horiuchi, and Tadashi Kotani (NTT, Japan)*
2-4	Pricing Wireless Service with MVNO Participation *Fumitaka Taniguchi (Waseda University, Japan), Kyoko Yamori (Asahi University, Japan), Cheng Zhang (Waseda University, Japan), Bo Gu (Kogakuin University, Japan), Yoshiaki Tanaka (Waseda University, Japan)*

Exhibition

ATTO Research : Innovation on Networking by SDN & NFV

ATTO Research is the venture company specialized in network virtualization with SDN and NFV technologies.
We are specialized in security-enhanced SDN control, network management, and cloud network virtualization. We have SDN/OpenFlow controller 'OBelle' and 'OBelle Fabric' for OpenFlow application, NFV Platform 'ATHENE' and VNFs, 3D&SDN-Based traffic monitoring solution 'Hermes'.
We have references in the Teleco, Finance and Public areas.
We are leading SDN/NFV solution provider adopting open-source solutions and open-standard in networking market having best developers and engineering resources.

INSOFT : CloudMesh for NFV Booth number

NFV is a next generation network operation management technology that can not only enhance flexibility by virtualizing existing network equipment but also save facility investment cost, data center server room space, operation cost and even energy consumption.
CloudMesh INSOFT's next generation network management solutions provides simple ways to design complex network topology and apply it to real world network configuration seemlesly via user friendly designer tool.
CloudMesh also provides complete management for Multi Data center via distributed NFV technology. Distrbuted cloud NFV management technology with INSOFT awaits you.

Chunghwa Telecom : EyeSee – Integrated ICT Management Service

Chunghwa Telecom provides enterprise customers with a variety of managed ICT services with superior quality, and has developed a one-stop, brand new management platform, called EyeSee, for enterprise customers to easily check the quality of these ICT services from the perspective of customers. EyeSee has the ability to proactively monitor the health and performance metrics of various ICT services and resources, such as IDC co-location, WAN, LAN, hardware infrastructure, application software, and hybrid cloud. EyeSee provides a unified web-based service portal, so enterprise customers can log on to the portal and check various kinds of dashboards, trend reports, and topologies of ICT services mentioned. Visit Chunghwa Telecom booth to learn more about EyeSee.

BOSCO Technologies : IT management for IoT era

Because of IoT and SDN/NFV, ICT infrastructures are becoming large and complicated. The unified, simplified and flexible ICT infrastructure management that does not depend on environment is required to manage such an ICT infrastructure. To implement such a management system, we focused on the traceability, client-less operation, and zero-touch operation.
BOSCO Technologies provides a SMART-GW, the brand new web-based unified and simplified ICT infrastructure management system. Operators can login to SMART-GW via web browsers and establish a connection such as SSH, http, RDP, and so on to manage the ICT infrastructures. All the connection behaviors are logged and traceable with user-friendly dashboards. Please visit our booth for more information and demonstrations.

General Information

About Korea

- Geography & Location

The Republic of Korea (herein after Korea) is a country visited by more than ten million international travelers every year. With its long history in culture and tradition, the country has a lot to offer to travelers. Continue reading to learn general information about Korea before visiting.

Where is Korea?

The Korean peninsula is located in Northeast Asia. It is surrounded by the ocean on three sides, making it a unique geographical location. With Seoul as its capital city, the landsite is roughly 1,030 km (612 miles) long and 175 km (105 miles) wide at its narrowest point. Korea's total land area is 100,033 square km, neighboring Japan to the east, China to the west, and sharing a northern border with Democratic People's Republic of Korea (North Korea).

- Population of Korea

The total population of Korea is approximately 51,634,618 (July 2016 data) with most of them residing in the Seoul metropolitan area. Outside of Seoul, other large and economically advanced cities such as Busan, Incheon, Daegu, Daejeon, Gwangju and Ulsan also have higher population densities than other cities in Korea.

General Information

About Seoul

Seoul has been the capital city of Korea for the past 600 years. The city of Seoul, which hosted the 1988 Seoul Olympic Games and 2002 FIFA World Cup Soccer Games, has many sight-seeing attractions and cultural events. Seoul's former role as the economic, political, and cultural heart of the "Chosun Dynasty" has now taken on international proportions.

Kwang-hwa-moon Plaza in Seoul, Korea

Useful Information

Korea's climate is regarded as a continental climate from a temperate standpoint and a monsoon climate from a precipitation standpoint. The climate of Korea is characterized by four distinct seasons. Spring and autumn are rather short, summer is hot and humid, and winter is cold and dry with abundant snowfall. Temperatures differ widely from region to region within Korea, with the average being between 6 oC (43oF) and 16 oC (61oF).

Monthly Temperature												
Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature	-4	0	5	12	17	22	26	28	17	10	0	-4

- Visa (for details ...)

All visitors to Korea must have a valid passport and visa, except for visitors from countries that have a special agreement with Korea.
VISA more

- Currency Exchange (for details ...)

Foreign currencies or traveler's checks can be exchanged for Korean currency at banks or currency exchange booths at the airport.
Currency Exchange more

General Information

- Time Difference / Business Hours

  Korean time is 9 hours ahead of Greenwich Mean Time (GMT+9)

  Business hours for banks are generally from 09:30 to 16:30 on weekdays only. Banks are closed on Saturdays, Sundays and public holidays. ATMs are widely available. Major department stores are open from 10:30 to 19:30, including Sundays, but smaller shops tend to open earlier and close later every day.

- Electricity

  In Korea, electrical outlets are operated at 220 volt only. Overseas delegates bringing laptop computers and other electrical appliances are advised to check whether a transformer is required

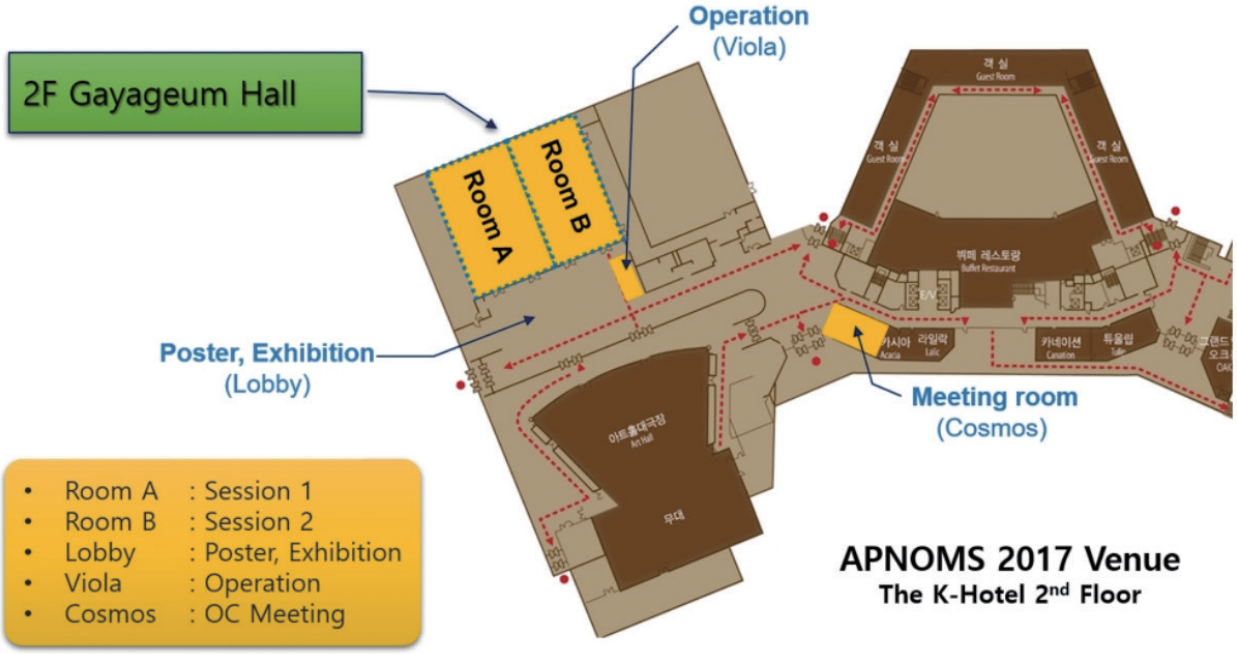
APNOMS 2017

Venue Information

APNOMS2017 will be held at The-K Hotel, Seoul, Korea

The-K Hotel : http://www.thek-hotel.co.kr/e_seoul/main.asp

Venue Information



- Room A : Session 1
- Room B : Session 2
- Lobby : Poster, Exhibition
- Viola : Operation
- Cosmos : OC Meeting

Transportation Information

From Incheon International Airport To Seoul

There are several ways to get to Seoul from Incheon International Airport. The following are the most convenient and economical methods of transportation.

- Airport Limousine Buses : Airport limousine buses are available throughout across Seoul as well as at hotels and major tourist attractions nationwide. (for details ...)
- Airport Express (AREX) : AREX trains are very convenient because they pass through Incheon International Airport and Gimpo International Airport to Seoul Station and are also connected to most Seoul subway lines. (for details ...)
- Subway : Seoul Metropolitan Government operates subway lines 1-9 run across Seoul. (for details ...)
- Taxis : Standard, Deluxe, Int'l, and Jumbo taxis are all available. (for details ...)

How to get to Venue (The-K Hotel)

- Address : 70, Baumoe-ro 12-gil, Seocho-gu, Seoul
- TEL : 82-2-571-8100
- Website : http://www.thek-hotel.co.kr/e_seoul/main.asp

1. From Incheon Airport to The-K Hotel

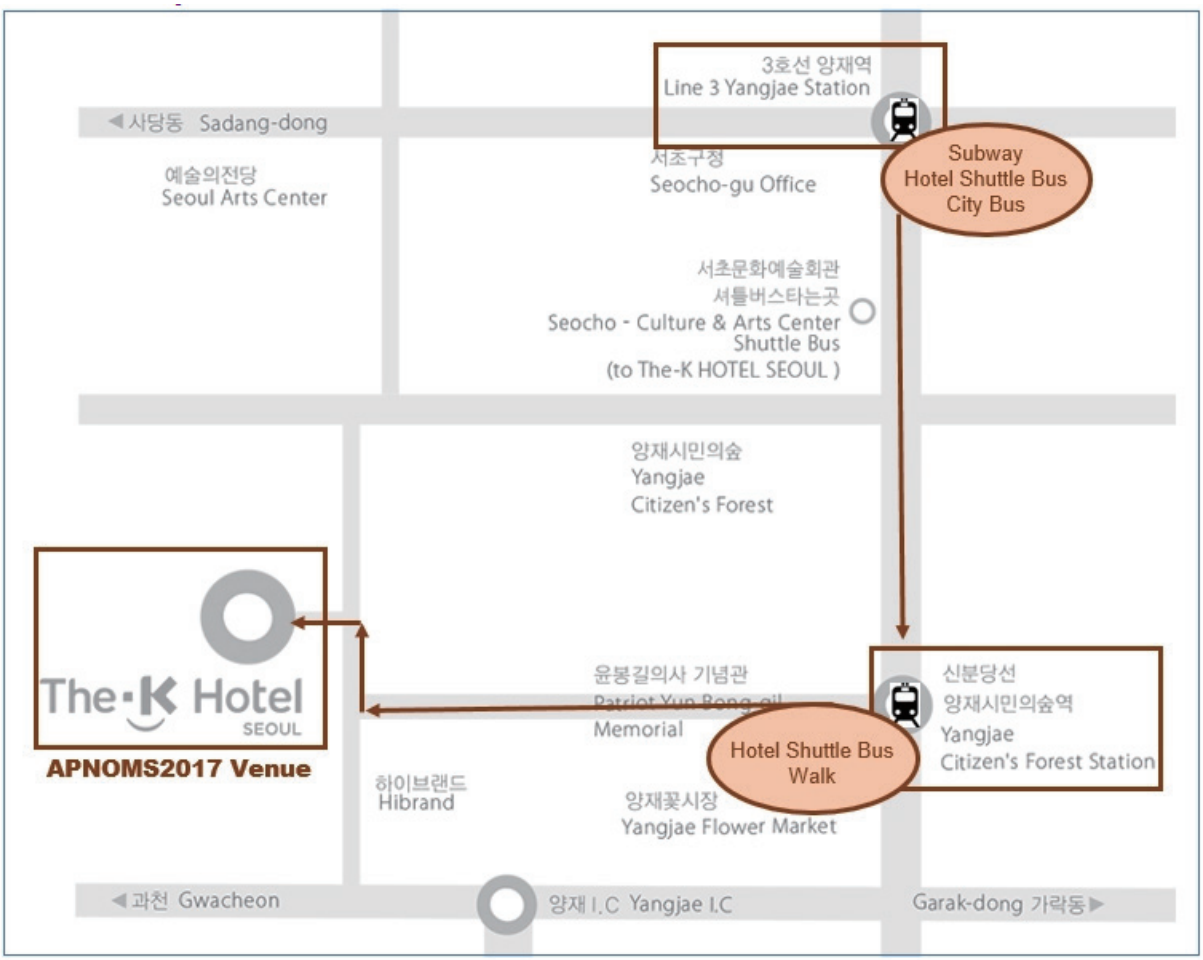
6500 Limousine Bus Board : Incheon Air port 1st floor 5A, 11B stop Get off : Hotel (In front of Convention Center Building) Time of Travel : Approx. 80 minutes [Costs (Fare)] Adult \15,000 Children \11,000(6~12) Time interval : (240 minutes) To Airport : 07:00 / 11:00 / 15:00 / 17:00 To Hotel : 09:20 / 13:20 / 17:20 / 21:20 **6009 Limousine Bus** Board : Incheon Air port 1st floor 5A, 11B stop Get off : Yangjae Station Exit 5 (opposite of Hilstate Gallery) Time of Travel : Approx. 70 minutes [Costs (Fare)] Adult \15,000 Children \11,000(6~12) Time interval : (15~25 minutes) To Airport : 04:05 ~ 21:00 To the City : 05:20 ~ 23:05	**By Taxi** • Estimated Fare : 70,000~80,000 Won • Time of Travel : Approx. 60 minutes

2. From Kimpo Airport to The-K Hotel

By Subway • Line 9 Kimpo Station -> Gosok Terminal Station -> Line 3 Yangjae Station • Time of travel : Approx. 60 minutes • Fare : 1,450 Won (Cash)	**By Taxi** • Time of Travel : Approx. 60 minutes • Fare : 30,000 Won

Transportation Information

3. Transportation Information



Subway	No. 9 Exit at Yangjae Station of Line 3 (Take the shuttle bus is front of Seocho-Culture & Arts Center) No. 5 Exit at Yangjae Citizen's Forest Station of Sinbundang Line (5 minutes on foot) * Line 2 Gangnam, Yangjae Station Sinbundang Line 3 Transit
Bus	General blue bus 405A, 405B, 408, 421, 140, 470, 441 No. 10 Exit at Yangjae Station of Line 3 Get off the bus at AT Center, Yangjae Flower Market(10 minutes on foot) Take the Town bus (NO. 08) at Yangjae Station No. 11 Exit
Trails	Yangjae Citizens' Forest 0.5km (5 minutes) Yangjaecheon 0.5 km (5 minutes) Seocho Culture & Art Park 0.2km (3 minutes)

Tour Information

Korea Tourism Organization : http://english.visitkorea.or.kr/enu/index.jsp
Metropolitan Government : http://www.visitseoul.net/index

Seoul City Tour by Bus (for details ...)

Seoul, the capital of Korea, is arguably the most popular tourist destination in all of Korea. Packed with countless sights to see and places to visit, such as ancient palaces, traditional markets, and high-end shopping districts, Seoul is a city with so much to offer that you might not know where to start. To get the most out of your stay, visit some of Seoul's most famous attractions by taking a trip aboard the Seoul City Tour Bus, which offers various routes.

The Downtown/Palace Course travels to all the major tourist spots, while the City & Traditional Culture Course stops at some of the best traditional markets and major shopping districts. Among other courses available, the Night Course provides an opportunity to take in the city's spectacular nightscape. Travelers can pick the tour that is best suited to their interests. Language interpretation services are available in different languages on the buses, installed in each seat for tourists to learn about the places they are visiting.

Downtown/Palace Course (single-level bus)

- Course itinerary:
  Gwanghwamun Gate → Deoksugung Palace → Namdaemun Market → Seoul Station → The War Memorial of Korea → Yongsan Station → The National Museum of Korea → Itaewon → Myeong-dong → Namsangol Hanok Village → Ambassador Hotel → The Shilla Hotel, Jangchungdan Park → N Seoul Tower → Grand Hyatt Seoul → Dongdaemun Design Plaza → Daehangno Street (University Street) → Changgyeonggung Palace → Changdeokgung Palace → Insa-dong → Cheong Wa Dae (Blue House) → Gyeongbokgung Palace, National Folk Museum of Korea, National Museum of Modern and Contemporary Art, Seoul → Sejong Center → Gwanghwamun Gate

- Operating hours: Tuesday-Sunday 09:00-20:00 (Last departure from Gwanghwamun Bus Stop at 18:00)
- Intervals / Duration of the tour: Weekdays every 30 min, weekends & national holidays every 25 min / Approx. 2 hours
- Departure point: Gwanghwamun Gate, next to Koreana Hotel (Gwanghwamun Station, Seoul Subway Line 5, Exit 6)s

<Photo: Heunginjimun Gate before skyscrapers>

Subway Tour (for details ...)

- Seoul Tour by Subway Line 1

Seoul Subway Line 1 was the first metro line introduced in Korea. Beginning with a route from Dobong-gu, Seoul to Incheon, the line has now expanded to Uijeongbu and Dong-Ducheon in the north as well as Suwon and Cheonan in the south. Not only does the route itself have a long history, the line also passes through downtown Seoul and many traditional monuments. From flea markets to wholesale fish markets and outlets to department stores, travelers can satisfy a variety of shopping needs on this line. In addition, Seoul Subway Line 1 is connected to several parts of the Seoul metropolitan area, making traveling outside of the city not only possible, but easy!

Tour Information

Beauty & Wellness (for details ...)

• Jjimjil-bang

Experience Korea's Unique Culture, 'Jjimjil-bang'

During your beauty and wellness trip to Korea, one of the recommendations is to visit a Korean spa called jjimjil-bang. Even if you do not fancy the idea of sitting in a boiling hot room, fret not, as most of the jjimjil-bangs are packed with all kinds of great entertainment besides their main sauna facility.

Jjimjil derives from the words meaning 'heating' in Korean, however, most of the facilities do not necessary limit its function to just a hot sauna. So, join us in uncovering all the fun and facts about a typical jjimjil-bang experience!

Registration

Registration Fees

Attendee/Type	Early-Bird/Authors (by Aug. 14, 2017)	Advance (by Sep. 4, 2017)	Late/Onsite (after Sep. 4, 2017)
Full	500,000 KRW	550,000 KRW	600,000 KRW
Student	170,000 KRW	210,000 KRW	250,000 KRW
Exhibitor	190,000 KRW	280,000 KRW	380,000 KRW
Extra Banquet Ticket	70,000 KRW	70,000 KRW	70,000 KRW
Extra Proceedings	45,000 KRW	45,000 KRW	45,000 KRW

- If you want to check your registration status, please email to Sun-Kyun(kyun@kangwon.ac.kr) and ask him.
- For each of all accepted papers, at least one author must register by the Early-Bird due date at the Full rate in order to guarantee their papers to be published in the symposium proceedings.
- **Presenters** must provide the paper number and title of their paper.
- **Full** registration fee includes proceedings, admissions to tutorial sessions, technical sessions, banquet, three lunches and coffee breaks.
- **Student** registration fee includes the same as full registration except the banquet is not included.
- **Exhibitor** registration fee includes lunches and banquet, but does not include admission to the tutorials and technical sessions.
- **Registration** fees will **be charged in Korean WON (KRW)** only according to local financial regulations.

Payment Methods

• Online Credit Card Payment Advance [Overseas, Korea]

– Online Credit Card Payment page(Korea) will be opened in Aug. 8, 2017 due to technical issues.
– Credit Card Payment System (VISA, MasterCard, JCB, Unionpay, etc.)

The online registration system uses the Eximbay online payment subsystem. At the very beginning, users have to put their personal information and then click the [payment] button to continue payment process.

• Credit Card Payment by E-Mail

– You may want to pay registration fee by credit card, but not to use online payment system due to security concern.
– In this case, please use a hard copy registration form (Word, PDF).
– Please complete the form to provide registration and credit card information.
– Scan the completed form in order to make a PDF or image file of it.
– And then, send it to Prof. Mi-Jung Choi via E-Mail(mjchoi(at)kangwon.ac.kr)

• Bank Transfer

* For USD (United States Dollar) or KRW (Korean Won) transfer
– Name of Bank: Woori Bank, Seoul, Korea
– Account No.: 133-118981-13-120
– Account Holder: Korea Information and Communication Society (KICS)
– Address of Bank : 1-203, Hoehyeon-dong, Jung-gu, Seoul, Korea
– Swift Code: HVBKKRSE
– All bank service charges for bank transfer must be paid by the registrants. Please email us a copy of the remittance statement to us along with this registration form(English: Word, PDF)
– E-Mail: mjchoi(at)kangwon.ac.kr

Registration

Request an Invoice

You can request an invoice for your registration you made with KICS (The Korea Institute of Communication and Information Sciences), a main sponsor of APNOMS 2017. Just download and fill out the form (Invoice Request Form). And then send it by e-mail to the address (budget (at) kics.or.kr) . We will send the invoice back to you within 48 hours via your e-mail address.

Refund Policy

There is 100 USD (120,000KRW) cancellation fee for registration. APNOMS 2017 must receive a written cancellation notice no later than September 5, 2017 to remit the curtailed refund. Refund will not be made after September 5, 2017. Author registration cannot be refunded.
Online Registration

Contact Information

For inquiries related to registration, please contact Prof. Mi-jung Choi.

- E-Mail: mjchoi(at)kangwon.ac.kr
- Tel: +82-33-250-8442

Visa Assistance

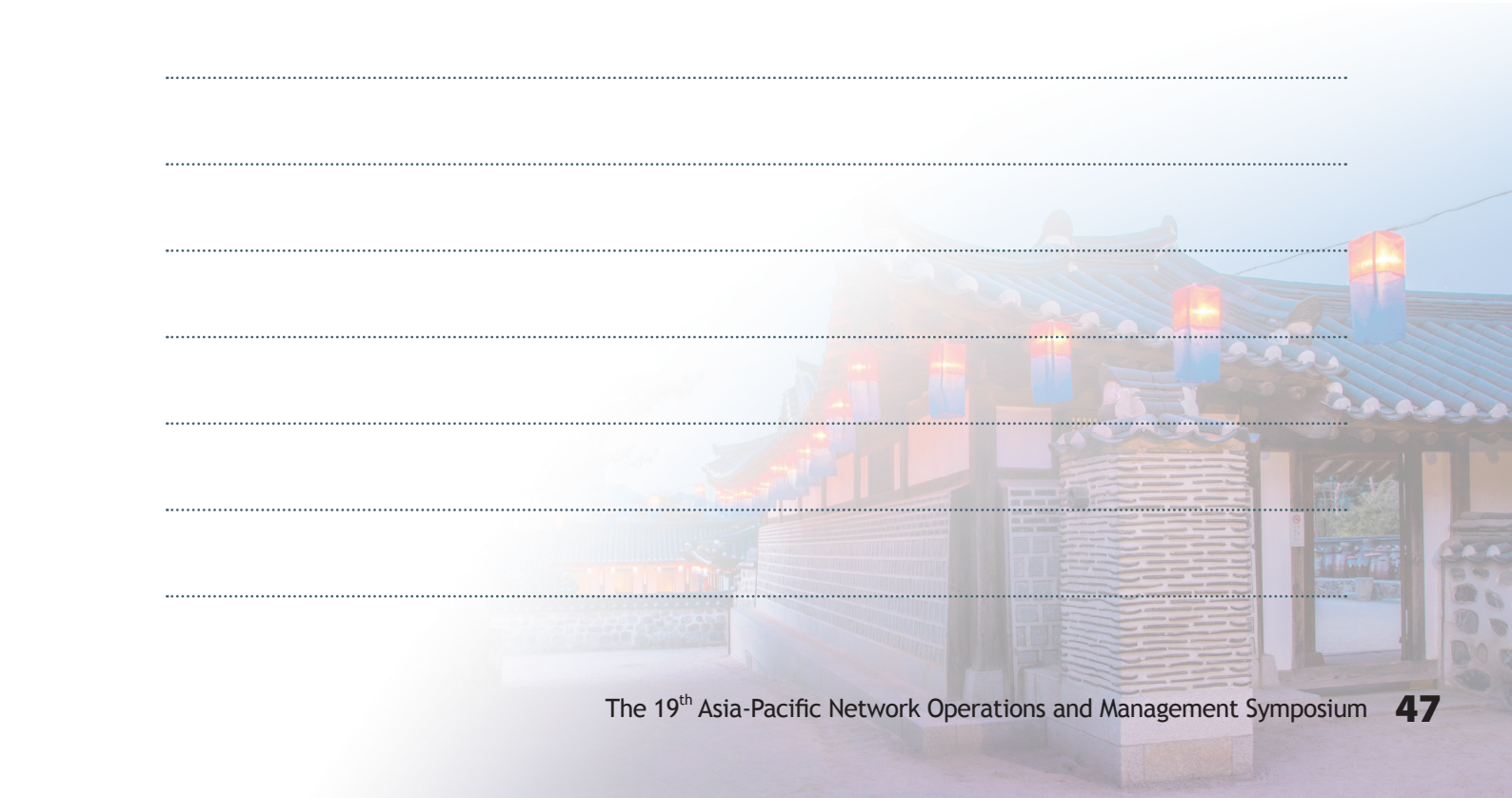
Foreign participants entering Korea must hold valid passport and Korean visa.
"Invitation Letter to APNOMS 2017" will be issued to:

- keynote speakers, presenters, panelists, and organizing committee members
- conference participant who has paid their registration fee

If you need an invitation letter to apply for visa, please fill out the "Request Form for Invitation Letter(author, speaker)", and send it to APNOMS2017 General Chair (Taesang Choi (ETRI, Korea), choits@etri.re.kr) before September 1, 2017. Meanwhile, please also send the scanned version of your passport for record.

For more details, please consult your travel agent, or visit [KOREA VISA PORTAL]

Memo



The 19th Asia-Pacific Network Operations and Management Symposium

APNOMS 2017

"Managing a World of Things"

Sep. 27-29, 2017 in Seoul, Korea