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Multi Screen Service Forum
ifs – Information & Software Engineering Group by Prof. A Min Tjoa (Technical University of Vienna)

Next Generation RFID/USN Reserch Center (Yonsei University)
Center for ICT & Automotive Convergence (Kyungpook National University)
Society Safety System Forum

July 3, 2018 (Tuesday)

[13:00-14:30, Aplaus]
ORAL SESSION 1A
DroneCAN 2018-I

Chair: Hwangnam Kim (Korea University)

[O1A-1] devKopter, Multicopter Development Platform for Engineers
Minwoo Kim and Bosung Lee (Korea Aerospace Research Institute, Korea)

[O1A-2] Simultaneous Attack on Drone and GCS in UAV Systems
Jaemin Yu, Byeong-Moon Cho, and Kyung-Joon Park (DGIST, Korea); Hwangnam Kim (Korea University, Korea)

[O1A-3] Unmanned Aerial System Traffic Management with WAVE Protocol for Collision Avoidance
Jong-Hong Park, Sung-Chan Choi, Jaeho Kim, and Kwang-Ho Won (Korea Electronics Technology Institute, Korea)

[O1A-4] Small Drone Development for Public Service Relating to Korean PPI
Yong Wun Jung, Wanggu Kang, and In Seong Hwang (KARI, Korea)

[13:00-14:30, Bravo]
ORAL SESSION 1B
IWMIL2018

Chair: Junhee Seok (Korea University)

[O1B-1] Rank Prediction for Portfolio Management Using Artificial Neural Networks
Jiyoon Bae, Hyungbin Yun, Ghudae Sim, and Junhee Seok (Korea University, Korea)

[O1B-2] A Comparison of Penalized Regressions for Estimating Directed Acyclic Networks
Kyu Min Lee, Sung Won Han, and Hyungbin Yun (University of Korea, Korea)

[O1B-3] Indoor Semantic Segmentation for Robot Navigating on Mobile
Wonsuk Kim and Junhee Seok (Korea University, Korea)

[O1B-4] Detecting Selfish Backoff Attack in IEEE 802.15.4 CSMA/CA Using Logistic Classification
Joongheon Kim and Kyeong Seon Kim (Chung-Ang University, Korea)

[O1B-5] Classifier Comparison for Failure Detection of Induction Motors Using Current Signal
GyuBeom Han and Jong-Kook Kim (Korea University, Korea)

[13:00-14:30, Ceremonie]
ORAL SESSION 1C
IWFSO & IQI

Chair: Jun Heo (Korea University)

[O1C-1] BER Analysis of Wavelength Division Multiplexing-Based Multiple Beam Scheduling Scheme Based on Gamma Approximation Channel
Sung Sik Nam and Ju-Hyung Lee (Korea University, Korea); Chang Seok Yoon (Korea Electronics Technology Institute, Korea); Young-Chai Ko (Korea University, Korea)

[O1C-2] Trajectory Optimization of Energy Efficient FSOC-UAV with Atmospheric and Geometric Loss
Ju-Hyung Lee (Korea University, Korea); Ki-Hong Park and Mohamed-Slim Alouini (King Abdullah University of Science and Technology (KAUST), Saudi Arabia); Young-Chai Ko (Korea University, Korea)

[O1C-3] Impact of Both Nonzero Boresight and Jitter Pointing Error on Outage Capacity of FSO Communication Systems over Strong Turbulence
Kug-Jin Jung, Sung Sik Nam, and Young-Chai Ko (Korea University, Korea)

[O1C-4] Efficient Reconciliation Protocol with Polar Codes for Quantum Key Distribution
Sunghoon Lee and Jun Heo (Korea University, Korea)

[O1C-5] An Introduction to Fault-Tolerant Quantum Computation and Its Overhead Reduction Schemes
Il Kwon Sohn and Jun Heo (Korea University, Korea)

[O1C-6] Implementation of Plug & Play Quantum Key Distribution Protocol
Byungkyu Ahn, Jinyoung Ha, and Youngjin Seo (Korea University, Korea); Jeonghwan Shin and Kyungwoon Lee (KT, Institution of Convergence Technology, Korea); Jun Heo (Korea University, Korea)

[14:40-16:10, Aplaus]
ORAL SESSION 2A
DroneCAN 2018-II

Chair: Kyung-Joon Park (DGIST)

[O2A-1] Geolocation-based Routing Protocol for Flying Adhoc Networks (FANETs)
Sung-Chan Choi, Hassen Redwan Hussen, Jong-Hong Park, and Jaeho Kim (Korea Electronics Technology Institute, Korea)

[O2A-2] Active Decoupling Control for a Planetary Coaxial Helicopter Using Force Feedback
Brijith Balakrishnan (National Institute of Technology Karnataka, India); G Shamrao and Aditya R (ISRO SATELLITE CENTRE, India); Narendranath S (National Institute of Technology Karnataka, India); Venkatesha Prasad (Delft University of Technology, The Netherlands); Sujay Narayana (TU Delft, The Netherlands)

[O2A-3] Study on the Network Architectures for Message Ferry Networks with Multiple UAVs
Mehdi Harounabadi (Ilmenau University of Technology, Germany); Martin Bocksberger (TU Ilmenau, Germany); Andreas Mitschele-Thiel (Ilmenau University of Technology, Germany)

[O2A-4] Dynamic Detection-Tracking Switching
Bruno Andries and Junhyeon Park (Korea Advanced Institute of Science and Technology, Korea); Sung Ju Hwang (KAIST, Korea); Minwoo Kim (Korea Aerospace Research Institute, Korea)

[O2A-5] Performance Analysis of MANET Routing Protocols for UAV Communications
Hassen Redwan Hussen, Sung-Chan Choi, Jong-Hong Park, and Jaeho Kim (Korea Electronics Technology Institute, Korea)

[14:40-16:10, Bravo]
ORAL SESSION 2B
IV2018

Chair: Dong Seog Han (Kyungpook National University)

[O2B-1] Real-time Drowsiness Detection Algorithm for Driver State Monitoring Systems
Jang Woon Baek (ETRI, Korea)

[O2B-2] Radar and Vision Sensor Fusion for Object Detection in Autonomous Vehicle Surroundings
Kim Jihun (Kyungpook National University, Korea); Benaoumeur Senouci (ECE Paris, France); Dong Seog Han (Kyungpook National University, Korea)

[O2B-3] Performances Evaluation study of VANET Communication Technologies for Smart and Autonomous Vehicles
Ben Senouci (ECE Paris, France); Yasser Abdelaziz Dahou Djilali and Yassine Bakhti (Telecommunication and Information Technology Institute, Algeria); Belkacem Kouninef (Laboratoire LaRATIC, INTTIC of Oran Algeria, Algeria)

[O2B-4] Vehicular Acceleration Advisory Algorithm Using V2V Communication in Highway Junction Point
Kwang-Wook Yun, Hyeong-Geon Kim, Joonho Kwon, Han-You Jeong, and Yoon-Ho Choi (Pusan National University, Korea)

[O2B-5] Vehicle Color Recognition via Representative Color Region Extraction and Convolutional Neural Network
Kwang-Ju Kim and Pyong-Kun Kim (ETRI, Korea); Kil-Taek Lim (Electronics and Telecommunications Research Institute, Korea); Yun-Su Chung (Electronics and Telecommunication Research Institute, Korea); Yun-Jeong Song and Soo In Lee (Electronics and Telecommunications Research Institute, Korea); Doo-Hyun Choi (Kyungpook national university, Korea)

[16:30-18:00, Aplaus]
ORAL SESSION 3A
Network Systems

Chair: Hyunggon Park (Ewha Womans University)

[O3A-1] Fuzzy Logic Based Network Selection in Hybrid OCC/Li-Fi Communication System
Moh Khalid Hasan, MD Shahjalal, Mostafa Zaman Chowdhury, Md. Tanvir Hossan, and Yeong Min Jang (Kookmin University, Korea)

[O3A-2] Error Mitigation in Optical Camera Communication Based Indoor Positioning System
MD Shahjalal, Moh Khalid Hasan, Md. Tanvir Hossan, Mostafa Zaman Chowdhury, and Yeong Min Jang (Kookmin University, Korea)

[O3A-3] Enhanced Failure Recovery Mechanism Using OpenState Pipeline in SDN
Abdullah Soliman Alshra'a (Technische Universität Ilmenau, Germany); Parag Sewalkar and Jochen Seitz (Technische Universitaet Ilmenau, Germany)

[O3A-4] Integration of Multiple IP Domains in Low-cost and Security-oriented Small Networks
Satoshi Kodama and Rei Nakagawa (Tokyo University of Science, Japan)

[O3A-5] OCC Protocol for Connected LEDs in Optical Camera Communication Networks
Thanh Luan Vu, Minh Duc Thieu, Van Thang Nguyen, and Yeong Min Jang (Kookmin University, Korea)

[16:30-18:00, Bravo]
ORAL SESSION 3B
Quality of Service

Chair: Seokjoo Shin (Chosun University)

[O3B-1] Leveraging OTT and ISP Cooperation to Enhance End to End QoS by Exchanging Valuable Resources
Michele Scarlato (University of Cagliari, Italy); Jordi Ortiz (University of Murcia, Spain); Cristian Perra (University of Cagliari, Italy); Antonio Fernando Skarmeta Gomez (University of Murcia, Spain)

[O3B-2] An Implementation of Binary Frequency Shift On-Off Keying Modulation for Optical Camera Communication
Van Thang Nguyen, Nam Tuan Le, Thanh Luan Vu, Minh Duc Thieu, and Yeong Min Jang (Kookmin University, Korea)

[O3B-3] Towards Application-Aware Networking: ML-based End-to-End Application KPI/QoE Metrics Characterization in SDN
Hamed Z Jahromi, Andrew Hines, and Declan T. Delaney (University College Dublin, Ireland)

[O3B-4] New Waveforms for Selective-RoI-Signaling High-rate Optical Camera Communication System
Minh Duc Thieu (Kookmin University, Korea); Trang Nguyen (Kookmin University, Korea); Thanh Luan Vu, Van Thang Nguyen, and Yeong Min Jang (Kookmin University, Korea)

[O3B-5] Adaptive ONU Energy-Saving via Software-Defined Mechanisms in TDMA-PON
Andrew Fernando Pakpahan (Yuan Ze University, Taiwan); I-Shyan Hwang (Yuan-Ze University, Taiwan)

July 4, 2018 (Wednesday)

[09:20-10:50, Aplaus]

ORAL SESSION 4A
Future Internet and Network

Chair: Kaewon Choi (SKKU)

[O4A-1] Cooperative Spectrum Sensing Algorithm Based on Phase Compensation in Cognitive Cloud Networks
Li Wang, Xiaoxiao Wu, Shibing Zhang, Guodong Zhang, and Zhihua Bao (Nantong University, P.R. China)

[O4A-2] User-Driven Smart Home Control System Based on Named Data Networking
Manxin Huang, Ru Li, Jun Fan, and Xin Zhang (Inner Mongolia University, P.R. China)

[O4A-3] Path Provisioning for Fibbing Controlled Load Balanced IP Networks
Saeed Barkabi Zanjani, Kuang-Yi Li, Steven S. W. Lee, and Yuan-Sun Chu (National Chung Cheng University, Taiwan)

[O4A-4] A Cache Replacement Strategy Based on Hierarchical Popularity in NDN
YingQi Li, Meiju Yu, and Ru Li (Inner Mongolia University, P.R. China)

[O4A-5] Fair and Efficient Channel Observation-Based Listen-Before Talk (CoLBT) for LAA-WiFi Coexistence in Unlicensed LTE
Rashid Ali (WIN LAB., Yeungnam University & WINLab, Korea); Nurullah Shahin and Arslan Musaddiq (Yeungnam University, Korea); Byung-Seo Kim (Hongik University, Korea); Sung Won Kim (Yeungnam University, Korea)

[09:20-10:50, Bravo]

ORAL SESSION 4B
SDN and Network Virtualization

Chair: Takeo Fujii (The University of Electro-Communications)

[O4B-1] Distributed NFV Orchestration in a WMN-based Disaster Network
Gregor Frick, Auberlin Paguem Tchinda, Ulrich Trick, and Armin Lehmann (Frankfurt University of Applied Sciences, Germany); Bogdan Ghita (Plymouth University, United Kingdom (Great Britain))

[O4B-2] Relay-Based iBGP Multicasting in Software Defined Networks
Ukemeobong Bassey (University of Ottawa, Canada); Amiya Nayak (SITE, University of Ottawa, Canada)

[O4B-3] MACsec Extension over Software-Defined Networks for In-Vehicle Secure Communication
Ju-Ho Choi and Sung-Gi Min (Korea University, Korea); Youn-Hee Han (Korea University of Technology and Education, Korea)

[O4B-4] Design of an SDN Security Mechanism to Detect Malicious Activities
Christopher Mansour and Danai Chasaki (Villanova University, USA)

[O4B-5] An Efficient Label-Based Packet Forwarding Scheme in Software Defined Networks
Yeim-Kuan Chang, Yi-Tsung Huang, and Yu-To Chen (National Cheng Kung University, Taiwan)

[09:20-10:50, Ceremonie]

ORAL SESSION 4C
Machine Learning and Computational Intelligence

Chair: Benaoumeur Senouci (ECE Paris)

[O4C-1] Development of a Hybrid Decision-Making Method Based on a Simulation-Genetic Algorithm in a Web-Oriented Metallurgical Enterprise Information System
Konstantin Aksyonov and Anna Antonova (Ural Federal University, Russia)

[O4C-2] Non Keyword-Based Music Retrieval Using Social Tags
Chang Bae Moon, Jong Yeol Lee, Dong-Seong Kim, and Byeong Man Kim (Kumoh National Institute of Technology, Korea)

[O4C-3] Automatic Sleep Stage Classification Using EEG and EMG Signal
Hyungjik Kim and Sunwoong Choi (Kookmin University, Korea)

[O4C-4] C4.5 Decision Tree Machine Learning Algorithm Based GIS Route Identification
Anurag Yadav (CDOT, India); Pankaj Kumar Dalela, Prashant Bansal, Vipin Tyagi, and Arun Yadav (C-DOT, India); Sabyasachi Majumdar (Research Engineer, India)

[O4C-5] UAV Detection Using the Cepstral Feature with Logistic Regression
Yoojeong Seo, Beomhui Jang, Jangwon Jung, and Sungbin Im (Soongsil University, Korea)

ORAL SESSION 5A
Smart Grid and Green Internets

Chair: Soo-Hyun Park (Kookmin University)

[O5A-1] Routing Redundancy Reducing Method for U-Bus Air Using Cloud Cooperation
Hiroshi Sanada (The University of Electro-Communications, Japan); Takuya Kawata (Tokyo Gas, Japan); Reina Aizawa (Tokyo Gas Co., Ltd, Japan); Takeo Fujii (The University of Electro-Communications, Japan)

[O5A-2] Modeling of Management System for Hydroelectric Power Generation from Water Flow
Kwang-Soon Choi and Ji-Woon Yeom (Korea Electronics Technology Institute, Korea)

[O5A-3] Path Similarity Based Spurious Retransmission Minimization over Flooding Based Routing in UWSN
Yeongjoon Bae, Sungwon Lee, Yonghwan Jeong, and Dongkyun Kim (Kyungpook National University, Korea)

[O5A-4] Design and Development of a WAVE Simulator Interoperable with Traffic Simulators
Won Hwa Lee, Tae Hoon Kwon, Minjin Baek, and Sang-Sun Lee (Hanyang University, Korea)

ORAL SESSION 5B
Internet of Things (IoT) - I

Chair: Amiya Nayak (University of Ottawa)

[O5B-1] Design and Evaluation of a Hybrid D2D Discovery Mechanism in 5G Cellular Networks
Mingfu Li and Hsin-Ling Tsai (Chang Gung University, Taiwan)

[O5B-2] Reduction Scheme for Sensor-Data Transmission on a Big Data Streaming Platform
Sheng-Tzong Cheng and Yi-Wei Huang (National Cheng Kung University, Taiwan)

[O5B-3] Trust-based Composition of M2M Application Services
Besfort Shala, Ulrich Trick and Armin Lehmann (Frankfurt University of Applied Sciences, Germany); Bogdan Ghita and Stavros Shiaeles (Plymouth University, United Kingdom (Great Britain))

[O5B-4] Topic Based Clustering of Vehicles for Information Retrieval and Sharing
Lijun Dong (Huawei, USA); Richard Li (Huawei USA, USA)

[O5B-5] Improving Physical Layer Security of NOMA Networks by Using Opportunistic Scheduling
Kyusung Shim (Hongik University, Korea); Tri Nhu Do (Hongik University, Sejong Campus, Korea); Beongku An (Hongik University, Korea)

ORAL SESSION 5C
Wireless and Communication Network-I

Chair: Stefano Tomasin (University of Padova)

[O5C-1] Tunnel-Based EAP Effective Security Attacks-WPA2 Enterprise Evaluation and Proposed Amendments
Mohamed A. Abo-Soliman (Nile University, Egypt); Marianne A. Azer (National Telecommunication Institute + Nile University, Egypt)

[O5C-2] Information and Energy Cooperation in Overlay Hierarchical Cognitive Radio Networks
Kun-Yueh Hsieh and Fan-Shuo Tseng (National Sun Yat-sen University, Taiwan); Meng-Lin Ku (National Central University, Taiwan); Chao-Yuan Hsu (Chunghwa Telecom Co., Ltd)

[O5C-3] Construction of Frequency-Hopping System Using RF Communications Trainer
Eisuke Kudoh, Hiroya Fujisawa, and Kohya Satoh (Tohoku Institute of Technology, Japan)

[O5C-4] Robust Spectrum Sensing Based on Hyperbolic Tangent in Gaussian and Non-Gaussian Noise Environments
Hua Qu, Xiguang Xu, Jihong Zhao, Feiyu Yan, and Weihua Wang (Xi'an Jiaotong University, P.R. China)

[O5C-5] Relay Position Considering Interference from Other Sub-Channels in D2D Group-casting Systems
Eulhyeon Go, Soyi Kim, Minjoong Rim, Junghwan Kim, and Yoonseok Song (Dongguk University, Korea)

ORAL SESSION 6A
Network Security and Management-I

Chair: Sunwoong Choi (Kookmin University)

[O6A-1] An Ahead-of-Time Compiler System for the IoT-Cloud Virtual Machine
Juho Jeong (Electronic Commerce Institute, Dongguk University Gyeongju Campus, Korea); Yunsik Son (Dongguk University, Korea); YangSun Lee (Seokyeong University, Korea)

[O6A-2] False Secret Keys to Disturb Power Analysis
Seungkwang Lee and Taesung Kim (ETRI, Korea)

[O6A-3] A Comparative Study of Off-Line Deep Learning Based Network Intrusion Detection
Jiaqi Yan and Dong Jin (Illinois Institute of Technology, USA); Cheol Won Lee (National Security Research Institute, Korea); Ping Liu (Illinois Institute of Technology, USA)

[O6A-4] Memory-Efficient Random Forest Generation Method for Network Intrusion Detection
Seok-Hwan Choi, DongHyun Ko, SeonJin Hwang, and Yoon-Ho Choi (Pusan National University, Korea)

[O6A-5] Blockchain Based Billing System for Electric Vehicle and Charging Station
Seohyeon Jeong, Nhu-Ngoc Dao, Yunseong Lee, Cheol Lee, and Sungrae Cho (Chung-Ang University, Korea)

[15:50-17:20, Bravo]
ORAL SESSION 6B
Internet of Things (IoT) - II

Chair: Gongchao Su (Shenzhen University)

[O6B-1] An Improved Mobility Support Mechanism for Downward Traffic in RPL
Soon-Woong Min, Sang-Hwa Chung, and Yu-Vin Ha (Pusan National University, Korea)

[O6B-2] Performance Evaluation of Centralized and Distributed Control Methods for Efficient Registration of Massive IoT Devices
Nurullah Shahin (Yeungnam University, Korea); Rashid Ali (WIN LAB., Yeungnam University & WINLab, Korea); Seung Yeob Nam and Young-Tak Kim (Yeungnam University, Korea)

[O6B-3] Fuzzy Energy Efficient Routing for Internet of Things (IoT)
Babar Shah (Zayed University, United Arab Emirates)

[O6B-4] High-level Architectural Design of Management System for the Internet of Underwater Things
Khamdamboy Urunov, Soo-Young Shin, Jung-Il Namgung, and Soo-Hyun Park (Kookmin University, Korea)

[15:50-17:20, Ceremonie]
ORAL SESSION 6C
Wireless and Communication Network-II

Chair: Eisuke Kudoh (Tohoku Institute of Technology)

[O6C-1] An Efficient Backoff Scheme in Wireless Sensor Networks
Batbayar Khandish and Eunsik Lee (Yonsei University, Wonju, Korea); Hyun Park (Yonsei University, Korea); Jung-Bong Suk (Yonsei University, Wonju, Korea)

[O6C-2] A Study on the Effect of Moving Small Cell in Heterogeneous Networks with Interference Cancellation
Inseok Kang, Sarang Han, and Cheolwoo You (MyongJi University, Korea)

[O6C-3] A Machine-Learning-Based Handover Prediction for Anticipatory Techniques in Wi-Fi Networks
Stefano Tomasin and Mauro Feltrin (University of Padova, Italy)

[O6C-4] Optimization-Based Resource Management Strategies for 5G C-RAN Slicing Capabilities
Frank Yeong-Sung Lin and Chiu-Han Hsiao (National Taiwan University, Taiwan); Yean-Fu Wen (National Taipei University, Taiwan); Ya-Syuan Wu (National Taiwan University, Taiwan)

[O6C-5] User Detection Performance Analysis for Grant-Free Uplink Transmission in Large-Scale Antenna Systems
Jonghyun Kim, Kyung Lin Ryu, and Kwang Soon Kim (Yonsei University, Korea)

[O6C-6] Detectors for Intent ICC Security Vulnerability with Android IDE
Xianyong Meng and Kai Qian (Kennesaw State University, USA); Prabir Bhattachrya (Morgan State University, USA); Dan Chia-Tien Lo (Kennesaw State University, USA)

July 5, 2018 (Thursday)

[09:20-10:50, Aplaus]
ORAL SESSION 7
Wireless and Communication Network-III

Chair: Hiroyuki Otsuka (Kogakuin University)

[O7-1] Multichannel-Sniffing-System for Real-World Analysing of Wi-Fi-Packets
Kristof Friess (Erfurt University of Applied Sciences, Germany)

[O7-2] AL-FEC Application on NGMN-Edge Computing Integrated Systems
Christos Bouras (University of Patras CTI&P-Diophantus & University of Patras, Greece); Nikolaos Kanakis (University of Patras, Greece)

[O7-3] Beamformer Design and Power Allocation for Two-Cluster Two-User NOMA System
Carlo Piccoli and Stefano Tomasin (University of Padova, Italy); Eduard Jorswieck (TU Dresden, Germany)

[O7-4] Joint User Association and RRH Clustering in Cloud Radio Access Networks
Hussein Taleb (ESIB, Saint-Joseph University, Lebanon); Melhem El Helou (Saint Joseph University of Beirut, Lebanon); Kinda Khawam (Université de Versailles, France); Samer Lahoud (ESIB, Saint-Joseph University of Beirut, Lebanon); Steven Martin (Paris-Sud University, France)

[O7-5] Pseudo-Random Beamforming with Beam Selection for Improving Physical-Layer Security
Woong Son, Bang Chul Jung, and Choul-Young Kim (Chungnam National University, Korea); Jongmin Kim (KAIST, Korea)

[O7-6] Downlink Multiuser Superposition Using QPSK and 256-QAM in Mobile Communication Systems
Koki Senda and Hiroyuki Otsuka (Kogakuin University, Japan)

[11:10-12:40, Aplaus]
ORAL SESSION 8
Cloud Computing and Networks

Chair: Sanghwan Lee (Kookmin University)

[O8-1] Cloud-based Microservices to Decision Support
Konstantin Aksyonov, Andrew Kondratyev, Natalia Buravova, and Olga Aksyonova (Ural Federal University, Russia)

[O8-2]   Monitoring of IoT Data for Reducing Network Traffic
Jeongjin Lee, Gunjae Yoon, and Hoon Choi (Chungnam National University, Korea)

[O8-3]   Selective Encryption for 3D Printing Model in DCT Domain
Giao Ngoc Pham, Jin-Hyeok Park, Oh-Heum Kwon, and Ha-Joo Song (Pukyong National University, Korea); Suk-Hwan Lee (TongMyong University, Korea); Kwang-Seok Moon (Pukyong National University, Korea); Yeong-Rak Choi (Social Network Communication, Korea); Seok Tae Kim and Ki-Ryong Kwon (Pukyong National University, Korea)

[O8-4]   Multi-Objective Mixed Integer Linear Programming Model for VM Placement to Minimize Resource Wastage in a Heterogeneous Cloud Provider Data Center
Rym Regaieg, Mohamed Koubaa, Evans Osei-Opoku, and Taoufik Aguili (Université Tunis El Manar - Ecole Nationale d'Ingénieurs de Tunis - Laboratoire SYStèmes de COMmunications)

[O8-5]   Appliance Type Constraint Design for Demand Response Smart Grid Systems
Yongwoon Jang, Laihyuk Park, Woongsoo Na, Chunghyun Lee, and Sungrae Cho (Chung-Ang University, Korea)

[O8-6]   Cloud Assisted Overlay Routing
Suat Mercan (American University of the Middle East, Kuwait)

[14:00-15:30, Aplaus]
ORAL SESSION 9
Wireless Sensor Networks-I

Chair: Mohammad Al Mojamed (UMM AL-QURA University)

[O9-1]   Joint Clustering and Routing Protocol for 3-D Underwater Acoustic Sensor Network
Sarang Dhongdi, Aashray Bhandari, Jayati Singh, Spandan Kachhadia, and Varad Joshi (BITS Pilani K K Birla Goa Campus, India)

[O9-2]   Novel Query Tree Algorithm Based on Reservation and Time-Divided Responses to Support Efficient Anti-Collision Protocol
Ji-Hwan Choi (Samsung Electronics, Korea); Hyuckjae Lee (Information and Communications University, Korea)

[O9-3]   Enhancements of IEEE802.15.4e DSME Model of Wireless Sensor Networks
Sameer K. Alsudany, Said Boussakta, and Martin Johnston (Newcastle University, United Kingdom (Great Britain))

[O9-4]   Performance Analysis of Hybrid-based Packet Forwarding in Wireless Sensor Networks
Irvanda Kurniadi Virdaus, Moonsoo Kang, and Chung Ghiu Lee (Chosun University, Korea)

[O9-5]   To Improve the Convergence and Parallelism of Gauss-Seidel Routing Algorithm with Finite Element Method for Wireless Sensor Networks
Ren-Song Ko (National Chung Cheng University, Taiwan)

[O9-6]   Research of optimal structure for autonomous earth-moving and construction machines' communication system
Tatyana Golubeva, Bahodir Yakubov, and Sergey Konshin (Almaty University of Power Engineering and Telecommunications, Kazakhstan); Boris Tshukin, Sergey Leshchev, and Natalia Mironova (National Research Nuclear University MEPhI, Russia)

[16:00-17:30, Aplaus]
ORAL SESSION 10
Network Applications

Chair: Ren-Song Ko (National Chung Cheng University)

[O10-1]   Performance Evaluation of Community Detection Algorithms Based on Relationship Strength Measurement
Soom Behera and Haoye Lu (University of Ottawa, Canada); Amiya Nayak (SITE, University of Ottawa, Canada)

[O10-2]   Mobility Robustness Optimization Based on Radio Link Failure Prediction
Yi-Wei Ma (Shanghai Maritime University, P.R. China); Jiann-Liang Chen (National Taiwan University of Science and Technology, Taiwan); Hao-Kai Lin (National Taiwan University of Science & Technology, Taiwan)

[O10-3]   Performance Evaluation of Kademlia in Mobile Ad Hoc Networks
Mohammad Al Mojamed (UMM AL-QURA University, Saudi Arabia); Awwadh Al-shehri (Technical and Vocational Training Corporation, Saudi Arabia)

[O10-4]   A Sequential Auction Game for QoS-aware User Association in Heterogeneous Cellular Networks
Gongchao Su (Faculty of Information Engineering, Shenzhen University, P.R. China)

[O10-5]   A Novel Approach to Make Presentation Using Powerpoint Without Projector in Local Area Network
Daniel Silli Bataona (State Polytechnic of Kupang, Indonesia); Rinaldi Munir (Bandung Institute of Technology, Indonesia); Tutun Juhana (Institut Teknologi Bandung, Indonesia); Gloria Christiana Manulangga and Jemsrado Sine (State Polytechnic of Kupang, Indonesia)

[O10-6]   Analysis of Call Detail Records of International Voice Traffic in Mobile Networks
Zagroz Aziz (Czech Technical University, Czech Republic); Robert Bestak (Czech Technical University in Prague, Czech Republic)

July 6, 2018 (Friday)

[09:20-10:50, Aplaus]

ORAL SESSION 11A
Network Security and Management-II

Chair: Qinghua Wang (Kristianstad University)

[O11A-1] SigPloit: A New Signaling Exploitation Framework
Loay Abdelrazek (Nile University, Egypt); Marianne Azer (National Telecommunication Institute + Nile University, Egypt)

[O11A-2] Adaptive Broadcast Routing Assignment Algorithm for Blockchain Synchronization Services
Frank Yeong-Sung Lin and Chiu-Han Hsiao (National Taiwan University, Taiwan); Yean-Fu Wen (National Taipei University, Taiwan); Yang-Che Su (National Taiwan University, Taiwan)

[O11A-3] Session Key Agreement for End-to-End Security in Time-Synchronized Networks
Qinghua Wang (Kristianstad University SWEDEN, Sweden); Xin Huang (Xi'an Jiaotong-Liverpool University, P.R. China); Dawit Mengistu (Kristianstad University, Sweden)

[O11A-4] Synchronization of Complex Dynamical Networks with Randomly Coupling via Nonfragile Control
Fehrs Adu-Gyamfi (University of Electronic Science and Technology of China, P.R. China); Yuhua Cheng and Chun Yin (University of Electronic Science and Technology of China & School of Automation Engineering, P.R. China); Shouming Zhong (University of Electronic and Technology of China, P.R. China)

[09:20-10:50, Bravo]

ORAL SESSION 11B
Wireless and Communication Network-IV

Chair: Huang-Chang Lee (Chang Gung University)

[O11B-1] Machine Learning Based Link-to-System Mapping for System-Level Simulation of Cellular Networks
Eunmi Chu, Hyuk Ju Jang, and Bang Chul Jung (Chungnam National University, Korea)

[O11B-2] Impact of SC-FDMA and Pilots on PAPR and Performance of Power Domain NOMA-UFMC System
Ajit Singh (Defence Institute of Advanced Technology Pune, India); K. Krishna Naik (Defence Institute of Advanced Technology, India); C.R.Suthikshn Kumar (DIAT, India)

[O11B-3] Low Complexity Polar Code Decoder for HARQ Application
Huang-Chang Lee (Chang Gung University, Taiwan); Guan-Chun Liao (Chang Gung University, Taoyuan, Taiwan)

[O11B-4] Research on Polar Code Construction Algorithms Under Gaussian Channel
Jianping Li, Man Hu, and Zhiyuan Cheng (Communication University of China, P.R. China)

[O11B-5] Multipath Selection Method for Maximum Ratio Combining in Underwater Acoustic Channels
Hojun Lee (Inha University, Korea); Jongmin An (University of Inha, Korea); Jongpil Seo and Jeahak Chung (Inha University, Korea)

[09:20-10:50, Ceremonie]

ORAL SESSION 11C
Wireless Sensor Networks-II

Chair: Sarang Dhongdi (BITS Pilani K K Birla Goa Campus)

[O11C-1] A Magnetic Field Detection and Localization Scheme for Internet of Underwater Things
Kwang-Yul Kim and Yoan Shin (Soongsil University, Korea)

[O11C-2] Localization of Submerged Sensors with a Single Beacon for Non-Parallel Planes State
Anisur Rahman and Vallipuram Muthukkumarasamy (Griffith University, Australia)

[O11C-3] A Multi-node Rechargeable Algorithm via Wireless Charging Vehicle with Optimal Traveling Path in Wireless Rechargeable Sensor Networks
Fan Zhang (Hohai University, P.R. China); Jie Zhang (HoHai University, P.R. China); Yujie Qian (Hohai University, P.R. China)

[O11C-4] A Probabilistic Model of File Transfer Time Based on Markov Chain in Vehicular Ad Hoc Networks
Xinyu Wu, Meiju Yu, and Ru Li (Inner Mongolia University, P.R. China)

[O11C-5] Inductive Coupling Characteristics of Nano-crystalline Alloy for Electric Vehicle PLC
Kyung-Rak Sohn (Korea Maritime and Ocean University, Korea)

July 5, 2018 (Thursday)

[09:20-10:50, Conference Foyer]

Poster Session 1

[P1-1] Hello-Message Transmission-Power Control for Network Self-Recovery in FANETs
Geon-Hwan Kim, Imtiaz Mahmud, and You-Ze Cho (Kyungpook National University, Korea)

[P1-2] Throughput Analysis of Dynamic Multi-Hop Network Under High Traffic Load
Yusuke Sunada (The University of Electro-Communications & Advanced Wireless & Communication Research Center, Japan); Koichi Adachi (The University of Electro-Communications, Japan); Yasushi Yamao (The University of Electro-Communications, Japan)

[P1-3] Design of Integrated LDM Information for Intersection Safety
Shin-kyung Lee (Etri, Korea); Jeong-woo Lee and Hyun-seo Oh (ETRI, Korea)

[P1-4] Performance Analysis of WAVE Communication for Emergency Broadcasting in Metro Environments
Seong Keun Jin, Soo Hyun Jang, Dae Kyo Shin, Sang Hun Yoon, and Han Gyun Jung (Korea Electronics Technology Institute, Korea)

[P1-5] A Quality Selection Mechanism Using a Deep Q-Network for Seamless Video Streaming Services
Iseul Kim, Seongjun Hong, Sungwook Jung, and Kyungshik Lim (Kyungpook National University, Korea)

[P1-6] Indoor Localization Using Digital Auto Zoom of a Smart-phone Camera and Integrated Sensors
Yoonsung Chae, Duy Thong Nguyen, Sangcheol Park, and Youngil Park (Kookmin University, Korea)

[P1-7] A Hybrid Optical Wireless System for Simultaneous Service of VLC and OCC
Duy Thong Nguyen, Yoonsung Chae, Sangcheol Park, and Youngil Park (Kookmin University, Korea)

[P1-8] Performance Improvement of Optical Satellite Communications by Interleaved IEEE 802.11 LDPC
Duy Thong Nguyen and Youngil Park (Kookmin University, Korea)

[P1-9] Delay Analysis of Fixed Multi-Thread Algorithm for DBA in Long Reach PON
Nguyen Khac Binh, Byeong-ho Kang, and Su-il Choi (Chonnam National University, Korea)

[P1-10] Diversity-Controlled Multi-User Superposition Transmission for Uplink Cellular Networks
Jeong Seon Yeom (Chungnam National University, Korea); Han Seung Jang (Korea Advanced Institute of Science and Technology, Korea); Bang Chul Jung (Chungnam National University, Korea)

[P1-11] Validation of MPTCP Performance Enhancement Algorithm in Real PS-LTE Environment
Byunggoo Lee (Yonsei University, Korea); Seungbeom Song (Yonsei University & Electrical & Electronic Engineering, Korea); Seok Ryu and Jaiyong Lee (Yonsei University, Korea)

[P1-12] Low Complexity Beam Searching Algorithm Using Asymptotic Property of Massive MIMO Systems
Heeyoung Kim and Jaemin Jung (University of Yonsei, Korea); Seongbae Han (Yonsei University, Korea); Seokki Kim and Seungkwon Baek (ETRI, Korea); Sooyong Choi (Yonsei University, Korea)

[P1-13] Support for Edge Computing in the 5G Network
Young-il Choi and Noik Park (ETRI, Korea)

[P1-14] A Physical Layer Security-based Transmit Antenna Selection Scheme for NOMA Systems
Kyusung Shim and HyukChun Oh (Hongik University, Korea); Tri Nhu Do (Hongik University, Sejong Campus, Korea); Beongku An (Hongik University, Korea)

[P1-15] Narrow-Band Interference Removing Filter for Mobile Communication Systems
Hoon Kang and Jong-Seon No (Seoul National University, Korea)

[P1-16] Achievable Rate Evaluation by System Level Simulation for mmWave Based Backhaul Network Adopting In-Band Full-Duplex
Seongbae Han (Yonsei University, Korea); Jaemin Jung and Heeyoung Kim (University of Yonsei, Korea); Seokki Kim and Seungkwon Baek (ETRI, Korea); Sooyong Choi (Yonsei University, Korea)

[P1-17] Study on the Effect of LTE on the Coexistence of NB-IoT
JungHoon Oh and Hoyoung Song (ETRI, Korea)

[P1-18] Uplink Scheduling Technique for the LTE System to Improve the Performance of the NB-IoT System
Hyungjin Kim, Seongchul Cho, Junghoon Oh, and Gweondo Jo (ETRI, Korea)

[P1-19] Determination of Optimum Threshold Values for NPRACH Preamble Detection in NB-IoT System
Seongchul Cho, Hyungjin Kim, and Gweondo Jo (ETRI, Korea)

[P1-20] EGE: A New Energy-Aware GPU Based Erasure Coding Scheduler for Cloud Storage Systems
Mehdi Pirahandeh and Deok-Hwan Kim (Inha University, Korea)

[P1-21] User Space Customized Recommendation Service Platform System in Mobile Edge Environment
Eungha Kim (ETRI, Korea)

[P1-22] Efficient Slice Allocation for Novel 5G Services
Min Kyung Lee and Choong Seon Hong (Kyung Hee University, Korea)

[P1-23] A Study on D2D Caching Systems with Mobile Helpers
Soyi Kim, Eulhyeon Go, YoonSeok Song, HyungJoon Cho, and Minjoong Rim (Dongguk University, Korea); Chung G. Kang (Korea University, Korea)

[P1-24] Threshold Secret Sharing Transmission Against Passive Eavesdropping in MIMO Wireless Network
Jungho Myung (Electronics and Telecommunications Research Institute, Korea); Taehong Kim (Chungbuk National University, Korea)

[P1-25] Performance Test of LTE-R Railway Wireless Communication at High-Speed (350 km/h) Environments
Sung-Hun Lee (Kwangwoon University, Korea); Mahn-suk Yoon, Chang-Kyo Lee, Soo-Hyun Cho, and Wan-jin Ko (Gumi Electronics and Information Technology Research Institute, Korea)

[11:10-12:40, Conference Foyer]
Poster Session 2

[P2-1] Mobility Modeling and Analysis in Mobile Communication Networks
Hee-Seon Jang (Pyeongtaek University, Korea)

[P2-2] Efficient Data Delivery Protocol Using Vehicle Mobility Information in VANETs
Yongje Shin, Hyun-seok Choi, Youngju Nam, and Euisin Lee (Chungbuk National University, Korea)

[P2-3] Efficient Deployment of Service Function Chains (SFCs) in a Self-Organizing SDN-NFV Networking Architecture to Support IOT
Kwang-Man Ko (Sangji University, Korea); Ali Mohammed Mansoor (Universiti Malaya & Computer Science and IT, Malaysia); Rodina Ahmad (Universiti Malaya, Malaysia); Soon-Gohn Kim (Joongbu University, Korea)

[P2-4] Reservation-Based Cooperative Intersection Crossing Scheme for Autonomous Driving in the Intersection
Myungwhan Choi and Areeya Rubenecia (Sogang University, Korea); Hyo Hyun Choi (Inha Technical College, Korea)

[P2-5] Maximal Ratio Combining for Long-Range Underwater Acoustic Communication in East Sea
Hyeonsu Kim, Sunhyo Kim, Kang-Hoon Choi, and Jee Woong Choi (Hanyang University, Korea); Ho seuk Bae (Agency for Defense Development, Korea)

[P2-6] Underwater Acoustic Communication Using Vector Sensor in KOREX-17
Sunhyo Kim, Hyeonsu Kim, Kang-Hoon Choi, and Jee Woong Choi (Hanyang University, Korea); Su-Uk Son (Agency for Defense Development, Korea)

[P2-7] Investigating Influence of North Korea Threat Events on Attractiveness of South Korea for Foreign Visitors through Big Data Analysis
Kyung Jin Cha, Elizaveta Srednik, and Hwa Jong Kim (Kangwon National University, Korea)

[P2-8] NFV-Based Mobile Edge Computing for Lowering Latency of 4K Video Streaming
Linh Van Ma (Chonnam National University, Korea); Van Quan Nguyen (Chonnam National University & SMMC Lab, Korea); Jaehyung Park and Jinsul Kim (Chonnam National University, Korea)

[P2-9] Semantic Ontology-based NFV Service Modeling
Sang il Kim (KwangWoon University, Korea); Hwa Sung Kim (Kwangwoon University, Korea)

[P2-10] Viewport Prediction Method of 360 VR Video Using Sound Localization Information
Eunyoung Jeong, Dongho You, Changjong Hyun, Bong-Seok Seo, Namtae Kim, Dong Ho Kim, and Ye Hoon Lee (Seoul National University of Technology, Korea)

[P2-11] MPEG-DASH MPD for Tile-based Hybrid Stereoscopic 360-Degree Video Streaming
Dongho You, Eunyoung Jeong, and Dong Ho Kim (Seoul National University of Science and Technology, Korea)

[P2-12] LED Color Detection of Visual-MIMO System Using Boosting Neural Network Algorithm
Partha Pratim Banik, Rappy Saha, Tae-Ho Kwon, and Ki-Doo Kim (Kookmin University, Korea)

[P2-13] An Effective Classification for DoS Attacks in Wireless Sensor Networks
Thi-Thu-Huong Le, Taehwan Park, Dongkeun Cho, and Howon Kim (Pusan National University, Korea)

[P2-14] DDoS Mitigation: Decentralized CDN Using Private Blockchain
Kyoungmin Kim, Youngin You, Mookyu Park, and Kyungho Lee (Korea University, Korea)

[P2-15] Route Plan Exchange Scheme Based on Block Chain
Doyoung Chung and Hae Sook Jeon (ETRI, Korea)

[P2-16] Authentication Protocol for Wearable Devices Using Mobile Authentication Proxy
Doo-Hee Hwang, Jin-Myeong Shin, and Yoon-Ho Choi (Pusan National University, Korea)

[P2-17] Parallel Implementation of Simeck Family Block Cipher by Using ARM NEON
Taehwan Park (Pusan National University, Korea); Hwajeong Seo (Hansung University, Korea); Chanhui Park and Howon Kim (Pusan National University, Korea)

[P2-18] Detection And Countermeasures of DDoS Attacks in Cloud Computing
Mahmoud Said Elsayed (Nile University, Egypt); Marianne Azer (National Telecommunication Institute + Nile University, Egypt)

[P2-19] A Low Overhead Feedback Scheme of Channel Covariance Matrix for Massive MIMO Systems
Youngrok Jang, Dongheon Lee, and Sooyong Choi (Yonsei University, Korea)

[P2-20] A Study on the Wi-Fi Radio Signal Attenuation In Various Construction Materials (Obstacles)
Tatyana Golubeva, Yevgeniy Zaitsev, Sergey Konshin, and Inkar Duisenbek (Almaty University of Power Engineering and Telecommunications, Kazakhstan)

[P2-21] A Novel Dimming Approach for Both TRIAC and Wall Switch LED Lighting Systems
Yuan-Ta Hsieh, Chi-Feng Su and Hann-Huei Tsai (National Chip Implementation Center, Taiwan); Ying-Zong Juang (Chip Implementation Center, National Applied Research Laboratories, Taiwan)

[14:00-15:30, Conference Foyer]

Poster Session 3

[P3-1] Hop Count Measurement Between Autonomous Systems Using a Combination of Active and Passive Monitoring
Nematullo Rahmatov, Hyeonwoo Kim, Meryam Essaid, and Hongtaek Ju (Keimyung University, Korea); Wooguil Pak (Keimyung Univ, Korea)

[P3-2] Research on Estimation of Equipment Sizing for Network Deployment
Geunwoo Park, Sohee Jin, Haeng-in Kim, Chan-ju Lee, and Moon-kil Lee (Telecommunications Technology Association, Korea)

[P3-3] Software Defined Radio Controller Using Bluetooth
Hyoseok Yoon, Saet-Byeol Yu, and Se-Ho Park (Korea Electronics Technology Institute, Korea)

[P3-4] Free-viewpoint Relationship Description Based Streaming Systems for Arbitrary View Switching
Seulki Song (KETI, Korea); Yonghwan Kim (Korea Electronics Technology Institute, Korea); Yong-Suk Park (Korea Electronics Technology Institute & Yonsei University, Korea); JungWook Wee (Korea Electronics Technology Institute, Korea)

[P3-5] Encapsulation Methods for Stable Free-viewpoint Video Streaming Service
Minjae Seo and Jong-Ho Paik (Seoul Women's University, Korea)

[P3-6] Initial Beam Selection Scheme Using Channel Correlation Matrix for mmWave Massive MIMO Systems
Jaemin Jung, Heeyoung Kim, Seongbae Han, and Youngrok Jang (Yonsei University, Korea); Seokki Kim and Seungkwon Baek (ETRI, Korea); Sooyong Choi (Yonsei University, Korea)

[P3-7] Research on Pedestrian Detection Based on Faster R-CNN and Hippocampal Neural Network
Biao Hao, Su-Bin Park, and Dae-Seong Kang (Dong-A University, Korea)

[P3-8] Indoor Localization with WiFi Fingerprinting Using Convolutional Neural Network
Jin-Woo Jang and Song-Nam Hong (Ajou University, Korea)

[P3-9] Multi-Source Localization Using Linear DoA Sensor Network
Hyoungsoo Lim and Cheon Sig Sin (ETRI, Korea)

[P3-10] A Study on the Traffic Light Identification and Guidance System for the Elderly Drivers
Myeon-gyun Cho and Zhafri Hariz Roslan (Semyung University, Korea)

[P3-11] Optical Spectrum Estimation Technique for Optical Interference Cancellation in High Speed Transmission MISO-OCVLC Environment
Doohee Han (Kyung Hee University, Korea); Kyujin Lee (Semyung University, Korea)

[P3-12] An Analysis of an RF Link Budget and RSSI Circuit Design for Long-Range Communications
Kyong-Hee Lee (ETRI, Korea)

[P3-13] A Pilot-based Beam-Tracking Technique for OFDM-based Millimeter-Wave Cellular Systems

Yong Soo Cho (Chung-Ang University, Korea); Yeong Jun Kim (LG Electronics, Korea)

[P3-14] Optimization of CHAM Encryption Algorithm Based on Javascript
Chanhui Park and Taehwan Park (Pusan National University, Korea); Hwajeong Seo (Hansung University, Korea); Howon Kim (Pusan National University, Korea)

[P3-15] Service Mediation Gateway for Heterogenous IoT Services Harmonization
Seung Woo Kum and Jaewon Moon (Korea Electronics Technology Institute, Korea)

[P3-16] An Efficient WOLA Structured OQAM-FBMC Transceiver
Jae Hoon Park and Won Choel Lee (Soongsil University, Korea)

[P3-17] Compatibility of Heterogeneous Devices Based on 2.5G Base-T
So-Ki Jung (aSSIST & SKbroadband Company, Korea)

[P3-18] A Feature Based Content Analysis of Blockchain Platforms
Suntae Kim (Chonbuk National University, Korea); Sooyong Park (Sogang University, Korea); YoungBeom Park (Dankook University, Korea); JeongAh Kim (Catholic Kwandong University, Korea); Young-Hwa Cho and Jae-young Choi (Sungkyunkwan University, Korea); Chin-Chol Kim (NIA(National Information Society Agency), Korea)

[P3-19] A Parallel Artificial Neural Network Learning Scheme Based on Radio Wave Fingerprint for Indoor Localization
Yong-Hoon Choi and Chan Uk Park (Kwangwoon University, Korea)

[P3-20] Integration of Contourlet Transform and Canny Edge Detector for Brain Image Segmentation
Lata Ayesha Akter and Goo-Rak Kwon (Chosun University, Korea)

[P3-21] Color Medical Image Encryption Using Two-dimensional Chaotic Map and C-MLCA
Hyun-soo Jeong, Sung-jin Cho, Kyu-Chil Park, and Seok-tae Kim (Pukyong National University, Korea)

[P3-22] Throughput Improvement by Using Dynamic Channel Selection in 2.4 GHz Band of IEEE 802.11 WLAN
Kavita Mathur, Diganta Jena, Sandeep Agrawal, Suja Baburaj, Sridhar Kondabathini, and Vipin Tyagi (Centre For Development of Telematics, India)

[P3-23] Study on an Energy-IoT Service Platform for Energy Saving in Legacy Manufacturing Site
Hyo-Sub Choi and Kyeo-Rae Yeom (KETI(Korea Electronics Technology Institute), Korea)

[P3-24] Prediction of Manufacturing Plant's Electric Power Using Machine Learning
Kyeo-Rae Yeom and Hyo-Sub Choi (KETI(Korea Electronics Technology Institute), Korea)

[P3-25] A TOTP-Based Two Factor Authentication Scheme for Hyperledger Fabric Blockchain
Woo-Suk Park, Dong-Yeop Hwang, and Ki-Hyung Kim (Ajou University, Korea)

[16:00-17:30, Conference Foyer]

Poster Session 4

[P4-1] Consideration of Constraints in Communication Terminal Devices Due to an Installed Environment of Sensor Networks
Seokjin Lee, Hong-Soon Nam, and Youn-Kwae Jeong (ETRI, Korea)

[P4-2] Demand Response Operation Method on Energy Big Data Platform
Tai-Yeon Ku, Wan-Ki Park (ETRI, Korea), and Hoon Choi (Chungnam National University)

[P4-3] Korean Sign Language Translation Using Machine Learning
Angela Caliwag, Stephen Ryan Angsanto, and Wansu Lim (Kumoh National Institute of Technology, Korea)

[P4-4] A Novel Resource Sharing Mechanism for Device-to-Device Communications Underlaying LTE-A Uplink Cellular Networks
Devarani Devi Ningombam, Suk-seung Hwang, and Seokjoo Shin (Chosun University, Korea)

[P4-5] Study of Analyzing and Mitigating Vulnerabilities in uC/OS Real-Time Operating System
Myeonggeon Lee, Gwangjun Choi, Junsang Park, and Seong-je Cho (Dankook University, Korea)

[P4-6] Situational Awareness Framework for Cyber Crime Prevention Model in Cyber Physical System
Minhee Joo, Junwoo Seo, Junhyoung Oh, Mookyu Park, and Kyungho Lee (Korea University, Korea)

[P4-7] Spectrogram-Based Automatic Modulation Recognition Using Convolutional Neural Network
Sinjin Jeong, Uhyeon Lee, and Suk Chan Kim (Pusan National University, Korea)

[P4-8] hyperCache: A Hypervisor-Level Virtualized I/O Cache on KVM/QEMU
Jaechun No and Taehoon Kim (Sejong University, Korea); Sung-soon Park (Anyang University, Korea); Seungho Choi (Sejong University, Korea)

[P4-9] Link Level Simulation of MHN-E System
Sung-Woo Choi and Ilgyu Kim (ETRI, Korea)

[P4-10] Design & Implementation of Real-time Parallel Image Processing Scheme on Fire-Control System
Chang Bae Moon, Byeong Man Kim, and Dong-Seong Kim (Kumoh National Institute of Technology, Korea)

[P4-11] Development of Visual Inspection System for Assembly Machine
Jeonghong Kim (Kyungpook National University, Korea)

[P4-12] Convolution Neural Network-based Spectrum Sensing for Cognitive Radio Systems Using USRP with GNU Radio
Gyu-Hyung Lee, Young-Doo Lee, and In-Soo Koo (University of Ulsan, Korea)

[P4-13] Convolutional Autoencoder-based Sensor Fault Classification
Jae-Wan Yang, Young-Doo Lee, and In-Soo Koo (University of Ulsan, Korea)

[P4-14] Video Surveillance System Based on 3D Action Recognition
Sungjoo Park and Dongchil Kim (Korea Electronics Techonlogy Institute (KETI), Korea)

[P4-15] A Study on Face Masking Scheme in Video Surveillance System
Dongchil Kim and Sungjoo Park (KETI, Korea)

[P4-16] Learning Through Adverse Event for Collision Avoidance: A Self-Learning Approach
Hyunjun Han, Jusung Kang, Muhammad Asif Raza, and Heung-No Lee (Gwangju Institute of Science and Technology, Korea)

[P4-17] Malicious activity against an HPC service environment exhibits a power-law-like frequency distribution
Jae-Kook Lee, Sung-Jun Kim, Taeyoung Hong, Minsu Joh, and Huiseung Chae (Korea Institute of Science and Technology Information, Korea)

[P4-18] Design and Comparison of Discrete Wavelet Transform Based OFDM (DWT-OFDM) System
Jun-Gu Lee and Heung-Gyoon Ryu (Chungbuk National University, Korea)

[P4-19] Outdoor Demonstration of 5Gbps MHN Enhanced System
Dae-Soon Cho (ETRI, Korea)

[P4-20] A Cluster-based Content Management Framework for Information-Centric Networking
Kamrul Hasan and Seong-Ho Jeong (Hankuk University of Foreign Studies, Korea)

[P4-21] Classification of Radar Signals with Convolutional Neural Networks
Seok-Jun Hong and Bo-Seok Seo (Chungbuk National University, Korea)

[P4-22] An Automated System Recovery Using BlockChain
Suhwan Bae and Yongtae Shin (Soongsil University, Korea)

[P4-23] Study on Simplified Test Bench for QoS Analysis Using Traffic Models of Pre-5G Service
Sung-Hun Lee (Kwangwoon University, Korea); Mahn-suk Yoon, Soo-Hyun Cho and Hyun-Kyu Cho (Gumi Electronics & Information Technology Research Institute, Korea)

[P4-24] The Systematic Survey for IP Traceback Methods
Tian Hongcheng (Institute of Network Science & Cyberspace, Tsinghua University, P.R. China); Jun Bi (Tsinghua University, P.R. China)

[P4-25] RESTful Interfaces for Application Initiated D2D Communications
Evelina Pencheva, Ivaylo Atanasov, Denitsa Kireva, and Vencislav Trifonov (Technical University of Sofia, Bulgaria)

Fair and Efficient Channel observation-based Listen-Before Talk (CoLBT) for LAA-WiFi Coexistence in Unlicensed LTE

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Abstract— **License Assisted Access-WiFi (LAA-WiFi) coexistence allows the operations on the unlicensed spectrum for Long Term Evolution (LTE) along with existing unlicensed wireless local area networks (WLANs). The current spectrum access process of legacy WLANs uses clear channel assessment (CCA) and carrier sense multiple access with collision avoidance (CSMA/CA), where the spectrum is sensed before use and a random binary exponential backoff (BEB) mechanism is employed for collision avoidance. While LAA uses a listen-before-talk (LBT) mechanism, moderately similar to the CCA CSMA/CA for channel access. However, there is a fairness issue when these two technologies coexist. In this paper, we propose a channel observation-based LBT (CoLBT) mechanism for fairness in LAA-Wi-Fi coexistence scenarios. Specifically, we introduce a more realistic practical channel observation-based collision probability observed by the LAA evolved Node B (eNB) to adaptively scale-up and scale-down the backoff contention window for channel contention, to reduce the waste of resources and improve LAA-WiFi coexistence performance. Simulation results validate that the proposed CoLBT mechanism is effective in LAA-WiFi coexistence scenario and can improve fairness performance, compared with the current mechanism of LBT.**

Index Terms—Wi-Fi; Unlicensed band; LAA; LAA-WiFi coexistence; listen before talk.

I. INTRODUCTION

5th generation (5G) wireless networks will support 1,000-fold gains in capacity, connections for at least 100 billion devices, and a 10 Gb/s individual user experience capable of extremely low latency [1]. To support capabilities for supporting massive capacity and massive connectivity, 3rd generation partnership project (3GPP) have been working to extend LTE/LTE-Advanced cellular system to the unlicensed bands [2], mainly 5 GHz band. In LTE Release 13, License assisted access (LAA) of 5 GHz Wi-Fi band is being studied for this purpose. However, these bands are already occupied by wireless local area networks (WLANs). Thus, WLAN will be facing a huge challenge in term of interference to access this band due to a massive increase in contention as shown in Fig. 1. Currently, WLAN medium access control (MAC) protocols mainly focus on maximizing the communication channel utilization using fair MAC layer resource allocation (MAC-RA) [5] using a carrier sense multiple access with collision avoidance (CSMA/CA) scheme of distributed coordination function (DCF) for the Wi-Fi stations (STAs) competing to access the channel, while LTE uses continuous traffic generation with minimum time gaps.

From this operational structure in both networks, WLAN is likely to have minimal chances to access the medium than LTE in coexistence scenarios, resulting 70% to 100% performance degradation for WLAN [3]. To withstand this challenge and coexist fairly, there has been an increasing amount of research going on LTE in an unlicensed band. One of the methods, Listen-Before-Talk (LBT) in LAA method [4] in which LAA performs CSMA/CA like channel access method to access the unlicensed band [6].

In general, terms, LBT is a procedure that uses clear channel assessment (CCA), that is, it determines the energy level on the communication channel before attempting to transmit data frames. LBT is also more closely resembles Wi-Fi CSMA/CA, and it seems spontaneous that utilizing channel access schemes with similar as disparate to differing mechanics for the two radio access technologies (RATs) might yield better coexistence performance. Since the availability of the communication channels cannot always be guaranteed, thus limits on the maximum duration of a transmission opportunity (TXOP) is imposed, usually < 10ms [7].

In WLAN, detection of a collision is performed using an acknowledgment control response (ACK) frame. While, in LTE, no such frame exists, so the collision detection is based on the hybrid automatic repeat request (HARQ) feedback [8]. HARQ contains a number of negative ACKs (NACKs) for the transmitted frames in a single TXOP. According to 3GPP, in LBT the backoff contention window (CW) size is proposed to be increased if 80% of the HARQ feedbacks of the most recent TXOP are NACKs [8]. Since LTE is capable of scheduling multiple Nodes in a single sub-frame, the 80% threshold is
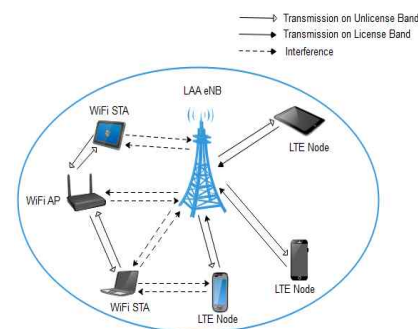

Fig. 1. LAA-WiFi coexistence deployment and interference scenario for LAA evolved Node B (eNB) with LAA users (Nodes) and Wi-Fi AP with Wi-Fi stations (STAs).
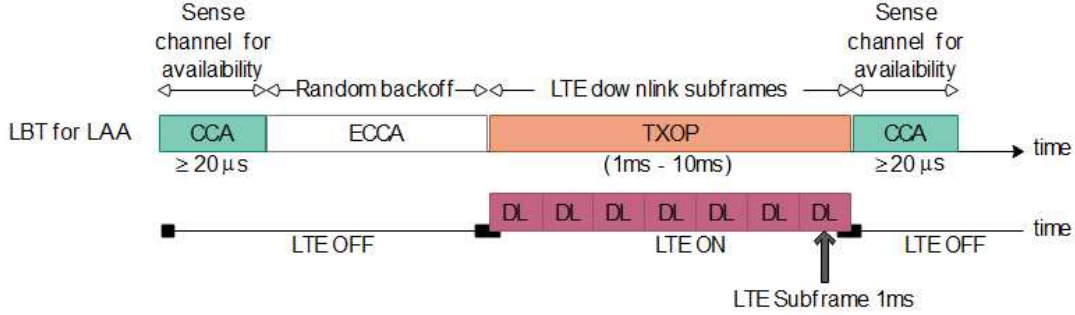
Fig. 2. Listen before talk (LBT) mechanism of License Assisted Access (LAA)

usually hard to meet. Even if a collision happens, that is, less than 80% of the scheduled data frames suffer from the collision, the LAA evolved Node B (eNB, similar as Wi-Fi Access Point that is AP) will not increase its backoff CW and collision will remain unsolved. Moreover, due to the integral latencies introduced by the LTE continues transmission protocol stack, the HARQ feedback associated with a certain sub-frame is received at least 4ms after its transmission time. Therefore, 3GPP proposes to consider only the collisions detected during the first sub-frame of a TXOP, in order to update the CW with a minimum delay. As a result, the collisions from the rest of the sub-frames are ignored.

However, in spite of adopting LBT by LAA, the performance of Wi-Fi when coexisting with LAA is highly dependent on how the LBT parameters are configured. The fairness for accessing the communication channel is one of the important aspects when implanting LBT. In this paper, we propose a channel observation-based unsuccessful (collision) probability to allow the LAA eNB scale the CW size (W) and bring fairness while sharing the resources with WLANs. Instead of waiting for HARQ feedbacks to be more than 80%, the proposed channel observation-based LBT (CoLBT) scales-up/scales-down the size W. Furthermore, the exponential increase, and reset to the minimum procedure of standard LBT is replaced with a more realistic and adaptive channel observation-based scaled backoff (COSB) mechanism for scaling-up W (unsuccessful probability) and scaling-down the W (successful probability). In particular, the proposed CoLBT scheme learn from the observation, through a channel sensing approach, how many NACKs per sub-frame of a TXOP are received along with busy time observed during the ECCA period (B) before TXOP.

The rest of this paper is organized as follows. In the next section, we describe the currently implemented LBT mechanism of LAA. In section III, we discuss proposed CoLBT using COSB. We then evaluate the performance of proposed mechanism using an event-driven NS3 simulator with a densely deployed LAA-WiFi coexistence scenario proposed by the 3GPP [8] for indoor deployments. Finally, we make conclusions and present our future research.

II. LISTEN-BEFORE-TALK (LBT)

3GPP evaluated different preferences for LBT, and the eventual algorithm selected was the one that allows most similarity to how Wi-Fi networks implement MAC-RA, that is binary exponential backoff (BEB) mechanism. Specifically,

BEB is a Distributed Coordination Function (DCF), which aims to resolve channel contention among competing STAs by implementing a random backoff with exponentially increasing maximum CW and by imposing limits on the transmission opportunity (TXOP) before contention resolution occurs again. In LAA's CCA-based LBT mechanism, LTE users (in this paper we refer Wi-Fi users as STAs and LAA users as Nodes) wishing to transmit must observe a CCA for an initial deferral period, if the channel is found to be clear (idle), a deferral-based extended CCA (ECCA) process is performed until the channel is idle as shown in Fig. 2. In an ECCA, the communication channel is observed for the duration of a random backoff factor B multiplied by the CCA slot-time (σ) duration. B defines the number of observed idle slots that need to be sensed before TXOP. The value of B is randomly selected as $B \in [1, W_u]$ every time an ECCA is required and the value is stored in a counter. The value of W_u is the upper bound of the contention window (W), which varies according to an exponential backoff stage. The size of W is exponentially increased upon collision detection, and reset to the minimum W_{min} upon the absence of collision detection.

III. CHANNEL OBSERVATION-BASED LBT (CoLBT)

In this section, we propose a replacement to the standard HARQ-based W size scaling with a more realistic channel observation-based mechanism. The proposed mechanism has two-fold changes to the standard one. Firstly, it replaces the HARQ-based scaling for backoff window W with a practical channel observation-based collision probability (p_{obs}). Secondly, instead of an exponential increase of W and reset back to minimum W_{min} as of BEB, the backoff window size W is scaled-up and scaled-down based on p_{obs}.

A. Channel Observation-Based Collision Probability (p_{obs})

In the proposed CoLBT mechanism, after the communication medium has been idle for a CCA, eNB competing for a channel proceed to the ECCA procedure by selecting a random backoff value B. The time immediately following an idle CCA is slotted into observation time slots (α). The duration of α is either a constant slot-time (σ) during an idle period or a variable busy (successful or collided transmission by other device in the network) period. While the wireless channel is sensed to be clear during σ, B decrements by one. A TXOP is availed only at the beginning of the slot time when B reaches zero. In addition, if the channel is sensed to be busy, the eNB freezes B and continues sensing the channel. If the channel is
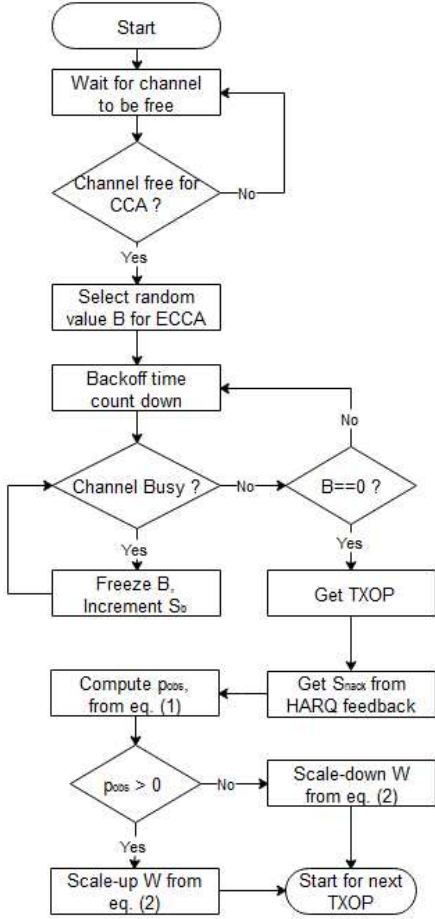
Fig. 3. CoLBT process for LAA eNB

where, $S_b = \sum_{k=0}^{B_{obs}-1} S_k$, and for an observation time slot k, $S_k = 0$ if α is empty (idle), while $S_k = 1$ if α is busy due to other device transmission. Following example explains the formulation of p_{obs}, suppose an eNB selects its ECCA backoff value $B = 10$ (from $W_{min} = 15$, and $W_{max} = 63$). If the tagged eNB observes three busy periods during the observation of B idle slots ($B_{obs} = 10 + 3 = 13$), and the number of NACKs from the most recent TXOP experience are two (that is, $S_{nack} = 2$). Thus p_{obs} is updated as $\frac{3+2}{13+2} = \frac{5}{15} = 0.33$ for next ECCA contention window stage.

The formulation of channel observation-based practical collision probability has a prominence to the LBT mechanism. The contention window update based on the observed practical collision probability leads to more adaptive contention procedure for LAA Nodes according to the all contenders (LAA and Wi-Fi devices) in the network, thus brings fair share between the two coexisting technologies.

B. Channel Observation-based scaled ECCA window

In HARQ feedback-based mechanism, scaling is based on observed NACKs from the recent TXOP, the idea here is that a NACK may be indicative that the receiving Node is experiencing high interference. Moreover, experienced NACKs do not specify the available number of contenders in the network. For this purpose, first, we replace the HARQ feedback-based scaling mechanism with a method based on channel observation-based practical collision probability p_{obs} formulated in the previous section. A tagged eNB can scale current ECCA contention window size if it finds $p_{obs} > 0$, which means even if there is no NACK received in the feedback, still contention window can be scaled due to busy slots during observation. Second, unlike the existing exponential increase for unsuccessful and resetting back to a minimum value of W in LBT, the CoLBT operates as, scaling-up and scaling-down of the W. In the scaling-up, the W is scaled-up if $p_{obs} > 0$ (that is, there exists busy slots or/and NACKs), and the W is scaled-down, if $p_{obs} = 0$ (that is no busy slots and NACKs). The scaling-up and scaling-down of the ECCA contention window operates as follows:

$$W_{cur} = \begin{cases} min\left[2 \times W_{pre} \times \omega^{p_{obs}}, W_{max}\right], & \text{if } \quad p_{obs} > 0 \\ max\left[W_{pre} \times \omega^{p_{obs}}/2, W_{min}\right], & \text{if } \quad p_{obs} = 0 \end{cases}, \quad (2)$$

where W_{cur} is current scaled-up/scaled-down ECCA contention window from a previous W_{pre}. The ω is a constant design parameter to control the adaptive size of the ECCA contention window and is expressed as $\omega = W_{min}$. The Fig. 3 explains the CoLBT algorithm procedure to utilize COSB to scale-up and scale-down their backoff contention window.

IV. PERFORMANCE EVALUATION

In this section we evaluate the performance of our proposed CoLBT mechanism using an event-driven simulator NS3 [10] with an available LAA-WiFi coexistence model [11]. Specifically, we consider two imaginary operators; operator-A (LAA), and operator-B (Wi-Fi), using the same 20 MHz channel. We evaluate performance in terms of the cumulative

again sensed to be clear for CCA, B is resumed. Each eNB can proficiently measure channel observation-based conditional collision probability p_{obs}. This happens if other devices in the network transmit during the same slot time. It might seem that the exact estimation of p_{obs} requires each eNB to observe and count the number of failed transmissions (NACKs) and divide it by the total number of transmission attempts. However, a more realistic observation for p_{obs} can be achieved if busy slots during the ECCA procedure are also counted, since a transmission would have collided if the tagged eNB transmit in the same busy slot time. Thus, we update p_{obs} at every ECCA backoff contention stage by counting number of NACKs (S_{nack}) in recent TXOP and the number of busy slots (S_b) during observed slot times (α) in order to consider dynamic changes in the traffic load.

We discretize the time in B_{obs}, where the value of B_{obs} is the total number of α (idle or busy, that is $B_{obs} = B + S_b$) between two consecutive ECCA backoff stages. A tagged eNB updates p_{obs} from B_{obs} of ECCA backoff stage as follows:

$$p_{obs} = \frac{S_b + S_{nack}}{S_{nack} + B_{obs}}, \quad (1)$$
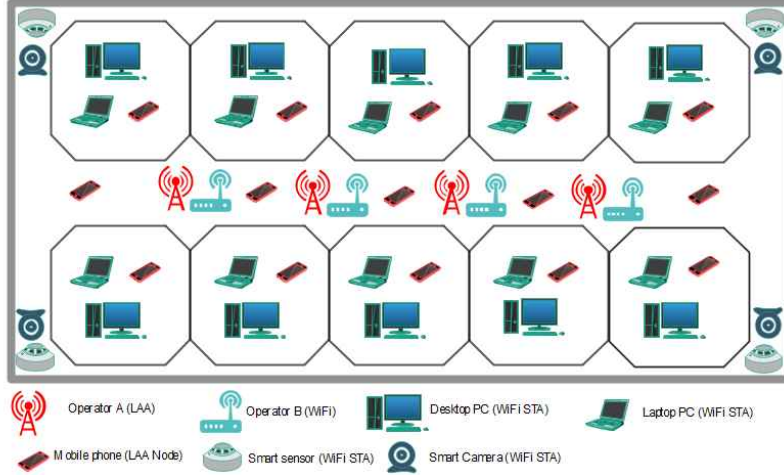
Fig. 4. LAA-WiFi coexistence indoor scenario for simulation

distribution function (CDF) of both operators with system throughput (Mbps) and latency (ms).

The operators deploy their networks according to the indoor scenario as designed and recommended for evaluation of LAA-Wi-Fi coexistence by 3GPP [8]. Fig. 4 provides an overview of the LAA Nodes and Wi-Fi STAs layout. The two operators deploy four small cells in an office floor with 10 cubical divisions as shown in Fig. 4. The four base stations (LAA eNBs, and Wi-Fi APs) for each operator are equally spaced (Fixed locations and offset from one another by a default of 5 meters). The Nodes and STAs are randomly distributed in the rectangular region, with some of the fixed Wi-Fi STAs (that is, sensors, cameras and desktop PCs). We performed simulations for two set of densities; five Nodes/STAs (N) per cell (that is, cell/operator = 4, N = 5, operators = 2, total N = 4 * 2 * 5 = 40), and ten Nodes/STAs (N) per cell (that is, cell/operator = 4, N = 10, operators = 2, total N = 4 * 2 * 10 = 80). Table 1 presents the details of the simulation scenarios for both operators. The current scenarios do not use user mobility.

A. Simulation Models

1) Wi-Fi Model

We consider a 20 MHz 802.11n channel for operator B (Wi-Fi), with an EDCA for QoS considerations. The energy detection-based (ED) CCA for detection of other RATs is set to -72dBm. Although the Wi-Fi has -62dBm since LTE has -72dBm so we set same for both operators, which does not cause much effect on the access mechanism [11]. Simulations described herein use data rates up to Modulation and Coding Scheme (MCS) 15 with no short guard interval. The Wi-Fi APs use BEB mechanism to update the W with W_{min} = 15, and W_{max} = 1023.

2) LAA Model

LAA implements an LBT and CoLBT protocols. All LBT parameters were approved in 3GPP RAN Plenary meeting in December 2015 [8]. The initial CCA time is 43μs, and the LAA CCA slot time (σ) is 9μs. LAA ED threshold is set to -72dBm. The maximum length of TXOP is configurable and it defaults to 8ms. The update of the W for LBT is implemented following an HARQ feedback based approach, as agreed in [8]. For LBT, the

upper bound of the contention window varies according to BEB between {15, 31, 63}, while for CoLBT it varies between {15-63} depending upon the network density (that is, p_{obs}).

3) Traffic Model

The overall offered load is the same for both coexisting networks. In experiments, we have implemented the File Transfer Protocol (FTP), and evaluated it on a downlink only scenario, as one of the recommended options in [9]. This model simulates file transfers arriving according to a Poisson process with arrival rate λ. The recommended range for λ is between 0.5 to 2.5 [9], we have implemented λ = 2.5 to use a level of load that allows both LAA and Wi-Fi to always have data available for transmission. To model this, we configured the FTP application to operate over UDP. We used simulation time of 244 seconds for λ = 2.5, because lower traffic intensities do not occupy the link enough to show interesting performance differences.

4) Performance Metrics

The main performance metrics described in TR 36.889 [9] are 'user perceived throughput (Mbps)' and 'latency (ms)'. In NS3, we are calculating these metrics by using the built-in

TABLE I.   PARAMETERS USED IN SIMULATIONS

| Parameter	Value
Network Scenario	Office Floor (Indoor)
Number of cells/operator	4
Number of devices/cell	5, 10
Traffic Model	FTP over UDP
Packet arrival rate (λ)	2.5
Operating Frequency	5 GHz
Bandwidth	20 MHz
Physical rate of the channel	MCS 15 (130Mbps)
Data frame payload	1000 bytes
W_{min}(LAA/WiFi)	15/15
W_{max}(LAA/WiFi)	63/1023
ED threshold (LAA/WiFi)	-72 dBm
SIFS	16 μs
DIFS/CCA	60/43 μs
Slot-time σ (LAA/WiFi)	9 μs
TXOP (LAA)	8 ms
NACKs feedback (LAA)	80%
Scaling design factor (ω)	32
Simulation time	250 s
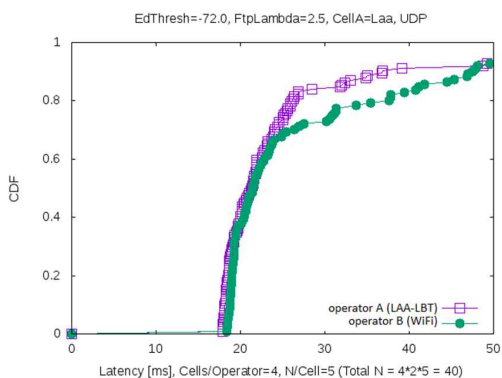
Fig. 5. Latency (ms) performance of LAA-WiFi coexistence with LAA LBT: FTP (arrival rate λ= 2.5) over UDP with 5 Nodes/STAs per cell/operator.
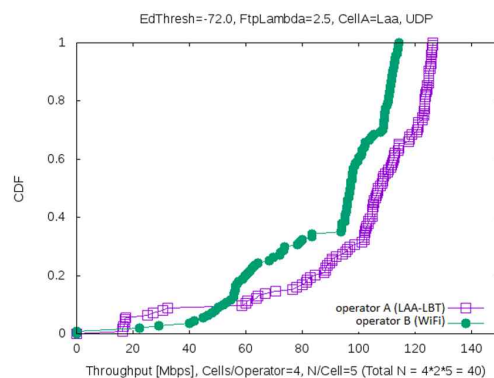

Fig. 7. Throughput (Mbos) performance of LAA-WiFi coexistence with LAA LBT: FTP (arrival rate λ= 2.5) over UDP with 5 Nodes/STAs per cell/operator.
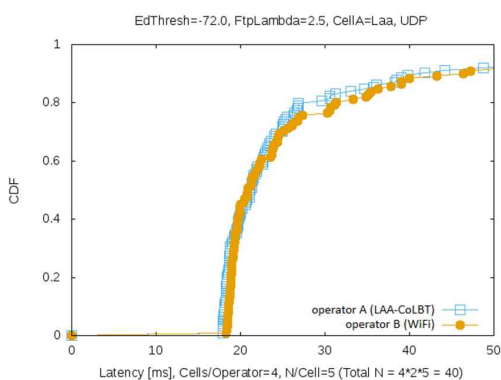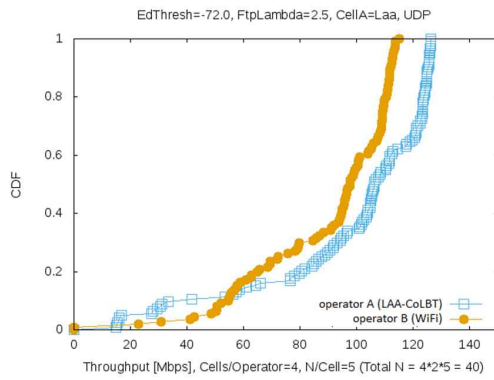

Fig. 6. Latency (ms) performance of LAA-WiFi coexistence with proposed LAA CoLBT: FTP (arrival rate λ= 2.5) over UDP with 5 Nodes/STAs per cell/operator.

Fig. 8. Throughput (Mbps) performance of LAA-WiFi coexistence with LAA CoLBT: FTP (arrival rate λ= 2.5) over UDP with 5 Nodes/STAs per cell/operator.

FlowMonitor tool that tracks per-flow statistics at the IP layer including throughput and latency. Later we post-process these flow results to obtain CDFs for 'user perceived throughput (Mbps)' and 'latency (ms)'.

B. Results and Discussions

Fig. 5 and Fig. 6 show latency impact of the LAA-WiFi coexistence when using LAA LBT and LAA CoLBT, respectively. The figures show that the ratio of Wi-Fi STAs suffers high latency coexisting with LAA LBT scheme and it decreases with LAA CoLBT scheme. Moreover, the Fig. 6 shows that both operators (LAA and Wi-Fi) fairly share the channel and have a similar latency performance. The throughput impact on the Wi-Fi networks is shown in Fig. 7 and Fig. 8 for both schemes. The Fig. 7 shows that there exists a prominent amount of throughput degradation for the Wi-Fi STAs, while the performance degradation of Wi-Fi network is comparatively smaller for the LAA CoLBT replaced network, as shown in Fig. 8.

The fairness between the LAA and Wi-Fi becomes more noticeable when the number of Nodes/STAs (*N*) increases per cell, due to increase in channel occupancy probability and time. This is because current LAA LBT mechanism only considers the HARQ feedback for backoff window update, which is received with much more delay that is after 7ms [9]. The Fig. 9 shows

that both operators face a noticeable amount of higher latency as compared to the less number of Nodes/STAs per cell (Fig. 5), and figure shows, Wi-Fi network is the one who suffers more than the LAA. When LAA LBT is replaced with LAA CoLBT, the degradation in latency performance is smaller and both operators follow the similar latency as shown in Fig. 10. Since the LAA CoLBT adjusts the backoff contention window based on the available probability of channel condition, therefore the throughput degradation due to an increase of the number of contenders has a small effect on CoLBT as compared to LBT as shown in Fig. 11 and Fig. 12. The practical channel observation-based channel access of CoLBT enhances the fair channel occupancy for both LAA and Wi-Fi devices in the network.

V. CONCLUSION

LAA-WiFi coexistence performance is highly sensitive to the factors that affect the channel access (e.g. BEB), that is the parameter choices in LAA LBT and contention window update mechanisms, such as HARQ feedback. Different aspects and LAA parameters affect the coexistence performance. In this paper, we propose a more realistic channel observation-based LBT (CoLBT) to enhance the fairness of LAA-WiFi coexistence. We have tested the impact of the parameters associated with the LBT access protocol and with the backoff
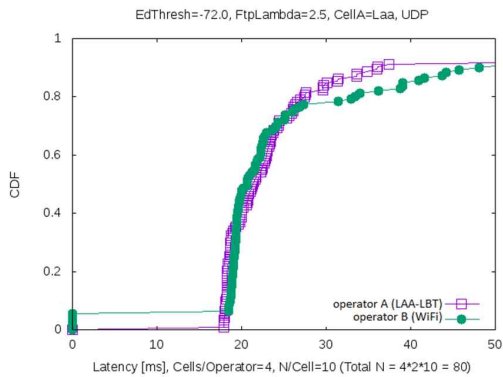
Fig. 9. Latency (ms) performance of LAA-WiFi coexistence with LAA LBT: FTP (arrival rate λ= 2.5) over UDP with 10 Nodes/STAs per cell/operator.
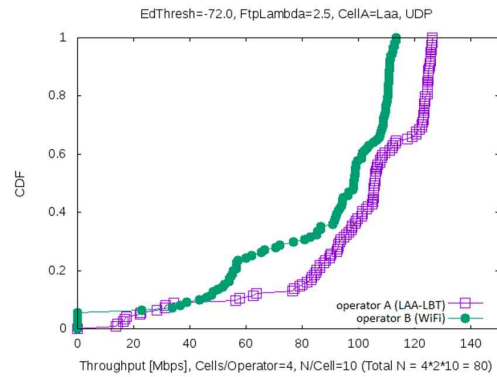

Fig. 11. Throughput (Mbos) performance of LAA-WiFi coexistence with LAA LBT: FTP (arrival rate λ= 2.5) over UDP with 5 Nodes/STAs per cell/operator.
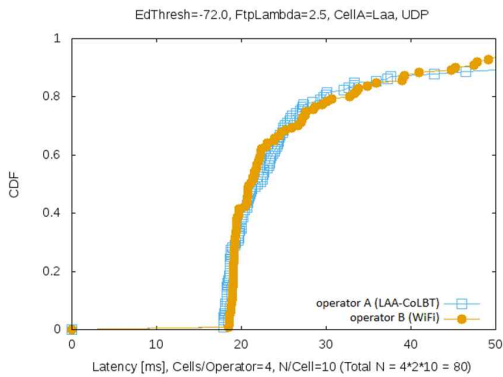

Fig. 10. Latency (ms) performance of LAA-WiFi coexistence with proposed LAA CoLBT: FTP (arrival rate λ= 2.5) over UDP with 10 Nodes/STAs per cell/operator.
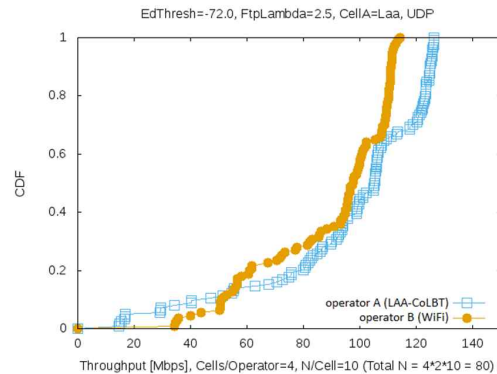

Fig. 12. Throughput (Mbps) performance of LAA-WiFi coexistence with LAA CoLBT: FTP (arrival rate λ= 2.5) over UDP with 10 Nodes/STAs per cell/operator.

algorithm to improve the fairness between LAA and Wi-Fi networks. In particular, we tested the sensitivity to 1) the parameter associated to the HARQ-based rule to update the contention window size, and 2) the BEB mechanism used by LAA for scaling of the contention window. In general, we observed that one of the reasons for coexistence performance degradation is by these parameters. Simulation results show that the proposed adaptive contention window scaling with COSB in CoLBT is effective in LAA-WiFi coexistence scenario and can improve fairness performance, compared with the current mechanism of LBT.

In the future, this research will be extended to include an analytical model to affirm the accuracy of the mechanism. In addition, the proposed algorithm must be validated for employing different QoS traffic applications, such as voice and video applications. Since we have evaluated CoLBT for increased user density only, thus another important aspect has to evaluate is to increase the network density (number of eNB and APs deployment).

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