2021 IEEE 22nd International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2021)

Virtual Conference 7 – 11 June 2021



IEEE Catalog Number: CFP ISBN: 978-

CFP21WOW-POD 978-1-6654-4652-5

Copyright © 2021 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

 IEEE Catalog Number:
 CFP21WOW-POD

 ISBN (Print-On-Demand):
 978-1-6654-4652-5

 ISBN (Online):
 978-1-6654-2263-5

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400

Fax: (845) 758-2633

E-mail: curran@proceedings.com Web: www.proceedings.com



2021 IEEE 22nd International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM)

WoWMoM 2021

Table of Contents

Message from the General Co-Chairs xii
Message from the TPC Co-Chairs xiii
Message from the ISMS Workshop Chairs xiv
Message from the NTN-6G and SwarmNet Workshop Chairs .xv
Message from the SC2 Workshop Chairs xvi
Organizing Committee xvii
Technical Program Committee xviii
Keynotes xx
Main Conference
A Game Theory-based Transportation System using Fog Computing for Passenger Assistance .1 Rahul Mishra (IIT (BHU) Varanasi, India), Preti Kumari (IIT (BHU) Varanasi, India), Hari Prabhat Gupta (IIT (BHU) Varanasi, India), Diksha Shrivastava (IIT (BHU) Varanasi, India), Tanima Dutta (IIT (BHU) Varanasi, India), Doug Young Suh (Kyung Her University, South Korea), and M. Jalil Piran (Sejong University, South Korea)
A Low Complexity Network-Coded ARQ protocol for Ultra-Reliable Low Latency Communication 11
Foteini Karetsi (University of Ioannina, Greece) and Evangelos Papapetrou (University of Ioannina, Greece)
A Truthful Auction Mechanism for Resource Allocation in Mobile Edge Computing .21
Context-Aware Fine-Grained Task Scheduling at Vehicular Edges: An Extreme Reinforcement Learning based Dynamic Approach 31

DeepMTL: Deep Learning Based Multiple Transmitter Localization .41. Caitao Zhan (Stony Brook University), Mohammad Ghaderibaneh (Stony Brook University), Pranjal Sahu (Stony Brook University), and Himanshu Gupta (Stony Brook University)
Delay Performance of UAV-Based Buffer-Aided Relay Networks under Bursty Traffic: Mobile or Static? 51
Extending the QUIC Protocol to Support Live Container Migration at the Edge .61
Fairness in Network-Friendly Recommendations .71
Feasibility of Multipath Construction in mmWave Backhaul .81
How UAVs' Highly Dynamic 3D Movement Improves Network Security? 91
Hy-Fi: Aggregation of LiFi and WiFi using MIMO in IEEE 802.11 .100. Anatolij Zubow (School of Electrical Engineering and Computer Science, Germany), Piotr Gawłowicz Gawłowicz (School of Electrical Engineering and Computer Science, Germany), Kai Lennert Bober (Fraunhofer Heinrich Hertz Institute, Germany), Volker Jungnickel (School of Electrical Engineering and Computer Science, Germany; Fraunhofer Heinrich Hertz Institute, Germany), Kai Habel (Fraunhofer Heinrich Hertz Institute, Germany), and Falko Dressler (School of Electrical Engineering and Computer Science, Germany)
Long-Term Wireless Sensor Network Deployments in Industry and Office Scenarios .109
Modeling Simple HetNet Configurations with Mixed Traffic Loads .119
Modelling Broadband Wireless Technology Coexistence in the Unlicensed Bands .129

OSLo: Optical Sensor Localization through Mesh Networked Cameras .139
Program Placement Optimization for Storage-Constrained Mobile Edge Computing Systems: A Multi-Armed Bandit Approach .149. Mingjie Feng (The University of Arizona, USA) and Marwan Krunz (The University of Arizona, USA)
Relational Deep Reinforcement Learning for Routing in Wireless Networks .159
Resilience Against Bad Mouthing Attacks in Mobile Crowdsensing Systems via Cyber Deception.169 Prithwiraj Roy (Missouri University of Science and Technology, USA), Shameek Bhattacharjee (Western Michigan University, USA), Hussein S Alsheakh (Western Michigan University, USA), and Sajal K. Das (Missouri University of Science and Technology, USA)
Service Placement and Bandwidth Allocation for MEC-Enabled Mobile Cloud Gaming .179 Tuo Cao (Nanjing University, China), Zhuzhong Qian (Nanjing University, China), Kun Wu (Nanjing University, China), Mingxian Zhou (Nanjing University, China), and Yibo Jin (Nanjing University, China)
Serving HTC and Critical MTC in a RAN Slice .189 Vincenzo Mancuso (IMDEA Networks Institute, Spain), Paolo Castagno (University of Turin, Italy), Matteo Sereno (University of Turin, Italy), and Marco G Ajmone Marsan (IMDEA Networks Institute, Spain; Polytechnic of Turin, Italy)
TTrees: Automated Classification of Causes of Network Anomalies with Little Data .199
VideoTrain: A Generative Adversarial Framework for Synthetic Video Traffic Generation .209 Chamara M Kattadige (The University of Sydney, Australia), Shashika Muramudalige (Colorado State University, USA), Kwon Nung Choi (The University of Sydney, Australia), Guillaume Jourjon (Data61, CSIRO Sydney, Australia), Haonan Wang (Colorado State University, USA), Anura P Jayasumana (Colorado State University, USA), and Kanchana Thilakarathna (The University of Sydney, Australia)
Phd Forum
Phd Forum: Data Traffic Classification Using Deep Learning Models 219
PhD Forum: Delay Guarantees of a Mobile Wireless Sensor Network using Stochastic Network Calculus 221



WIP: Demand-Driven Power Allocation in Wireless Networks with Deep Q-Learning .248
WIP: Leveraging QUIC for a Receiver-Driven BBR for Cellular Networks 252 Habtegebreil Haile (Karlstad University, Sweden), Karl-Johan Grinnemo (Karlstad University, Sweden), Simone Ferlin (Ericsson AB, Stockholm, Sweden), Per Hurtig (Karlstad University, Sweden), and Anna Brunstrom (Karlstad University, Sweden)
WIP: Preliminary Evaluation of Digital Twins on MEC Software Architecture .256
WIP: Short-Term Flow-Based Bandwidth Forecasting Using Machine Learning .260
WIP: Sysnif: Constructing Workflow from Interleaved Logs in Intelligent IoT System .264
Workshops
ISMS
A Preliminary Evaluation of QUIC for Mobile Serverless Edge Applications .268
Comparison of Trip Matching Algorithms for Mobility Sharing Applications .27.4

Multi-Agent Navigation of a Multi-Storey Parking Garage via Game Theory .280..... Elvina Gindullina (Università degli Studi di Padova via Gradenigo 6B, Italy), Sebastian Mortag (Università degli Studi di Padova via Gradenigo 6B, Italy), Maxim Dudin (Università degli Studi di Padova via Gradenigo 6B, Italy), and Leonardo Badia (Università degli Studi di Padova via Gradenigo 6B, Italy) Similarity Measures for Location-Dependent MMIMO, 5G Base Stations On/Off Switching Using Radio Environment Map .286. Marcin Hoffmann (Institute of Radiocommunications, Poznań University of Technology, Poland) and Paweł Kryszkiewicz (Institute of Radiocommunications, Poznań University of Technology, Poland) NTN-6G-SwarmNet A System Simulator for 5G Non-Terrestrial Network Evaluations 292..... Jani Puttonen (Magister Solutions Ltd., Finland), Lauri Sormunen (Magister Solutions Ltd., Finland), Henrik Martikainen (Magister Solutions Ltd., Finland), Sami Rantanen (Magister Solutions Ltd., Finland), and Janne Kurjenniemi (Magister Solutions Ltd., Finland) Effect of Antenna Orientation on the Air-to-Air Channel in Arbitrary 3D Space .298..... N. Cameron Matson (Southern Methodist University, USA), Syed Muhammad Hashir (Southern Methodist University, USA), Sicheng Song (Southern Methodist University, USA), Dinesh Rajan (Southern Methodist University, USA), and Joseph Camp (Southern Methodist University, USA) Interoperable Simulation Tools for Satellite Networks .304..... Anastasia Yastrebova (VTT Technical Research Centre of Finland, Finland), Antti Anttonen (VTT Technical Research Centre of Finland, Finland), Mika Lasanen (VTT Technical Research Centre of Finland, Finland), Mikko Vehkaperä (VTT Technical Research Centre of Finland, Finland), and Marko Höyhtyä (VTT Technical Research Centre of Finland, Finland) Multi-Platform Hardware In The Loop (HIL) Simulation for Decentralized Swarm Communication Using ROS and Gazebo 310. Saran Khaliq (Swarm Robotics Lab, NCRA, University of Engineering & Technology (UET), Taxila), Shahzeb Ahsan (Swarm Robotics Lab, NCRA, University of Engineering & Technology (UET), Taxila), and M. Danish Nisar (Sir Syed CASE Institute of Technology (SSCIT), Pakistan) Performance Analysis of a Dual Terahertz/Ka Band Communication System for Satellite Mega-Constellations 316. Ali J. Algaraghuli (Northeastern University, Boston, USA), Hussam Abdellatif (Northeastern University, Boston, USA), and Josep M. Jornet (Northeastern University, Boston, USA) Tethered UAV with High Gain Antenna for BVLOS CNPC: A Practical Design for Widespread Use 323 Andrew L. Yingst (Mississippi State University, United States) and Vuk

Marojevic (Mississippi State University, United States)

SC2

3D Position Optimization for the UAV-Assisted Relay Networks Enhancing by NOMA and MRC 329 Daosen Zhai (Northwestern Polytechnical University, Xi'an, China; State Key Laboratory of Integrated Services Networks, Xidian University, Xi'an, China), Huan Li (Northwestern Polytechnical University, Xi'an, China), Ruonan Zhang (Northwestern Polytechnical University, Xi'an, China), and Haotong Cao (The Hong Kong Polytechnic University, Hong Kong)
A Novel Method for Analyzing Weather Effect on Smart City Traffic 335
Optimizing Task Allocation for Edge Micro-Clusters in Smart Cities .341
RA-RL: Reputation-Aware Edge Device Selection Method based on Reinforcement Learning .348 Yanlei Dong (The 54th Institute of China Electronics Technology Group Corporation, Shijiangzhuang, China), Peng Gan (China University of Petroleum (East China), China), Gangeet Singh Aujla (Durham University, United Kingdom), and Peiying Zhang (China University of Petroleum (East China), China)
Secure Link Selection for Relay Networks with Buffer 354. Dawei Wang (School of Electronics and Information, Northwestern Polytechnical University, Xi'an, China), Yang Zhao (School of Electronics and Information, Northwestern Polytechnical University, Xi'an, China), Xiao Tang (School of Electronics and Information, Northwestern Polytechnical University, Xi'an, China), Daosen Zhai (School of Electronics and Information, Northwestern Polytechnical University, Xi'an, China), Zihao Wei (Beihang University of Aeronautics and Astronautics, China), Haotong Cao (Hong Kong Polytechnic University, Hong Kong), and Wei Liang (School of Electronics and Information, Northwestern Polytechnical University, Xi'an, China)
Author Index 359.