

NOMS 2020 – 2020 IEEE/IFIP Network Operations and Management Symposium

**Budapest, Hungary
20-24 April 2020**

Pages 1-617



**IEEE Catalog Number: CFP20NOM-POD
ISBN: 978-1-7281-4974-5**

**Copyright © 2020 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:	CFP20NOM-POD
ISBN (Print-On-Demand):	978-1-7281-4974-5
ISBN (Online):	978-1-7281-4973-8
ISSN:	1542-1201

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

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

BIIT: STANDARDIZATION OF BLOCKCHAIN-BASED IOT SYSTEMS IN THE I4 ERA	1
<i>Sina Rafati Niya, Eryk Schiller, Ile Cepilov, Burkhard Stiller</i>	
OPTIMIZING HAS FOR 360-DEGREE VIDEOS.....	10
<i>Christian Moldovan, Frank Loh, Michael Seufert, Tobias Hofffeld</i>	
PRACTICAL 5G KPI MEASUREMENT RESULTS ON A NON-STANDALONE ARCHITECTURE.....	16
<i>Gábor Soós, Dániel Ficzer, Pál Varga, Zsolt Szalay</i>	
DECENTRALIZATION OF 5G SLICE RESOURCE ALLOCATION.....	21
<i>Francesca Fossati, Stefano Moretti, Stephane Rovedakis, Stefano Secci</i>	
JOINT RESOURCE AND ADMISSION MANAGEMENT FOR SLICE-ENABLED NETWORKS.....	30
<i>Sina Ebrahimi, Abulfazl Zakeri, Behzad Akbari, Nader Mokari</i>	
INHERENT VULNERABILITY OF DEMAND RESPONSE OPTIMISATION AGAINST FALSE DATA INJECTION ATTACKS IN SMART GRIDS	37
<i>Thusitha Dayaratne, Carsten Rudolph, Ariel Liebman, Mahsa Salehi</i>	
THE SERVICE METRICS AND PERFORMANCE ANALYSIS OF INTERNET TIME SERVICE	46
<i>Jing Ling, Guochu Shou, Mengjie Guo, Yihong Hu</i>	
A PROCESS MINING APPROACH FOR SUPPORTING IOT PREDICTIVE SECURITY	52
<i>Adrien Hemmer, Rémi Badonnel, Isabelle Chrisment</i>	
P4 SWITCH CODE DATA FLOW ANALYSIS: TOWARDS STRONGER VERIFICATION OF FORWARDING PLANE SOFTWARE.....	61
<i>Karine Birnfeld, Diogo C. Da Silva, Weverton Cordeiro, Breno B. N. De França</i>	
PREDICTIONS OF NETWORK ATTACKS IN COLLABORATIVE ENVIRONMENT	69
<i>Martin Husák, Pavel Celeda</i>	
INFERRING CLOUD-NETWORK SLICE'S REQUIREMENTS FROM NON-STRUCTURED SERVICE DESCRIPTION	75
<i>Rafael Pasquini, Javier Baliosian, Joan Serrat, Juan-Luis Gorricho, Augusto Neto, Fábio Verdi</i>	
RECOVERY COMMAND GENERATION TOWARDS AUTOMATIC RECOVERY IN ICT SYSTEMS BY SEQ2SEQ LEARNING	80
<i>Hiroki Ikeuchi, Akio Watanabe, Tsutomu Hirao, Makoto Morishita, Masaaki Nishino, Yoichi Matsuo, Keishiro Watanabe</i>	
PREVENTING DDOS ATTACKS IN PATH IDENTIFIERS-BASED INFORMATION CENTRIC NETWORKS.....	86
<i>Basheer Al-Duwairi, Öznur Özkasap</i>	
SLA DRIVEN AUTOMATIC FAULT-RECOVERY SCHEDULING METHOD WITH COST EVALUATION	91
<i>Atsushi Takada, Toshihiko Seki, Kyoko Yamagoe</i>	

CONTRAST: CONTAINER-BASED TRANSCODING FOR INTERACTIVE VIDEO STREAMING.....	97
<i>Sajad Sameti, Mea Wang, Diwakar Krishnamurthy</i>	
RESOURCE ALLOCATION AND MANAGEMENT TECHNIQUES FOR NETWORK SLICING IN WIFI NETWORKS	106
<i>Matías Richart, Javier Baliosian, Joan Serrat, Juan-Luis Gorricho</i>	
MOBILITY AND QOS PREDICTION FOR DYNAMIC COVERAGE OPTIMIZATION.....	112
<i>Janne Ali-Tolppa, Márton Kajó</i>	
UAV-ASSISTED VEHICULAR COMMUNICATION FOR DENSELY CROWDED ENVIRONMENTS	114
<i>Ouns Bouachir, Moayad Aloqaily, Ismaeel Al Ridhawi, Omar Alfandi, Haythem Bany Salameh</i>	
KATHARÁ: A LIGHTWEIGHT NETWORK EMULATION SYSTEM.....	118
<i>Mariano Scazzariello, Lorenzo Ariemma, Tommaso Caiazzi</i>	
INTERFERENCE CANCELLATION FOR SOFTWARE DEFINED IMPULSE RADIO BY TEMPLATE DESIGN.....	120
<i>Xufang Wang, Feng Lin, Wen-Kang Jia</i>	
UNVEILING THE TYPE OF RELATIONSHIP BETWEEN AUTONOMOUS SYSTEMS USING DEEP LEARNING.....	125
<i>Tal Shapira, Yuval Shavitt</i>	
MULTI-TECHNOLOGY MANAGEMENT OF HETEROGENEOUS WIRELESS NETWORKS	131
<i>Tom De Schepper, Jeroen Famaey, Steven Latré</i>	
VOICEPERF: A QUALITY ESTIMATION APPROACH FOR NO-REFERENCE IP VOICE TRAFFIC	137
<i>Péter Orosz, Tamás Tóthfalusi</i>	
TOWARDS DELAY-AWARE CONTAINER-BASED SERVICE FUNCTION CHAINING IN FOG COMPUTING	146
<i>José Santos, Tim Wauters, Bruno Volckaert, Filip De Turck</i>	
NETWORK SERVICE MAPPING AND SCHEDULING UNDER UNCERTAIN PROCESSING TIME	155
<i>Yuncan Zhang, Fujun He, Eiji Oki</i>	
LAYER-INTEGRATED EDGE DISTRIBUTED DATA STORE FOR REAL-TIME AND STATEFUL SERVICES	163
<i>Koichiro Amemiya, Akihiro Nakao</i>	
A DYNAMIC SPECTRUM FOOTPRINT ADAPTATION FRAMEWORK FOR COLLABORATIVE SPECTRUM SHARING.....	172
<i>Ruben Mennes, Jakob Struye, Carlos Donato, Steven Latré</i>	
ATMOS: AUTONOMOUS THREAT MITIGATION IN SDN USING REINFORCEMENT LEARNING.....	176
<i>Iman Akbari, Ezzeldin Tahoun, Mohammad A. Salahuddin, Noura Limam, Raouf Boutaba</i>	
SERVICE AND AGENT BASED SYSTEM ARCHITECTURES FOR INDUSTRIE 4.0 SYSTEMS.....	185
<i>Hartwig Baumgärtel, Richard Verbeet</i>	

A DYNAMIC CLUSTERING APPROACH FOR INCREASING USER THROUGHPUT IN 5G WIRELESS NETWORKS	191
<i>Wael S. Afifi, Ali A. El-Moursy, Mohamed Saad, Salwa M. Nassar, Hadia M. El-Hennawy</i>	
USER GROUP BEHAVIOURAL PATTERN IN A CELLULAR MOBILE NETWORK FOR 5G USE-CASES.....	199
<i>Gábor Soós, Dániel Ficzer, Pál Varga</i>	
λBGP: RETHINKING BGP PROGRAMMABILITY	206
<i>Nicholas Hart, Charalampos Rotsos, Vasileios Giotsas, Nicholas Race, David Hutchison</i>	
XRAC: EXECUTION AND ACCESS CONTROL FOR RESTRICTED APPLICATION CONTAINERS ON MANAGED HOSTS	215
<i>Frederik Hauser, Mark Schmidt, Michael Menth</i>	
CAPACITY EXPANSION AND MODERNIZATION OF CORE NETWORK ELEMENTS RUNNING ON ATCA PLATFORM.....	224
<i>Attila Hilt, József Varga, Gábor Járó</i>	
DEMO: EXECUTION AND ACCESS CONTROL FOR RESTRICTED APPLICATION CONTAINERS ON MANAGED HOSTS (XRAC)	229
<i>Frederik Hauser, Michael Menth</i>	
UNCOVERING VULNERABLE INDUSTRIAL CONTROL SYSTEMS FROM THE INTERNET CORE	231
<i>Marcin Nawrocki, Thomas C. Schmidt, Matthias Wählisch</i>	
DEMONSTRATION OF NETWORK SERVICE HEADER BASED SERVICE FUNCTION CHAIN APPLICATION WITH FUNCTION ALLOCATION MODEL	240
<i>Rui Kang, Fujun He, Takehiro Sato, Eiji Oki</i>	
USING BLACKBOX ML TECHNIQUES TO DIAGNOSE QOE PROBLEMS FOR AN IPTV SERVICE	242
<i>Jawwad Ahmed, Amadeu Do Nascimento, Caner Kilinc, Dan Pan, Jaume Rius I Riu, Jorgen Gustafsson</i>	
DUAL VOTE CONFIRMATION BASED CONSENSUS DESIGN FOR BLOCKCHAIN INTEGRATED IOT	250
<i>Zheng Qiu, Jianjun Hao, Yijun Guo, Yi Zhang</i>	
ON THE IMPACT OF FLOW MONITORING CONFIGURATION.....	257
<i>Petr Velan, Tomas Jirsik</i>	
GLOBAL-SCALE ANYCAST NETWORK MANAGEMENT WITH VERFPLOETER.....	264
<i>Wouter B. De Vries, Salman Aljammaz, Roland Van Rijswijk-Deij</i>	
DIVIDING DEEP LEARNING MODEL FOR CONTINUOUS ANOMALY DETECTION OF INCONSISTENT ICT SYSTEMS	273
<i>Kengo Tajiri, Yasuhiro Ikeda, Yuusuke Nakano, Keishiro Watanabe</i>	
ELASTICWISP: ENERGY-PROPORTIONAL WISP NETWORKS.....	278
<i>Duncan Cameron, Alvin Valera, Winston K. G. Seah</i>	
ATTACK-RESISTANT ROUTING : A FRAMEWORK FOR ENHANCING ROUTING ROBUSTNESS IN WIRELESS AD-HOC NETWORKS	287
<i>Gi Tae Kim, Constantin Serban, Ritu Chadha</i>	

A GAME-THEORETIC APPROACH FOR DISTRIBUTED ATTACK MITIGATION IN INTELLIGENT TRANSPORTATION SYSTEMS.....	294
<i>Talal Halabi, Omar A. Wahab, Mohammad Zulkernine</i>	
ELASTIC MONITORING ARCHITECTURE FOR CLOUD NETWORK SLICES	300
<i>André Beltrami, Celso Cesila, Paulo Ditarso Maciel, Christian Rothenberg, Fábio L. Verdi</i>	
MICROBURSTS IN SOFTWARE AND HARDWARE-BASED TRAFFIC LOAD GENERATION	302
<i>Ralf Kundel, Amr Rizk, Boris Koldehofe</i>	
DISCOVERING COLLABORATION: UNVEILING SLOW, DISTRIBUTED SCANNERS BASED ON COMMON HEADER FIELD PATTERNS	304
<i>Harm Griffioen, Christian Doerr</i>	
MATCHING THEORY APPLICATION FOR EFFICIENT ALLOCATION OF INDIVISIBLE TESTBED RESOURCES	313
<i>Donatos Stavropoulos, Vasileios Miliotis, Thanasis Korakis, Leandros Tassiulas</i>	
BLOOM FILTER-BASED ROUTING FOR DOMINATING SET-BASED SERVICE-CENTRIC NETWORKS.....	320
<i>Ali Marandi, Vincent Hofer, Mikael Gasparyan, Torsten Braun, Nikolaos Thomos</i>	
SDN-ASSISTED CONTAINERIZED SECURITY AND MONITORING COMPONENTS.....	329
<i>Miguel Borges De Freitas, Pedro Quitério, Luis Rosa, Tiago Cruz, Paulo Simões</i>	
A RESOURCE EFFICIENT IMPLEMENTATION OF THE RESTCONF PROTOCOL FOR OPENWRT SYSTEMS.....	334
<i>Malte Granderath, Jürgen Schönwälder</i>	
MANAGEMENT OF SMART VEHICULAR HANDOVERS IN OVERLAPPED V2X NETWORKS.....	340
<i>Hyundong Hwang, Young-Tak Kim</i>	
NFV-BASED IOT SECURITY FOR HOME NETWORKS USING MUD.....	346
<i>Yehuda Afek, Anat Bremler-Barr, David Hay, Ran Goldschmidt, Lior Shafir, Gafnit Avraham, Avraham Shalev</i>	
HGDOM: HETEROGENEOUS GRAPH CONVOLUTIONAL NETWORKS FOR MALICIOUS DOMAIN DETECTION	355
<i>Xiaoqing Sun, Jiahai Yang, Zhiliang Wang, Heng Liu</i>	
ELASTICSDK: A MONITORING SOFTWARE DEVELOPMENT KIT FOR ENABLING DATA-DRIVEN MANAGEMENT AND CONTROL IN 5G	364
<i>Xenofon Vasilakos, Berkay Köksal, Dwi Hartati Izaldi, Navid Nikaein, Robert Schmidt, Nasim Ferdosian, Riri Fitri Sari, Ray-Guang Cheng</i>	
HIGH-PRECISION LATENCY FORWARDING OVER PACKET-PROGRAMMABLE NETWORKS.....	371
<i>Alexander Clemm, Toerless Eckert</i>	
OPTIMIZING THE FLEXIBILITY OF SDN CONTROL PLANE	379
<i>Mu He, Mei-Yuan Huang, Wolfgang Kellerer</i>	
CYBER SITUATION AWARENESS VIA IP FLOW MONITORING.....	388
<i>Tomas Jirsik, Pavel Celeda</i>	

DDOS ATTACKS DETECTION WITH AUTOENCODER	394
<i>Kun Yang, Junjie Zhang, Yang Xu, Jonathan Chao</i>	
A ONEM2M INTRUSION DETECTION AND PREVENTION SYSTEM BASED ON EDGE MACHINE LEARNING	403
<i>Nadia Chaabouni, Mohamed Mosbah, Akka Zemmari, Cyrille Sauvignac</i>	
IOT OR NOT: IDENTIFYING IOT DEVICES IN A SHORT TIME SCALE	410
<i>Anat Bremler-Barr, Haim Levy, Zohar Yakhini</i>	
COST-AWARE PLACEMENT AND CHAINING OF SERVICE FUNCTION CHAIN WITH VNF INSTANCE SHARING.....	419
<i>Hantao Guo, Ying Wang, Zifan Li, Xuesong Qiu, Hengbin An, Peng Yu, Ningcheng Yuan</i>	
BLOCKCHAIN BASED DECENTRALIZED FRAMEWORK FOR ENERGY DEMAND RESPONSE MARKETPLACE.....	427
<i>Varun Deshpande, Laurent George, Hakim Badis, Alemayehu Addisu Desta</i>	
INTEGRATING SMART PRODUCTION PLANNING INTO SMART PRODUCTION.....	436
<i>Tobias Vogel, Benjamin Gernhardt, Matthias Hemmje</i>	
AUTOMATED GENERATION OF AVAILABILITY MODELS FOR SFCS: THE CASE OF VIRTUALIZED IP MULTIMEDIA SUBSYSTEM.....	442
<i>Mario Di Mauro, Giovanni Galatro, Maurizio Longo, Arcangelo Palma, Fabio Postiglione, Marco Tambasco</i>	
P4STA: HIGH PERFORMANCE PACKET TIMESTAMPING WITH PROGRAMMABLE PACKET PROCESSORS	448
<i>Ralf Kundel, Fridolin Siegmund, Jeremias Blendin, Amr Rizk, Boris Koldehofe</i>	
COMPUTING AT THE EDGE: BUT, WHAT EDGE?	457
<i>Luis M. Contreras, Javier Baliosian, Pedro Martínez-Julia, Joan Serrat</i>	
DEMO: EFFICIENT MULTI-SERVICE RAN SLICE MANAGEMENT AND ORCHESTRATION.....	466
<i>Robert Schmidt, Navid Nikaein</i>	
DEEPSIP: A SYSTEM FOR PREDICTING SERVICE IMPACT OF NETWORK FAILURE BY TEMPORAL MULTIMODAL CNN.....	468
<i>Yoichi Matsuo, Tatsuaki Kimura, Ken Nishimatsu</i>	
BOTFP: FINGERPRINTS CLUSTERING FOR BOT DETECTION.....	474
<i>Agathe Blaise, Mathieu Bouet, Vania Conan, Stefano Secci</i>	
PHYSICAL LAYER ANOMALY DETECTION MECHANISMS IN IOT NETWORKS	481
<i>Pedro Martins, André B. Reis, Paulo Salvador, Susana Sargento</i>	
INDUSTRIAL GRADE METHODOLOGY FOR FIREWALL SIMULATION AND REQUIREMENTS VERIFICATION	490
<i>Ramon Barakat, Faruk Catal, Nikolay Tcholtchev, Yacine Rebahi, Ina Schieferdecker</i>	
TOWARDS A CLIENT-CENTRIC QOS AUTO-SCALING SYSTEM.....	497
<i>Thomas Lin, Alberto Leon-Garcia</i>	
SCAN CORRELATION – REVEALING DISTRIBUTED SCAN CAMPAIGNS.....	506
<i>Steffen Haas, Florian Wilkens, Mathias Fischer</i>	

AUTOMATED KEYWORD EXTRACTION FROM "ONE-DAY" VULNERABILITIES AT DISCLOSURE	512
<i>Clément Elbaz, Louis Rilling, Christine Morin</i>	
INTENT-BASED ORCHESTRATION OF NETWORK SLICES AND RESOURCE ASSURANCE USING MACHINE LEARNING	521
<i>Talha Ahmed Khan, Asif Mehmood, Javier Jose Diaz Ravera, Afaq Muhammad, Khizar Abbas, Wang-Cheol Song</i>	
HIERARCHICAL CONGESTION CONTROL (HCC): COOPERATION OF UNCORRELATED FLOWS FOR BETTER FAIRNESS AND THROUGHPUT	523
<i>Shiva Ketabi, Yashar Ganjali</i>	
AI ENABLED RESOURCE ALLOCATION IN FUTURE MOBILE NETWORKS	528
<i>Umer Rehman Mughal, Manzoor Ahmed Khan, Azam Beg, Ghulam Qadir Mughal</i>	
ESTIMATING LOGARITHMIC AND EXPONENTIAL FUNCTIONS TO TRACK NETWORK TRAFFIC ENTROPY IN P4.....	534
<i>Damu Ding, Marco Savi, Domenico Siracusa</i>	
EXPLOITING CASE BASED REASONING TO AUTOMATE MANAGEMENT OF NETWORK SLICES.....	543
<i>Pedro Martinez-Julia, Jose Ordonez-Lucena, Ved P. Kafle, Hitoshi Asaeda, Diego Lopez</i>	
DESIGN AND IMPLEMENTATION OF AN ELASTIC MONITORING ARCHITECTURE FOR CLOUD NETWORK SLICES	549
<i>André Beltrami, Paulo D. Maciel, Francesco Tusa, Celso Cesila, Christian Rothenberg, Rafael Pasquini, Fábio L. Verdi</i>	
IS IT TIME FOR A 999-LIKE (OR 112/911) SYSTEM FOR CRITICAL INFORMATION SERVICES?	556
<i>Emeka Obiodu, Nishanth Sastry, Aravindh Raman</i>	
ACCUPIPE: ACCURATE HEAVY FLOW DETECTION IN THE DATA PLANE USING PROGRAMMABLE SWITCHES	562
<i>Yang Guo, Franklin Liu, An Wang, Hang Liu</i>	
NEW IP FRAMEWORK AND PROTOCOL FOR FUTURE APPLICATIONS.....	567
<i>Zhe Chen, Chuang Wang, Guanwen Li, Zhe Lou, Sheng Jiang, Alex Galis</i>	
A CLOUD-AGNOSTIC FRAMEWORK TO ENABLE COST-AWARE SCHEDULING OF APPLICATIONS IN A MULTI-CLOUD ENVIRONMENT	572
<i>Fan Jiang, Kyle Ferriter, Claris Castillo</i>	
TOWARDS EFFICIENT AND ADAPTABLE MONITORING OF SOFTWAREZED MOBILE NETWORKS.....	581
<i>Alan Plascinskas, Xenofon Foukas, Mahesh K. Marina</i>	
REINFORCING CLOUD ENVIRONMENTS VIA INDEX POLICY FOR BURSTY WORKLOADS	587
<i>Venkatraman Balasubramanian, Moayad Aloqaily, Olufogorehan Tunde-Onadele, Zhengyu Yang, Martin Reisslein</i>	
PERFECT IS THE ENEMY OF GOOD: LLOYD-MAX QUANTIZATION FOR RATE ALLOCATION IN CONGESTION CONTROL PLANE	594
<i>Shiva Ketabi, Yashar Ganjali</i>	

MODEL-BASED DESIGN OF A ROADSIDE UNIT FOR EMERGENCY AND DISASTER MANAGEMENT	603
<i>Nur Hilal, Arda Yurdakul</i>	
LEARNING A CONFIGURABLE DEPLOYMENT DESCRIPTORS MODEL IN NFV	609
<i>Wassim Sellil Atoui, Nour Assy, Walid Gaaloul, Imen Grida Ben Yahia</i>	
MICRORCA: ROOT CAUSE LOCALIZATION OF PERFORMANCE ISSUES IN MICROSERVICES	618
<i>Li Wu, Johan Tordsson, Erik Elmroth, Odej Kao</i>	
SIMPLIFICATION OF THE DESIGN, DEPLOYMENT, AND TESTING OF 5G VERTICAL SERVICES	627
<i>Mauro Femminella, Matteo Pergolesi, Gianluca Reali</i>	
FROM 2D TO NEXT GENERATION VR/AR VIDEOS: ENABLING EFFICIENT STREAMING VIA QOE-AWARE MOBILE NETWORKS	634
<i>Roberto I. T. Da Costa Filho, Filip De Turck, Luciano Paschoal Gaspary</i>	
AIOS: AN INTELLIGENCE LAYER FOR SD-WLANS	640
<i>Estefanía Coronado, Abin Thomas, Suzan Bayhan, Roberto Riggio</i>	
DISTRIBUTED DDOS DEFENSE:A COLLABORATIVE APPROACH AT INTERNET SCALE	649
<i>Jessica Steinberger, Anna Sperotto, Harald Baier, Aiko Pras</i>	
LOCHIP: A DISTRIBUTED COLLABORATIVE CACHE MANAGEMENT SCHEME AT THE NETWORK EDGE	655
<i>Junaid Ahmed Khan, Cedric Westphal, J. J. Garcia-Luna-Aceves, Yacine Ghamri-Doudane</i>	
CITRUS: ORCHESTRATING SECURITY MECHANISMS VIA ADVERSARIAL DECEPTION.....	662
<i>Ryan Mills, Nicholas Race, Matthew Broadbent</i>	
SCALABLE MONITORING HEURISTICS FOR IMPROVING NETWORK LATENCY	666
<i>M. Mouchet, M. Randall, M. Ségneré, I. Amigo, P. Belzarena, O. Brun, B. Prabhu, S. Vaton</i>	
COMPARATIVE ANALYSIS OF NETWORK FAULT CLASSIFICATION USING MACHINE LEARNING.....	675
<i>Junichi Kawasaki, Genichi Mouri, Yusuke Suzuki</i>	
IS THE UPLINK ENOUGH? ESTIMATING VIDEO STALLS FROM ENCRYPTED NETWORK TRAFFIC.....	681
<i>Frank Loh, Florian Wamser, Christian Moldovan, Bernd Zeidler, Dimitrios Tsilimantos, Stefan Valentin, Tobias Hoßfeld</i>	
PERFORMABILITY MANAGEMENT OF SOFTWAREZIZED IP MULTIMEDIA SUBSYSTEM	690
<i>Mario Di Mauro, Giovanni Galatro, Maurizio Longo, Fabio Postiglione, Marco Tambasco</i>	
HARDENING X.509 CERTIFICATE ISSUANCE USING DISTRIBUTED LEDGER TECHNOLOGY	696
<i>Holger Kinkel, Richard Von Seck, Christoph Rudolf, Georg Carle</i>	
A SERVICE MIGRATION METHOD BASED ON DYNAMIC AWARENESS IN MOBILE EDGE COMPUTING.....	702
<i>Menglei Zhang, Haoqiu Huang, Lanlan Rui, Guo Hui, Ying Wang, Xuesong Qiu</i>	

IMPROVEMENTS TO MULTIMEDIA CONTENT DELIVERY OVER IEEE 802.11 NETWORKS.....	709
<i>Estefanía Coronado, José Villalón, Antonio Garrido</i>	
IMPLEMENTING A SECURITY POLICY MANAGEMENT FOR 5G CUSTOMER EDGE NODES.....	715
<i>Hammad Kabir, Muhammad Hassaan Bin Mohsin, Raimo Kantola</i>	
LOAD MIGRATION IN DISTRIBUTED SDN CONTROLLERS.....	723
<i>Mohammad Amin Beiruti, Yashar Ganjali</i>	
A PROACTIVE CACHE PRIVACY ATTACK ON NDN	732
<i>Alberto Compagno, Mauro Conti, Eleonora Losiouk, Gene Tsudik, Sebastiano Valle</i>	
A NETWORK EMULATOR FOR HIGH-PRECISION LATENCY FORWARDING OVER PACKET-PROGRAMMABLE NETWORKS (DEMO PAPER).....	739
<i>Alexander Clemm, Toerless Eckert</i>	
ENABLING ELASTICITY CONTROL FUNCTIONS FOR CLOUD-NETWORK SLICE-DEFINED DOMAINS	741
<i>Alisson Medeiros, Augusto Neto, Silvio Sampaio, Rafael Pasquini, Javier Baliosian</i>	
GRAPH-BASED EVALUATION OF PROBABILITY OF DISCLOSING THE NETWORK STRUCTURE BY TARGETED ATTACKS.....	748
<i>Andrei Privalov, Ekaterina Skudneva, Igor Kotenko, Igor Saenko</i>	
ANALYSIS OF SMART GRID FAULT RECOVERY PROTOCOLS	754
<i>Luana Uchôa, Silvio Quincozes, Juan Lucas Vieira, Diego Passos, Célio Albuquerque, Daniel Mosse</i>	
INTRUSION DETECTION SYSTEM USING SEMI-SUPERVISED LEARNING WITH ADVERSARIAL AUTO-ENCODER.....	762
<i>Kazuki Hara, Kohei Shiimoto</i>	
DELAY-AWARE NFV RESOURCE ALLOCATION WITH DEEP REINFORCEMENT LEARNING.....	770
<i>Ningcheng Yuan, Wenchen He, Jing Shen, Xuesong Qiu, Shaoyong Guo, Wenjing Li</i>	
END-TO-END MOBILE NETWORK SLICE EMBEDDING LEVERAGING EDGE COMPUTING	777
<i>Andrea Fendt, Christian Mannweiler, Katja Ludwig, Lars Christoph Schmelz, Bernhard Bauer</i>	
5G CLOUD-NATIVE: NETWORK MANAGEMENT & AUTOMATION.....	784
<i>Osama Arouk, Navid Nikaein</i>	
ADAPTIVE SCALING OF KUBERNETES PODS.....	786
<i>David Balla, Csaba Simon, Markosz Maliosz</i>	
PLEBEUS: A POLICY-BASED BLOCKCHAIN SELECTION FRAMEWORK.....	791
<i>Eder J. Scheid, Daniel Lakic, Bruno B. Rodrigues, Burkhard Stiller</i>	
PREDICTING ROUND-TRIP TIME DISTRIBUTIONS IN IOT SYSTEMS USING HISTOGRAM ESTIMATORS	799
<i>Christofer Flinta, Wenqing Yan, Andreas Johnsson</i>	

A MACHINE LEARNING-BASED FRAMEWORK TO ESTIMATE THE LIFETIME OF NETWORK LINE CARDS.....	808
<i>Juan Luis Herrera, Marco Polverini, Jaime Galán-Jiménez</i>	
A PROCESS MINING TOOL FOR SUPPORTING IOT SECURITY	813
<i>Adrien Hemmer, Rémi Badonnel, Jérôme François, Isabelle Chrisment</i>	
CONTEXT AND LOCATION AWARENESS IN ECO-DRIVING RECOMMENDATIONS.....	815
<i>André Campolina, Azzedine Boukerche, Antonio A. F. Loureiro</i>	
EDGE CONCIERGE: DEMOCRATIZING COST-EFFECTIVE AND FLEXIBLE NETWORK OPERATIONS USING NETWORK LAYER AI AT PRIVATE NETWORK EDGES	821
<i>Anan Sawabe, Takanori Iwai, Kozo Satoda, Akihiro Nakao</i>	
DEMO: DEPLOYING TRANSPARENT APPLICATIONS AT THE NETWORK EDGES WITH LIGHTEDGE	828
<i>Estefanía Coronado, Zarrar Yousaf, Roberto Riggio</i>	
CLUSTERING IOT MALWARE BASED ON BINARY SIMILARITY	830
<i>Márton Bak, Dorottya Papp, Csongor Tamás, Levente Buttyán</i>	
GOING BEYOND DIFFSERV IN IP TRAFFIC CLASSIFICATION.....	836
<i>Davide Aureli, Antonio Cianfrani, Alessio Diamanti, José Manuel Sanchez Vilchez, Stefano Secci</i>	
OVS-DPDK PORT MIRRORING VIA NIC OFFLOADING.....	842
<i>Liang-Min Wang, Tim Miskell, Patrick Fu, Cunming Liang, Edwin Verplanke</i>	
TOWARDS A FRAMEWORK FOR AUTOMATIC FIREWALLS CONFIGURATION VIA ARGUMENTATION REASONING	844
<i>Erisa Karafili, Fulvio Valenza, Yichen Chen, Emil C. Lupu</i>	
ON THE DETECTION OF PERSISTENT ATTACKS USING ALERT GRAPHS AND EVENT FEATURE EMBEDDINGS	848
<i>Benjamin Burr, Shelly Wang, Geoff Salmon, Hazem Soliman</i>	
ALLOCATING AND SCHEDULING MEASUREMENT APPLICATIONS	852
<i>Raquel Rugani Lage, Anthony Lambert</i>	
FLEXIBLE CONTENT-BASED PUBLISH/SUBSCRIBE OVER PROGRAMMABLE DATA PLANES	861
<i>Ralf Kundel, Christoph Gärtner, Manisha Luthra, Sukanya Bhowmik, Boris Koldehofe</i>	
RAIN: TOWARDS REAL-TIME CORE DEVICES ANOMALY DETECTION THROUGH SESSION DATA IN CLOUD NETWORK	866
<i>Haoyu Liu, Chongrong Fang, Yining Qi, Jian Bai, Shaozhe Wang, Xiong Xiao, Daxiang Kang, Biao Lyu, Peng Cheng, Jiming Chen</i>	
FROM MODELS TO MANAGEMENT AND BACK: TOWARDS A SYSTEM-OF-SYSTEMS ENGINEERING TOOLCHAIN	872
<i>Géza Kulcsár, Kadosa Koltai, Szvetlin Tanyi, Bálint Péceli, Akos Horváth, Zoltán Micskei, Pál Varga</i>	
A DEVICE IDENTIFICATION METHOD BASED ON COMBINATION OF MULTIPLE INFORMATION	878
<i>Yuki Imamura, Nobuyuki Nakamura, Taketsugu Yao, Shingo Ata, Ikuo Oka</i>	

TOWARDS AN ASSET ADMINISTRATION SHELL SCENARIO: A USE CASE FOR INTEROPERABILITY AND STANDARDIZATION IN INDUSTRY 4.0.....	882
<i>Miguel A. Iñigo, Alain Porto, Blanca Kremer, Alain Perez, Felix Larrinaga, Javier Cuenca</i>	
MODELLING MOBILE TRAFFIC PATTERNS USING A GENERATIVE ADVERSARIAL NEURAL NETWORKS.....	888
<i>Bo Ma, Bowei Yang, Zitian Zhang, Jie Zhang</i>	
TOWARDS DETECTING DNSSEC VALIDATION FAILURE WITH PASSIVE MEASUREMENTS	895
<i>Kensuke Fukuda, Yoshiro Yoneya, Takeshi Mitamura</i>	
DEMO: NFV-BASED IOT SECURITY AT THE ISP LEVEL	901
<i>Yehuda Afek, Anat Bremler-Barr, David Hay, Lior Shafir, Ihab Zhaika</i>	
NETWORK SERVICE EMBEDDING WITH MULTIPLE RESOURCE DIMENSIONS	903
<i>Angelos Pentelas, George Papathanail, Ioakeim Fotoglou, Panagiotis Papadimitriou</i>	
MIKROTIK DEVICES LANDSCAPE, REALISTIC HONEYPOTS, AND AUTOMATED ATTACK CLASSIFICATION.....	912
<i>João M. Ceron, Christian Scholten, Aiko Pras, Jair Santanna</i>	
SHARING INCENTIVE MECHANISM, TASK ASSIGNMENT AND RESOURCE ALLOCATION FOR TASK OFFLOADING IN VEHICULAR MOBILE EDGE COMPUTING	921
<i>Tra H. T. Le, Nguyen H. Tran, Yan Kyaw Tun, Oanh T. T. Kim, Kitae Kim, Choong S. Hong</i>	
A NOVEL FLOW-LEVEL SESSION DESCRIPTOR WITH APPLICATION TO OS AND BROWSER IDENTIFICATION	929
<i>Omar Richardson, Johan Garcia</i>	
FEW-SHOT LEARNING FOR ENODEB PERFORMANCE METRIC ANALYSIS FOR SERVICE LEVEL ASSURANCE IN LTE NETWORKS.....	938
<i>Shogo Aoki, Kohei Shimoto, Chin Lam Eng, Sebastian Backstad</i>	
TOWARDS ADVERSARIAL RESILIENCE IN PROACTIVE DETECTION OF BOTNET DOMAIN NAMES BY USING MTD	942
<i>Christian Dietz, Gabi Dreo, Anna Sperotto, Aiko Pras</i>	
AUTOMATED OPTIMAL FIREWALL ORCHESTRATION AND CONFIGURATION IN VIRTUALIZED NETWORKS	947
<i>Daniele Bringhenti, Guido Marchetto, Riccardo Sisto, Fulvio Valenza, Jalolliddin Yusupov</i>	
AN ENGINEERING PROCESS MODEL FOR MANAGING A DIGITALISED LIFE-CYCLE OF PRODUCTS IN THE INDUSTRY 4.0	954
<i>Gianvito Urgese, Paolo Azzoni, Jan Van Deventer, Jerker Delsing, Enrico Macii</i>	
PROGRAMMABLE AND AUTOMATED DEPLOYMENT OF TENANT-MANAGED SDN NETWORK SLICES.....	960
<i>M. Gharbaoui, B. Martini, P. Castoldi</i>	
A DYNAMIC DECENTRALIZED TRAFFIC LIGHT MANAGEMENT SYSTEM: A TCP INSPIRED APPROACH.....	966
<i>Omar Hiari, Ibraheem Nofal</i>	
LEVERAGING ECLIPSE IOT IN THE ARROWHEAD FRAMEWORK.....	970
<i>Lukas Römer, Sven Erik Jeroschewski, Johannes Kristan</i>	

PADDY: AN EVENT LOG PARSING APPROACH USING DYNAMIC DICTIONARY	976
<i>Shaohan Huang, Yi Liu, Carol Fung, Rong He, Yining Zhao, Hailong Yang, Zhongzhi Luan</i>	
STARC: LOW-POWER DECENTRALIZED COORDINATION PRIMITIVE FOR VEHICULAR AD-HOC NETWORKS	984
<i>Patrick Rathje, Valentin Poirot, Olaf Landsiedel</i>	
CHARACTERISING NETWORK-CONNECTED DEVICES USING AFFILIATION GRAPHS.....	990
<i>Kyle Millar, Adriel Cheng, Hong Gunn Chew, Cheng-Chew Lim</i>	
DDOS MITIGATION: A MEASUREMENT-BASED APPROACH.....	996
<i>Mattijs Jonker, Anna Sperotto, Aiko Pras</i>	
NETWORK MONITORING AND ENUMERATING VULNERABILITIES IN LARGE HETEROGENEOUS NETWORKS.....	1002
<i>Martin Laštovicka, Martin Husák, Lukáš Sadlek</i>	
OPENFLOW ENABLED INTEGRATED ROUTING AND BRIDGING OVER ETHERNET VIRTUAL PRIVATE NETWORKS.....	1008
<i>Panagiotis Karamichailidis, Kostas Choumas, Thanasis Korakis</i>	
DISTRIBUTED REAL-TIME FORECASTING FRAMEWORK FOR IOT NETWORK AND SERVICE MANAGEMENT.....	1013
<i>Diogo Ferreira, Carlos Senna, Susana Sargento</i>	
A HYBRID GAME THEORY AND REINFORCEMENT LEARNING APPROACH FOR CYBER-PHYSICAL SYSTEMS SECURITY.....	1017
<i>Joseph Houry, Mohamed Nassar</i>	
PROCESS MINING-BASED APPROACH FOR INVESTIGATING MALICIOUS LOGIN EVENTS.....	1026
<i>Sofiane Lagraa, Radu State</i>	
DATA QUALITY MAXIMIZATION FOR MOBILE CROWDSENSING.....	1031
<i>Cheng Zhang, Noriaki Kamiyama</i>	
RELIABLE NETWORK SLICES BASED ON ELASTIC NETWORK RESOURCE DEMAND.....	1038
<i>Gabriel Da Silva, Dyego Oliveira, Rafael L. Gomes, Luiz F. Bittencourt, Edmundo R. M. Madeira</i>	
BLOCKCHAIN SOLUTION FOR IOT-BASED CRITICAL INFRASTRUCTURES: BYZANTINE FAULT TOLERANCE.....	1047
<i>Omar Alfandi, Safa Otoum, Yaser Jararweh</i>	
USING TLS FINGERPRINTS FOR OS IDENTIFICATION IN ENCRYPTED TRAFFIC	1051
<i>Martin Laštovicka, Stanislav Špacek, Petr Velan, Pavel Celeda</i>	
MEGALOS: A SCALABLE ARCHITECTURE FOR THE VIRTUALIZATION OF NETWORK SCENARIOS.....	1057
<i>Mariano Scazzariello, Lorenzo Ariemma, Giuseppe Di Battista, Maurizio Patrignani</i>	
EFFICIENT REAL-TIME TRAFFIC GENERATION FOR 5G RAN.....	1064
<i>Diarmuid Corcoran, Per Kreuger, Christian Schulte</i>	
DECISION SUPPORT FOR MISSION-CENTRIC NETWORK SECURITY MANAGEMENT.....	1073
<i>Michal Javorník, Jana Komárková, Lukáš Sadlek, Martin Husák</i>	

USING MACHINE LEARNING TO ESTIMATE THE OPTIMAL TRANSMISSION RANGE FOR RPL NETWORKS	1079
<i>Moussa Aboubakar, Mounir Kellil, Abdelmadjid Bouabdallah, Pierre Roux</i>	
PREDICTING INTERNET OF THINGS DATA TRAFFIC THROUGH LSTM AND AUTOREGRESSIVE SPECTRUM ANALYSIS	1084
<i>Yuhong Li, Di Jin, Bailin Wang, Xiang Su, Jukka Riekkki, Chao Sun, Hanyu Wei, Hao Wang, Lei Han</i>	
VALUE OF INFORMATION BASED OPTIMAL SERVICE FABRIC MANAGEMENT FOR FOG COMPUTING	1092
<i>Filippo Poltronieri, Mauro Tortonesi, Alessandro Morelli, Cesare Stefanelli, Niranjana Suri</i>	
ANOMALY PREDICTION IN MOBILE NETWORKS : A DATA DRIVEN APPROACH FOR MACHINE LEARNING ALGORITHM SELECTION.....	1101
<i>Imed Hadj-Kacem, Sana Ben Jemaa, Sylvain Allio, Yosra Ben Slimen</i>	
TOWARDS A DYNAMIC POLICY ENHANCED INTEGRATED SECURITY ARCHITECTURE FOR SDN INFRASTRUCTURE	1108
<i>Kallol Krishna Karmakar, Vijay Varadharajan, Uday Tupakula, Michael Hitchens</i>	
5G QOS: IMPACT OF SECURITY FUNCTIONS ON LATENCY	1117
<i>Sebastian Gallenmüller, Johannes Naab, Iris Adam, Georg Carle</i>	
A SCALABLE SON COORDINATION FRAMEWORK FOR 5G.....	1126
<i>Diego Fernando Preciado Rojas, Andreas Mitschele-Thiel</i>	
UNAVAILABILITY-AWARE SHARED VIRTUAL BACKUP ALLOCATION MODEL FOR MIDDLEBOXES	1134
<i>Fujun He, Eiji Oki</i>	
ENVIRONMENT MODELING AND ABSTRACTION OF NETWORK STATES FOR COGNITIVE FUNCTIONS	1141
<i>Stephen S. Mwanje, Márton Kajó, Sayantini Majumdar, Georg Carle</i>	
UNVEILING THE FEATURES OF NETWORK DYNAMICS: A DATA-ORIENTED APPROACH.....	1149
<i>Shibo Lu, Daphne Tuncer, Stuart Clayman</i>	
IMPACT OF FALSE DATA INJECTION ATTACKS ON DEEP LEARNING ENABLED PREDICTIVE ANALYTICS	1154
<i>Gautam Raj Mode, Prasad Calyam, Khaza Anuarul Hoque</i>	
SCALABLE TRAFFIC ENGINEERING FOR HIGHER THROUGHPUT IN HEAVILY-LOADED SOFTWARE DEFINED NETWORKS	1161
<i>Che Zhang, Shiwei Zhang, Yi Wang, Weichao Li, Bo Jin, Ricky K. P Mok, Qing Li, Hong Xu</i>	
ALL THAT GLITTERS IS NOT BITCOIN – UNVEILING THE CENTRALIZED NATURE OF THE BTC (IP) NETWORK	1168
<i>Sami Ben Mariem, Pedro Casas, Matteo Romiti, Benoit Donnet, Rainer Stütz, Bernhard Haslhofer</i>	
RAPID DETECTION AND LOCALIZATION OF GRAY FAILURES IN DATA CENTERS VIA IN-BAND NETWORK TELEMETRY.....	1177
<i>Chenhao Jia, Tian Pan, Zizheng Bian, Xingchen Lin, Enge Song, Cheng Xu, Tao Huang, Yunjie Liu</i>	

SEMANTIC FEATURE SELECTION FOR NETWORK TELEMETRY EVENT DESCRIPTION	1186
<i>Thomas Feltin, Parisa Foroughi, Wenqin Shao, Frank Brockners, Thomas H. Clausen</i>	
ADJUSTED LOCATION PRIVACY SCHEME FOR VANET SAFETY APPLICATIONS.....	1192
<i>Ruqayah Al-Ani, Bo Zhou, Qi Shi, Thar Baker, Mohamed Abdlhamed</i>	
DEEP CLUSTERING OF MOBILE NETWORK DATA WITH SPARSE AUTOENCODERS	1196
<i>Márton Kajó, Benedek Schultz, Georg Carle</i>	
A PRIVACY-AWARE COLLABORATIVE DDOS DEFENCE NETWORK.....	1202
<i>Carol Fung, Yadunandan Pillai</i>	
SSH KERNEL: A JUPYTER EXTENSION SPECIFICALLY FOR REMOTE INFRASTRUCTURE ADMINISTRATION	1207
<i>Masaru Ueno, Yuji Imai</i>	
ON THE IMPLEMENTATION OF MATCHING THEORY BASED RESOURCE ALLOCATION IN NETWORKING TESTBEDS.....	1212
<i>Donatos Stavropoulos, Vasileios Miliotis, Thanasis Korakis, Leandros Tassiulas</i>	
AN EMPIRICAL STUDY OF THE EFFECTIVENESS OF FALLBACK ON THE ECN.....	1214
<i>Linzhi Zoul, Chun-Xiang Chenl, Kenichi Nagaoka</i>	
MOVING TARGET DEFENSE FOR VIRTUAL NETWORK FUNCTIONS	1218
<i>Reuven Peretz, Shlomo Shenzis, David Hay</i>	
THE RISE OF EBPF FOR NON-INTRUSIVE PERFORMANCE MONITORING.....	1227
<i>Cyril Cassagnes, Lucian Trestioreanu, Clement Joly, Radu State</i>	
UNSUPERVISED DETECTION OF ANOMALOUS BEHAVIOR IN WIRELESS DEVICES BASED ON AUTO-ENCODERS.....	1234
<i>A. Albasir, Q. Hu, M. Al-Tekreeti, K. Naik, N. Naik, A. J. Kozłowski, N. Goel</i>	
NETWORK SLICE MANAGEMENT ON TOP OF ONAP	1241
<i>Veronica Quintuna Rodriguez, Fabrice Guillemin, Amina Boubendir</i>	
COSMOS: AN ORCHESTRATION FRAMEWORK FOR SMART COMPUTATION OFFLOADING IN EDGE CLOUDS.....	1243
<i>George Papathanail, Ioakeim Fotoglou, Christos Demertzis, Angelos Pentelas, Kyriakos Sgouromitis, Panagiotis Papadimitriou, Dimitrios Spatharakis, Ioannis Dimolitsas, Dimitrios Dechouniotis, Symeon Papavassiliou</i>	
PROTECTING HOME NETWORKS FROM INSECURE IOT DEVICES	1249
<i>Elmer Lastdrager, Cristian Hesselman, Jelte Jansen, Marco Davids</i>	
ONLINE MONITORING OF TCP THROUGHPUT LIMITATIONS.....	1255
<i>Simon Bauer, Kilian Holzinger, Benedikt Jaeger, Paul Emmerich, Georg Carle</i>	
COMMUNITY CLEANUP: INCENTIVIZING NETWORK HYGIENE VIA DISTRIBUTED ATTACK REPORTING	1264
<i>Yu Liu, Craig A. Shue</i>	
COST-AND-QOS-BASED NFV SERVICE FUNCTION CHAIN MAPPING MECHANISM.....	1273
<i>Yimin Li, Lifang Gao, Siya Xu, Qinghai Ou, Xinyu Yuan, Feng Qi, Shaoyong Guo, Xuesong Qiu</i>	

PRIME: PROGRAMMING IN-NETWORK MODULAR EXTENSIONS	1282
<i>Ricardo Parizotto, Lucas Castanheira, Fernanda Bonetti, Anderson Santos, Alberto Schaeffer-Filho</i>	
TOWARDS IMPROVED FAULT LOCALIZATION USING TRANSFER LEARNING AND LANGUAGE MODELING.....	1291
<i>Yusufu Shehu, Robert Harper</i>	
LOGISIG: AUTOMATIC INTERACTION DETECTION IN SOFTWARE-BASED NETWORKS	1297
<i>Daphne Tuncer, Marinos Charalambides</i>	
TWO DECADES OF AI4NETS - AI/ML FOR DATA NETWORKS: CHALLENGES & RESEARCH DIRECTIONS	1306
<i>Pedro Casas</i>	

Author Index