Innovative Mobile and Internet Services in Ubiquitous Computing: Proceedings of the 12th International Conference on Innovative Mobile and Internet Services ... Intelligent Systems and Computing Book 773)

Pages: 950
Publisher: Springer; 1st ed. 2019 edition (June 7, 2018)
Format: pdf, epub
Language: English

Volume 773Advances in Intelligent Systems and ComputingSeries EditorJanuszÂ Kacprzyk Polish Academy of Sciences, Warsaw, PolandThe series â€œAdvances in Intelligent Systems and Computingâ€• contains publications on theory, applications, and design methods of Intelligent Systems and Intelligent Computing. Virtually all disciplines such as engineering, natural sciences, computer and information science, ICT, economics, business, e-commerce, environment, healthcare, life science are covered. The list of topics spans all the areas of modern intelligent systems and computing such as: computational intelligence, soft computing including neural networks, fuzzy systems, evolutionary computing and the fusion of these paradigms, social intelligence, ambient intelligence, computational neuroscience, artificial life, virtual worlds and society, cognitive science and systems, Perception and Vision, DNA and immune based systems, self-organizing and adaptive systems, e-Learning and teaching, human-centered and human-centric computing, recommender systems, intelligent control, robotics and mechatronics including human-machine teaming, knowledge-based paradigms, learning paradigms, machine ethics, intelligent data analysis, knowledge management, intelligent agents, intelligent decision making and support, intelligent network security, trust management, interactive entertainment, Web intelligence and multimedia.The publications within â€œAdvances in Intelligent Systems and Computingâ€• are primarily proceedings of important conferences, symposia and congresses. They cover significant recent developments in the field, both of a foundational and applicable character. An important characteristic feature of the series is the short publication time and world-wide distribution. This permits a rapid and broad dissemination of research results. *Advisory Board* ChairmanNikhil R. Pal, Indian Statistical Institute, Kolkata, Indiae-mail: nikhil@isical.ac.inMembersRafael Bello Perez, Universidad Central â€œMarta Abreuâ€• de Las Villas, Santa Clara, Cubae-mail: rbellop@uclv.edu.cuEmilio S. Corchado, University of Salamanca, Salamanca, Spaine-mail: escorchado@usal.esHani Hagras, University of Essex, Colchester, UKe-mail: hani@essex.ac.ukLÃ¡szlÃ³ T. KÃ³czy, SzÃ©chenyi IstvÃ¡n University, GyÅ‘r, Hungarye-mail: koczy@sze.huVladik Kreinovich, University of Texas at El Paso, El Paso, USAe-mail: vladik@utep.eduChin-Teng Lin, National Chiao Tung University, Hsinchu, Taiwane-mail: ctlin@mail.nctu.edu.twJie Lu, University of Technology, Sydney, Australiae-mail: Jie.Lu@uts.edu.auPatricia Melin, Tijuana Institute of Technology, Tijuana, Mexicoe-mail: epmelin@hafsamx.orgNadia Nedjah, State University of Rio de Janeiro, Rio de Janeiro, Brazile-mail: nadia@eng.uerj.brNgoc Thanh Nguyen, Wroclaw University of

Technology, Wroclaw, Polande-mail: Ngoc-Thanh.Nguyen@pwr.edu.plJun Wang, The Chinese University of Hong Kong, Shatin, Hong Konge-mail: jwang@mae.cuhk.edu.hk
More information about this series at http://â€‹www.â€‹springer.â€‹com/â€‹series/â€‹11156 *EditorsLeonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya EnokidoInnovative Mobile and Internet Services in Ubiquitous ComputingProceedings of the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018)*EditorsLeonardÂ Barolli
Department of Information and Communication Engineering, Fukuoka Institute of Technology, Fukuoka, JapanFatosÂ Xhafa
Technical University of Catalonia, Barcelona, SpainNadeemÂ Javaid
Department of Computer Science, COMSATS Institute of Information Technology, Islamabad, PakistanTomoyaÂ Enokido
Rissho University, Tokyo, JapanISSN 2194-5357e-ISSN 2194-5365Advances in Intelligent Systems and Computing ISBN 978-3-319-93553-9e-ISBN 978-3-319-93554-6
https://doi.org/10.1007/978-3-319-93554-6Library of Congress Control Number: 2018946631Â© Welcome Message of IMIS-2018 International Conference Organizers
Welcome to the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018), which will be held from July 4th to July 6th, 2018, at Kunibiki Messe, Matsue, Japan, in conjunction with the 12th International Conference on Complex, Intelligent and Software Intensive System *s* (CISIS-2018). This International Conference focuses on the challenges and solutions for Ubiquitous and Pervasive Computing (UPC) with an emphasis on innovative, mobile, and Internet services. With the proliferation of wireless technologies and electronic devices, there is a fast-growing interest in UPC. UPC enables to create a human-oriented computing environment where computer chips are embedded in everyday objects and interact with physical world. Through UPC, people can get online even while moving around, thus having almost permanent access to their preferred services. With a great potential to revolutionize our lives, UPC also poses new research challenges. The conference provides an opportunity for academic and industry professionals to discuss the latest issues and progress in the area of UPC.For IMIS-2018, we received many paper submissions from all over the world. The papers included in the proceedings cover important aspects of UPC research domain. This year, we received 168 submissions and after a careful review process of 3 independent reviews per submission, 47 papers were accepted (about 28% acceptance rate).It is impossible to organize such a successful program without the help of many individuals. We would like to express our great appreciation to the authors of the submitted papers, the program committee members, who provided timely and significant reviews, and

special session chairs for their great efforts. We are grateful to Honorary Chair: Prof. Makoto Takizawa, Hosei University, Japan, for his advice and support.This year in conjunction with IMIS-2018 we have 7 International Workshops that complemented IMIS-2018 program with contributions for specific topics. We would like to thank the Workshop Co-chairs and all workshop organizers for organizing these workshops.We thank Donald Elmazi, Yi Liu, Miralda Cuka, and Kosuke Ozera, Fukuoka Institute of Technology, Japan, for their excellent work and support as Web Administrators.Finally, we would like to thank: Matsue City, Shimane Prefecture, Support Center for Advanced Telecommunications Technology Research (SCAT), Foundation, Japan, for their support.We hope that all of you enjoy IMIS-2018 and find this a productive opportunity to learn, exchange ideas, and make new contacts.IMIS-2018 International Conference Organizers IMIS-2018 General Chair *Leonard Barolli*

Fukuoka Institute of Technology (FIT), Japan IMIS-2018 Program Committee Co-chairs *Tomoya Enokido*

Rissho University, Japan*Nadeem Javaid*

COMSATS Institute of IT, Pakistan*Hsing-Chung Chen*

Asia University, Taiwan Welcome Message from IMIS-2018 Workshops Co-chairsWelcome to the Workshops of the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018), which will be held from July 4th to July 6th, 2018 at Kunibiki Messe, Matsue, Japan.This year we have 7 workshops, which will be held together with IMIS-2018. The objective was to complement as much as possible the main themes of IMIS-2018 with the specific topics of the different workshops to cover many topics of Ubiquitous and Pervasive Computing (UPC). The list of workshops follows below: *1. The 12th International Workshop on Advances in Information Security (WAIS-2018) 2. The 8th International Workshop on Mobile Commerce, Cloud Computing, Network and Communication Security (MCNCS-2018) 3. The 8th International Workshop on Intelligent Techniques and Algorithms for Ubiquitous Computing (ITAUC-2018) 4. The 8th international workshop on Future Internet and Next Generation Networks (FINGNet-2018) 5. The 7th International Workshop on Frontiers in Innovative Mobile and Internet Services (FIMIS-2018) 6. The 7th International Workshop on Sustainability Management of e-Business and Ubiquitous Commerce Engineering (SMEUCE-2018) 7. The 4th International Workshop on Big Data and IoT Security (BDITS-2018)* We would like to thank IMIS-2018 International Conference Organizers for their help and support. We are grateful to the workshop organizers for their great efforts and hard work in proposing the workshops, selecting the papers, organizing interesting programs, and for the arrangements of the workshops during the conference days.We are grateful to Donald Elmazi, Yi Liu, Miralda Cuka, and Kosuke Ozera, Fukuoka Institute of Technology, Japan, for their excellent work and support as Web Administrators.We hope you enjoy the workshops programs and proceedings.Workshops Co-chairs of IMIS-2018 International Conference *Hae-Duck Joshua Jeong*

Korean Bible University, Korea*Hiroaki Kikuchi*

Meiji University, Japan*Fang-Yie Leu*

Tunghai University, Taiwan IMIS-2018 Organizing CommitteeHonorary Chair *Makoto Takizawa*

Hosei University, Japan General Chair *Leonard Barolli*

Fukuoka Institute of Technology, Japan Program Committee Co-chairs ***Tomoya Enokido***

Rissho University, Japan***Nadeem Javaid***

COMSATS Institute of IT, Pakistan***Hsing-Chung Chen***

Asia University, Taiwan Workshops Co-chairs ***Hae-Duck Joshua Jeong***

Korean Bible University, Korea***Hiroaki Kikuchi***

Meiji University, Japan***Fang-Yie Leu***

Tunghai University, Taiwan Advisory Committee Members ***Vincenzo Loia***

University of Salerno, Italy***Arjan Durresi***

IUPUI, USA***Kouichi Sakurai***

Kyushu University, Japan Award Co-chairs ***Kangbin Yim***

SCH University, Korea***Antonio J. Jara***

HES-SO, Switzerland***Marek Ogiela***

AGH University of Science and Technology, Poland International Liaison Co-chairs ***Francesco Palmieri***

University of Salerno, Italy***Xiaofeng Chen***

Xidian University, China***Kin Fun Li***

University of Victoria, Canada Publicity Co-chairs ***Baojiang Cui***

Beijing Univ. of Posts and Telecom, China***Akio Koyama***

Yamagata University, Japan Local Arrangement Co-chairs ***Akimitsu Kanzaki***

Shimane University, Japan***Keita Matsuo***

Fukuoka Institute of Technology***Elis Kulla***

Okayama University of Science, Japan Web Administrators ***Donald Elmazi***

Fukuoka Institute of Technology, Japan***Yi Liu***

Fukuoka Institute of Technology, Japan***Miralda Cuka***

Fukuoka Institute of Technology, Japan***Kosuke Ozera***

Fukuoka Institute of Technology, Japan Track Areas and PC Members1. Multimedia and Web ComputingTrack Co-chairs ***Chi-Yi Lin***

Tamkang University, Taiwan***Tomoyuki Ishida***

Ibaraki University, Japan PC Members ***Noriki Uchida***

Fukuoka Institute of Technology, Japan*Tetsuro Ogi*

Keio University, Japan*Yasuo Ebara*

Kyoto University, Japan*Hideo Miyachi*

Tokyo City University, Japan*Kaoru Sugita*

Fukuoka Institute of Technology, Japan*Chia-Mu Yu*

National Chung Hsing University, Taiwan*Chih-Lin Hu*

National Central University, Taiwan*Ching-Ting Tu*

Tamkang University, Taiwan*Shih-Hao Chang*

Tamkang University, Taiwan 2. Context and Location-Aware ComputingTrack Co-chairs ***Massimo Ficco***

University of Campania Luigi Vanvitelli, Italy*Jeng-Wei Lin*

Tunghai University, Taiwan*Neil Yen*

The University of Aizu, Japan PC Members ***Paolo Bellavista***

University of Bologna, Italy*David Camacho*

Universidad AutÃ³noma de Madrid, Spain*Michal Choras*

University of Science and Technology, Poland*Gianni D'Angelo*

University of Benevento, Italy*Hung-Yu Kao*

National Cheng Kung University, Taiwan*Ray-I Chang*

National Taiwan University, Taiwan*Mu-Yen Chen*

National Taichung University of Science and Technology, Taiwan*Shian-Hua Lin*

National Chi Nan University, Taiwan*Chun-Hsin Wu*

National University of Kaohsiung, Taiwan*Sheng-Lung Peng*

National Dong Hwa University, Taiwan 3. Data Management and Big DataTrack Co-chairs ***Been-Chian Chien***

National University of Tainan, Taiwan*Akimitsu Kanzaki*

Shimane University, Japan*Wen-Yang Lin*

National University of Kaohsiung, Taiwan PC Members ***Rung-Ching Chen***

Chaoyang University of Technology, Taiwan*Mong-Fong Horng*

National Kaohsiung University of Applied Sciences, Taiwan*Bao-Rong Chang*

National University of Kaohsiung, Taiwan*Tomoki Yoshihisa*

Osaka University, Japan*Hideyuki Kawashima*

The University of Tsukuba, Japan*Pruet Boonma*

Chiang Mai University, Thailand*Wen-Yang Lin*

National University of Kaohsiung, Taiwan*Nik Bessis*

Edge Hill University, UK*James Tan*

SIM University, Singapore*Kun-Ta Chuang*

National Cheng Kung University, Taiwan*Jerry Chun-Wei Lin*

Harbin Institute of Technology Shenzhen Graduate School, China 4. Security, Trust and PrivacyTrack Co-chairs ***Tianhan Gao***

Northeastern University, China*Aniello Castiglione*

University of Salerno, Italy*Joan Arnedo Moreno*

Open University of Catalonia, Spain PC Members ***Qingshan Li***

Peking University, China*Zhenhua Tan*

Northeastern University, China*Zhi Guan*

Peking University, China*Nan Guo*

Northeastern University, China*Xibin Zhao*

Tsinghua University, China*Cristina Alcaraz*

Universidad de MÃ¡laga, Spain*Massimo Cafaro*

University of Salento, Italy*Giuseppe Cattaneo*

University of Salerno, Italy*Zhide Chen*

Fujian Normal University, China*Clara Maria*

Colombini, University of Milan, Italy*Richard Hill*

University of Derby, UK*Dong Seong Kim*

University of Canterbury, New Zealand*Victor Malyshkin*

Russian Academy of Sciences, Russia*Barbara Masucci*

University of Salerno, Italy*Arcangelo Castiglione*

University of Salerno, Italy*Xiaofei Xing*

Guangzhou University, China*Mauro Iacono*

University of Campania Luigi Vanvitelli, Italy*Joan Melià*

Universitat Oberta de Catalunya, Spain*Jordi Casas*

Universitat Oberta de Catalunya, Spain*Jordi Herrera*

Universitat AutÃ²noma de Barcelona, Spain*Antoni Martínez*

Universitat Rovira i Virgili, Spain*Francesc Sebé*

Universitat de Lleida, Spain 5. Energy Aware and Pervasive SystemsTrack Co-chairs ***Chi Lin***

Dalian University of Technology, China*Elis Kulla*

Okayama University of Science, Japan PC Members ***Jiankang Ren***

Dalian University of Technology, China*Qiang Lin*

Dalian University of Technology, China*Peng Chen*

Dalian University of Technology, China*Tomoya Enokido*

Rissho University, Japan*Makoto Takizawa*

Hosei University, Japan*Oda Tetsuya*

Okayama University of Science, Japan*Admir Barolli*

Aleksander Moisiu University of Durres, Albania*Makoto Ikeda*

Fukuoka Institute of Technology, Japan*Olivier Terzo*

Istituto Superiore Mario Boella, Italy 6. Modeling, Simulation and Performance Evaluation Track Co-chairs ***Tetsuya Shigeyasu***

Prefectural University of Hiroshima, Japan*Bhed Bahadur Bista*

Iwate Prefectural University, Japan PC Members ***Masaaki Noro***

Fujitsu Laboratory, Japan*Masaaki Yamanaka*

Japan Coast Gaurd Academy, Japan*Nobuyoshi Sato*

Iwate Prefectural University, Japan*Tetsuya Shigeyasu*

Prefectural University of Hiroshima, Japan*Jiahong Wang*

Iwate Prefectural University, Japan*Shigetomo Kimura*

University of Tsukuba, Japan*Chotipat Pornavalai*

King Mongkutâ€™s Institute of Technology Ladkrabang, Thailand*Danda B. Rawat*

Howard University, USA*Gongjun Yan*

University of Southern Indiana, USA 7. Wireless and Mobile NetworksTrack Co-chairs ***Luigi Catuogno***

University of Salerno, Italy*Hwamin Lee*

Soonchunhyang University, Korea PC Members ***Aniello Del Sorbo***

Orange Labs, Orange Innovation, UK*Clemente Galdi*

University of Naples Federico II, Italy*Stefano Turchi*

University of Florence, Italy*Ermelindo Mauriello*

Deloitte Spa, Italy*Gianluca Roscigno*

University of Salerno, Italy*DaeWon Lee*

Seokyoung University, Korea*JongHyuk Lee*

Samsung Electronics, Korea*SungHo Chin*

LG Electronics, Korea*JiSu Park*

Korea University, Korea*Jaehwa Chung*

Korea National Open University, Korea 8. Intelligent Technologies and ApplicationsTrack Co-chairs ***Marek Ogiela***

AGH University of Science and Technology, Krakow, Poland*Yong-Hwan Lee*

Wonkwang University, Korea*Hsing-Chung Chen*

Asia University, Taiwan PC Members ***Gangman Yi***

Dongguk University, Korea*Hoon Ko*

J. E. Purkinje University, Czech Republic*Lidia Ogiela*

AGH University of Science and Technology, Poland*Libor Mesicek*

J. E. Purkinje University, Czech Republic*Rung-Ching Chen*

Chaoyang University of Technology, Taiwan*Mong-Fong Horng*

National Kaohsiung University of Applied Sciences, Taiwan*Bao-Rong Chang*

National University of Kaohsiung, Taiwan*Shingo Otsuka*

Kanagawa Institute of Technology, Japan*Tomoki Yoshihisa*

Osaka University, Japan*Pruet Boonma*

Chiang Mai University, Thailand*Izwan Nizal Mohd Shaharanee*

University Utara Malaysia*Youngseop Kim*

Dankook University, Korea*Cheong-Ghil Kim*

Namseoul University, Korea*Fumitaka Ono*

Tokyo Polytechnic University, Japan*Schelkens Peter*

Vrije Universiteit Brussel, Belgium*You-Seok Won*

Uzbrainnet Inc., Korea*Zhenhua Tan*

Northeastern University, China*Tianhan Gao*

Northeastern University, China*Nan Guo*

Northeastern University, China*Yung-Fa Huang Huang*

Chaoyang University of Technology, Taiwan*Tzu-Liang Kung*

Asia University, Taiwan 9. Cloud Computing and Service-Oriented ApplicationsTrack Co-chairs ***Baojiang Ciu***

Beijing University of Posts and Telecommunications, China*Francesco Palmieri*

University of Salerno, Italy PC Members ***Aniello Castiglione***

University of Salerno, Italy*Ashiq Anjum*

University of Derby, UK*Beniamino Di Martino*

University of Campania Luigi Vanvitelli, Italy*Gang Wang*

Nankai University, China*Shaozhang Niu*

Beijing University of Posts and Telecommunications, China*Jianxin Wang*

Beijing Forestry University, China*Jie Cheng*

Shandong University, China*Shaoyin Cheng*

University of Science and Technology of China, China*Jingling Zhao*

Beijing University of Posts and Telecommunications, China*Qing Liao*

Beijing University of Posts and Telecommunications, China*Xiaohui Li*

Wuhan University of Science and Technology, China*Chunhong Liu*

Hainan Normal University, China*Yan Zhang*

Yan Hubei University, China 10. Ontology and Semantic WebTrack Co-chairs ***Alba Amato***

Italian National Research Center (CNR), Italy*Fong-Hao Liu*

National Defense University, Taiwan*Farookh Hussain*

University of Technology Sydney, Australia PC Members ***Flora Amato***

University of Naples Federico II, Italy*Claudia Di Napoli*

Italian National Research Center (CNR), Italy*Salvatore Venticinque*

University of Campania Luigi Vanvitelli, Italy*Marco Scialdone*

University of Campania Luigi Vanvitelli, Italy*Wei-Tsong Lee*

Tamkang University, Taiwan, ROC*Tin-Yu Wu*

National Ilan University, Taiwan, ROC*Liang-Chu Chen*

National Defense University, Taiwan, ROC*Omar Khadeer Hussain*

University of New South Wales, Canberra, Australia*Salem Alkhalaf*

Qassim University, Saudi Arabia*Omar Khadeer Hussain*

University of New South Wales, Canberra, Australia*Salem Alkhalaf*

Qassim University, Saudi Arabia*Osama Alfarraj*

King Saud University, Saudi Arabia*Thamer AlHussain*

Saudi Electronic University, Saudi Arabia*Mukesh Prasad*

University of Technology, Sydney, Australia 11. IoT and Opportunistic NetworkingTrack Co-chairs ***Antonio Jara***

HES-SO, Switzerland*Isaac Woungang*

Ryerson University, Canada PC Members ***Gianluca Rizzo***

HES-SO, Switzerland*Marcin Pawlowski*

Warsaw University of Technology, Poland*Gaetano Manzo*

HES-SO, Switzerland*Dominique Gabioud*

HES-SO, Switzerland*Markus Jung*

Osram, Germany*Sebastien Ziegler*

Mandat International, Switzerland*Pierre-André Mudry*

HES-SO, Switzerland*Leire Bastida*

Tecnalia, Spain*Charalampos Doukas*

CREATE-NET, Italy*Marco Fiore*

CNR, Italy*Diego Gachet*

Universidad Europea de Madrid, Spain*Dominique Genoud*

HES-SO, Switzerland*Dimosthenis Ioannidis*

CERTH-ITI, Greece*Ved Kafle*

NICT, Japan*Daeyoung Kim*

KAIST, Korea*Lambros Lambrinos*

Cyprus University of Technology, Cyprus*Pedro Malo*

Universidade Nova de Lisboa, Portugal*Septimiu Nechifor*

Siemens, Romania*Alexis Olivereau*

CEA, France*Marcin Piotr*

Jagiellonian University, Poland*Mirko Presser*

Alexandra Institute, Denmark*Martin Brynskov*

OASC, Denmark*Dario Russo*

National Research Council of Italy, Italy*Martin Serrano*

NUIG, Ireland*Felix Villanueva*

UCLM, Spain 12. Embedded Systems and Wearable ComputersTrack Co-chairs *Jiankang Ren*

Dalian University of Technology, China*Keita Matsuo*

Fukuoka Institute of Technology, Japan*Kangbin Yim*

SCH University, Korea PC Members *Xiulong Liu*

The Hong Kong Polytechnic University, Hong Kong*Yong Xie*

Xiamen University of Technology, Xiamen, China*Yang Zhao*

Tianjin University, Tianjin, China*Fangmin Sun*

Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China*Shaobo Zhang*

Central South University, Changsha, China*Kun Wang*

Liaoning Police Academy, Dalian, China IMIS-2018 ReviewersLeonard BarolliMakoto TakizawaFatos XhafaIsaac WoungangHae-Duck Joshua JeongFang-Yie LeuKangbin YimMarek OgielaMakoto IkedaKeita MatsuoFrancesco PalmieriMassimo FiccoSalvatore VenticinqueMauro MigliardiNoriki UchidaNik BessisYoshitaka ShibataKaoru SugitaAntonio J. JaraAdmir BarolliElis KullaEvjola SpahoArjan DurresiBhed BistaMuhammad YounasHsing-Chung ChenKin Fun LiHiroaki KikuchiLidia OgielaNan GuoXiaofeng ChenHwamin LeeTetsuya ShigeyasuFumiaki SatoKosuke TakanoFlorin PopFlora AmatoTomoya EnokidoMinoru UeharaSanti CaballÃ©Tomoyuki IshidaHwa Min LeeJiyoung LimTianhan GaoDanda RawatFarookh HussainJongSuk LeeOmar HussainWang Xu AnWelcome Message from WAIS-2018 International Workshop OrganizersIt is our great pleasure to welcome you to the 12th International Workshop on Advances in Information Security (WAIS-2018). The workshop is held in conjunction with 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) from July 4th to July 6th, 2018, at Kunibiki Messe, Matsue, Japan.As computing systems have begun to pervade every aspect of daily life, people need to be able to trust themâ€"so much of their lives depend on them. Today, many of these systems are far too vulnerable to cyber attacks that can inhibit their operation, corrupt valuable data, or expose private information. Future systems will include sensors and computers everywhere, exacerbating the attainment of security and privacy. Current security practices largely address current and known threats, but there is a need for research to take account of future threats too.The goal of WAIS-2018 is to bring together computer scientists, industrial engineers, and researchers to discuss and exchange experimental or theoretical results, novel designs, work-in-progress, experience, case studies, and trend-setting ideas in the area of Information Security.We would like to thank all authors for submitting their research works to the workshop and the PC Members for checking carefully the papers.We look forward to meet all of you in Matsue, Japan.WAIS-2018 Workshop Co-chairs *Leonard Barolli*

Fukuoka Institute of Technology (FIT), Japan*Arjan Durresi*

Indiana Universityâ€"Purdue University at Indianapolis (IUPUI), USA*Hiroaki Kikuchi*

Meiji University, Japan WAIS-2018 Organizing CommitteeWorkshop Co-chairs *Leonard Barolli*

Fukuoka Institute of Technology (FIT), Japan*Arjan Durresi*

Indiana Universityâ€"Purdue University at Indianapolis (IUPUI), USA*Hiroaki Kikuchi*

Meiji University, Japan Advisory Co-chairs *Makoto Takizawa*

Hosei University, Japan*Raj Jain*

Washington University in St. Louis, USA Program Committee Members *Sriram Chellappan*

Missouri University of Science and Technology, USA*Koji Chida*

NTT, Japan*Tesuya Izu*

Fujitsu Laboratories, Japan*Qijun Gu*

Texas State University, San Marcos, USA*Youki Kadobayashi*

Nara Institute of Science and Technology, Japan*Akio Koyama*

Yamagata University, Japan*Michiharu Kudo*

IBM Japan, Japan*Sanjay Kumar Madria*

Missouri University of Science and Technology, USA*Masakatsu Morii*

Kobe University, Japan*Masakatsu Nishigaki*

Shizuoka University, Japan*Vamsi Paruchuri*

University of Central Arkansas, USA*Hiroshi Shigeno*

Keio University, Japan*Yuji Suga*

Internet Initiative Japan Inc., Japan*Keisuke Takemori*

KDDI Co., Japan*Ryuya Uda*

Tokyo University of Technology, Japan*Xukai Zou*

Indiana Universityâ€“Purdue University Indianapolis, USA*Wenye Wang*

North Carolina State University, USA*Hiroshi Yoshiura*

University of Electro-Communications, Japan Welcome Message from MCNCS-2018 International Workshop ChairWelcome to the 8th International Workshop on Mobile Commerce, Cloud Computing, Network and Communication and their Securities (MCNCS-2018) which will be in conjunction with the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) from July 4th to July 6th, 2018, at Kunibiki Messe, Matsue, Japan.Computer network and communication have been a part of our everyday life. People use them to contact others almost anytime anywhere. On the other hand, hackers due to business benefits, enjoying their skill/professional achievement or some other reasons very often attack, intrude, or penetrate our systems. This is the key reason why computer/network and their securities have been the important issues in computer research. Many researchers have tried to do their best to develop system network, security techniques, and the methods to protect a system. But system attacks still occur worldwide every day. In fact, current network techniques and system security technology are still far away from convenient to use and completely secure and should be further improved.This workshop aims to present the innovative researches, methods and for mobile commerce, cloud computing, network and communication and their securities. The workshop contains high-quality research papers, which were selected carefully by Program Committee Members.It is impossible to organize such a successful program without the help of many individuals. We would like to

express our appreciation to the authors of the submitted papers and to the program committee members, who provided timely and significant reviews.We hope all of you will enjoy MCNCS-2018 and find this a productive opportunity to exchange ideas with many researchers.MCNCS-2018 International Workshop OrganizersMCNCS-2018 Workshop Co-chairs ***Fang-Yie Leu***

Tunghai University, Taiwan***Aniello Castiglione***

University of Salerno, Italy***Chu-Hsing Lin***

Tunghai University, Taiwan MCNCS-2018 Advisory Co-chairs ***Yi-Li Huang***

Tunghai University, Taiwan***Jung-Chun Liu***

Tunghai University, Taiwan***Kun-Lin Tsai***

Tunghai University, Taiwan MCNCS-2018 Organizing CommitteeWorkshop Co-chairs ***Fang-Yie Leu***

Tunghai University, Taiwan***Aniello Castiglione***

University of Salerno, Italy***Chu-Hsing Lin***

Tunghai University, Taiwan Advisory Co-chairs ***Yi-Li Huang***

Tunghai University, Taiwan***Jung-Chun Liu***

Tunghai University, Taiwan***Kun-Lin Tsai***

Tunghai University, Taiwan Program Committee Members ***Alessandra Sala***

University of California Santa Barbara, USA***Antonio Colella***

Italian Army, Italy***Chin-Cheng Lien***

Soochow University, Taiwan***Chin-Ling Chen***

Chaoyang University of Technology, Taiwan***Chiu-Ching Tuan***

National Taipei University of Technology, Taiwan***Claudio Soriente***

Universitat Politecnica de Madrid, Spain***Francesco Palmieri***

University of Salerno, Italy***Fuw-Yi Yang***

Chaoyang University of Technology, Taiwan***I-Long Lin***

Central Police University, Taiwan***Ilsun You***

Korean Bible University, Korea***Jason Ernst***

University of Guelph, Canada***Jinn-Ke Jan***

National Chung Hsing University, Taiwan*Jung-Chun Liu*

TungHai University, Taiwan*Lein Harn*

University of Missouri Kansas City, USA*Sen-Tang Lai*

Shih Chien University, Taiwan*Sergio Ricciardi*

Universitat PolitÃ¨cnica de Catalunya, Spain*Shyhtsun Felix Wu*

University of California, Davis, USA*Tzung-HerChen*

National Chiayi University, Taiwan*Ugo Fiore*

University of Naples, Italy*Heru Susanto*

University of Brunei, Brunei Welcome Message from ITACU 2018 International Workshop Co-chairsWelcome to the 8th International Workshop on Intelligent Techniques and Algorithms for Ubiquitous Computing (ITAUC-2018) which will be held in conjunction with the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) at Kunibiki Messe, Matsue, Japan, from July 4th to July 6th, 2018.The aim of this workshop is to present the innovative researches, methods, and algorithms for wireless networks, sensor networks, and ubiquitous computing. It is intended to facilitate exchange of ideas and collaborations among researchers from computer science, network computing, mathematics, statistics, intelligent computing and such related sciences, to discuss various aspects of innovative intelligent algorithms and networks security, intelligent techniques for sensor networks and radio networks, and their applications.Many people have kindly helped us to prepare and organize the ITAUC-2018 workshop. First, we highly thank the authors who submitted high-quality papers and reviewers who carefully evaluated these submissions. We thank Honorary Co-chair, General Co-chairs, PC Co-chairs, and Workshops Co-chairs of IMIS-2018 for their advice and support to make possible organization of ITAUC-2018.We hope you will enjoy the conference and have a great time in Torino, Italy.ITAUC-2018 Co-chairs ***Leonard Barolli***

Fukuoka Institute of Technology, Japan*Hsing-Chung Chen*

Asia University, Taiwan*Tzu-Liang Kung*

Asia University, Taiwan ITAUC-2018 Organizing CommitteeWorkshop Co-chairs ***Leonard Barolli***

Fukuoka Institute of Technology, Japan*Hsing-Chung Chen*

Asia University, Taiwan*Tzu-Liang Kung*

Asia University, Taiwan Program Committee Members ***Arjan Durresi***

Indiana Universityâ€“Purdue University at Indianapolis (IUPUI), USA*Makoto Ikeda*

Fukuoka Institute of Technology, Japan*Akio Koyama*

Yamagata University, Japan*Neng-Yih Shih*

Asia University, Taiwan*Yeong-Chin Chen*

Asia University, Taiwan*Timothy K. Shih*

National Central University, Taiwan*Hsi-Chin Hsin*

National United University, Taiwan*Ming-Shiang Huang*

Asia University, Taiwan*Chia-Cheng Liu*

Asia University, Taiwan*Chia-Hsin Cheng*

National Formosa University Yunlin County, Taiwan*Tzu-Liang Kung*

Asia University, Taiwan*Gene Shen*

Asia University, Taiwan*Jim-Min Lin*

Feng Chia University, Taiwan*Chia-Cheng Liu*

Asia University, Taiwan*Yen-Ching Chang*

Chung Shan Medical University, Taiwan*Shu-Hong Lee*

Chienkuo Technology University, Taiwan*Ho-Lung Hung*

Chienkuo Technology University, Taiwan*Gwo-Ruey Lee*

Lung-Yuan Research Park, Taiwan*Li-Shan Ma*

Chienkuo Technology University, Taiwan*Chung-Wen Hung*

National Yunlin University of Science & Technology University, Taiwan*Yung-Chen Chou*

Asia University, Taiwan*Chen-Hung Chuang*

Asia University, Taiwan*Jing-Doo Wang*

Asia University, Taiwan*Jui-Chi Chen*

Asia University, Taiwan*Young-Long Chen*

National Taichung University of Science and Technology, Taiwan Web Administrators
Donald Elmazi

Fukuoka Institute of Technology, Japan*Miralda Cuka*

Fukuoka Institute of Technology, Japan Welcome Message from FINGNet-2018 International Workshop OrganizersWelcome to the 8th International Workshop on Future Internet and Next Generation Networks (FINGNet-2018), which is held in conjunction with the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) from July 4th to July 6th, 2018, at Kunibiki Messe, Matsue, Japan.Over the last years, new paradigms and concepts have emerged in

telecommunication networks that are currently being realized in the Internet. Among those are the social networking, the peer-to-peer, and the quality of experience paradigms. Nevertheless, it is difficult or even impossible to predict how the network of the future will emerge. However, it is quite clear that some major issues have to be addressed for the future Internet or next-generation networks. This includes solutions, e.g., for security and privacy issues, such as spam or service-oriented approaches to enable flexible networking. In addition, new applications or services emerge such as social media networks or crowdsourcing platforms enabling collaborative networking of Internet users. To address these issues, there is an increased interest in the scientific community to propose and design new algorithms and methodologies as well as to understand and model new applications and services.The aim of this workshop is to present such innovative research, methods, and numerical analysis related to advanced Internet and network technologies. The workshop contains high-quality research papers, which were carefully selected by the technical program committee members.It is impossible to organize such a successful program without the help of many authors, program committee members, and organizers. We also would like to deeply express our appreciation to the authors of the submitted papers and to the program committee members, who provided timely and significant reviews.We hope all of you will enjoy FINGNet-2018 and find this a productive opportunity to exchange ideas with many researchers. Finally, we would like to thank everyone for participating in FINGNet-2018 workshop. We hope that you will find the workshop along with other joint workshops and conferences stimulating.FINGNet-2018 Workshop Co-chairs *Tobias Hossfeld*

University of Wuerzburg, Germany*Inshil Do*

Ewha Womans University, Korea*Hae-Duck Joshua Jeong*

Korean Bible University, Korea FINGNet-2018 Workshop Advisory Co-chairs *Kijoon Chae*

Ewha Womans University, Korea*Akihiro Nakao*

University of Tokyo, Japan*Jiyoung Lim*

Korean Bible University, Korea FINGNet-2018 Organizing CommitteeWorkshop Co-chairs *Tobias Hossfeld*

University of Wuerzburg, Germany*Inshil Do*

Ewha Womans University, Korea*Hae-Duck Joshua Jeong*

Korean Bible University, Korea Advisory Co-chairs *Kijoon Chae*

Ewha Womans University, Korea*Akihiro Nakao*

University of Tokyo, Japan*Jiyoung Lim*

Korean Bible University, Korea Program Committee Members *Kento Aida*

National Institute of Informatics, Japan*Xiangjiu Che*

Jilin University, China*Kyo-Il Chung*

ETRI, Korea*Cuong Dinh*

University of Science Ho Chi Minh City, Vietnam*Greg Ewing*

University of Canterbury, New Zealand*Shanmugasundaram Hariharan*

B.S. Abdur Rahman University, India*P. T. Ho*

University of Hong Kong, Hong Kong*Ching-Hsien Hsu*

Chung Hua University, Taiwan*Wen-Tzeng Huang*

Minghsin University of Science and Technology, Taiwan*Hai Jin*

Huazhong University of Science and Technology, China*Hyung Chan Kim*

ETRI, Korea*Joo-Man Kim*

Pusan National University, Korea*Wing-Keung Kwan*

University of Hong Kong, Hong Kong*Chong Deuk Lee*

Chonbuk National University, Korea*JongSuk Ruth Lee*

KISTI, Korea*Hing Yan Lee*

IDA, Singapore*Fang-Pang Lin*

NCHC, Taiwan*Te-Lung Liu*

NCHC, Taiwan*Nobutaka Matsumoto*

KDDI R&D Laboratories Inc., Japan*Don McNickle*

University of Canterbury, New Zealand*Nam Ng*

University of Hong Kong, Hong Kong*Seungjin Park*

University of Southern Indiana, USA*Anan Phonphoem*

Kasetsart University, Thailand*Zhuzhong Qian*

Nanjing University, China*Kiwook Sohn*

ETRI, Korea*Torab Torabi*

La Trobe University, Australia*Putchong Uthayopas*

Kasetsart University, Thailand*Xiaohui Wei*

Jilin University, China*Lawrence WC Wong*

National University of Singapore, Singapore*Kun-Ming Yu*

Chung Hua University, Taiwan Welcome Message from FIMIS-2018 International

Workshop ChairIt is our great pleasure to welcome you the 7th International Workshop on Frontiers in Innovative Mobile and Internet Services (FIMIS-2018), which will be held in conjunction with the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) from July 4th to July 6th, 2018, at Kunibiki Messe, Matsue, Japan.The workshop focuses on challenges and solutions for Ubiquitous and Pervasive Computing (UPC) with an emphasis on innovative, mobile and Internet services. Especially, the main goal of FIMIS-2018 is to bring together researchers, practitioners, and decision-makers to demonstrate the state of the art as well as future directions for UPC.The organization of a workshop needs the help of many people. We would like to express our special thanks to the authors and reviewers whose contribution makes this workshop a reality.Hopefully, you will enjoy the workshop and have a great time in Matsue, Japan.FIMIS-2018 Workshop Chair *Leonard Barolli*

Fukuoka Institute of Technology, Japan FIMIS-2018 Organizing CommitteeWorkshop Co-chairs *Leonard Barolli*

Fukuoka Institute of Technology, Japan Program Committee Members *Feilong Tang*

Shanghai Jiao Tong University, China*Arjan Durresi*

IUPUI, USA*Hae-Duck Joshua Jeong*

Korean Bible University, Korea*Hiroaki Kikuchi*

Meiji University, Japan*Chu-Hsing Lin*

Tunghai University, Taiwan*Jinshu Su*

National University of Defense Technology, China*Tomoya Enokido*

Rissho University*Fang-Yie Leu*

Tunghai University, Taiwan*Chunqing Wu*

National University of Defense Technology, China*Makoto Ikeda*

Fukuoka Institute of Technology, Japan*Marek Ogiela*

AGH University of Science and Technology, Poland*Kin Fun Li*

University of Victoria, Canada*Joan Arnedo*

Open University of Catalonia, Spain*Tetsuya Shigeyasu*

Prefectural University of Hiroshima, Japan*Kangbin Yim*

Soonchunhyang University, Korea Web Administrator *Donald Elmazi*

Fukuoka Institute of Technology, Japan Welcome Message from SMEUCE-2018 International Workshop Co-chairsWe welcome you to the 7th International Workshop on Sustainability Management of e-Business and Ubiquitous Commerce Engineering (SMEUCE-2018), which will be held in conjunction with the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) at

Kunibiki Messe, Matsue, Japan, from July 4th to July 6th, 2018.The aim objective of SMEUCE-2018 is to provide a platform for academics, business leaders, consultants, and other professionals from all over the world to exchange the latest research findings in the field of sustainability management of e-business, e-business, and u-business (ubiquitous business) engineering, Cloud commerce and their relative applications. This conference provides opportunities for the delegates to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration.Many people have kindly helped us to prepare and organize the SMEUCE-2018 workshop. First, we highly thank the authors who submitted high-quality papers and reviewers who carefully evaluated these submissions. We are thankful to Prof. Makoto Takizawa, Hosei University, Japan, as Honorary Chair of IMIS-2018. We would like to give our special thanks to Prof. Leonard Barolli as General Chair of IMIS-2018 for their strong encouragement and guidance to organize this workshop. We would like to thank the PC Co-chairs and Workshops Co-chairs for their advice and support to make possible organization of SMEUCE-2018.We hope you will enjoy the conference and have a great time in Matsue, Japan.SMEUCE-2018 Co-chairs *Kuei-Yuan Wang*

Asia University, Taiwan*Ying-Li Lin*

Asia University, Taiwan*Mei-Hua Liao*

Asia University, Taiwan*Hsing-Chung Chen*

Asia University, Taiwan*Hidekazu Sone*

Shizuoka University of Art and Culture, Japan SMEUCE-2018 Organizing Committee Workshop Co-chairs *Kuei-Yuan Wang*

Asia University, Taiwan*Ying-Li Lin*

Asia University, Taiwan*Mei-Hua Liao*

Asia University, Taiwan*Hsing-Chung Chen*

Asia University, Taiwan*Hidekazu Sone*

Shizuoka University of Art and Culture, Japan Program Committee Members *Ching-Hui Shih*

Asia University, Taiwan*Shu-Hui Chuang*

Asia University, Taiwan*Ting-Chang Chang*

Asia University, Taiwan*Ya-Wen Yu*

Asia University, Taiwan*Shyh-Weir Tzang*

Asia University, Taiwan*Chia-Hsin Cheng*

National Formosa University Yunlin County, Taiwan*Shu-Hong Lee*

Chienkuo Technology University, Taiwan*Ho-Lung Hung*

Chienkuo Technology University, Taiwan*Chung-Wen Hung*

National Yunlin University of Science & Technology University, Taiwan*Horimoto Saburo*

Shiga University, Japan*Pulukkuttige Don Nimal*

University of Peradeniya, Sri Lanka*Mei Hua Huang*

Asia University, Taiwan*Young-Long Chen*

National Taichung University of Science and Technology, Taiwan Web Administrator Chair ***Donald Elmazi***

Fukuoka Institute of Technology, Japan Welcome Message from BDITS-2018 International Workshop Co-chairsWelcome to the 4th International Workshop on Big Data and IoT Security (BDITS-2018), which is held in conjunction with the 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018), from July 4th to July 6th, 2018, at Kunibiki Messe, Matsue, Japan.The aim objective of BDITS-2018 is to provide a platform for academics, the leaders of network security, consultants and other professionals from all over the world to exchange the latest research findings in the field of Security Technologies of Big Data and Internet of Things (IoT), cloud and ubiquitous computing and their applications. This workshop provides opportunities for the delegates to exchange new ideas and application experiences face to face, to establish research relations and to find global partners for future collaboration.Many people have kindly helped us to prepare and organize the BDITS-2018 workshop. First, we would like to thank the authors who submitted high-quality papers and reviewers who carefully evaluated the submitted papers.We would like to give our special thanks to Prof. Leonard Barolli for his strong encouragement and guidance to organize this workshop. We would like to thank PC Co-chairs and Workshop Co-chairs of IMIS-2018 for their kind support. We would like to thank all PC members for their serious review works in order to make successful organization of BDITS-2018.We hope you will enjoy the conference and have a great time in Matsue, Japan.BDITS-2018 Co-chairs ***Baojiang Cui***

Beijing University of Posts and Telecommunications, China*Zheli Liu*

Nankai University, China*Tainhan Gao*

National Pilot Software College, China*Hsing-Chung Chen*

Asia University, Taiwan BDITS-2018 Organizing CommitteeWorkshop Co-chairs ***Baojiang Cui***

Beijing University of Posts and Telecommunications, China*Zheli Liu*

Nankai University, China*Tainhan Gao*

National Pilot Software College, China*Hsing-Chung Chen*

Asia University, Taiwan Program Committee Members ***Nan Guo***

National Pilot Software College, China*Makoto Ikeda*

Fukuoka Institute of Technology, Japan*Neng-Yih Shih*

Asia University, Taiwan*Timothy K. Shih*

National Central University, Taiwan*Yung-Fa Huang*

Chaoyang University of Technology, Taiwan*Chia-Hsin Cheng*

National Formosa University Yunlin County, Taiwan*Tzu-Liang Kung*

Asia University, Taiwan*Shu-Hong Lee*

Chienkuo Technology University, Taiwan*Ho-Lung Hung*

Chienkuo Technology University, Taiwan*Gwo-Ruey Lee*

Lung-Yuan Research Park, Taiwan*Li-Shan Ma*

Chienkuo Technology University, Taiwan*Chung-Wen Hung*

National Yunlin University of Science & Technology University, Taiwan*Jui-Chi Chen*

Asia University, Taiwan Web Administrator ***Donald Elmazi***

Fukuoka Institute of Technology, Japan CISIS-2018 Keynote TalksSNS as Social Sensors: Technologies for Extracting Knowledge from SNSsTakahiro Hara, Osaka University, Osaka, Japan Abstract. Due to surprisingly rapid popularization of smartphones and Social Network Services (SNSs), ordinary people generate and share a large amount of data using SNSs on smartphones. Recent studies have revealed that messages posted on SNSs such as Twitter can be used for detecting various kinds of facts in the real world such as events, trends, and user sentiment, which can be considered as kinds of social sensor data. Social sensor data are very useful for Big Data analysis because these tell many things representing the real world, which cannot be known by only analyzing traditional Big Data. In this talk, I will present our recent studies on social sensing based on data mining on SNSs such as Twitter. We will start with our approaches for knowledge extraction from Twitter and then move on to some fundamental techniques which can be used commonly for such knowledge extraction. I will also present our ongoing work for building a framework to share not only social sensor data (i.e., SNS analytical results) but also definitions of social sensor data and analytical procedures. I will conclude this talk with some discussion on future research opportunities for social sensing.Fog Computing: A New Research Direction in Distributed Computingâ€"Applications, Issues and Challenges Farookh Khadeer Hussain, University of Technology Sydney (UTS), Sydney, Australia Abstract. The objective of this talk is to introduce the emerging research area of â€˜Fog Computingâ€™ or â€˜Edge Computingâ€™ and discuss the research opportunities and research challenges in this area. In order to do so, firstly, this talk presents the transition in the discipline of Distributed Computing from â€˜Grid Computingâ€™ to â€˜Cloud Computingâ€™ to â€˜Cloud-of-Thingsâ€™ and then to a â€˜Fog computingâ€™ environment. It then highlights clearly the role of â€˜Internet of Thingsâ€™ and â€˜Cloud Computingâ€™ in realizing â€˜Fog Computing.â€™ Secondly, it briefly discusses some research issues and challenges associated with realizing and developing practical Fog Computing-driven solutions. Finally, it outlines and discusses the future role of â€˜Cloud-of-Thingsâ€™ in achieving business efficiencies in both developed and developing economies. ContentsThe 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018) An Energy Efficient Scheduling of a Smart Home Based on Optimization Techniques AqibÂ Jamil, NadeemÂ Javaid,

MuhammadÂ UsmanÂ Khalid, MuhammadÂ NadeemÂ Iqbal, SaadÂ Rashid and NaveedÂ Anwar Differential-Evolution-Earthworm Hybrid Meta-heuristic Optimization Technique for Home Energy Management System in Smart Grid NadeemÂ Javaid, IhtishamÂ Ullah, SyedÂ ShahabÂ Zarin, MohsinÂ Kamal, BabatunjiÂ Omoniwa and AbdulÂ Mateen Performance Analysis of Simulation System Based on Particle Swarm Optimization and Distributed Genetic Algorithm for WMNs Considering Different Distributions of Mesh Clients AdmirÂ Barolli, ShinjiÂ Sakamoto, LeonardÂ Barolli and MakotoÂ Takizawa A Hybrid Flower-Grey Wolf Optimizer Based Home Energy Management inÂ Smart Grid Pamir, NadeemÂ Javaid, AttiqÂ ullahÂ Khan, SyedÂ MuhammadÂ Mohsin, YasirÂ KhanÂ Jadoon and OroojÂ Nazeer A Fuzzy-Based Approach for Improving Peer Coordination Quality inÂ MobilePeerDroid Mobile System YiÂ Liu, KosukeÂ Ozera, KeitaÂ Matsuo, MakotoÂ Ikeda and LeonardÂ Barolli A Fuzzy-Based System for Selection of IoT Devices in Opportunistic Networks Considering IoT Device Contact Duration, Storage and Remaining Energy MiraldaÂ Cuka, DonaldÂ Elmazi, KeitaÂ Matsuo, MakotoÂ Ikeda and LeonardÂ Barolli Efficient Routing in Geographic and Opportunistic Routing for Underwater WSNs GhazanfarÂ Latif, NadeemÂ Javaid, AasmaÂ Khan, AishaÂ Fatima, LandingÂ Jatta and WahabÂ Khan Supporting Online/â€‹Offline Collaborative Work with WebRTC Application Migration FatosÂ Xhafa, DavidÂ Zaragoza and SantiÂ CaballÃ© One-to-One Routing Protocols for Wireless Ad-Hoc Networks Considering the Electric Energy Consumption EmiÂ Ogawa, ShigenariÂ Nakamura, TomoyaÂ Enokido and MakotoÂ Takizawa Virtual Machine Migration Algorithms to Reduce Electric Energy Consumption of a Server Cluster RyoÂ Watanabe, DilawaerÂ Duolikun, TomoyaÂ Enokido and MakotoÂ Takizawa Evaluating Motion and Heart Rate Sensors to Measure Intensity of Physical Activity MiguelÂ A.Â Wister, PabloÂ Pancardo and IvanÂ Rodriguez Implementation of WiFi P2P Based DTN Routing and Gateway for Disaster Information Networks NorikiÂ Uchida, HarukiÂ Kuga, TomoyukiÂ Ishida and YoshitakaÂ Shibata A New Contents Delivery Network Mixing on Static/â€‹Dynamic Heterogeneous DTN Environment ShokoÂ Takabatake and TetsuyaÂ Shigeyasu Predicate Clustering-Based Entity-Centered Graph Pattern Recognition for Query Extension on the LOD JongmoÂ Kim, JunsikÂ Kong, DaeunÂ Park and MyeÂ Sohn Discrimination of Eye Blinks and Eye Movements as Features for Image Analysis of the Around Ocular Region for Use as an Input Interface ShogoÂ Matsuno, MasatoshiÂ Tanaka, KeisukeÂ Yoshida, KotaÂ Akehi, NaoakiÂ Itakura, TotaÂ Mizuno and KazuyukiÂ Mito Dynamic Group Formation for an Active Learning System Using Smartphone to Improve Learning Motivation NoriyasuÂ Yamamoto and NorikiÂ Uchida Evaluation of 13.â€‹56Â MHz RFID System Considering Communication Distance Between Reader and Tag KiyotakaÂ Fujisaki An Efficient Routing Protocol via Depth Adjustment and Energy Gradation in Underwater Wireless Sensor Networks GhazanfarÂ Latif, NadeemÂ Javaid, ArshadÂ Iqbal, JavedÂ Ahmad, AtherÂ AbdulÂ Jabbar and MuhammadÂ Imran Vulnerability Analysis on the Image-Based Authentication Through the PS/â€‹2 Interface InsuÂ Oh, KyungroulÂ Lee, Sun-YoungÂ Lee, KyunghwaÂ Do, HyoÂ beomÂ Ahn and KangbinÂ Yim A Spacecraft AIT Visualization Control System Based on VR Technology WeiÂ Peng, ZhangÂ Liwei, WuÂ Qiong, WangÂ Miaoxin and LiÂ Jian An Efficient Home Energy Management and Power Trading in Smart Grid SherazÂ Aslam, SakeenaÂ Javaid, NadeemÂ Javaid, SyedÂ MuhammadÂ Mohsin, SaadÂ Sulman Khan and MariamÂ Akbar Hierarchical Based Coordination Strategy to Efficiently Exchange the Power Among Micro-grids AqibÂ Jamil, NadeemÂ Javaid, ZafarÂ Iqbal, MuhammadÂ Abdullah, MuhammadÂ ZaidÂ Riaz and MariamÂ Akbar Weighted Cuckoo Search Based Load Balanced Cloud for Green Smart Grids MuhammadÂ HassanÂ Rahim, NadeemÂ Javaid, SaharÂ Rahim, MuqaddasÂ Naz, MariamÂ Akbar and FarhanaÂ Javed Foged Energy Optimization in Smart Homes AyeshaÂ AnjumÂ Butt, NadeemÂ Javaid, SanaÂ Mujeeb, SalmanÂ Ahmed, MalikÂ MuhammadÂ ShahidÂ Ali and WaqarÂ Ali Short Term Load Forecasting based on Deep Learning for Smart Grid Applications GhulamÂ Hafeez, NadeemÂ Javaid,

SafeerÂ Ullah, ZafarÂ Iqbal, MahnoorÂ Khan, AzizÂ UrÂ Rehman and Ziaullah Efficient Resource Allocation Model for Residential Buildings in Smart Grid Using Fog and Cloud Computing AishaÂ Fatima, NadeemÂ Javaid, MominaÂ Waheed, ToobaÂ Nazar, ShaistaÂ Shabbir and TanzeelaÂ Sultana Feature Selection and Extraction Along with Electricity Price Forecasting Using Big Data Analytics IsraÂ Shafi, NadeemÂ Javaid, AqdasÂ Naz, YasirÂ Amir, IsrarÂ Ishaq and KashifÂ Naseem Proposal of a Disaster Support Expert System Using Accumulated Empirical Data TatsuyaÂ Ohyanagi, TomoyukiÂ Ishida, NorikiÂ Uchida, YoshitakaÂ Shibata and HiromasaÂ Habuchi Proposal of a Regional Knowledge Inheritance System Using Location-Based AR and Historical Maps HayatoÂ Ito, TatsuyaÂ Ohyanagi, TomoyukiÂ Ishida and TatsuhiroÂ Yonekura QoS Management for Virtual Reality Contents KoÂ Takayama and KaoruÂ Sugita A Webshell Detection Technology Based on HTTP Traffic Analysis WenchuanÂ Yang, BangÂ Sun and BaojiangÂ Cui Enhanced Secure ZigBee Light Link Protocol Based on Network Key Update Mechanism JunÂ Yang, RuiqingÂ Liu and BaojiangÂ Cui Intrusion Detection Model Based on GA Dimension Reduction and MEA-Elman Neural Network ZeÂ Zhang, GuidongÂ Zhang, YongjunÂ Shen and YanÂ Zhu Location Privacy Protection Scheme Based on Random Encryption Period in VANETs TianhanÂ Gao and XinÂ Xin An Improvement RFID Security Authentication Protocol Based on Hash Function HaowenÂ Sun, PengÂ Li, HeÂ Xu and FengÂ Zhu Classifying Malicious URLs Using Gated Recurrent Neural Networks JinglingÂ Zhao, NanÂ Wang, QianÂ Ma and ZishuaiÂ Cheng A Fast PQ Hash Code Indexing JingsongÂ Shan, YongjunÂ Zhang, MingxinÂ Jiang, ChunhuaÂ Jin and ZhengweiÂ Zhang Dynamic Incentive Mechanism for Direct Energy Trading NanÂ Zhao, PengfeiÂ Fan, MinghuÂ Wu, XiaoÂ He, MenglinÂ Fan and ChaoÂ Tian Improve Memory for Alzheimer Patient by Employing Mind Wave on Virtual Reality with Deep Learning MarwanÂ KadhimÂ Mohammed Al-shammari and GaoÂ TianÂ Han Fast FFT-Based Inference in 3D Convolutional Neural Networks BoÂ Xie, GuidongÂ Zhang, YongjunÂ Shen, ShunÂ Liu and YabinÂ Ge Cognitive Informatics Approaches for Data Sharing and Management in Cloud Computing MarekÂ R.Â Ogiela and LidiaÂ Ogiela Implementation of Lane Detection Algorithm for Self-driving Vehicles Using Tensor Flow HyunheeÂ Park Design and Implementation of Cognitive System of Childrenâ€™s Education Based on RFID HongyuÂ Gan, ChenghaoÂ Wu, JieÂ Xu, PengÂ Li and HeÂ Xu Delay Optimization for Mobile Cloud Computing Application Offloading in Smart Cities ShanÂ Guo, YingÂ Wang, SachulaÂ Meng and NanÂ Ma Joint User Association and Power Allocation for Minimizing Multi-bitrate Video Transmission Delay in Mobile-Edge Computing Networks HongÂ Wang, YingÂ Wang, RuijinÂ Sun, RuncongÂ Su and BaolingÂ Liu Cyber-Physical Sensors and Devices for the Provision of Next-Generation Personalized Services BorjaÂ Bordel, TeresaÂ Iturrioz, RamÃ³nÂ Alcarria and DiegoÂ SÃ¡nchez-de-Rivera Device Stand-by Management of IoT:â€‹ A Framework for Dealing with Real-World Device Fault in City Platform as a Service ToshihikoÂ YamakamiThe 12th International Workshop on Advances in Information Security (WAIS-2018) A Security-Aware Fuzzy-Based Cluster Head Selection System for VANETs KosukeÂ Ozera, KevinÂ Bylykbashi, YiÂ Liu and LeonardÂ Barolli Research on Food Safety Traceability Technology Based on RFID Security Authentication and 2-Dimensional Code JieÂ Ding, HeÂ Xu, PengÂ Li and FengÂ Zhu DoS Attack Pattern Mining Based on Association Rule Approach for Web Server Hsing-ChungÂ Chen and Shyi-ShiunÂ Kuo Current Status on Elliptic Curve Discrete Logarithm Problem (Extended Abstract) MakiÂ Inui and TetsuyaÂ Izu Study on Signature Verification Process for the Firmware of an Android Platform EunseonÂ Jeong, JunyoungÂ Park, ByeonggeunÂ Son, MyoungsuÂ Kim and KangbinÂ Yim Detecting and Extracting Hidden Information from Stego-Images Based on JPG File on StegoMagic KyungroulÂ Lee, Sun-YoungÂ Lee, KyunghwaÂ Do and KangbinÂ YimThe 8th International Workshop on Mobile Commerce, Cloud Computing, Network and Communication Security (MCNCS-2018) Clickbait Detection Based on Word Embedding Models VorakitÂ Vorakitphan, Fang-YieÂ Leu and Yao-ChungÂ Fan A Micro Services Quality Measurement Model for Improving the Efficiency

and Quality of DevOps Sen-TarngÂ Lai and Fang-YieÂ Leu A Study on Firewall Services with Edge Computers of vEPC in 5G Networks Fang-YieÂ Leu and Ping-HungÂ Chou The Study of MME Pool Management and Fault Tolerance in 5G Networks with SDN Controllers Fang-YieÂ Leu and Cheng-YanÂ GuThe 8th International Workshop on Intelligent Techniques and Algorithms for Ubiquitous Computing (ITAUC-2018) Home Energy Management Using Hybrid Meta-heuristic Optimization Technique OroojÂ Nazeer, NadeemÂ Javaid, AdnanÂ AhmedÂ Rafique, SajidÂ Kiani, YasirÂ Javaid and ZeeshanÂ Khurshid On the Channel Congestion of the Shortest-Path Routing for Unidirectional Hypercube Networks Tzu-LiangÂ Kung, Chun-NanÂ Hung and Yuan-HsiangÂ Teng A Diagnosis Algorithm on the 2D-torus Network LidanÂ Wang, NingningÂ Liu, Cheng-KuanÂ Lin, Tzu-LiangÂ Kung and Yuan-HsiangÂ Teng Construction Schemes for Edge Fault-Tolerance of Ring Networks Chun-NanÂ Hung, Tzu-LiangÂ Kung and En-ChengÂ Zhang Review of RFID-Based Indoor Positioning Technology JingkaiÂ Zhu and HeÂ Xu Designing a Cybersecurity Board Game Based on Design Thinking Approach Shian-ShyongÂ Tseng, Tsung-YuÂ Yang, Yuh-JyeÂ Wang and Ai-ChinÂ LuThe 8th International Workshop on Future Internet and Next Generation Networks (FINGNet-2018) A Localization Algorithm Based on Availability of Direct Signal from Neighbor Anchor Nodes in a Sensor Networks MegumiÂ Yamamoto and ShigetomoÂ Kimura Prediction Model of Optimal Bid Price Based on Keyword Auction Data Through Machine Learning Algorithms MinjunÂ Ji and HyunheeÂ Park Complex Activity Recognition Using Polyphonic Sound Event Detection JaewoongÂ Kang, JooyeongÂ Kim, KunyoungÂ Kim and MyeÂ Sohn Dynamic Group Key Management for Efficient Fog Computing JiyoungÂ Lim, InshilÂ Doh and KijoonÂ Chae A Network Slice Resource Allocation Process in 5G Mobile Networks AndreaÂ Fendt, LarsÂ ChristophÂ Schmelz, WieslawaÂ Wajda, SimonÂ LohmÃ¼ller and BernhardÂ BauerThe 7th International Workshop on Frontiers in Innovative Mobile and Internet Services (FIMIS-2018) An Intelligent Opportunistic Scheduling of Home Appliances for Demand Side Management ZunairaÂ Nadeem, NadeemÂ Javaid, AsadÂ WaqarÂ Malik, AbdulÂ BasitÂ Khan, MuhammadÂ Kamran and RidaÂ Hafeez Fog Computing Based Energy Management System Model for Smart Buildings SamanÂ Zahoor, NadeemÂ Javaid, AdiaÂ Khalid, AnilaÂ Yasmeen and ZunairaÂ Nadeem A Novel Indoor Navigation System Based on RFID and LBS Technology YizhuoÂ Wang, XuanÂ Xu, XinyuÂ Wang and HeÂ Xu A Social Dimension View Model of Divergence of IoT Standardization ToshihikoÂ Yamakami Design and Implementation of a VANET Testbed:â€‹ Performance Evaluation Considering DTN Transmission overÂ VANETs ShogoÂ Nakasaki, YuÂ Yoshino, MakotoÂ Ikeda and LeonardÂ Barolli A Survey of Automated Root Cause Analysis of Software Vulnerability JeeSooÂ Jurn, TaeeunÂ Kim and HwankukÂ KimThe 7th International Workshop on Sustainability Management of e-Business and Ubiquitous Commerce Engineering (SMEUCE-2018) The Effect of Personal Moral Philosophy on Perceived Moral Intensity in Hotel Industry Chia-JuÂ Lu, Chiung-ChiÂ Pen and Chiou-ShyaÂ Torng Study on Production and Marketing of Tea:â€‹ A Company Kuei-YuanÂ Wang, Xiao-HongÂ Lin, Chien-KuoÂ Han, Chi-ChengÂ Lin, Yi-ChiÂ Liao, Tzu-YunÂ Ting and Ting-ShiuanÂ Fang The Influence of U.â€‹S.â€‹ FEDâ€™s Interest Rate-Raising Event Announcements on the Abnormal Returns in the Taiwan Stock Market Xiao-HongÂ Lin, Kuei-YuanÂ Wang, Chien-KuoÂ Han, Yu-SinÂ Huang, Yi-ChiÂ Liao, Tzu-YunÂ Ting and Ting-ShiuanÂ Fang The Relationship Between Dividend, Business Cycle, Institutional Investor and Stock Risk Yung-ShunÂ Tsai, Shyh-WeirÂ Tzang, Chih-HsingÂ Hung and Chun-PingÂ Chang Commercial Real Estate Evaluation:â€‹ The Real Options Approach Shyh-WeirÂ Tzang, Chih-HsingÂ Hung, Chun-PingÂ Chang and Yung-ShunÂ Tsai A Dynamic Model of Optimal Share Repurchase Chun-PingÂ Chang, Yung-ShunÂ Tsai, Shyh-WeirÂ Tzang and YongÂ ZulinaÂ Zubairi Direct and Indirect Effects of Job Complexity of Senior Managers on Their Compensation and Operating Performances Ying-LiÂ Lin and Yi-JingÂ Chen The Impact of Online Commentary on Young Consumerâ€™s Purchase Decision Mei-HuaÂ Huang, Wen-ShinÂ Huang,

Chiung-YenÂ Chen and An-ChiÂ Kuan Penalty or Benefit?â€‹ The Effect of Dividend Taxes on Stock Valuation Wen-hsinÂ Huang, SumingÂ Lin and Mei-HuaÂ Huang The Determinants of Admission Strategy and School Choice:â€‹ A Case Study of a Private Senior Vocational School in Taiwan Ling-YiÂ Chou and Yi-YangÂ Li Professional Training and Operational Performance:â€‹ Considering the Impact of CPA Disciplinary Incidents Chiung-YenÂ Chen, Mei-HuaÂ Huang and Zhen-XinÂ Xu Constructing a System for Effective Implementation of Strategic Corporate Social Responsibility Chiung-YaoÂ Huang and Chung-JenÂ Fu Study of the Factors that Influence Brand Loyalty Toward the Use of Tablets in Indonesia Chien-WenÂ Lai, CandraÂ AdiÂ Kurnia, Shao-ChunÂ Chiu and Ya-LanÂ Chan Five Elements and Stock Market Mei-HuaÂ Liao, Shih-HanÂ Hong and NorihisaÂ Yoshimura Asset Structure of Long-Lived Company Mei-HuaÂ Liao, Yi-JunÂ Guo and HidekazuÂ Sone An Inventory Policy for Perishable Products with Permissible Delay in Payment Ya-LanÂ Chan and Sue-MingÂ Hsu The Research on Lifestyle, Physical and Mental Health, and Potential Consumption for Elderly Sue-MingÂ Hsu and Ya-LanÂ ChanThe 4th International Workshop on Big Data and IoT Security (BDITS-2018) A Cooperative Evaluation Approach Based on Blockchain Technology for IoT Application Hsing-ChungÂ Chen, BambangÂ Irawan and Zon-YinÂ Shae The Study and Realization of Vulnerability-Oriented Fuzzing Technology for ActiveX Plug-Ins BaojiangÂ Cui and PinÂ Mao An Open Source Software Defect Detection Technique Based on Homology Detection and Pre-identification Vulnerabilitys JunÂ Yang, XuyanÂ Song, YuÂ Xiong and YuÂ Meng Analysis on Mobile Payment Security and Its Defense Strategy SiminÂ Yin, JingyeÂ Sheng, TongÂ Wang and HeÂ XuAuthor Index The 12th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2018)

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_1An Energy Efficient Scheduling of a Smart Home Based on Optimization TechniquesAqib Jamil1, Nadeem Javaid1 _, Muhammad Usman Khalid1, Muhammad Nadeem Iqbal2, Saad Rashid2 and Naveed Anwar3(1)
COMSATS Institute of Information Technology, Islamabad, 44000, Pakistan(2)
COMSATS Institute of Information Technology, Wah Cantt, 47040, Pakistan(3)
University of Wah, Wah Cantt, 47040, Pakistan **NadeemÂ JavaidEmail:**
nadeemjavaidqau@gmail.comAbstractAfter the introduction of smart grid in power system, two-way communication is now possible which helps in optimizing the energy consumption of consumers. To optimize the energy consumption on the consumer side, demand side management is used. In this paper, we focused on the optimization of smart home appliances with the help of optimization techniques. Cuckoo search algorithm, earthworm optimization and a hybrid technique cuckoo-earthworm optimization are used for scheduling the smart home appliances. Home appliances are classified into three groups and real-time pricing scheme is used. Techniques are evaluated and a performance comparison is performed. Results show that the proposed hybrid technique has decreased the electricity cost by 49% as compared to unscheduled cost and a trade-off exists between electricity cost and user comfort.**KeywordsCuckoo search algorithmEarthworm optimizationSmart gridDemand side managementHeuristic techniques****1 IntroductionIn last few decades, there is a huge increase in electricity consumption whereas, traditional grids are insufficient to meet such immense demand and they had lot of problems such as unidirectional power flow, manual-monitoring, manual-healing and incompatibility with new technologies. Also, 65% of produced electricity is wasted during production, transmission and distribution [1]. For this purpose, the concept of smart grid (SG) is evolved, which includes two-way power flow and communication, self-monitoring, self-healing and compatibility with new technologies in the power system. SG is considered to be the future of power system because it is an**

energy efficient system. To solve the energy supply and demand difference problem, supply side management (SSM) or demand side management (DSM) is used in power system. SSM includes installation of new power plants however, installation of these power plants requires a lot of time to complete. In DSM, consumer energy demand can be adjusted by load strategies: load shifting, valley filling and flexible load. Load shifting is considered as the most efficient load management strategy [8].Most usually load shifting strategy is implemented by demand response (DR) program. DR program is the changes in consumer electricity usage patterns in response to price signal sent by utility. DR is considered as a most efficient and reliable program [2]. DR program has two types: incentive-based DR program (IDR) and priced-based DR (PDR) program. IDR program gives consumers some incentives on using more electricity during off-peak hours in order to decrease some stress from the power system during on-peak hours. In PDR program, price of electricity is set for each hour that encourages the users to shift their load to low price hours in order to decrease their electricity cost. Basically, DR program aims in educating the consumers to use most of the electricity during the off-peak hours.Most common price signals used by utilities are real-time pricing (RTP), day ahead pricing (DAP), time of use (TOU) and inclined block rate (IBR). RTP is considered as most efficient pricing scheme for scheduling in DSM [3].In this paper, a load shifting strategy is implemented while considering a RTP scheme. In our scenario, a single home is considered which consists of different appliances which are divided into three groups. Meta-heuristic techniques: cuckoo search algorithm (CSA), earthworm optimization (EWA) and a hybrid technique cuckoo-earthworm optimization (HCEO) are implemented to schedule the household appliances to evaluate the performance of these three optimization techniques. The objective is to decrease the electricity cost and results indicate that hybrid technique reduced the cost by 49%.The remainder of the paper is described as: in Sect.Â 2, literature review of related papers is discussed. SectionÂ 3 explains the working of proposed system model. SectionÂ 4 gives information about the implemented optimization techniques. SectionÂ 5 demonstrates the simulations results and conclusion is given in Sect.Â 6.2 Related WorkSome literature review about the home energy management system (HEMS) is presented in this section. Pedram Samadi *et al.* considered a system model for scheduling the home appliances and they integrated the renewable energy sources (RES) [4]. For this purpose, dynamic programming is implemented to shift home appliances to certain time intervals and game theory is used for the coordination of extra produced energy with neighbors and utility. In their proposed system model, consumers generate electricity from RES and they can sell extra electricity to neighbors and utility.A HEMS is considered by Sheraz *et al.* to decrease the electricity cost and peak average ratio (PAR) using genetic algorithm (GA), CSA and crow search algorithm [5]. Their proposed system model consists of a smart building and authors integrated energy storage system (ESS) to reduce the cost and PAR. Simulations demonstrate that they achieved their objectives.In [6], a HEMS is proposed where appliances are scheduled by using heuristic techniques. They used GA and particle swarm optimization (PSO) to decrease the total electricity cost and PAR. To achieve their objectives, multiple knapsack problem (MKP) is implemented with three price signals i.e., RTP, TOU and CPP. GA performed better than PSO in case of cost.An expert energy management system while focusing on the supply side management is proposed in [7]. They used modified bacterial foraging algorithm to schedule the different distributed energy resources to get an optimal point. Results show that, their proposed system has reduced the operational cost and net emissions. However, they ignored the demand side management. In [8], residential, industrial and commercial users are considered for solving optimization problem, to decrease the electricity cost and PAR by using heuristic based evolutionary algorithm. Results demonstrate that they handled the large number of devices and achieved a considerable amount of reduction in cost and PAR.Muralitharan *et al.* [9] considered a model to decrease the electricity cost and waiting time using multi-objective evolutionary algorithm. Authors implemented this algorithm

with threshold limit to balance the load and to avoid peaks. If consumerâ€™s load exceeds from utilityâ€™s defined threshold limit then consumer will pay extra amount in the form of penalty. From simulations it can be concluded that desired objectives are achieved. In [10], authors proposed a system model in which each house has two types of loads: flexible and essential loads. Flexible loads are divided into delay sensitive and delay insensitive loads. On the bases of this division, authors formulated an optimization problem to reduce the cost and delay of sensitive loads.In [11], authors proposed a robust-index method to handle the uncertainties associated with the consumers behavior to increase the user comfort in home appliance scheduling. Simulations represent that proposed model succeeded in increasing user comfort. A residential DR is studied in [12] using multi-integer non-linear programming (MINLP). Results demonstrates that more than 25% cost is reduced and most consumers shifted their load to low price hours to gain some incentives.In [13], a mixed integer linear programming (MILP) technique is considered to optimize the household appliances while integrating the RESs, ESSs and electric vehicles (EV) in a smart home. A heuristic technique is used for scheduling and to reduce consumers electricity cost. Three case studies for different time horizons are performed by varying few factors by using taguchi method.In this work, we used meta-heuristics techniques CSA, EWA and a hybrid technique HCEO to schedule the home appliances.3 System ModelSystem model consists of advance metering infrastructure (AMI), smart meter (SM), scheduling unit (SU) and home appliances. This system model is proposed to decrease the electricity expenses of users in a smart home. Smart home is equipped with SM, SU, household appliances and each SM is connected to AMI. AMI makes a bridge between SM and utility. AMI and SM make the two-way communication possible between utility and consumer. Further, SM informs the utility about the consumption patterns of consumers. With the help of information received from SM, utility calculates the energy demand for the upcoming hours and informs the generation station about the power requirement for the upcoming hours. On the basis of this information, generation station changes the power generation to fulfill the utility requirements.SU schedules the appliances according to userâ€™s defined hours by using the meta-heuristic techniques EWA, CSA and HCEO. System model of this work is given in Fig.Â 1.In this work, a residential area where each home contains appliances, SM and SU is considered. In each home, appliances, SU and SM communicate with each other through home area network (HAN). Moreover, communication between SM and utility takes place through wireless networks. Price scheme used in this scenario is RTP. Utility sends the RTP signal to SM through wireless communication and then, SM sends the pricing signal to SU. In SU, CSA, EWA and proposed hybrid scheme schedule the appliances on the basis of RTP signal for each hour of a day to decrease cost. These appliances are scheduled for 24 time slots.3.1 Load ClassificationIn this work, home devices are classified into following groups: Interruptible appliances, non-interruptible appliances and base appliances. This classification helps in scheduling the home appliances more efficiently and whole day scheduling of household appliances is performed as explained below A residential area is considered where each smart home consists of fifteen appliances. These appliances have different power ratings and operational time.*Fig. 1.*Proposed system model 3.1.1 Interruptible AppliancesInterruptible appliances considered in this scenario are water heater, water pump, air conditioner, refrigerator, iron, dish washer and vacuum cleaner. These appliances are shiftable and can be shifted to any time slot during their operational time.Let A, represents the set of interruptible appliances and is an appliance from the interruptible group and is the power rating of every interruptible appliance. Then, electricity consumed by interruptible appliances for 24Â h can be given as (1)The total electricity cost of 24 h in a day which will be paid to the utility by the consumer against all interruptible appliances is given by (2)here shows the status of interruptible appliances which can be 0 or 1, is the price signal sent by the utility and is the total electricity cost for interruptible appliances. Status of interruptible appliances is given as (3) 3.1.2

Non-interruptible AppliancesThese appliances are washing machine and cloth dryer. Due to their operation, these appliances can not be interrupted during their operational time. As cloth dryer is needed after the Washing machine operation therefore, and cloth dryer is scheduled immediately after the washing machine.Let , represents each non-interruptible appliance where, is the set of non-interruptible appliances. is the power rating then, total electricity consumed by these appliances can be explained as (4)During their operational time, these appliances will not be shifted, regardless of electricity cost. The total electricity cost for all non-interruptible appliances for 24 h can be given as (5)where is the status of non-interruptible appliances, is the price signal sent by the utility and is the total electricity cost for non-interruptible appliances. Status of these appliances is given by following equation (6) 3.1.3 Base AppliancesBase appliances or fixed appliance are oven, blender and four lights of different power rating. These appliances are not scheduled and consumer can switch ON these appliances any time according to desired requirements.Let , represents each base appliance where, is the set of base appliances and is the power rating of each appliance then, total energy consumed during the whole day can be explained as (7)The cost of electricity consumed by base appliances for 24 h can be found as (8)where shows the status of interruptible appliances which can be 0 or 1, is the price signal sent by the utility and is the total electricity cost for base appliances. Status of base appliances is given as (9)To find the total cost of electricity consumed during the whole day can be found by Eqs.Â 2, 5 and 8 as (10)where, is the total cost of all appliances in a day.4 Optimization TechniquesIn SG, each smart home contains a SM which makes the communication between consumer and the utility. Consumers are able to send their energy usage patterns to utilities and receive price signals from the utility using SM. To optimize the consumer load, optimization techniques are implemented in this paper which are explained below:4.1 CSAThe CSA is a nature-inspired algorithm which is based upon the natural behavior of some special kinds of cuckoo. Some species of cuckoo such as *Ani* and *Guira*, tries to lay eggs in other birdsâ€™ nests and it removes other eggs from host nests to increase its childâ€™s food share in the nest. If host bird founds the alien eggs it will either throw them out or leave the nest and make a new nest [14].For optimization problem, each egg represents a solution. Cuckoo performs *Levy flight* to find the host nest and lays a egg which can be explained as (11)where, is step size and mostly it is taken as 1. Levy flight is used for random walk and its step length is random and it only depends upon its current location. It is an efficient way to explore the search space.4.2 EWAEWA is a bio-inspired optimization technique, inspired from the reproduction system of earthworms. In earthworms, two types of reproduction exists. In Reproduction-1, off-springs are produced by single parent and in reproduction-2 off-springs are produced by two earthworm parents [15].Reproduction-1 is formulated as (12)where is the element of that shows the position of the earthworm *i*. Similarly, is the element of which is the new position of the earthworm *i*1 and is the similarity factor. and are upper and lower limits respectively.Reproduction-2 is an improved form of crossover operator. Crossover can be single point, multipoints or uniform. In this paper, uniform crossover is used and an off-spring is produced. After implementing above reproductions, both off-springs are combine by following equation (13)where is a proportional factor which adjusts the proportion of off-springs. At the end *Cauchy mutation* is applied to increase the search ability and moves it towards the global optimal point [15].4.3 Hybrid CSA and EWAHybrid optimization technique (HCEO) is proposed in this paper, which is hybridized from CSA and EWA. Hybridization is done in order to enhance the performance of an optimization technique as explained in [16]. Hybridization can be loosely coupled or strongly coupled, in strongly coupled hybridization, flow of a technique is followed and in loosely coupled hybridization internal steps of techniques are interchanged. Our proposed hybrid technique is hybrid in such a way that steps of EWA are fully followed whereas, only few steps from EWA are opted in order get an optimal solution.5 Simulations and DiscussionsTo show the effectiveness of our scheme in HEMS, simulations are performed in MATLAB

2017a and RTP scheme is used. Algorithms: EWA, CSA and proposed hybrid scheme HCEO are evaluated and performance is compared with each other on the basis of PAR, electricity cost, consumed electricity and waiting time of appliances. Simulations are conducted for a smart home with fifteen appliances.FigureÂ 2 illustrates the hourly electricity cost of single home with RTP signals. Results show that most of the load is shifted to off-peak hours and only necessary load is scheduled during high price hours therefore, very low cost is paid during on-peak hours. FigureÂ 3 indicates the total cost comparison with each other and with unscheduled cost. It is clear from figure that proposed hybrid scheme has outperformed CSA in case of cost. Further, all implemented techniques have decreased the total electricity cost as compared to unscheduled cost. From Fig.Â 3 it is cleared that EWA, CSA and HCEO have reduced cost by 49%, 25% and 49% respectively by using RTP scheme.*Fig. 2.*Per hour electricity cost of scheduling techniques *Fig. 3.*Total electricity cost in a day *Fig. 4.*Hourly electricity consumption of household appliances *Fig. 5.*Total load consumed by implemented optimization techniques Proposed hybrid scheme, in case of per hour electricity consumption, schedules most of the load during off-peak hours and schedules very small load during on-peak hours thus, reducing cost as shown in Fig.Â 4. Moreover, Fig.Â 5 illustrates that total load before and after scheduling remains same because load is only shifted not terminated. As we have only scheduled the load optimally and not implemented any load shedding strategy therefore, total load with and without scheduling remains same.*Fig. 6.*PAR of implemented optimization techniques Performance comparison of CSA, EWA and proposed hybrid scheme on the basis of PAR is shown in Fig.Â 6. On the base of Fig.Â 6, it can be concluded that PAR of all used techniques is less than unscheduled load and also in case of scheduled schemes, PAR of CSA is less as compared to other two schemes. Further PAR reduction by CSA, EWA and proposed hybrid scheme is 34.8%, 6.72% and 10.8% respectively. PAR comparison of all used schemes is shown in Fig.Â 6.In this work, user comfort by CSA, EWA and proposed hybrid scheme is calculated in terms of waiting time of appliances. It is defined as the time interval for which a user waits for an appliance to switch ON. User comfort of implemented schemes is given in Fig.Â 7.*Fig. 7.*Waiting time of home appliances using EWA, CSA and HCEO From simulation findings, it is concluded that, hybrid technique performs better in case of electricity cost and it surpassed the EWA and CSA in case of cost. A trade-off exists between electricity cost and user comfort. To reduce the electricity bill, HCEO shifts most of the home appliances from high price hours to low price hours as a result, waiting time of appliances is increased. So if consumer wants to reduce the waiting time of household appliances then, electricity cost will be high.6 ConclusionAn optimization based HEMS is proposed, in which appliance scheduling is performed using load shifting strategy. For scheduling the home appliances, optimization algorithms (CSA, EWA and HCEO) are used and their performance is calculated using four parameters: electricity cost, electricity consumed, PAR and waiting time of appliances using RTP scheme sent by the utility. Objective of this study is to decrease the electricity cost by shifting the household load. The hybrid technique HCEO decreased the electricity cost by 49% with respect to unscheduled electricity cost because it has scheduled the most of the appliances during the low price hours. Thus, it has reduced the electricity consumption during on-peak hours. From simulations, it is observed that there is a trade-off between electricity cost and user comfort. So, if consumer wants to decrease the waiting time of home electrical devices then, consumer needs to compromise on electrical cost.In future, we will integrate the pumped storage system to generate the electricity when demand and prices are low and will use it during high price and demand hours. In addition, we will focus on the coordination of smart homes to sell extra electricity produced by consumers.

References1.Evangelisti, S., Lettieri, P., Clift, R., Borello, D.: Distributed generation by energy from waste technology: a life cycle perspective. Process Safety Environ. Protect. **93**, 161–172 (2015) Crossref2.Vardakas, J.S., Zorba, N., Verikoukis, C.V.: A survey on demand response programs in smart grids: pricing methods and optimization algorithms. IEEE Commun. Surv. Tutor. **17**(1),

152–178 (2015)Crossref3.Yi, P., Dong, X., Iwayemi, A., Zhou, C., Li, S.: Real-time opportunistic scheduling for residential demand response. IEEE Trans. Smart Grid **4**(1), 227–234 (2013)Crossref 4.Samadi, P., Wong, V.W.S., Schober, R.: Load scheduling and power trading in systems with high penetration of renewable energy resources. IEEE Trans. Smart Grid **7**(4), 1802–1812 (2016)Crossref 5.Aslam, S., Iqbal, Z., Javaid, N., Khan, Z.A., Aurangzeb, K., Haider, S.I.: Towards efficient energy management of smart buildings exploiting heuristic optimization with real time and critical peak pricing schemes. Energies **10**(12), 2065 (2017)Crossref6.Mahmood, A., Javaid, N., Khan, N.A., Razzaq, S.: An optimized approach for home appliances scheduling in smart grid. In: 19th International Multi-topic Conference (INMIC), Islamabad, pp. 1–5 (2016)7.Motevasel, M., Seifi, A.R.: Expert energy management of a micro-grid considering wind energy uncertainty. Energy Convers. Manage. **83**, 58–72 (2014)Crossref8.Logenthiran, T., Srinivasan, D., Shun, T.Z.: Demand side management in smart grid using heuristic optimization. IEEE Trans. Smart Grid **3**(3), 1244–1252 (2012)Crossref9.Muralitharan, K., Sakthivel, R., Shi, Y.: Multiobjective optimization technique for demand side management with load balancing approach in smart grid. Neurocomputing **177**, 110–119 (2016)Crossref10.Liu, Y., Yuen, C., Yu, R., Zhang, Y., Xie, S.: Queuing-based energy consumption management for heterogeneous residential demands in smart grid. IEEE Trans. Smart Grid **7**(3), 1650–1659 (2016)Crossref11.Wang, C., Zhou, Y., Wu, J., Wang, J., Zhang, Y., Wang, D.: Robust-index method for household load scheduling considering uncertainties of customer behavior. IEEE Trans. Smart Grid **6**(4), 1806–1818 (2015)Crossref12. Setlhaolo, D., Xia, X., Zhang, J.: Optimal scheduling of household appliances for demand response. Electr. Power Syst. Res. **116**, 24–28 (2014)Crossref13.Melhem, F.Y., Grunder, O., Hammoudan, Z., Moubayed, N.: Optimization and energy management in smart home considering photovoltaic, wind, and battery storage system with integration of electric vehicles. Canad. J. Electr. Comput. Eng. **40**(2), 128–138 (2017)14.Yang, X.S., Deb, S.: Cuckoo search via levy flights. In: World Congress on Nature and Biologically Inspired Computing (NaBIC), Coimbatore, pp. 210–214 (2009)15.Wang, G.G., Deb, S., Coelho, L.D.S.: Earthworm optimization algorithm: a bio-inspired metaheuristic algorithm for global optimization problems. Int. J. Bio Inspired Comput. **7**, 1–23 (2015)Crossref16. Xhafa, F., Gonzalez, J.A., Dahal, K.P., Abraham, A.: A GA (TS) hybrid algorithm for scheduling in computational grids. In: International Conference on Hybrid Artificial Intelligence Systems (HAIS), Berlin, pp. 285–292 (2009)

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_2Differential-Evolution-Earthworm Hybrid Meta-heuristic Optimization Technique for Home Energy Management System in Smart GridNadeem Javaid1 _, Ihtisham Ullah1, Syed Shahab Zarin1, Mohsin Kamal1, Babatunji Omoniwa1 and Abdul Mateen1(1)

COMSATS Institute of Information Technology, Islamabad, 44000, Pakistan **NadeemÂ Javaid Email:** nadeemjavaidqau@gmail.com**URL:** http://www.njavaid.comAbstractIn recent years, advanced technology is increasing rapidly, especially in the field of smart grids. A home energy management systems are implemented in homes for scheduling of power for cost minimization. In this paper, for management of home energy we propose a meta-heuristic technique which is hybrid of existing techniques enhanced differential evolution (EDE) and earthworm optimization algorithm (EWA) and it is named as earthworm EWA (EEDE). Simulations show that EWA performed better in term of reducing cost and EDE performed better in reducing peak to average ratio (PAR). However proposed scheme outperformed in terms of both cost and PAR. For evaluating the performance of proposed technique a home energy system proposed by us. In our work we are considering a single home, consists of many appliances. Appliances are categorized into two groups: Interruptible and un-interruptible. Simulations and results show that both algorithms performed well in terms of reducing costs and PAR. We also measured waiting time to find out user comfort and energy consumption.**KeywordsEDE algorithmEWA algorithmUser comfortHybrid meta-heuristic technique****1 IntroductionPopulation of the world is**

increasing day by day and due to increase in population demands also increasing. The use of electricity is also increasing. The demand is increasing for electricity, in order to provide reliable electricity the concept of smart grid (SG) is implemented everywhere. The SG acts as a medium between the utility and consumer for exchange of information about price signals and energy demand. Demand side management (DSM) is very important for consumers to reduce electricity cost. Some strategies are discussed in the literature to reduce electricity cost, PAR and energy consumption. For optimization of energy consumption and by applying various methods these strategies are used. To balance supply from the utility and demand from consumers, DSM strategies are very useful. Demand and supply are balanced by using dynamic pricing schemes. These schemes are more effective, especially for electricity management to reduce costs and PAR rapidly. Some of dynamic pricing schemes like Real time pricing (RTP), time of use (TOU), critical peak pricing (CPP) and inclined block rate (IBR) are very useful. Smart grid provides consumers a safe way to reduce cost, PAR, energy consumption and to maximize user comfort. Demand and response is the best technique to achieve all objectives like in [1], authors using DR technique to reduce the cost and PAR and achieving maximum user comfort. Electricity consumption is increasing because demand is increasing due to high number of consumers, so to fulfill this problem we use different techniques in home energy management to reduce energy consumption, cost and PAR and to increase user comfort.Demand side management strategy has been used in [2], saving cost and reducing PAR. Energy consumption when increases, so load on utility side also increases, which results in decreasing performance of utility. The increase in demand can create a shortage of electricity. When in peak hours electricity demand is high, so utility have to use extra energy resources to cover that space, which results in creating an imbalance between supply and demand. For the management of demand and response issue in DSM demand response (DR) is used. DR provides sufficient knowledge to users to use minimum electricity during peak hours, in order that energy loss can be controlled.Two algorithms teaching and learning based optimization (TLBO), shuffled the frog leaping (SFL) are used in [3]. Scheduling different appliances in smart homes in smart grid (SG). The main objective is to reduce consumer cost. Results showed that the program we used demand response DR by shifting the load minimizing cost successfully. The Large number of appliances is aggregated which are based on DR and its decomposition it non-convex. Heuristic algorithm is applied in [4], using an intelligent decision support system (IDSS) for cost minimizing costs of appliances. Two models for cost generic and flexible are utilized in this model. Real time pricing (RTP), RTP/2-RTP schemes is being used, but the performance of combination works well than RTP alone.Energy is consumed in such way in [5], that there is the utilization of appliances and minimization of cost is balanced. Realistic scheduling algorithm (RSM) is used to achieve user comfort, scheduling appliances into time slots sub slots effectively. The results shows that it maximize appliance utilization and cost is reduced. RSM is working along with BPSO. In this paper we are using meta-heuristic techniques EDE and EWA and hybrid meta-heuristic technique EEDE, our aim is to minimize cost, PAR, energy consumption to increase user comfort.Rest of paper is organized as follows: Sect.Â 2 contains the Related Work. The Problem statement is presented in Sect.Â 3. Proposed solution is discussed in Sect.Â 4. SectionÂ 5 consists of the system model. Optimization techniques are explained in Sect.Â 6. Simulation and the results are presented in Sect.Â 6 and conclusion of the paper is in Sect.Â 8.2 Related WorkMany researchers around the world are working in the smart grid, scheduling home appliances using different algorithms. In this regard, some of the papers are discussed as follows:The results shows that it maximize appliance utilization and cost is reduced. RSM is working along with BPSO. In [6], authors are using renewable energy for battery optimal control and management. The neural network is used to apply adaptive dynamic programming (ADP). In each iteration discount factor is chosen appropriately, the simulations show the effectiveness of developed algorithm. In [7], the authors presented a new HEM model,

they have worked on using the TOU pricing scheme in two conditions. In the first condition with the addition of RES energy and in second condition without renewable energy resource (RES) energy. They have evaluated performance on a base of three algorithms, genetic algorithm (GA), binary particle swarm optimization (BPSO) and Cuckoo, minimizing the user bill and achieving low peaks. The result shows that the cuckoo has shown better results in comparison to GA and BPSO, reducing cost and high peaks.The authors presented the energy management model to schedule in [8], the resident load by optimization and also to reduce electricity bills, carbon emissions. Another objective is to achieve high user comfort in zero energy buildings. The algorithms used are GA, TLBO and EDE. With the use of RES after performing simulations the electricity cost, carbon emissions and PAR are reduced upÂ to 67%, 55% and 29%.The authors used GA, BPSO and ant colony optimization (ACO) techniques [9], to minimize cost, PAR and achieving user comfort. The price schemes used are TOU and IBR. In this paper Hybrid of GA, BPSO and ACO are used to combine with the energy management controller (EMC) to reduce costs, PAR. The results show that GA-EMC performed well. Proposed optimal and dynamic energy control flow strategies in [10]. In this paper residential energy local network (RELN) combined with DSM and using RTP scheme. The results show that cost is minimized. Several conclusions are made on the basis of RES. DR is combined with a DG program in [11]. The results show that PAR and cost are reduced for multiple homes with the least effect on user comfort. Several issues are needed to be addressed in the future like securing and reliable home energy management system.In [12], using different pricing schemes like RTP and TOU, the author indicates that the home energy management system over a varying household set may not perform equally with respect to the load. Shifting and reducing the load are two factors. The results show that the home energy management system is not only based on DR but also we have to look after individual preferences. A multi-period artificial bee colony (MABC) is proposed to achieve maximum operational efficiency and minimum cost in home micro-grids by authors in [13], the proposed energy management scheme (EMS) performs well in increasing convergence speed also in combination mixed integer nonlinear programming (MINLP) algorithm is also used. An optimal algorithm is used for minimization of electricity tariffs from the user and demand power on the supply side in [14], also solar energy is used to minimize demand load in distribution network in order to increase stability of the grid. In both user mode and manually an adaptable autonomous thermostat used for residential energy management in order to save more energy and reduce costs, Adaptive Fuzzy Logic Model (AFLM) was also used to adapt itself to new user preferences, the results shows that proposed scheme performed well but users opts maximum in automatic mode in [15]. In near future smart home technology will be preferred everywhere for energy management in homes and also for better performance of appliances, users want to reduce cost and on demand side stability is important. Electricity utilization in a better way is important both for users and utility, so authors in [16] have focused on smart technologies, giving brief knowledge about different technologies and also predicting about future aspects.Awareness on energy management is very important which type of appliances should be used and how to control cost, authors in [17] worked on increasing life cycle cost of different appliance in reducing expenses of organization in term of cost and operation. Using inventor in AC can reduce energy consumption by 38%. The main idea is to manage energy. A DSM technique consists of a smart grid is used in [18], smart consumers connected to the grid. A distributed algorithm micro-grid energy management, distributed optimization Algorithm (MEM-DOA) designed for customers of each type, installed on smart meters is used for simulations, results show that PAR and peak demand reduced. This algorithm also shows that active consumers benefited more than passive.EWA method performed well in finding values of better function as compare to other algorithms in [19], it is also very useful for parallel computation. A hybrid teacher learning, TLBO is used in [20] to minimize cost-user dis-comfort and PAR, TLBO performed well in reducing costs while GA performed well in

term of reducing cost.3 Problem StatementIn SG the main issues which need to be solved are cost minimization, to reduce PAR, to balance load and increasing user comfort. In [7], the authors HEM model, using the TOU pricing scheme in two conditions. The algorithms used are GA, TLBO and EDE. With the use of RES after performing simulations the electricity cost, carbon emissions and PAR are reduced. However the user comfort is not considered. Demand side management strategy has been used in [2]. The results show that proposed algorithm can handle a large number of controllable devices, saving cost and reducing PAR but again user comfort is not considered in this work. To overcome the problem of waiting time we propose a useful home energy model, we have used EDE and EWA heuristic techniques to overcome the problem of user comfort. In terms of cost our proposed technique performed as well as maximizing user comfort. Energy is consumed in [5], in such way that there is the utilization of appliances and minimization of cost is balanced. However, PAR reduction is not considered in this paper.In our work, we apply EDE and EWA and hybrid meta-heuristic technique EEDE in a single home. We schedule different appliances. Appliances are categorized into two groups as discussed in system model. Overall objectives of our proposed work are: Cost reduction PAR reduction Minimizing energy consumption Increasing user comfort.4 Proposed SolutionThe objectives of our work are: cost reduction, minimizing PAR and load balancing along with increasing user comfort. For the solution of our problem we are using EDE and EWA algorithms and hybrid meta-heuristic technique EEDE, using the dynamic CPP pricing scheme. For 24Â h schedule, we are taking 96 time slots. We are dealing with seven appliances. Our proposed technique will schedule all appliances to minimize cost, PAR and balancing load. We will also increase user comfort dealing with waiting time.We will calculate all parameters for different number of operational time intervals (OTI). In our paper we will optimize the problem by taking 15, 30 and 60Â min OTI and then comparing them all.5 System ModelWe discussed working of our designed system in this portion. As shown in Fig.Â 1, we propose a model of HEMS for single homes. In order to schedule appliances of home to minimize cost, PAR and maximizing user comfort.In our scenario we are scheduling appliances of single smart home. The smart home appliances are connected with the smart meter (SM). An EMC is used in order to receive price signals from SM. SM working jointly and it also takes data about energy consumption from EMC and sends it to the utility. SM and Utility are communicating with each other through a wireless network. All information between SM, utility and smart meter are exchanged in the home area network. Formulas for Cost, load and PAR are mentioned in Eqs.Â (1), (2) and (3). (1) (2) (3)In our research work we are considering single home with 7 appliances. For electricity bill we are using the CPP pricing scheme. In our scenario a single time slot for one appliance to complete its working is 15Â min. OTI in our scenario is 15Â min. We have also calculated the cost on the basis of 30Â min OTI and 60Â min. The length of operational time of appliances is 15Â min, so dividing 24Â h in 96Â slots. Each hour consist of 4 slots. One slot is about 15Â min. Dividing the whole day on the basis of hours, like scheduling an appliance for hours will result in loss of time, because each appliance working time is not more than 15Â min. So diving day on the basis of appliance working time will reduce cost and will the whole system stability greater.For scheduling according to their nature appliances are divided into two categories according to their nature on the basis of power consumption.*Fig. 1.*System model 5.1 Interruptible AppliancesA type of appliances which can be interrupted during operational time and can be shifted. In our case, interruptible appliances are air conditioner and refrigerator, they are also known as heavy loads. Heavy loads operating at the same time will be costly.5.2 Un-interruptibleType of appliances can be shifted to any time slots, but once their operation is started they cannot be interrupted until they complete their operation. In our model non-interruptible appliances are Dishwasher, cloth washer and dryer, oven1, oven2, and the electric vehicle.5.3 Price ModelThe price rate set by utility electricity cost is calculated on that basis, different pricing schemes are used to calculate the price. A utility used different tariff schemes. For the reduction of cost and

PAR mostly dynamic pricing schemes are used like TOU, IBR, CPP, DAT and RTP. Mostly dynamic pricing scheme is used because the user can shift their appliances from high rate hours to low in order to reduce cost. Mostly RTP is used but in our scenario we have used CPP pricing scheme.6 Optimization TechniquesWe have applied heuristic algorithms for our proposed work. Traditional techniques are known to not good for real time optimization. The techniques we used are the EDE and EWA. EDE and EWA are described in detail in the following sections.6.1 EDEDifferential evolution (DE) was the first version followed by EDE. EDE is an evolutionary algorithm mostly used for population generation, Storn developed it in 1955. DE algorithm execution is in three steps: mutation, crossover and selection. Initially a random population is generated, then after generation of population mutation is performed. In mutation step three random vectors are selected in order for each target vector, the difference between any two random vectors is added into a third vector to form a new mutant vector. The equation of the mutant vector is: (4)In Eq.Â (4), where a1, a2 and a3 are distinct vectors and Q is a scaling factor. After generation of mutant vector crossover starts, in a crossover trial vector generation takes place. By combing elements of mutant and the target vector, a trial vector is generated. For the formation of the trial vector, a rate is decided which is known as a crossover rate. The crossover rates decides from target and a mutant vector how much information is collected, a random number is generated to compare with the crossover rate to decide a value for a specific position is chosen either form target or mutant vector. When trial vector is created, then in phase of selection trial and target vectors are compared. A vector having better fitness value, for the next generation that vector is selected.In DE algorithm we have 3 numbers of parameter used to control: population size (PZ), the factor of scaling Q and crossover (C), in EDE these are reduced to two parameters only PZ and Q. The only difference between EDE and DE is that at crossover phase, five trial vectors are generated in EDE instead of one.Different crossover rates are used for the generation of first three trial vectors. To increase convergence speed fourth trail vector is used and the fifth one is used only to enhance the diversity of the trial vectors.A vector with maximum fitness value is selected from the trial vectors finally generated, after the selection of a final trial vector, it is compared with the target vector and then the vector with a fitness value which is better selected for the next generation.6.2 EWAEWA is a bio-inspired heuristic optimization algorithm. It consists of two kinds of reproductions of wormâ€™s reproduction 2 and reproduction 2. The offspring are generated through reproductions and then we calculate weightage sum of all offspring, so we can get final earthworms for the next generation. One offspring is only generated by reproduction 1 which is special, reproduction two generates more than one offspring whit the help of crosser operators which are nine in numbers. For improvement of searching ability a Cauchy mutation (CM) is added to EWA. The earthworm has the finest fitness permit on straight next generation, and operators can not alter them. The population of earthworm cannot fail in generations in the increment this is the assurance.6.3 EEDEOur proposed hybrid technique is EEDE. In EWA in last step best population is generated, in this paper, we assigned best generated population of EWA to EDE to make it hybrid in form of EEDE. EEDE is more better it consists of both EDE and EWA and results in better performance.7 Simulation and ResultsThis section composed of simulations and results. In this section we evaluated the performance of EDE and EWA techniques and new hybrid meta-heuristic technique EEDE. All the simulations are conducted by using MATLAB. We evaluated the proposed EDE and EWA and EEDE Techniques on the basis of four parameters: Electricity cost, Energy consumption, PAR and user comfort.For simulation purpose, we are considering single home, consists of seven appliances using the CPP price scheme. We have categorized appliances into two groups discussed in the TableÂ 2.We applied both techniques using three different OTI of 15Â min, 30Â min and 60Â min, using a CPP price scheme for 24Â h. Simulations and results are discussed in the following sections for four parameters, cost, PAR, energy consumption and user comfort.7.1 CostThe overall cost for single home for a day is illustrated in Fig.Â 2,

sub-figures a, b, c. In these figures we have calculated the cost of electricity of single home for one day. Total cost reduction in case of 15Â min OTI is 2.8% by using EDE algorithm. Now for OTI of 30Â min using EDE the total cost reduction is 1%.In case of 60Â min OTI the cost is using EDE, the total cost is reduced upÂ to 6%. Overall, our proposed technique showed good performance in reducing cost. A comparison of the costs of different OTI. EWA also showed good performance in reducing cost. In case 15Â min, 30Â min and 60Â min EWA reduced costs by 1%, 5%, 8% respectively.EEDE performed better than both techniques, reducing cost by 8%, 9%, 10% in case of 15Â min, 30Â min and 60Â min OTI respectively.*Fig. 2.*Cost against different OTIs 7.2 Energy ConsumptionIn my paper, I have taken two types of appliances: interruptible and non-interruptible. In case of interruptible appliances, the running time of the appliances is not reduced, but is shifted from a peak to non-peak hours. In Fig.Â 3, sub-figures a, b, c energy consumption of appliances is shown during different hours. The electrical appliances consume energy in case of 15Â min, 30Â min and 60Â min OTI, using EWA energy consumption is low during (0 to 5) hours for 24Â h and EDE algorithm appliances consume more energy for all OTIs. During peak hours (10 to 4) for 24Â h in comparison to EEDE, EDE and EWA algorithm appliances consume more energy. The normal consumption of energy for both schedule and unscheduled case are same. During high peak hours (10 to 4) EDE and EWA algorithm appliances consume more energy than EEDE, on the other hand EEDE reduce energy consumption efficiently by scheduling appliances during low and mid peak hours. EDE and EWA do not turn on appliances during peak hours.*Fig. 3.*Energy consumption comparison for different OTIs 7.3 PARDSM is good for utility as well as consumers. PAR reduction helps in reducing costs as well as in retaining utility stability. In comparison to the un-scheduled case from Fig.Â 4, sub-figures a, b, c, it is clear that in case of 15, 30 and 60Â min OTI, EEDE algorithm performed well than EDE and EWA in reducing PAR.In case of 15Â min OTI PAR is reduced upÂ to 1% after using EDE. In 30Â min OTI PAR is reduced upÂ to 6% using EDE, and for 30Â min, reducing it upÂ to 4%. EWA reducing PAR for 15Â min, 30Â min and 60Â min upÂ to 2%, 3%, 4% respectively. EEDE reduced PAR for 15Â min, 30Â min and 60Â min by 13%, 7%, 8%, performed better then EDE and EWA.*Fig. 4.*PAR in case of different OTIs 7.4 User ComfortThis term is related to cost as well as waiting time. We calculated in terms of waiting time the user comfort that how much the user will wait to turn on the appliance, in order to have minimum cost users must schedule their appliances in low rate hours. For reduction of cost user will compromise on user comfort. User comfort and cost are inversely related to each other. We are calculating waiting time for 15Â min, 30Â min and 60Â min OTI.The results show in Fig.Â 5, sub-figures a, b, c, that EDE algorithm has maximum waiting time as compared to EWA. There is a tradeoff between cost and user comfort, and other hand EWA has less waiting time as compared to both EDE and EEDE and unscheduled case. It shows that EWA performs well in increasing user comfort, and reducing cost. So EWA is considered good for those consumers who are sensitive about cost and also wants user comfort.*Fig. 5.*Waiting time comparison for different OTIs 7.5 Feasible RegionA region containing solutions bonded by set of points. In this paper cost and energy consumption depends on price of electricity for different time slots and the power consumption. As all the consumers wants to minimize cost, so they can only rely on power consumption adjustment. All the consumers can not change electricity price. There is indirect relationship between cost and user comfort.Feasible Region for Energy Consumption and Cost. The Feasible region for energy consumption and cost for 15Â min, 30Â min and 60Â min OTI is shown in Fig.Â 6, sub-figures a, b, c. A bounded region by P1 (0.1396, 0.0991), P2 (0.1396, 0.3085), P3 (0.7740, 1.7105), P4 (0.7740, 0.5945) in Fig.Â 6(a) shows an overall cost region for 15Â min OTI. Similarly, when minimum load is scheduled using minimum price is shown by P1 (0.1396, 0.0991) and P2 (0.1396, 0.3085) represents the cost at maximum price using minimum load. Coordinates (P3, P4) represents the cost by keeping load maximum using maximum and minimum prices. The maximum cost at any time slot must be less than the maximum cost in unscheduled case which is 1.5 dollars.

After applying constraints a feasible region is found which consists of coordinates (P1, P2, P3, P4, P5, P6) where coordinate P5 (0.52, 1.1525) shows that schedule load must not exceed than 0.52 kWh at that time slot where the price is the maximum and maximum load, i.e. 0.7740 kWh is represented by coordinate P6 (0.7740, 1.525), at any time slot price is higher than 1.5 dollars should not be scheduled.Similarly, we find feasible region for 30Â min OTI, a bounded region by P1 (0.8375, 3.5594), P2 (0.8375, 11.0969), P3 (4.6790, 61.9968), P4 (4.6790, 19.8858) in Fig.Â 6(b) shows an overall cost region for 30Â min OTI. Similarly, when minimum load is scheduled using minimum price is shown by P1 and P2 represents the cost at maximum price using minimum load. Coordinates (P3, P4) represent the cost of keeping load maximum using maximum and minimum prices. The maximum cost at any time slot must be less than the maximum cost in unscheduled case which is 58.0969 dollars. After applying constraints a feasible region is found which consists of coordinates (P1, P2, P3, P4, P5, P6) where coordinate P5 (4.4, 58.0969) shows that schedule load must not exceed than 4.4 kWh at that time slot where the price is the maximum and maximum load, i.e. 4.6790 kWh is represented by coordinate P6 (4.6790, 58.0969), at any time slot price is higher than 58.0969 dollars should not be scheduled.*Fig. 6.*Feasible region for different OTIs FigureÂ 6(c) shows feasible region for 60Â min OTI, where, at any time slot if the price is higher than 159 dollars should not be scheduled, and at any time slot P5 shows that schedule load must not be exceed than 6.05Â kWh where the price the price is maximum. All possible cases are discussed in Table 5.7.6 Performance Trade-OffIn this paper, we evaluated the performance of EDE and EWA and EEDE algorithms, the hybrid meta-heuristic technique performed well in minimizing cost, PAR, but there is a trade-off between cost and user-comfort. EWA maximize user-comfort, so it is good for those consumers who not worries about cost. On the other hand EEDE performed well in reducing cost. If a consumer wants to reduce costs, then he must sacrifice user comfort. In short, there is a trade-off between cost and user comfort.8 ConclusionIn this paper, we evaluated the performance of EDE, EWA and a hybrid meta-heuristic technique EEDE using the CPP pricing scheme. We take 7 appliances on a single home divided them into two categories according to the pattern of their energy consumption. The optimization technique we used to measure performance on the basis of four parameters, energy consumption, cost, PAR and user comfort. We have done simulations by taking three different OTI, in each case our proposed techniques EDE and EWA and EEDE performed well. EDE shows the reduction in cost upÂ to 2%, 1% and 6%, while EWA shows cost reduction upÂ to 1%, 5% and 8% in each OTI. EEDE showed better performance than other techniques, reducing costs upÂ to 1%, 2% and 4%, in case of 15Â min, 30Â min, and 60Â min OTI the PAR was reduced upÂ to 13%, 20% and 14% by using EDE and reduced upÂ to 2%, 3%, 4% by using EWA for 15, 30 and 60Â min OTI respectively.EEDE reduced PAR by 13%, 7%, 8% in case of each OTI, performed better than other techniques. Hybrid meta-heuristic technique performed well in reducing cost, PAR, energy consumption. The results show that EEDE performed better than other techniques in reducing cost and PAR. However, there is a trade-off between cost and user comfort. We will study other pricing schemes in future work and will consider multiple homes instead of single home.

References1.Rasheed, M.B., et al.: Energy optimization in smart homes using customer preference and dynamic pricing. Energies **9**(8), 1–25 (2016)Crossref2.Logenthiran, T., Member, S., Srinivasan, D., Member, S., Shun, T.Z.: Demand side management in smart grid using heuristic optimization. IEEE Trans. Smart Grid **3**(3), 1244–1252 (2015)Crossref3.Mhanna, S., Chapman, A.C., Verbic, G.: A fast distributed algorithm for large-scale demand response aggregation. IEEE Trans. Smart Grid **7**(4), 2094–2107 (2016)Crossref4.Ogwumike, C., Short, M., Abugchem, F.: Heuristic optimization of consumer electricity costs using a generic cost model. Energies **9**(1), 6 (2016)Crossref5.Mahmood, D., et al.: Realistic Scheduling Mechanism for smart homes. Energies **9**(3), 1–28 (2016)Crossref6. Wei, Q., Lewis, F.L., Shi, G., Song, R.: Error-tolerant iterative adaptive dynamic programming for optimal renewable home energy scheduling and battery management. IEEE Trans. Ind. Electron. **64**(12), 1–1 (2017)7.Javaid, N., et al.: An intelligent load management system with renewable

energy integration for smart homes. IEEE Access **5**, 13587–13600 (2017)Crossref8.Javaid, N., et al.: Demand side management in nearly zero energy buildings using heuristic optimizations. Energies **10**(8), 1131 (2017)Crossref9.Rahim, S., et al.: Exploiting heuristic algorithms to efficiently utilize energy management controllers with renewable energy sources. Energ. Build. **129**, 452–470 (2016)Crossref10.Yang, X., Zhang, Y., Zhao, B., Huang, F., Chen, Y., Ren, S.: Optimal energy flow control strategy for a residential energy local network combined with demand-side management and real-time pricing. Energ. Build. **150**, 177–188 (2017)Crossref11.Celik, B., Roche, R., Suryanarayanan, S., Bouquain, D., Miraoui, A.: Electric energy management in residential areas through coordination of multiple smart homes. Renew. Sustain. Energ. Rev. **80**(May), 260–275 (2017)Crossref12.Koolen, D., Sadat-razavi, N., Ketter, W.: Applied sciences machine learning for identifying demand patterns of home energy management systems with dynamic electricity pricing (2017)Crossref13.Marzband, M., Ghazimirsaeid, S.S., Uppal, H., Fernando, T.: A real-time evaluation of energy management systems for smart hybrid home Microgrids. Electr. Power Syst. Res. **143**, 624–633 (2017)Crossref14.Zhou, Y.: The optimal home energy management strategy in smart grid. J. Renew. Sustain. Energ. **8**, 45101 (2016)Crossref15.Keshtkar, A., Arzanpour, S.: An adaptive fuzzy logic system for residential energy management in smart grid environments. Appl. Energ. **186**, 68–81 (2017)Crossref16.Lobaccaro, G., Carlucci, S., Löfström, E.: A review of systems and technologies for smart homes and smart grids. Energies **9**(5), 1–33 (2016)Crossref17.Schulze, M., Heidenreich, S., Spieth, P.: The impact of energy management control systems on energy efficiency in the german manufacturing industry, vol. 0, no. 0, pp. 1–14 (2017)18.Longe, O.M., Ouahada, K., Rimer, S., Ferreira, H.C., Han Vinck, A.J.: Distributed optimisation algorithm for demand side management in a grid-connected smart microgrid. Sustainability **9**(7), 1088–1104 (2017)Crossref19.Wang, G.G., Deb, S., Coelho, L.D.S.: Earthworm optimization algorithm: a bio-inspired metaheuristic algorithm for global optimization problems. Int. J. Bio Inspired Comput. **1**(1), 1 (2015)Crossref20.Manzoor, A., Javaid, N., Ullah, I., Abdul, W., Almogren, A., Alamri, A.: An intelligent hybrid heuristic scheme for smart metering based demand side management in smart homes. Energies **10**(9), 1–28 (2017)Crossref

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_3Performance Analysis of Simulation System Based on Particle Swarm Optimization and Distributed Genetic Algorithm for WMNs Considering Different Distributions of Mesh ClientsAdmir Barolli1 , Shinji Sakamoto2 , Leonard Barolli3 and Makoto Takizawa4 (1)
Department of Information Technology, Aleksander Moisiu University of Durres, L.1, Rruga e Currilave, Durres, Albania(2)
Department of Computer and Information Science, Seikei University, 3-3-1 Kichijoji-Kitamachi, Musashino-shi, Tokyo 180-8633, Japan(3)
Department of Information and Communication Engineering, Fukuoka Institute of Technology, 3-30-1 Wajiro-Higashi, Higashi-Ku, Fukuoka 811-0295, Japan(4)
Department of Advanced Sciences, Faculty of Science and Engineering, Hosei University, Kajino-Machi, Koganei-Shi, Tokyo 184-8584, Japan **AdmirÂ BarolliEmail:** admir.barolli@gmail.com **ShinjiÂ SakamotoÂ (Corresponding author)Email:** shinji.sakamoto@ieee.org **LeonardÂ BarolliEmail:** barolli@fit.ac.jp **MakotoÂ TakizawaEmail:** makoto.takizawa@computer.orgAbstractThe Wireless Mesh Networks (WMNs) are becoming an important networking infrastructure because they have many advantages such as low cost and increased high speed wireless Internet connectivity. In our previous work, we implemented a Particle Swarm Optimization (PSO) based simulation system, called WMN-PSO, and a simulation system based on Genetic Algorithm (GA), called WMN-GA, for solving node placement problem in WMNs. In this paper, we implement a hybrid simulation system based on PSO and distributed GA (DGA), called WMN-PSODGA. We analyze the performance of WMN-PSODGA by computer

simulations considering different client distributions. Simulation results show that the WMN-PSODGA has good performance when the client distribution is Normal compared with the case of Exponential distribution.**1 IntroductionThe wireless networks and devises are becoming increasingly popular and they provide users access to information and communication anytime and anywhereÂ [11â€“14, 22, 28â€“30]. Wireless Mesh Networks (WMNs) are gaining a lot of attention because of their low cost nature that makes them attractive for providing wireless Internet connectivity. A WMN is dynamically self-organized and self-configured, with the nodes in the network automatically establishing and maintaining mesh connectivity among them-selves (creating, in effect, an ad hoc network). This feature brings many advantages to WMNs such as low up-front cost, easy network maintenance, robustness and reliable service coverageÂ [1]. Moreover, such infrastructure can be used to deploy community networks, metropolitan area networks, municipal and corporative networks, and to support applications for urban areas, medical, transport and surveillance systems.Mesh node placement in WMN can be seen as a family of problems, which are shown (through graph theoretic approaches or placement problems, e.g.Â [8, 17]) to be computationally hard to solve for most of the formulationsÂ [34]. In fact, the node placement problem considered here is even more challenging due to two additional characteristics:*(a)locations of mesh router nodes are not pre-determined, in other wards, any available position in the considered area can be used for deploying the mesh routers. (b)routers are assumed to have their own radio coverage area.* Here, we consider the version of the mesh router nodes placement problem in which we are given a grid area where to deploy a number of mesh router nodes and a number of mesh client nodes of fixed positions (of an arbitrary distribution) in the grid area. The objective is to find a location assignment for the mesh routers to the cells of the grid area that maximizes the network connectivity and client coverage. Node placement problems are known to be computationally hard to solveÂ [15, 16, 35]. In some previous works, intelligent algorithms have been recently investigatedÂ [2â€“4, 6, 7, 9, 10, 18, 20, 23â€“25, 36].In our previous work, we implemented a Particle Swarm Optimization (PSO) based simulation system, called WMN-PSOÂ [26]. Also, we implemented another simulation system based on Genetic Algorithm (GA), called WMN-GAÂ [21], for solving node placement problem in WMNs.In this paper, we design and implement a hybrid simulation system based on PSO and distributed GA (DGA). We call this system WMN-PSODGA. We analyze the performance of the implemented WMN-PSODGA system by computer simulations considering Normal and Exponential client distributions.The rest of the paper is organized as follows. The mesh router nodes placement problem is defined in Sect.Â 2. We present our designed and implemented hybrid simulation system in Sect.Â 3. The simulation results are given in Sect.Â 4. Finally, we give conclusions and future work in Sect.Â 5.2 Node Placement Problem in WMNsFor this problem, we have a grid area arranged in cells we want to find where to distribute a number of mesh router nodes and a number of mesh client nodes of fixed positions (of an arbitrary distribution) in the considered area. The objective is to find a location assignment for the mesh routers to the area that maximizes the network connectivity and client coverage. Network connectivity is measured by Size of Giant Component (SGC) of the resulting WMN graph, while the user coverage is simply the number of mesh client nodes that fall within the radio coverage of at least one mesh router node and is measured by Number of Covered Mesh Clients (NCMC).An instance of the problem consists as follows. *N* mesh router nodes, each having its own radio coverage, defining thus a vector of routers.An area where to distribute *N* mesh routers. Positions of mesh routers are not pre-determined and are to be computed.*M* client mesh nodes located in arbitrary points of the considered area, defining a matrix of clients. It should be noted that network connectivity and user coverage are among most important metrics in WMNs and directly affect the network performance.In this work, we have considered a bi-objective optimization in which we first maximize the network connectivity of the WMN (through the maximization of the SGC) and then, the maximization of the NCMC.In fact, we**

can formalize an instance of the problem by constructing an adjacency matrix of the WMN graph, whose nodes are router nodes and client nodes and whose edges are links between nodes in the mesh network. Each mesh node in the graph is a triple representing the 2D location point and *r* is the radius of the transmission range. There is an arc between two nodes and , if is within the transmission circular area of .3 Proposed and Implemented Simulation System3.1 Particle Swarm OptimizationIn PSO a number of simple entities (the particles) are placed in the search space of some problem or function and each evaluates the objective function at its current location. The objective function is often minimized and the exploration of the search space is not through evolutionÂ [19]. However, following a widespread practice of borrowing from the evolutionary computation field, in this work, we consider the bi-objective function and fitness function interchangeably. Each particle then determines its movement through the search space by combining some aspect of the history of its own current and best (best-fitness) locations with those of one or more members of the swarm, with some random perturbations. The next iteration takes place after all particles have been moved. Eventually the swarm as a whole, like a flock of birds collectively foraging for food, is likely to move close to an optimum of the fitness function. Each individual in the particle swarm is composed of three -dimensional vectors, where is the dimensionality of the search space. These are the current position , the previous best position and the velocity .The particle swarm is more than just a collection of particles. A particle by itself has almost no power to solve any problem; progress occurs only when the particles interact. Problem solving is a population-wide phenomenon, emerging from the individual behaviors of the particles through their interactions. In any case, populations are organized according to some sort of communication structure or topology, often thought of as a social network. The topology typically consists of bidirectional edges connecting pairs of particles, so that if *j* is in *i*â€™s neighborhood, *i* is also in *j*â€™s. Each particle communicates with some other particles and is affected by the best point found by any member of its topological neighborhood. This is just the vector for that best neighbor, which we will denote with . The potential kinds of population â€œsocial networksâ€• are hugely varied, but in practice certain types have been used more frequently. We show the pseudo code of PSO in AlgorithmÂ 1.In the PSO process, the velocity of each particle is iteratively adjusted so that the particle stochastically oscillates around and locations.3.2 Distributed Genetic AlgorithmDistributed Genetic Algorithm (DGA) has been focused from various fields of science. DGA has shown their usefulness for the resolution of many computationally hard combinatorial optimization problems. We show the pseudo code of DGA in AlgorithmÂ 2.*Fig. 1.*Model of migration in DGA. *Fig. 2.*Relationship among global solution, particle-patterns and mesh routers in PSO part. Population of individuals:Â Unlike local search techniques that construct a path in the solution space jumping from one solution to another one through local perturbations, DGA use a population of individuals giving thus the search a larger scope and chances to find better solutions. This feature is also known as â€œexplorationâ€• process in difference to â€œexploitationâ€• process of local search methods.Fitness: The determination of an appropriate fitness function, together with the chromosome encoding are crucial to the performance of DGA. Ideally we would construct objective functions with â€œcertain regularitiesâ€• , i.e. objective functions that verify that for any two individuals which are close in the search space, their respective values in the objective functions are similar.Selection: The selection of individuals to be crossed is another important aspect in DGA as it impacts on the convergence of the algorithm. Several selection schemes have been proposed in the literature for selection operators trying to cope with premature convergence of DGA. There are many selection methods in GA. In our system, we implement 2 selection methods: Random method and Roulette wheel method.Crossover operators: Use of crossover operators is one of the most important characteristics. Crossover operator is the means of DGA to transmit best genetic features of parents to offsprings during generations of the evolution process. Many methods for crossover

operators have been proposed such as Blend Crossover (BLX-), Unimodal Normal Distribution Crossover (UNDX), Simplex Crossover (SPX).Mutation operators: These operators intend to improve the individuals of a population by small local perturbations. They aim to provide a component of randomness in the neighborhood of the individuals of the population. In our system, we implemented two mutation methods: uniformly random mutation and boundary mutation.Escaping from local optima: GA itself has the ability to avoid falling prematurely into local optima and can eventually escape from them during the search process. DGA has one more mechanism to escape from local optima by considering some islands. Each island computes GA for optimizing and they migrate its gene to provide the ability to avoid from local optima (See Fig.Â 1).Convergence: The convergence of the algorithm is the mechanism of DGA to reach to good solutions. A premature convergence of the algorithm would cause that all individuals of the population be similar in their genetic features and thus the search would result ineffective and the algorithm getting stuck into local optima. Maintaining the diversity of the population is therefore very important to this family of evolutionary algorithms.3.3 WMN-PSODGA Hybrid Simulation SystemIn this subsection, we present the initialization, particle-pattern, fitness function and replacement methods.InitializationOur proposed system starts by generating an initial solution randomly, by *ad hoc* methodsÂ [36]. We decide the velocity of particles by a random process considering the area size. For instance, when the area size is , the velocity is decided randomly from to .Particle-PatternA particle is a mesh router. A fitness value of a particle-pattern is computed by combination of mesh routers and mesh clients positions. In other words, each particle-pattern is a solution as shown is Fig.Â 2 .Gene CodingA gene describes a WMN. Each individual has its own combination of mesh nodes. In other words, each individual has a fitness value. Therefore, the combination of mesh nodes is a solution.Fitness FunctionOne of most important thing in PSO algorithm is to decide the determination of an appropriate objective function and its encoding. In our case, each particle-pattern has an own fitness value and compares it with other particle-patternâ€™s fitness value in order to share information of global solution. The fitness function follows a hierarchical approach in which the main objective is to maximize the SGC in WMN. Thus, the fitness function of this scenario is defined asClient DistributionsIn our system, many kinds of client distributions are generated. In this paper, we consider Normal and Exponential distributions for mesh clients. Clients are distributed randomly to a considered area for Normal distribution. On the other hand, Exponential distribution is a hot-spot model supposition.Routers Replacement Method for PSO PartA mesh router has *x*, *y* positions and velocity. Mesh routers are moved based on velocities. There are many moving methods in PSO field, such as:Constriction Method (CM)CM is a method which PSO parameters are set to a week stable region (,) based on analysis of PSO by Clerc et al.Â [5, 32]. Random Inertia Weight Method (RIWM)In RIWM, the parameter is changing randomly from 0.5 to 1.0. The and are kept 2.0. The can be estimated by the week stable region. The average of is 0.75Â [32]. Linearly Decreasing Inertia Weight Method (LDIWM)In LDIWM, and are set to 2.0, constantly. On the other hand, the parameter is changed linearly from unstable region () to stable region () with increasing of iterations of computationsÂ [32, 33]. Linearly Decreasing Vmax Method (LDVM)In LDVM, PSO parameters are set to unstable region (,). A value of which is maximum velocity of particles is considered. With increasing of iteration of computations, the is kept decreasing linearlyÂ [31]. Rational Decrement of Vmax Method (RDVM)In RDVM, PSO parameters are set to unstable region (,). The is kept decreasing with the increasing of iterations as Where, *W* and *H* are the width and the height of the considered area, respectively. Also, *T* and *x* are the total number of iterations and a current number of iteration, respectivelyÂ [27]. *Fig. 3.*Model of WMN-PSODGA migration. *Fig. 4.*System structure for web interface. 3.4 WMN-PSODGA Web GUI Tool and Pseudo CodeThe Web application follows a standard Client-Server architecture and is implemented using LAMP (Linux + Apache + MySQL + PHP) technology (see Fig.Â 4). Remote users (clients) submit

their requests by completing first the parameter setting. The parameter values to be provided by the user are classified into three groups, as follows. *Fig. 5.*WMN-PSODGA Web GUI Tool. Parameters related to the problem instance: These include parameter values that determine a problem instance to be solved and consist of number of router nodes, number of mesh client nodes, client mesh distribution, radio coverage interval and size of the deployment area.Parameters of the resolution method: Each method has its own parameters.Execution parameters: These parameters are used for stopping condition of the resolution methods and include number of iterations and number of independent runs. The former is provided as a total number of iterations and depending on the method is also divided per phase (e.g., number of iterations in a exploration). The later is used to run the same configuration for the same problem instance and parameter configuration a certain number of times. We show the WMN-PSODGA Web GUI tool in Fig.Â 5. The pseudo code of our implemented system is shown in AlgorithmÂ 3.*Fig. 6.*Simulation results of WMN-PSODGA for Normal distribution of mesh clients. *Fig. 7.*Simulation results of WMN-PSODGA for Exponential distribution of mesh clients. *Fig. 8.*Visualized simulation results of WMN-PSODGA for different client distributions. *Table 1.*WMN-PSODGA parameters.

ParametersValues
Clients distributionNormal, Exponential
Area size
Number of mesh routers16
Number of mesh clients48
Number of migrations200
Evolution steps9
Number of GA islands16
Radius of a mesh router2.5â€“3.5
Replacement methodLDVM
Selection methodRoulette wheel method
Crossover methodSPX
Mutation methodBoundary mutation
Crossover rate0.8
Mutation rate0.2

4 Simulation ResultsIn this section, we show simulation results using WMN-PSODGA system. In this work, we analyse the performance of WMN-PSODGA system considering Normal and Exponential distribution of mesh clients. The number of mesh routers is considered 16 and the number of mesh clients 48. We conducted simulations 10 times, in order to avoid the effect of randomness and create a general view of results. We show the parameter setting for WM-PSODGA in TableÂ 1.We show simulation results from Figs.Â 6, 7 and 8. In Figs.Â 6a and 7a, we see that WMN-PSODGA performs better when the client distribution is Normal. For Normal distribution, WMN-PSODGA can find the maximum SGC for all cases. However, for Exponential distribution, the average of best solutions does not reach the maximum. Also, in Figs.Â 6b and 7b, the WMN-PSODGA system perfoms better when the client distribuion is Normal. We show the visualized simulation results in Fig.Â 8. For Normal distribution, only one mesh client is not covered. However, seven mesh clients are not covered when the client distribution is Exponential.5 ConclusionsIn this work, we evaluated the performance of a hybrid simulation system based on PSO and DGA (called WMN-PSODGA). Simulation results show that the WMN-PSODGA has good performance when the client distribution is Normal compared with the case of Exponential distribution.In our future work, we would like to evaluate the performance of the proposed system for different parameters and patterns.

References1. Akyildiz, I.F., Wang, X., Wang, W.: Wireless mesh networks: a survey. Comput. Netw. **47**(4), 445–487 (2005)Crossref2.Amaldi, E., Capone, A., Cesana, M., Filippini, I., Malucelli, F.: Optimization models and methods for planning wireless mesh networks. Comput. Netw. **52**(11), 2159–2171 (2008)Crossref3.Barolli, A., Spaho, E., Barolli, L., Xhafa, F., Takizawa, M.: QoS routing in Ad-hoc

networks using GA and multi-objective optimization. Mob. Inf. Syst. **7**(3), 169–188 (2011)4. Behnamian, J., Ghomi, S.F.: Development of a PSO-SA hybrid metaheuristic for a new comprehensive regression model to time-series forecasting. Expert Syst. Appl. **37**(2), 974–984 (2010)Crossref5.Clerc, M., Kennedy, J.: The particle swarm-explosion, stability, and convergence in a multidimensional complex space. IEEE Trans. Evol. Comput. **6**(1), 58–73 (2002)Crossref6.Cunha, MdC, Sousa, J.: Water distribution network design optimization: simulated annealing approach. J. Water Resour. Plann. Manag. **125**(4), 215–221 (1999)Crossref7.Del Valle, Y., Venayagamoorthy, G.K., Mohagheghi, S., Hernandez, J.C., Harley, R.G.: Particle swarm optimization: basic concepts, variants and applications in power systems. IEEE Trans. Evol. Comput. **12**(2), 171–195 (2008) Crossref8.Franklin, A.A., Murthy, C.S.R.: Node placement algorithm for deployment of two-tier wireless mesh networks. In: Proceedings of Global Telecommunications Conference, pp. 4823–4827 (2007)9.Ge, H., Du, W., Qian, F.: A hybrid algorithm based on particle swarm optimization and simulated annealing for job shop scheduling. In: Third International Conference on Natural Computation (ICNC-2007), vol. 3, pp. 715–719 (2007)10.Girgis, M.R., Mahmoud, T.M., Abdullatif, B.A., Rabie, A.M.: Solving the wireless mesh network design problem using genetic algorithm and simulated annealing optimization methods. Int. J. Comput. Appl. **96**(11), 1–10 (2014)11.Goto, K., Sasaki, Y., Hara, T., Nishio, S.: Data gathering using mobile agents for reducing traffic in dense mobile wireless sensor networks. Mob. Inf. Syst. **9**(4), 295–314 (2013)12.Inaba, T., Elmazi, D., Sakamoto, S., Oda, T., Ikeda, M., Barolli, L.: A secure-aware call admission control scheme for wireless cellular networks using fuzzy logic and its performance evaluation. J. Mob. Multimed. **11**(3&4), 213–222 (2015)13.Inaba, T., Obukata, R., Sakamoto, S., Oda, T., Ikeda, M., Barolli, L.: Performance evaluation of a QoS-aware fuzzy-based CAC for LAN access. Int. J. Space Based Situated Comput. **6**(4), 228–238 (2016)Crossref14.Inaba, T., Sakamoto, S., Oda, T., Ikeda, M., Barolli, L.: A testbed for admission control in WLAN: a fuzzy approach and its performance evaluation. In: International Conference on Broadband and Wireless Computing, Communication and Applications, pp. 559–571. Springer (2016)15.Lim, A., Rodrigues, B., Wang, F., Xu, Z.: k-center problems with minimum coverage. In: Computing and Combinatorics, pp. 349–359 (2004)16. Maolin, T., et al.: Gateways placement in backbone wireless mesh networks. Int. J. Commun. Netw. Syst. Sci. **2**(1), 44 (2009)17.Muthaiah, S.N., Rosenberg, C.P.: Single gateway placement in wireless mesh networks. In: Proceedings of 8th International IEEE Symposium on Computer Networks, pp. 4754–4759 (2008)18.Naka, S., Genji, T., Yura, T., Fukuyama, Y.: A hybrid particle swarm optimization for distribution state estimation. IEEE Trans. Power Syst. **18**(1), 60–68 (2003)Crossref 19.Poli, R., Kennedy, J., Blackwell, T.: Particle swarm optimization. Swarm Intell. **1**(1), 33–57 (2007) Crossref20.Sakamoto, S., Kulla, E., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: A comparison study of simulated annealing and genetic algorithm for node placement problem in wireless mesh networks. J. Mob. Multimed. **9**(1–2), 101–110 (2013)21.Sakamoto, S., Kulla, E., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: A comparison study of hill climbing, simulated annealing and genetic algorithm for node placement problem in WMNs. J. High Speed Netw. **20**(1), 55–66 (2014)22. Sakamoto, S., Kulla, E., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: A simulation system for WMN based on SA: performance evaluation for different instances and starting temperature values. Int. J. Space Based Situated Comput. **4**(3–4), 209–216 (2014)Crossref23.Sakamoto, S., Kulla, E., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: Performance evaluation considering iterations per phase and SA temperature in WMN-SA system. Mob. Inf. Syst. **10**(3), 321–330 (2014)24.Sakamoto, S., Lala, A., Oda, T., Kolici, V., Barolli, L., Xhafa, F.: Application of WMN-SA simulation system for node placement in wireless mesh networks: a case study for a realistic scenario. Int. J. Mob. Comput. Multimed. Commun. (IJMCMC) **6**(2), 13–21 (2014)Crossref25.Sakamoto, S., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: An integrated simulation system considering WMN-PSO simulation system and network simulator 3. In: International Conference on Broadband and Wireless Computing, Communication and Applications, pp. 187–198. Springer (2016)26.Sakamoto, S., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: Implementation and evaluation of a simulation system based on particle swarm optimisation for node placement problem in wireless mesh networks. Int. J. Commun. Netw. Distrib. Syst. **17**(1), 1–13 (2016)Crossref27.Sakamoto, S., Oda, T., Ikeda, M., Barolli, L., Xhafa, F.: implementation of a new replacement method in WMN-PSO simulation system and its

performance evaluation. In: The 30th IEEE International Conference on Advanced Information Networking and Applications (AINA-2016), pp. 206–211 (2016). https://doi.org/10.1109/AINA.2016.42
28.Sakamoto, S., Obukata, R., Oda, T., Barolli, L., Ikeda, M., Barolli, A.: Performance analysis of two wireless mesh network architectures by WMN-SA and WMN-TS simulation systems. J. High Speed Netw. **23**(4), 311–322 (2017)Crossref29.Sakamoto, S., Ozera, K., Barolli, A., Ikeda, M., Barolli, L., Takizawa, M.: Implementation of an intelligent hybrid simulation systems for WMNs based on particle swarm optimization and simulated annealing: performance evaluation for different replacement methods. Soft Comput. 1–7 (2017)30.Sakamoto, S., Ozera, K., Ikeda, M., Barolli, L.: Implementation of intelligent hybrid systems for node placement problem in WMNs considering particle swarm optimization, hill climbing and simulated annealing. Mob. Netw. Appl. **23**, 1–7 (2017)31.Schutte, J.F., Groenwold, A.A.: A study of global optimization using particle swarms. J. Global Optim. **31**(1), 93–108 (2005)MathSciNetCrossref32.Shi, Y.: Particle swarm optimization. IEEE Connections **2**(1), 8–13 (2004)MathSciNet33.Shi, Y., Eberhart, R.C.: Parameter selection in particle swarm optimization. In: Evolutionary Programming VII, pp. 591–600 (1998)34. Vanhatupa, T., Hannikainen, M., Hamalainen, T.: Genetic algorithm to optimize node placement and configuration for WLAN planning. In: Proceedings of 4th IEEE International Symposium on Wireless Communication Systems, pp. 612–616 (2007)35.Wang, J., Xie, B., Cai, K., Agrawal, D.P.: Efficient mesh router placement in wireless mesh networks. In: Proceedings of IEEE International Conference on Mobile Adhoc and Sensor Systems (MASS-2007), pp. 1–9 (2007)36.Xhafa, F., Sanchez, C., Barolli, L.: Ad hoc and neighborhood search methods for placement of mesh routers in wireless mesh networks. In: Proceedings of 29th IEEE International Conference on Distributed Computing Systems Workshops (ICDCS-2009), pp. 400–405 (2009)

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_4A Hybrid Flower-Grey Wolf Optimizer Based Home Energy Management in Smart GridPamir1, Nadeem Javaid1 _, Attiq ullah Khan2, Syed Muhammad Mohsin1, Yasir Khan Jadoon1 and Orooj Nazeer2(1) COMSATS Institute of Information Technology, Islamabad, 44000, Pakistan(2) Abasyn University, Islamabad, 44000, Pakistan **NadeemÂ JavaidEmail:** nadeemjavaidqau@gmail.com**URL:** http://www.njavaid.comAbstractDemand side management (DSM) in smart grid (SG) makes users able to take informed decisions according to the power usage pattern of the electricity users and assists the utility in minimizing peak power demand in the duration of high energy demand slots. Where, this ultimately leads to carbon emission reduction, total electricity cost minimization and maximization of grid efficiency and sustainability. Nowadays, many DSM strategies are available in existing literature concentrate on house hold appliances scheduling to decrease electricity cost. However, they ignore peak to average ratio (PAR) and consumer's delay minimization. In this paper, a load shifting strategy of DSM is

considered, to decrease PAR and waiting time. To gain aforementioned objectives, the flower pollination algorithm (FPA), grey wolf optimizer (GWO) and their hybrid i.e., flower grey wolf optimizer (FGWO) are used. Simulations were conducted for a single home consist of 15 appliances and critical peak pricing (CPP) tariff is used for computing user's electricity payment. The results show and validate that load is successfully transferred to low price rate hours using our proposed FGWO technique, which ultimately leads to 50.425% reduction in PAR, 2.4148 h waiting time and with 54.654% reasonable reduction in cost.**KeywordsFlower pollination algorithmGrey wolf optimizerMetaheuristic TechniquesHeuristic techniquesAppliances schedulingHome energy managementDemand side managementSmart grid****1 IntroductionConventional power grid is insufficient to mitigate electricity grid challenges; i.e., security, scalability, robustness and reliability [1]. Hence, an advanced and smart infrastructure of the existing power grid is required to satisfy these challenges smartly. So, in this way, smart grid (SG) adds various information and communication technologies (ICTs) to conventional grid. With the emerging of SG, the electricity consumers are no more only consumers but they are prosumers as well because now, they have the authority to sell back the surplus energy to the grid. Utility companies are focus on maximizing their profit with minimizing peak to average ratio (PAR). However, customers want to reduce electricity cost without paying cost of their comfort. Demand side management (DSM) is an important element of SG which keeps balance between demand side and supply side. There are two main elements or aspects of DSM [2]; demand response (DR) and load management. The second function of DSM i.e., load management concentrates on energy efficiency improvement to avoid load shedding problem. DR is an action taken by electricity customers against the dynamic price schemes.The most common goals and objectives of SG are minimization of PAR, total electricity payment and maximization of consumer satisfaction. To gain these objectives, a large number of DSM strategies and techniques are proposed by the researchers. Wang et al. [3, 4] use mixed integer nonlinear programming (MINLP) technique to minimize electricity payment and aggregated power usage. In [5], the authors use integer linear programming (ILP) to minimize the load in low price hours, to maximize user satisfaction. On the other hand, these techniques cannot deal with the appliances having nonlinear and complex power usage pattern. In this article, we use meta-heuristic techniques: flower pollination algorithm (FPA) [8], grey wolf optimizer (GWO) [9] and the proposed one which is the hybrid of FPA and GWO i.e., flower-grey wolf optimizer (FGWO) algorithms are used. In literature, a lot of work is available that they have worked to improve the efficiency of DSM using heuristic techniques. For example, in [6], the authors use genetic algorithm (GA), ant colony optimization (ACO) and binary particle swarm optimization (BPSO) to reduce PAR, electricity bill and user comfort maximization. Different models present to minimize electricity cost using GA in [7]. Although, aforementioned work done well for gaining their objectives. However, there is still a big gap for research, as upÂ to now there is no comprehensive solution available to fulfill all energy problems of existing power grid.Our achievements and contributions are, designing of the smart energy management controller (EMC) based on FPA, GWO and FGWO for a single home and compared their performance in terms of PAR, consumer comfort level, electricity bill and power usage pattern. Results show that our prosed FGWO based EMC outperformed the other schemes. Remainder of this article is arranged as: Sect.Â 2 describes the background. SectionÂ 3 elaborates the problem statement. Next, Sect.Â 4 illustrates the proposed system model. SectionÂ 5 discusses about the optimization algorithms. Simulation results and discussion are elaborated in Sect.Â 6. SectionÂ 7 shows the feasible region. Finally, Sect.Â 8 conclusion of our paper.2 BackgroundMany scientists and researchers in the world have worked to schedule residential appliances in an optimal way. Here, some of the research papers are summarized below.In [5], authors concentrate on power scheduling. They employed integer linear programming (ILP) algorithm for minimization of energy usage in high price rate hours, to maximize user satisfaction level. The smart meter (SM) is connected with the**

user interface (UI) and gets the necessary data for scheduling; the priority of appliances, the power consumption related plan. Using the data and information collected, the SM minimizes the hourly usage of energy. Simulations have been carried out and the results presented that hourly based high load is optimized. On the other hand, user comfort and electricity payment are not considered.In [6], authors targeted renewable energy sources (RES) integration and user satisfaction maximization. In this context, the authors has given solution using three techniques; ACO, BPSO and GA. Where, these heuristic algorithms would be installed into EMC. Simulation results depicted that GA-EMC is more effective in achieving high user satisfaction, low electricity payments and low PAR as compared to ACO based designed EMC and BPSO based designed EMC. However, RES installation and maintenance cost is neglected. On the other hand, high consumer satisfaction level can be achieve in further less payment than this paper achieved. A DSM model is presented in [7] for residential area consumers to decrease PAR and electricity payments. GA is employed for scheduling of appliances in optimal way. A tradeoff is exist between consumer delay and electricity payment. Simulation Results prove the effectiveness of the proposed DSM architecture for both single consumer and multiple consumers.In [10], authors propose residential appliances scheduling strategy to minimize total electricity payment, userâ€™s dissatisfaction and carbon dioxide emissions. A cooperative multi swarm particle swarm optimization (PSO) technique is used to achieve aforementioned objectives. Simulation results shown that the performance convergence of DMS-PSO-CLS is performed well. However, PAR is not considered. An optimal real time schedule controller is presented in [11] for smart home energy management. A binary backtracking search technique (BBSA) is used to reduce energy usage, total electricity payment and PAR. The BBSA is used in two various cases; first, usage of appliances in week days from 4pm to 11pm, and second, usage of appliances at various time of the day in weekend. From simulation results, it is cleared that in terms of, reduction in power usage, total electricity payment and PAR, the binary backtracking search technique based schedule controller outperformed the BPSO based controller. However, the user satisfaction is neglected.In [12], authors propose an approach to reduce high load along with home area network (HAN) activated inside home. HAN system algorithm ran by the HAN controller. The benefits of the proposed system are the power reduction for achieving a comparatively lower cost. However, the user satisfaction is compromised. In [13], authors address the minimization of electricity usage and PAR. A new smart homes community architecture is proposed. In which, the controller of the community works as virtual energy distribution, and they also, introduced a true RTP between smart houses community, consumers and community controller. Although, these mentioned propositions are best met in addressing of PAR and energy usage reduction. However, user satisfaction is neglected.In [14], authors worked on home energy management (HEM) approach to investigate two parameters and objectives in a sequential way. The first one is, reducing monetary cost, Then, the second objective is, reducing deviation in consumers load profile. Results revealed minimized energy monetary cost and energy profile deviation. On the other hand, users satisfaction is ignored. In [15], authors focus on PAR and electricity monetary payment minimization. A HEM model is designed. This model considers both power consumption and generation. Although, It is very good option to have such model that at the same time it deals with both energy utilization and generation to achieve PAR and electricity cost reduction. However, the they ignored consumers comfort.3 Problem StatementThe most targeted issues in SG are; balancing of load, PAR minimization, energy monetary payment reduction and user satisfaction maximization. Some of the optimization algorithms are used in the literature to gain above mentioned objectives. In [10], a cooperative multi swarm PSO technique is used to minimize total electricity payment, user dissatisfaction and carbon dioxide emissions. Results shown that the performance convergence of DMS-PSO-CLS is good under various scenarios. However, PAR is not considered. In [12], authors employed HAN system algorithm ran by the HAN controller for power reduction, to achieve a

comparatively small cost. The load and cost are minimized. However, the user satisfaction is compromised. In [14], authors worked on home energy management (HEM) approach to investigate multi objectives. The first one is, reducing monetary cost. The second objective is, reducing deviation in consumers load profile. Simulation results revealed minimized energy monetary cost and energy profile deviation. On the other hand, consumer satisfaction is ignored. In our paper, we employ FPA, GWO and besides, we propose a hybrid FGWO algorithm by considering a single home with 15 appliances scheduling.4 Proposed System ModelIn SG, DSM allows efficient grid operations. In residential sector, every smart house is equipped with SM having EMCs to enable reliable two way communication between end users and utilities. All smart components of the smart home submit their information to the EMC using HAN. And EMC controls the appliances scheduling. After receiving all information, EMC transfers it to the utility via SM and the communication is performed among EMC, SM and utility is based on wide area network (WAN) as shown in the proposed system architecture in Fig.Â 1. An EMC receives information from all smart elements of smart home. A SM receives the information from EMC which can be about the load demand, extra load demand for the next day, or other demands of a specific smart home where the EMC is operating. This information sends from EMC to SM via WAN and SM after receiving, sends these information to the utility by WAN. And the utility may tell to SM about pricing information or about a new policy if exists. Then, SM communicates and shares these informaion to the EMC. Now, EMC has pricing information from utility and also has appliances and other smart home elements information like, appliances power rating information, length of operation time (LoT) information, operational time interval (OTI) information. Finally, based on the power rating, pricing signal and other required information, the EMC based on FPA, GWO or FGWO makes an optimal power scheduling for PAR reduction, consumer satisfaction maximization and cost reduction.*Fig. 1.*Proposed System Model In this paper, we perform scheduling for a single home with 15 appliances of various classes. The appliances are categorized into two main classes; first class is, non-schedule able and the second class is, Schedulable appliances. Schedulable appliances category is further divided into two types which are, interruptible and non-interruptible appliances. Non interruptible appliances are the appliance that can not disturb during its functioning or working time. And non-interruptible appliances cannot be switch on and scheduled on the basis of demand of the consumer. Where, interruptible appliances are the appliances that can be scheduled at various time slots. There is only one constraint that cloth dryer will always start its working after completion of washing machine working time. Appliances with their corresponding category, power rating and length of operation time (LoT) are shown in TableÂ 1 below. Our main objectives of this work are: to reduce PAR, increase consumer satisfaction level by decreasing their waiting time for an appliance to operate and to decrease energy consumption during high price time intervals to reduce cost. The total energy utilization in 24Â h is computed in Eq.Â 1. (1)PAR is computed in Eq.Â 2 and Total cost for 24Â h is calculated in Eq.Â 3. (2) (3)where, in Eq.Â 1, shows the power rating of appliances, and S(t) is the (on or off) status of the appliances where 1 means that appliance is on at a specific time slot and 0 means the appliance is off. In Eq.Â 2 PAR is calculated as, take maximum load from 24Â h energy usage pattern and then divide it by the average of the same 24Â h energy usage pattern. And then, in Eq.Â 3, EP shows the electric price for 24Â h. *Table 1.*Appliances employed in simulations

Appliance group	Appliances	Power ratings (kWh)	LoT (h)
Interruptible load appliances	AC	1.5	14
	Iron	1	3
	Water heater	5	8
	Dish washer	1.8	4
	Water pump	1	8
	Vacuum cleaner	0.7	6

Refrigerator0.22520
Non-interruptible load appliancesWashing machine0.75
Cloth dryer54
Non-schedule able load appliancesLight10.0312
Light20.0310
Light30.0119
Light40.188
Blender0.32
Oven2.154 5 Optimization AlgorithmsConventional optimization algorithms which are mostly mathematical techniques such as, MINLP, ILP are not working satisfactory in case of large number of electronic devices and also they are computationally slow. That is why, we employ meta heuristic techniques FPA and GWO to gain our objectives. We prposed a hybrid of FPA and GWO i.e., FGWO. Selected algorithms are discussed in detail in the subsections below.5.1 FPAIn this section, we are discussing about FPA which is inspired from the flowersâ€™ pollination process. FPA is proposed by Yang [8] in 2013. Flower pollination is basically related with the transfer of pollens by different pollinators such as, birds, insects etc. Flower pollination can be performed using two main forms; abiotic or local or self pollination and biotic or cross pollination or global pollination. The wind blowing and water diffusion help abiotic pollination of flowers to take place. The local or self pollination is occurred from pollen of the same flower or from different flowers of the same plant. Whereas, biotic pollination can occur at huge distance and pollinators like birds can fly a huge distance and they may act as Levy flight.Now we can represent the flower pollination characteristics:*1.Biotic pollination is considered as the global pollination. 2.Abiotic pollination is recognized as the local pollination. 3.Another characteristics of flower pollination process flower constancy is considered as the probability of reproduction is related with the two flowers' similarity that are involved. 4.global pollination and local pollination or biotic pollination and abiotic pollination is controlled and directed by probability p [0, 1].* **5.2 GWOGWO [9], is a new meta-heuristic algorithm inspired by the leadership chain and hunting behaviour of grey wolves. The leadership chain of grey wolves consist of four types of wolves; alpha (), beta (), delta () and omega (). Moreover, there are three main phases of hunting that are, searching for the prey, encircling the prey and attacking over the prey. According to the social hierarchy of grey wolves, the alpha is considered as the most fittest solution, then the beta, delta and omega comes respectively. The main steps involved in GWO are:*1.Encircling the prey. 2.Hunting: Grey wolves have the capability of prey location recognition and encircle them. 3.Exploitation: It is also called attacking the prey. Grey wolves end the hunt while starting attack over the prey when the prey stops movement. 4.Exploration: It is also known as search for prey. The searching is mostly performed in grey wolves based the location of , and . The grey wolves diverge for "search for prey" and converge in order to attack prey or exploitation.* **5.3 FGWOIn this section, we discusses about our proposed hybrid algorithm. In FPA, the updating of the population is performed using the comparison of a random number with the probability (p) value which is equal to 0.9 in our scenario, and then, the p value decides either to perform global or local pollination. In addition, in GWO the population update is performed, in GWO, the update of the population is fully dependent on the location of the first three best candidates that are, alpha, beta and delta. So in GWO, we record first three best solutions and by force, oblige the other wolves or search agents to modify and update their locations on the basis of the location of the best search agent. Here, in GWO the best search agent location is calculated by Eq.Â 4 which is the average location of the top three best solutions. Hence, we can say that FPA based population update strategy is better as compared to the GWO based population update strategy, because here, our goal is to find the more optimized result as possible and the more optimized result can be possible by having a huge random and diverge population. And in FPA, the population is updated under the condition i.e. comparison of the random number with the p which is probability switch value then based**

on this comparison it decides either global or local pollination will be performed. Where, in GWO, update of the population is performed according to the position of the best search agent. Where, GWO based initialization strategy is better than FPA. So, we selected FPA based population update strategy and GWO based initialization strategy, so that, we proposed a new hybrid algorithm FGWO. (4) 6 Simulation Results and DiscussionIn this section, simulation results are shown and discussed in detail. Using simulations, algorithms are validated on the bases of PAR, waiting time, electricity cost and energy consumption. For the simulation, we consider single home with 15 appliances. CPP pricing scheme is used here for the computation of electricity bill. CPP pricing signal is depicted in Fig.Â 2 below.*Fig. 2.*Pricing signal *Fig. 3.*Hourly load *Fig. 4.*PAR FigureÂ 3 depicts the power consumption pattern for each slot in unscheduled as well as scheduled scenarios. The results for energy consumption show that the proposed FGWO technique schedules the power in efficient way. FGWO overall energy consumption peak is less than the other techniques because in order to avoid peak creation at any slot of the day, this technique is proposed. It is noteworthy that the energy consumption pattern of all scheduling algorithms is quite better as compared to unscheduled power consumption pattern. It is finalized that the proposed FGWO optimization technique optimizes daily load consumption pattern in a better way through shifting the load from peak time intervals to off peak time intervals. Shifting of load affects the user satisfaction level, on the other hand, it gives benefit to the user in terms of cost reduction. DSM is not only useful for consumers but it is also beneficial for utility. Decrease in PAR assists the utility to keep its stability and it finally, leads to cost reduction. The performance of various optimization algorithms in the form of PAR is illustrated in Fig.Â 4. The figure is clearly shows that, proposed FGWO outperformed the other techniques in terms of PAR. The PAR is minimized 50.425%, 40.266% and 47.448% by FGWO, GWO and FPA respectively in comparison with unscheduled scenario.*Fig. 5.*Hourly cost *Fig. 6.*Total cost FigureÂ 5 shows per hour cost for FPA, GWO, and Proposed FGWO. Plot shows that cost of the aforementioned scheduling techniques in peak hours is lower than unscheduled scenario the reason is that the load is transferred from high price hours to low price hours. FigureÂ 6 indicates the performance ratio between unscheduled case and scheduled algorithms with respect to total cost. It is clearly visible in the plot that our proposed FGWO technique outperformed the GWO and unscheduled in overall cost. However, FPA beats our proposed FGWA as well as GWO and unscheduled. It is worth mentioning that the cost is minimized at all aforementioned scheduling algorithms in comparison with unscheduled scenario. As we can say that total cost is minimized 54.654%, 48.699% and 58.026% in cases of FGWO, GWO and FPA respectively in difference with unscheduled case.In Fig.Â 7, the waiting is shown. The user or consumer comfort is computed in the form of waiting time. In our scenario, the user comfort is the amount of time a user waits for a particular appliance to switch on. So, the user comfort is inversely proportional to the delay time or waiting time. The delay time is 2.4148Â h, 3.3854Â h and 2.4527Â h by FGWO, GWO and FPA algorithms respectively. Hence, it is noteworthy, that our proposed FGWO technique outperformed all other techniques in terms of delay time. FigureÂ 8 depicts the total power consumption which is 122.799 kWh for a single home consists of 15 appliances. The total energy consumption is equal in all the scenarios; in unscheduled case as well as in scheduling techniques.*Fig. 7.* Waiting time *Fig. 8.*Total load 7 Feasible RegionFeasible region is an area, which is covered by a set of points in which the fitness function satisfies its results. In this work, we discuss the feasible region of cost and energy utilization. The feasible region of cost reduction through reducing the hourly energy usage is shown in Fig.Â 9 below. This set of points which will be draw a complete cost region are the constraints to the problem. In order to find the constraints or sets of points use to draw overall cost region, we employ CPP scheme ranges from 11.4 to 123.4 cent/kWh. Furthermore, the energy utilization profile in unscheduled case is ranges from 0.225 to 13.375 kWh is also employed. Finally, we calculate all the possible combinations of unscheduled power utilization with CPP as

shown in TableÂ 2.*Fig. 9.*Feasible Region *Table 2.*All possible combinations CombinationsUnscheduled load (kWh)CPP price (cent)Cost (cent) Minimum load, Minimum price0.22511.42.565 Minimum load, Maximum price0.225123.427.765 Maximum load, Minimum price11.99611.4136.7544 Maximum load, Maximum price11.996123.41480.3064 The overall cost region is shown using these points: P1(0.225, 2.565), P2(0.225, 27.765), P3(11.996, 1480.3064) and P4(11.996, 136.7544). Where, P1 demonstrates the electricity payment if the minimum energy is scheduled at minimum price. Furthermore, P2 shows the electricity cost if minimum power is used at maximum price. In the same way, P3 represents the electricity payment when maximum load is utilized at maximum price. Finally, P4 shows the electricity cost when maximum energy is consumed at minimum price. Now, we have an another core constraint that maximum electricity cost at any time slot must be smaller than maximum electricity cost in unscheduled case i.e., 1480.3 cents. After the consideration of all the constraints, the feasible region is drawn which is depicted and demonstrated by the shaded region covered by points (P1, P2, P4, P5 and P6). Where, P5(11.75, 1480.3) depicts that energy usage in scheduled case must not cross 11.75Â kWh at hour where the electricity cost is maximum. Furthermore, point P6(11.996, 1480.3) shows that maximum possible energy consumption i.e., 11.996Â kWh must never be scheduled at a time slot where electricity payment is more than 1480.3 cents.8 Conclusion In this work, we considered load shifting strategy of DSM with EMC based on FPA, GWO, and a hybrid of FPA and GWO i.e., FGWO to decrease PAR and increase user comfort with an affordable amount of cost. A various sets of residential area appliances are incorporated and appliances scheduling are performed based on the energy usage pattern of the appliances. From performance evaluation of the techniques in the simulation results, it is finalized, that FGWO technique performed well as compared to GWO and FPA in terms of PAR and waiting time. However, in terms of cost, FPA outperformed the other techniques.
References1.Gungor, V.C., Sahin, D., Kocak, T., Ergut, S., Buccella, C., Cecati, C., Hancke, G.P.: Smart grid technologies: communication technologies and standards. IEEE Trans. Ind. Inf. **7**(4), 529–539 (2011)Crossref2.Rahimi, F., Ipakchi, A.: Demand response as a market resource under the smart grid paradigm. IEEE Trans. Smart Grid **1**(1), 82–88 (2010)Crossref3. Wang, J., Sun, Z., Zhou, Y., Dai, J.: Optimal dispatching model of smart home energy management system. In: 2012 IEEE Innovative Smart Grid Technologies-Asia (ISGT Asia), pp. 1-5. IEEE (2012)4. Ahmad, A., Javaid, N., Alrajeh, N., Khan, Z.A., Qasim, U., Khan, A.: A modified feature selection and artificial neural network-based day-ahead load forecasting model for a smart grid. Appl. Sci. **5**(4), 1756–1772 (2015)Crossref5.Zhu, Z., Tang, J., Lambotharan, S., Chin, W.H., Fan, Z.: An integer linear programming based optimization for home demand-side management in smart grid. In: 2012 IEEE PES Innovative Smart Grid Technologies (ISGT), pp. 1-5. IEEE (2012)6.Rahim, S., Javaid, N., Ahmad, A., Khan, S.A., Khan, Z.A., Alrajeh, N., Qasim, U.: Exploiting heuristic algorithms to efficiently utilize energy management controllers with renewable energy sources. Energy Buildings **129**, 452–470 (2016)Crossref7.Khan, M.A., Javaid, N., Mahmood, A., Khan, Z.A., Alrajeh, N.: A generic demand-side management model for smart grid. Int. J. Energy Res. **39**(7), 954–964 (2015)Crossref 8.Yang, X.-S.: Flower pollination algorithm for global optimization. In: UCNC, pp. 240–249 (2012) Crossref9.Mirjalili, S., Mirjalili, S.M., Lewis, A.: Grey wolf optimizer. Adv. Eng. Softw. **69**, 46–61 (2014)Crossref10.Ma, K., Shubing, H., Yang, J., Xia, X., Guan, X.: Appliances scheduling via cooperative multi-swarm PSO under day-ahead prices and photovoltaic generation. Appl. Soft Comput. **62**, 504–513 (2018)Crossref11.Ahmed, M.S., Mohamed, A., Khatib, T., Shareef, H., Homod, R.Z., Ali, J.A.: Real time optimal schedule controller for home energy management system using new binary backtracking search algorithm. Energy Buildings **138**, 215–227 (2017)Crossref12. Bazydło, G., Wermiński, S.: Demand side management through home area network systems. Int. J. Electr. Power Energy Syst. **97**, 174–185 (2018)Crossref13.Anees, A., Chen, Y.-P.P.: True real time pricing and combined power scheduling of electric appliances in residential energy management system. Appl. Energy **165**, 592–600 (2016)Crossref14.Sattarpour, T., Nazarpour, D., Golshannavaz,

S.: A multi-objective HEM strategy for smart home energy scheduling: a collaborative approach to support microgrid operation. Sustainable Cities Soc. **37**, 26–33 (2018)Crossref15.Shirazi, E., Jadid, S.: Cost reduction and peak shaving through domestic load shifting and DERs. Energy **124**, 146–159 (2017)Crossref

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_5A Fuzzy-Based Approach for Improving Peer Coordination Quality in MobilePeerDroid Mobile SystemYi Liu1 , Kosuke Ozera1 , Keita Matsuo2 , Makoto Ikeda2 and Leonard Barolli2 (1)
Graduate School of Engineering, Fukuoka Institute of Technology (FIT), 3-30-1 Wajiro-Higashi, Fukuoka Higashi-ku, 811-0295, Japan(2)
Department of Information and Communication Engineering, Fukuoka Institute of Technology (FIT), 3-30-1 Wajiro-Higashi, Fukuoka Higashi-ku, 811-0295, Japan **YiÂ LiuÂ (Corresponding author)Email:** ryuui1010@gmail.com **KosukeÂ OzeraEmail:** kosuke.o.fit@gmail.com **KeitaÂ MatsuoEmail:** kt-matsuo@fit.ac.jp **MakotoÂ IkedaEmail:** makoto.ikd@acm.org **LeonardÂ BarolliEmail:** barolli@fit.ac.jpAbstractIn this work, we present a distributed event-based awareness approach for P2P groupware systems. In our approach, the awareness of collaboration will be achieved by using primitive operations and services that are integrated into the P2P middleware. We propose an abstract model for achieving these requirements and we discuss how this model can support awareness of collaboration in mobile teams. We present a fuzzy-based system for improving peer coordination quality according to three parameters. This model will be implemented in MobilePeerDroid system to give more realistic view of the collaborative activity and better decisions for the groupwork, while encouraging peers to increase their reliability in order to support awareness of collaboration in MobilePeerDroid Mobile System. We evaluated the performance of proposed system by computer simulations. From the simulations results, we conclude that when GS and SCT are high, the peer coordination quality is high. With increasing of AA, the peer coordination quality is increasing.**1 IntroductionPeer to Peer technologies has been among most disruptive technologies after Internet. Indeed, the emergence of the P2P technologies changed drastically the concepts, paradigms and protocols of sharing and communication in large scale distributed systems. As pointed out since early 2000 years [1â€“5], the nature of the sharing and the direct communication among peers in the system, being these machines or people, makes possible to overcome the limitations of the flat communications through email, newsgroups and other forum-based communication forms.The usefulness of P2P technologies on one hand has been shown for the development of stand alone applications. On the other hand, P2P technologies, paradigms and protocols have penetrated other large scale distributed systems such as Mobile Ad hoc Networks (MANETs), Groupware systems, Mobile Systems to achieve efficient sharing, communication, coordination, replication, awareness and synchronization. In fact, for every new form of Internet-based distributed systems, we are seeing how P2P concepts and paradigms again play an important role to enhance the efficiency and effectiveness of such systems or to enhance information sharing and online collaborative activities of groups of people. We briefly introduce below some common application scenarios that can benefit from P2P communications.Awareness is a key feature of groupware systems. In its simplest terms, awareness can be defined as the systemâ€™s ability to notify the members of a group of changes occurring in the groupâ€™s workspace. Awareness systems for online collaborative work have been proposed since in early stages of Web technology. Such proposals started by approaching workspace awareness, aiming to inform users about changes occurring in the shared workspace. More recently, research has focussed on using new paradigms, such as P2P systems, to achieve fully decentralized, ubiquitous groupware systems and awareness in such systems. In P2P groupware systems group processes may be more efficient because**

peers can be aware of the status of other peers in the group, and can interact directly and share resources with peers in order to provide additional scaffolding or social support. Moreover, P2P systems are pervasive and ubiquitous in nature, thus enabling contextualized awareness.Fuzzy Logic (FL) is the logic underlying modes of reasoning which are approximate rather then exact. The importance of FL derives from the fact that most modes of human reasoning and especially common sense reasoning are approximate in nature [6]. FL uses linguistic variables to describe the control parameters. By using relatively simple linguistic expressions it is possible to describe and grasp very complex problems. A very important property of the linguistic variables is the capability of describing imprecise parameters.The concept of a fuzzy set deals with the representation of classes whose boundaries are not determined. It uses a characteristic function, taking values usually in the interval [0, 1]. The fuzzy sets are used for representing linguistic labels. This can be viewed as expressing an uncertainty about the clear-cut meaning of the label. But important point is that the valuation set is supposed to be common to the various linguistic labels that are involved in the given problem.The fuzzy set theory uses the membership function to encode a preference among the possible interpretations of the corresponding label. A fuzzy set can be defined by examplification, ranking elements according to their typicality with respect to the concept underlying the fuzzy set [7].In this paper, we propose a fuzzy-based system for MobilePeerDroid system considering three parameters: Activity AwarenessÂ (AA), Group SynchronizationÂ (GS), Sustained Communication TimeÂ (SCT) to decide the Peer Coordination QualityÂ (PCQ). We evaluated the proposed system by simulations.The structure of this paper is as follows. In Sect.Â 2, we introduce the scenarios of collaborative teamwork. In Sect.Â 3, we introduce the group activity awareness model. In Sect.Â 4, we introduce FL used for control. In Sect.Â 5, we present the proposed fuzzy-based system. In Sect.Â 6, we discuss the simulation results. Finally, conclusions and future work are given in Sect.Â 7.2 Scenarios of Collaborative TeamworkIn this section, we describe and analyse some main scenarios of collaborative teamwork for which P2P technologies can support efficient system design.2.1 Collaborative Teamwork and Virtual CampusesCollaborative work through virtual teams is a significant way of collaborating in modern businesses, online learning, etc. [8]. Collaboration in virtual teams requires efficient sharing of information (both data sharing among the group members as well as sharing of group processes) and efficient communication among members of the team. Additionally, coordination and interaction are crucial for accomplishing common tasks through a shared workspace environment. P2P systems can enable fully decentralized collaborative systems by efficiently supporting different forms of collaboration [9]. One such form is using P2P networks, with super-peer structure as show in Fig.Â 1.*Fig. 1.*Super-peer P2P group netwok. During the last two decades, online learning has become very popular and there is a widespread of virtual campuses or combinations of face-to-face with semi-open teaching and learning. Virtual campuses are now looking at ways to effectively support learners, especially for online courses implemented as PBL-Project Based Learning or SBL Scenario Based Learning there is an increasing need to develop mobile applications that support these online groupwork learning paradigms [10]. In such setting, P2P technologies offer interesting solutions for (a) decentralizing the virtual campuses, which tend to grow and get further centralized with the increase of number of students enrolled, new degrees, and increase in academic activity; (b) in taking advantage of resources of students and developing volunteerbased computing systems as part of virtual campuses and (c) alleviating the communication burden for efficient collaborative teamwork. The use of P2P libraries such as JXTA have been investigated to design P2P middleware for P2P eLearning applications. Also, the use of P2P technologies in such setting is used for P2P video synchronization in a collaborative virtual environment [11]. Recently, virtual campuses are also introducing social networking among their students to enhance the learning activities through social support and scaffolding. Again the P2P solutions are sought in this context [12] in

combination with social networking features to enhance especially the interaction among learners sharing similar objectives and interest or accomplishing a common project.2.2 Mobile Ad Hoc Networks (MANETs)Mobile ad-hoc networks are among most interesting infrastructureless network of mobile devices connected by wireless having self-configuring properties [13]. The lack of fixed infrastructure and of a centralized administration makes the building and operation in MANETS challenging. P2P networks and mobile ad hoc networks (MANETs) follow the same idea of creating a network without a central entity. All nodes (peers) must collaborate together to make possible the proper functioning of the network by forwarding information on behalf of others in the network [14]. P2P and MANETs share many key characteristics such as self-organization and decentralization due to the common nature of their distributed components. Both MANETs and P2P networks follow a P2P paradigm characterized by the lack of a central node or peer acting as a managing server, all participants having therefore to collaborate in order for the whole system to work. A key issue in both networks is the process of discovering the requested data or route efficiently in a decentralized manner. Recently, new P2P applications which uses wireless communication and integrates mobile devices such as PDA and mobile phones is emerging. Several P2P-based protocols can be used for MANETs such as Mobile P2P Protocol (MPP), which is based on Dynamic Source Routing (DSR), JXTA prtotocols, and MANET Anonymous Peer-to-peer Communication Protocol (MAPCP), which serves as an efficient anonymous communication protocol for P2P applications over MANET.3 Group Activity Awareness ModelThe awareness model considered here focuses on supporting group activities so to accomplish a common group project, although it can also be used in a broader scope of teamwork. The main building blocks of our model (see also [15, 16] in the context of web-based groupware) are described below.Activity awareness: Activity awareness refers to awareness information about the project-related activities of group members. Project-based work is one of the most common methods of group working. Activity awareness aims to provide information about progress on the accomplishment of tasks by both individuals and the group as a whole. It comprises knowing about actions taken by members of the group according to the project schedule, and synchronization of activities with the project schedule. Activity awareness should therefore enable members to know about recent and past actions on the projectâ€™s work by the group. As part of activity awareness, we also consider information on group artifacts such as documents and actions upon them (uploads, downloads, modifications, reading). Activity awareness is one of most important, and most complex, types of awareness. As well as the direct link to monitoring a groupâ€™s progress on the work relating to a project, it also supports group communication and coordination processes.Process awareness: In project-based work, a project typically requires the enactment of a workflow. In such a case, the objective of the awareness is to track the state of the workflow and to inform users accordingly. We term this process awareness. The workflow is defined through a set of tasks and precedence relationships relating to their order of completion. Process awareness targets the information flow of the project, providing individuals and the group with a partial view (what they are each doing individually) and a complete view (what they are doing as a group), thus enabling the identification of past, current and next states of the workflow in order to move the collaboration process forward.Communication awareness: Another type of awareness considered in this work is that of communication awareness. We consider awareness information relating to message exchange, and synchronous and asynchronous discussion forums. The first is intended to support awareness of peer-to-peer communication (when some peer wants to establish a direct communication with another peer); the second is aimed at supporting awareness about chat room creation and lifetime (so that other peers can be aware of, and possibly eventually join, the chat room); the third refers to awareness of new messages posted at the discussion forum, replies, etc.Availability awareness: Availability awareness is useful for provide individuals and the group with information on

membersâ€™ and resourcesâ€™ availability. The former is necessary for establishing synchronous collaboration either in peer-to-peer mode or (sub)group mode. The later is useful for supporting membersâ€™ tasks requiring available resources (e.g. a machine for running a software program). Groupware applications usually monitor availability of group members by simply looking at group workspaces. However, availability awareness encompasses not only knowing who is in the workspace at any given moment but also who is available when, via membersâ€™ profiles (which include also personal calendars) and information explicitly provided by members. In the case of resources, awareness is achieved via the schedules of resources. Thus, both explicit and implicit forms of gathering availability awareness information should be supported.4 Application of Fuzzy Logic for ControlThe ability of fuzzy sets and possibility theory to model gradual properties or soft constraints whose satisfaction is matter of degree, as well as information pervaded with imprecision and uncertainty, makes them useful in a great variety of applications.The most popular area of application is Fuzzy Control (FC), since the appearance, especially in Japan, of industrial applications in domestic appliances, process control, and automotive systems, among many other fields.4.1 FCIn the FC systems, expert knowledge is encoded in the form of fuzzy rules, which describe recommended actions for different classes of situations represented by fuzzy sets.In fact, any kind of control law can be modeled by the FC methodology, provided that this law is expressible in terms of â€œif ... then ...â€• rules, just like in the case of expert systems. However, FL diverges from the standard expert system approach by providing an interpolation mechanism from several rules. In the contents of complex processes, it may turn out to be more practical to get knowledge from an expert operator than to calculate an optimal control, due to modeling costs or because a model is out of reach.4.2 Linguistic VariablesA concept that plays a central role in the application of FL is that of a linguistic variable. The linguistic variables may be viewed as a form of data compression. One linguistic variable may represent many numerical variables. It is suggestive to refer to this form of data compression as granulation [17].The same effect can be achieved by conventional quantization, but in the case of quantization, the values are intervals, whereas in the case of granulation the values are overlapping fuzzy sets. The advantages of granulation over quantization are as follows:it is more general;it mimics the way in which humans interpret linguistic values;the transition from one linguistic value to a contiguous linguistic value is gradual rather than abrupt, resulting in continuity and robustness. 4.3 FC RulesFC describes the algorithm for process control as a fuzzy relation between information about the conditions of the process to be controlled, x and y, and the output for the process z. The control algorithm is given in â€œif ... then ...â€• expression, such as:If x is small and y is big, then z is medium;If x is big and y is medium, then z is big.These rules are called *FC rules*. The â€œifâ€• clause of the rules is called the antecedent and the â€œthenâ€• clause is called consequent. In general, variables x and y are called the input and z the output. The â€œsmallâ€• and â€œbigâ€• are fuzzy values for x and y, and they are expressed by fuzzy sets.Fuzzy controllers are constructed of groups of these FC rules, and when an actual input is given, the output is calculated by means of fuzzy inference.4.4 Control Knowledge BaseThere are two main tasks in designing the control knowledge base. First, a set of linguistic variables must be selected which describe the values of the main control parameters of the process. Both the input and output parameters must be linguistically defined in this stage using proper term sets. The selection of the level of granularity of a term set for an input variable or an output variable plays an important role in the smoothness of control. Second, a control knowledge base must be developed which uses the above linguistic description of the input and output parameters. Four methods [18â€“21] have been suggested for doing this:expertâ€™s experience and knowledge;modelling the operatorâ€™s control action;modelling a process;self organization. Among the above methods, the first one is the most widely used. In the modeling of the human expert operatorâ€™s knowledge, fuzzy rules of the form â€œIf Error is small and Change-in-error is small then the Force is

smallâ€• have been used in several studies [22, 23]. This method is effective when expert human operators can express the heuristics or the knowledge that they use in controlling a process in terms of rules of the above form.4.5 Defuzzification MethodsThe defuzzification operation produces a non-FC action that best represent the membership function of an inferred FC action. Several defuzzification methods have been suggested in literature. Among them, four methods which have been applied most often are:Tsukamotoâ€™s Defuzzification Method;The Center of Area (COA) Method;The Mean of Maximum (MOM) Method;Defuzzification when Output of Rules are Function of Their Inputs. 5 Proposed Fuzzy-Based System for Peer Coordination QualityThe P2P group-based model considered is that of a superpeer model. In this model, the P2P network is fragmented into several disjoint peergroups (see Fig.Â 2). The peers of each peergroup are connected to a single superpeer. There is frequent local communication between peers in a peergroup, and less frequent global communication between superpeers.*Fig. 2.*P2P group-based model. *Fig. 3.*Proposed sytem of stucture. To complete a certain task in P2P mobile collaborative team work, peers often have to in teract with unknow peers. Thus, it is important that group members must select reliable peers to interact.In this work, we consider three parameters: Activity AwarenessÂ (AA), Group SynchronizationÂ (GS), Sustained Communication TimeÂ (SCT) to decide the Peer Coordination QualityÂ (PCQ). The structure of this system called Fuzzy-based Coordination Qualityt SystemÂ (FCQS) is shown in Fig.Â 3. These three parameters are fuzzified using fuzzy system, and based on the decision of fuzzy system the peer coordination quality is calculated. The membership functions for our system are shown in Fig.Â 4. In TableÂ 1, we show the Fuzzy Rule Base (FRB) of our proposed system, which consists of 36 rules.*Fig. 4.*Membership functions.
*Table 1.*FRB.

RuleAAGSSCTPCQ
1BBaVSEB
2BBaSEB
3BBaLMG
4BBaVLEB
5BNorVSBD
6BNorSPG
7BNorLBD
8BNorVLMG
9BGoVSVG
10BGoSEB
11BGoLBD
12BGoVLPG
13NBaVSBD
14NBaSMG
15NBaLG
16NBaVLMG
17NNorVSPG
18NNorSVG
19NNorLBD
20NNorVLMG
21NGoVSG
22NGoSMG
23NGoLPG
24NGoVLVG
25GBaVSPG
26GBaSG
27GBaLVVG
28GBaVLMG

29GNorVSPG
30GNorSVG
31GNorLPG
32GNorVLG
33GGoVSVVG
34GGoSG
35GGoLVG
36GGoVLVVG The input parameters for FCQS are: AA, GS and SCT the output linguistic parameter is PCQ. The term sets of *AA*, *GS* and *SCT* are defined respectively as:and the term set for the output *PCQ* is defined as: 6 Simulation ResultsIn this section, we present the simulation results for our proposed system. In our system, we decided the number of term sets by carrying out many simulations. These simulation results were carried out in MATLAB.From Fig.Â 5(a) to (c), we show the relation between AA, GS, SCT and PCQ. In this simulation, we consider the AA as a constant parameter.In Fig.Â 5(a), we consider the AA value 10 units. We change the GS value from 0 to 100 units. When the GS increases, the PCQ is increased. Also, when the SCT increases, the PCQ is increased.In Fig.Â 5(b) to (c), we increase the AA values to 50 and 90 units, respectively. We see that, when the AA increases, the PCQ is increased.*Fig. 5.*PCQ for different AA. 7 Conclusions and Future Work In this paper, we proposed a fuzzy-based system to decide the PCQ. We took into consideration three parameters: AA, GS and SCT. We evaluated the performance of proposed system by computer simulations. From the simulations results, we conclude that when GS and SCT are high, the peer coordination quality is high. With increasing of AA, the peer coordination quality is increased.In the future, we would like to make extensive simulations to evaluate the proposed systems and compare the performance with other systems.References1.Oram, A. (ed.): Peer-to-Peer: Harnessing the Power of Disruptive Technologies. O'Reilly and Associates, CA (2001)2.Sula, A., Spaho, E., Matsuo, K., Barolli, L., Xhafa, F., Miho, R.: A new system for supporting children with autism spectrum disorder based on IoT and P2P technology. Int. J. Space-Based Situated Comput. **4**(1), 55–64 (2014). https://doi.org/10.1504/IJSSC.2014.060688Crossref3.Di Stefano, A., Morana, G., Zito, D.: QoS-aware services composition in P2PGrid environments. Int. J. Grid Util. Comput. **2**(2), 139–147 (2011). https://doi.org/10.1504/IJGUC.

2011.

040601Crossref4.Sawamura, S., Barolli, A., Aikebaier, A., Takizawa, M., Enokido, T.: Design and evaluation of algorithms for obtaining objective trustworthiness on acquaintances in P2P overlay networks. Int. J. Grid Util. Comput. **2**(3), 196–203 (2011).
https://
doi.

org/

10.

1504/

IJGUC.

2011.

042042Crossref5.Higashino, M., Hayakawa, T., Takahashi, K., Kawamura, T., Sugahara, K.: Management of streaming multimedia content using mobile agent technology on pure P2P-based distributed e-learning system. Int. J. Grid Util. Comput. **5**(3), 198–204 (2014).
https://
doi.

org/

10.

1504/

IJGUC.

2014.

062928Crossref6.Inaba, T., Obukata, R., Sakamoto, S., Oda, T., Ikeda, M., Barolli, L.: Performance evaluation of a QoS-aware fuzzy-based CAC for LAN access. Int. J. Space-Based Situated Comput. **1** (1) (2011).
https://
doi.

org/

10.

1504/

IJSSC.

2016.

0827687.Terano, T., Asai, K., Sugeno, M.: Fuzzy Systems Theory and Its Applications. Academic Press Inc. Harcourt Brace Jovanovich, Publishers, SanDiego (1992)8.Mori, T., Nakashima, M., Ito,

T.: SpACCE: a sophisticated ad hoc cloud computing environment built by server migration to facilitate distributed collaboration. Int. J. Space-Based Situated Comput. **1**(1) (2011). https://doi.org/10.1504/IJSSC.2012.050000
9.Xhafa, F., Poulovassilis, A.: Requirements for distributed event-based awareness in P2P groupware systems. In: Proceedings of AINA 2010, pp. 220–225 (2010)
10.Xhafa, F., Barolli, L., Caballé, S., Fernandez, R.: Supporting scenario-based online learning with P2P group-based systems. In: Proceedings of NBiS 2010, pp. 173–180 (2010)
11.Gupta, S., Kaiser, G.: P2P video synchronization in a collaborative virtual environment. In: Proceedings of the 4th International Conference on Advances in Web-Based Learning, ICWL 2005, pp. 86–98 (2005)Crossref
12. Martnez-Alemn, A.M., Wartman, K.L.: Online Social Networking on Campus Understanding What Matters in Student Culture. Taylor and Francis, Routledge (2008)
13.Puzar, M., Plagemann, T.: Data sharing in mobile ad-hoc networks – a study of replication and performance in the MIDAS data space. Int. J. Space-Based Situated Comput. **1**(1) (2011). https://doi.org/10.1504/IJSSC.2011.040340
14.Spaho, E., Kulla, E., Xhafa, F., Barolli, L.: P2P solutions to efficient mobile peer collaboration in MANETs. In: Proceedings of 3PGCIC 2012, pp. 379–383, November 2012
15. Gutwin, C., Greenberg, S., Roseman, M.: Workspace awareness in real time distributed groupware: framework, widgets, and evaluation. In: BCS HCI 1996, pp. 281–298Crossref
16.You, Y., Pekkola, S.: Meeting others -supporting situation awareness on the WWW. Decis. Support Syst. **32**(1), 71–82 (2001)Crossref
17.Kandel, A.: Fuzzy Expert Systems. CRC Press, Boca Raton (1992)
18.Zimmermann, H.J.: Fuzzy Set Theory and Its Applications. Kluwer Academic Publishers (1991). Second Revised Edition
19.McNeill, F.M., Thro, E.: Fuzzy Logic: A Practical Approach. Academic Press Inc., Boston (1994)MATH
20.Zadeh, L.A., Kacprzyk, J.: Fuzzy Logic for the Management of Uncertainty. Wiley, New York (1992)
21.Procyk, T.J., Mamdani, E.H.: A linguistic self-organizing process controller. Automatica **15**(1), 15–30 (1979)Crossref
22.Klir, G.J., Folger, T.A.: Fuzzy Sets, Uncertainty, and Information. Prentice Hall, Englewood Cliffs (1988)MATH
23.Munakata, T., Jani, Y.: Fuzzy systems: an overview. Commun. ACM **37**(3), 69–76 (1994)

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_6A Fuzzy-Based System for Selection of IoT Devices in Opportunistic Networks Considering IoT Device Contact Duration, Storage and Remaining EnergyMiralda Cuka1 , Donald Elmazi1 , Keita Matsuo2 , Makoto Ikeda2 and Leonard Barolli2 (1)
Graduate School of Engineering, Fukuoka Institute of Technology (FIT), 3-30-1 Wajiro-Higashi, Higashi-Ku, Fukuoka 811-0295, Japan(2)
Department of Information and Communication Engineering, Fukuoka Institute of Technology (FIT), 3-30-1 Wajiro-Higashi, Higashi-Ku, Fukuoka 811-0295, Japan
MiraldaÂ CukaÂ (Corresponding author)Email: mcuka91@gmail.com **DonaldÂ ElmaziEmail:** donald.elmazi@gmail.com **KeitaÂ MatsuoEmail:** kt-matsuo@fit.ac.jp **MakotoÂ IkedaEmail:** makoto.ikd@acm.org **LeonardÂ BarolliEmail:** barolli@fit.ac.jpAbstractThe OppNets are a subclass of delay-tolerant networks where communication opportunities (contacts) are intermittent and there is no need to establish an end-to-end link between the communication nodes. The Internet of Things (IoT) is the network of devices, vehicles, buildings and other items embedded with software, electronics, sensors and network connectivity that enables these objects to collect and exchange data. There are different issues for these networks. One of them is the selection of IoT devices in order to carry out a task in opportunistic networks. In this work, we implement a Fuzzy-Based System for IoT device selection in opportunistic networks. For our system, we use three input parameters: IoT Contact Duration (IDCD), IoT Device Storage (IDST) and IoT Device Remaining Energy (IDRE). The output parameter is IoT Device Selection Decision (IDSD). The simulation results show that the proposed system makes a proper selection decison of IoT-devices in opportunistic networks. The IoT device selection is increased up to 19% and 53% by increasing IDCD and IDRE respectively.**1 IntroductionThe OppNets have appeared as an evolution of the MANETs. They are also a wireless based network and hence, they face various issues similar to MANETs such as frequent disconnections, highly variable links and limited bandwidth. In OppNets, nodes are always moving which makes the network easy to deploy and decreases the dependence on infrastructure for communicationÂ [1]. The Internet of Things (IoT) can seamlessly connect the real world and cyberspace via physical objects that embed with various types of intelligent sensors. A large number of Internet-connected machines will generate and exchange an enormous amount of data that make daily life more convenient, help to make a tough decision and provide beneficial services. The IoT probably becomes one of the most popular networking concepts that has the potential to bring out many benefitsÂ [2, 3].OppNets are the variants of Delay Tolerant Networks (DTNs). Owing to the transient and un-connected nature of the nodes, routing becomes a challenging task in these networks. Sparse connectivity, no infrastructure and limited resources further complicate the situationÂ [4, 5]. Routing methods for such sparse mobile networks use a different paradigm for message delivery. They utilize node mobility by having nodes carry messages, waiting for an opportunity to transfer messages to the destination or the next relay rather than transmitting them over a pathÂ [6]. Hence, the challenges for routing in OppNets are very different from the traditional wireless networks and their utility and potential for scalability makes them a huge success.However, most of the proposed routing schemes assume long contact durations such that all buffered messages can be transferred within a single contact. For example, when hand-held devices communicate via Bluetooth that has a typical wireless range of about 10 m, the contact duration tends to be as short as several seconds if the users are walking. For high speed vehicles that communicate via WiFi (802.11g), which has a longer range (upÂ to 38Â m indoors and 140Â m outdoors), the contact duration is still short. In the presence of short contact durations, there are two key issues that must be addressed. First is the relay selection issue. We need to select relay nodes that will contact the messageâ€™s destination long enough so that the entire message can be successfully transmitted. Second is the message scheduling issue. Since not all messages can be**

exchanged between nodes within a single contact, it is important to schedule the transmission of messages in such a way that will maximize the network delivery ratioÂ [7].In an OppNet, when nodes move away or turn off their power to conserve energy, links may be disrupted or shut down periodically. These events result in intermittent connectivity. When there is no path between the source and the destination, the network partition occurs. Therefore, nodes need to communicate with each other via opportunistic contacts through store-carry-forward operation. Since these types of networks require the IoT devices to store some information, storage is an important parameter in evaluation of their performance. However, the storage capacity of the device is limited which makes storage a requirement to be considered.The Fuzzy Logic (FL) is unique approach that is able to simultaneously handle numerical data and linguistic knowledge. The fuzzy logic works on the levels of possibilities of input to achieve the definite output. Fuzzy set theory and FL establish the specifics of the nonlinear mapping.In this paper, we propose and implement a simulation system for selection of IoT devices in OppNets. The system is based on fuzzy logic and considers three parameters for IoT device selection. We show the simulation results for different values of parameters.The remainder of the paper is organized as follows. In the Sect.Â 2, we present a brief introduction of IoT. In Sect.Â 3, we describe the basics of OppNets including research challenges and architecture. In Sect.Â 4, we introduce the proposed system model and its implementation. Simulation results are shown in Sect.Â 5. Finally, conclusions and future work are given in Sect.Â 6.2 IoT2.1 IoT ArchitectureThe typical IoT architecture can be divided into five layers as shown in Fig.Â 1. Each layer is briefly described below.Perception Layer: The perception layer is similar to physical layer in OSI model which consists of the diffThe OppNets are the variants of Delay Tolerant Networks (DTNs). These networks can be useful for routing in places where there are few base stations and connected routes for long distances. In an OppNets, when nodes move away or turn off their power to conserve energy, links may be disrupted or shut down periodically. These events result in intermittent connectivity. When there is no path existing between the source and the destination, the network partition occurs. Therefore, nodes need to communicate with each other via opportunistic contacts through store-carry-forward operation. This layer generally deals with identification and collection of specific information by each type of sensor devices. The gathered information can be location, wind speed, vibration, pH level, humidity, amount of dust in the air and so on. The gathered information is transmitted through Network layer toward central information processing system.*Fig. 1.*IoT architecture layers Network Layer: The Network layer plays an important role in securely transferring and keeping the sensitive information confidential from sensor devices to the central information processing system through 3G, 4G, UMTS, WiFi, WiMAX, RFID, Infrared and Satellite dependent on the type of sensors devices. Thus, this layer is mainly responsible for transfering the information from Perception layer to upper layer.Middleware Layer: The devices in the IoT system may generate various type of services when they are connected and communicate with others. Middleware layer has two essential functions, including service management and store the lower layer information into the database. Moreover, this layer has capability to retrieve, process, compute information, and then automatically decide based on the computational results.Application Layer: Application layer is responsible for inclusive applications management based on the processed information in the Middleware layer. The IoT applications can be smart postal, smart health, smart car, smart glasses, smart home, smart independent living, smart transportation, etc.Business Layer: This layer functions cover the whole IoT applications and services management. It can create practically graphs, business models, flow chart and executive report based on the amount of accurate data received from lower layer and effective data analysis process. Based on the good analysis results, it will help the functional managers or executives to make more accurate decisions about the business strategies and roadmaps.2.2 IoT ProtocolsIn following we will briefly describe about the most frequently used protocols for

Machine-to-Machine (M2M) communication.The Message Queue Telemetry Transport (MQTT) is a Client Server publishes or subscribes messaging transport protocol. It is light weight, open, simple and designed so as to be easy to implement. The protocol runs over TCP/IP or over other network protocols that provide ordered, lossless, bi-directional connections. The MQTT features include the usage of the publish/subscribe message pattern which provides one-to-many message distribution, a messaging transport that is agnostic to the content of the payload. Furthermore, the MQTT protocol has not only minimized transport overhead and protocol exchange to reduce network traffic but also has an extraordinary mechanism to notify interested parties when an abnormal disconnection occurs as well.The Constraint Application Protocol (CoAP) is a specialized web transfer protocol for use with constrained nodes and constrained networks. The nodes often have 8-bit microcontroller with small amounts of ROM and RAM, while constrained network often have high packet error rate and typical throughput is 10Â kbps. This protocol designed for M2M application such as smart city and building automation. The CoAP provides a request and response interaction model between application end points, support build-in discovery services and resources, and includes key concepts of the Web such as URIs and Internet media types. CoAP is designed to friendly interface with HTTP for integration with the Web while meeting specialized requirements such as multicast support, very low overhead and simplicity for constrained environments.3 OppNets3.1 OppNets ChallengesIn this section, we consider two specific challenges in an OppNets: the contact opportunity and the node storage. *Contact Opportunity:* Due to the node mobility or the dynamics of wireless channel, a node can make contact with other nodes at an unpredicted time. Since contacts between nodes are hardly predictable, they must be exploited opportunistically for exchanging messages between some nodes that can move between remote fragments of the network. Mobility increases the chances of communication between nodes. When nodes move randomly around the network, where jamming signals are disrupting the communication, they may pass through unjammed area and hence be able to communicate. In addition, the contact capacity needs to be consideredÂ [8, 9].*Node Storage:* As described above, to avoid dropping packets, the intermediate nodes are required to have enough storage to store all messages for an unpredictable period of time until next contact occurs. In other words, the required storage space increases as a function of the number of messages in the network. Therefore, the routing and replication strategies must take the storage constraint into considerationÂ [10]. 3.2 OppNets ArchitecturesIn an OppNet, a network is typically separated into several network partitions called regions. Traditional applications are not suitable for this kind of environment because they normally assume that the end-to-end connection must exist from the source to the destination.The OppNets enables the devices in different regions to interconnect by operating message in a store-carry-forward fashion. The intermediate nodes implement the store-carry-forward message switching mechanism by overlaying a new protocol layer, called the bundle layer, on top of heterogeneous region-specific lower layers.In an OppNet, each node is an entity with a bundle layer which can act as a host, a router or a gateway. When the node acts as a router, the bundle layer can store, carry and forward the entire bundles (or bundle fragments) between the nodes in the same region. On the other hand, the bundle layer of gateway is used to transfer messages across different regions. A gateway can forward bundles between two or more regions and may optionally be a host, so it must have persistent storage and support custody transfers.4 Proposed System4.1 System ParametersBased on OppNets characteristics and challenges, we consider the following parameters for implementation of our proposed system.*Fig. 2.*Proposed system model. *Fig. 3.*FLC structure. IoT Device Contact Duration (IDCD): This is an important parameter in mobility-assisted networks as contact times represent the duration of message communication opportunity upon a contact. Contact durations is the time in which all buffered messages can be transferred within a single contact.IoT Device Storage (IDST): In

delay tolerant networks data is carried by the IoT device until a communication opportunity is available. Considering that different IoT devices have different storage capabilities, the selection desicion should consider the storage capacity.IoT Device Remaining Energy (IDRE): The IoT devices in OppNets are active and can perform tasks and exchange data in different ways from each other. Consequently, some IoT devices may have a lot of remaining power and other may have very little, when an event occurs.*Fig. 4.* Triangular and trapezoidal membership functions. IoT Device Selection Decision (IDSD): The proposed system considers the following levels for IoT device selection:Very Low Selection Possibility (VLSP) - The IoT device will have very low probability to be selected.Low Selection Possibility (LSP) - There might be other IoT devices which can do the job better.Middle Selection Possibility (MSP) - The IoT device is ready to be assigned a task, but is not the â€œchosenâ€• one.High Selection Possibility (HSP) - The IoT device takes responsibility of completing the task.Very High Selection Possibility (VHSP) - The IoT device has almost all the required information and potential to be selected and then allocated in an appropriate position to carry out a job. *Table 1.*Parameters and their term sets for FLC.

ParametersTerm sets
IoT Device Contact Duration (IDCD)Short (Sho), Medium (Med), Long (Lg)
IoT Device Remaining Energy (IDRE)Low (Lo), Medium (Mdm), High (Hgh)
IoT Device Storage (IDST)Small (Sm), Medium (Me), High (Hi)
IoT Device Selection Decision (IDSD)VLSP, LSP, MSP, HSP, VHSP

*Table 2.*FRB of proposed fuzzy-based system.

No.IDCDIDREIDSTIDSD
1ShoLoSmVLSP
2ShoLoMeVLSP
3ShoLoHiLSP
4ShoMdmSmVLSP
5ShoMdmMeVLSP
6ShoMdmHiMSP
7ShoHghSmLSP
8ShoHghMeMSP
9ShoHghHiVHSP
10MedLoSmVLSP
11MedLoMeVLSP
12MedLoHiHSP
13MedMdmSmLSP
14MedMdmMeLSP
15MedMdmHiHSP
16MedHghSmMSP
17MedHghMeHSP
18MedHghHiVHSP
19LgLoSmLSP
20LgLoMeMHSP
21LgLoHiVHSP
22LgMdmSmMSP
23LgMdmMeHSP
24LgMdmHiVHSP
25LgHghSmHSP
26LgHghMeVHSP
27LgHghHiVHSP

4.2 System ImplementationFuzzy sets and fuzzy logic have been developed to manage vagueness and uncertainty in a reasoning process of an intelligent system such as a knowledge based system, an expert system or a logic control systemÂ [11 â€“24]. In this work, we use fuzzy logic to implement the proposed system.The structure of

the proposed system is shown in Fig.Â 2. It consists of one Fuzzy Logic Controller (FLC), which is the main part of our system and its basic elements are shown in Fig.Â 3. They are the fuzzifier, inference engine, Fuzzy Rule Base (FRB) and defuzzifier.As shown in Fig.Â 4, we use triangular and trapezoidal membership functions for FLC, because they are suitable for real-time operationÂ [25]. The in $f(x)$ is the center of triangular function, in $g(x)$ is the left (right) edge of trapezoidal function, and is the left (right) width of the triangular or trapezoidal function. We explain in details the design of FLC in following.*Fig. 5.*Fuzzy membership functions. 4.3 Description of FLCWe use three input parameters for FLC: IoT Device Contact Duration (IDCD), IoT Device Storage (IDST), IoT Device Remaining Energy (IDRE).The term sets for each input linguistic parameter are defined respectively as shown in TableÂ 1. The membership functions for input parameters of FLC are defined as: The small letters *w0* and *w1* mean left width and right width, respectively.The output linguistic parameter is the IoT device Selection Decision (IDSD). We define the term set of IDSD as: The membership functions for the output parameter *IDSD* are defined as: The membership functions are shown in Fig.Â 5 and the Fuzzy Rule Base (FRB) for our system are shown in TableÂ 2. The FRB forms a fuzzy set of dimensions , where $|T(x)|$ is the number of terms on $T(x)$. We have three input paramters, so our system has 27 rules. The control rules have the form: IF â€œconditionsâ€• THEN â€œcontrol actionâ€• .5 Simulation ResultsWe present the simulation results in Fig.Â 6. In this figure, we show the relation between the probability of an IoT device to be selected (IDSD) to carry out a task, versus IDCD, IDST and IDRE. We consider IDCD as a constant parameter and change the values of IDST and IDRE. We see that IoT devices with more remaining energy, have a higher possibility to be selected for carrying out a job. By increasing the IDST value, the IDSD is also increased because devices with more storage capacity are more likely to carry the message until there is a contact opportunity.*Fig. 6.*Results for different values of *IDCD*. In Fig.Â 6(a), when IDRE is 0.1 and IDST is 0.7, the IDSD is 0.18. For IDRE 0.5, the IDSD is 0.3 and for IDRE 0.9, IDSD is 0.72, thus the IDSD is increased about 23% and 53%, for IDRE 0.5 and IDRE 0.9, respectively.In Fig.Â 6(b) and (c), we increase the IDCD value to 0.5 and 0.9, respectively. The contact duration between two nodes depends on the speed of device. The speed makes the device move faster, making them break contact more often but increases the possibility of having a contact with another node. We see that with the increase of the IDCD parameter, the possibility of an IoT device to be selected is increased, since contacts last longer. For IDSTÂ =Â 0.7 and IDREÂ =Â 0.9, comparing Fig.Â 6(b) with (a) and Fig.Â 6(c) with (a), the IDSD is increased 13% and 19%, respectively.6 Conclusions and Future WorkIn this paper, we proposed and implemented a fuzzy-based IoT device selection system for OppNets, which is used to select an IoT device for a required task.We evaluated the proposed system by computer simulations. The simulation results show that the devices with high contact opportunity, are more likely to be selected for carrying out a job, so with the increase of IDCD the possibility of an IoT device to be selected increases. We can see that by increasing IDST and IDRE, the IDSD is also increased.In the future work, we will also consider other parameters for IoT device selection such as Message Time-out Ratio, Node Computational Time and make extensive simulations to evaluate the proposed system.

References1.Sharma, D.K., Sharma, A., Kumar, J., et al.: KNNR: K-nearest neighbour classification based routing protocol for opportunistic networks. In: 2017 Tenth International Conference on Contemporary Computing (IC3), pp. 1–6. IEEE (2017)2.Kraijak, S., Tuwanut, P.: A survey on internet of things architecture, protocols, possible applications, security, privacy, real-world implementation and future trends. In: IEEE 16th International Conference on Communication Technology (ICCT), pp. 26–31. IEEE (2015)3.Arridha, R., Sukaridhoto, S., Pramadihanto, D., Funabiki, N.: Classification extension based on IoT-big data analytic for smart environment monitoring and analytic in real-time system. Int. J. Space-Based Situated Comput. **7** (2), 82–93 (2017)Crossref4.Dhurandher, S.K., Sharma, D.K., Woungang, I., Bhati, S.: HBPR: history based prediction for routing in infrastructure-less opportunistic networks. In: IEEE 27th International Conference on Advanced Information Networking and Applications (AINA), pp.

931–936. IEEE (2013)5.Spaho, E., Mino, G., Barolli, L., Xhafa, F.: Goodput and PDR analysis of AODV, OLSR and DYMO protocols for vehicular networks using cavenet. Int. J. Grid Util. Comput. **2**(2), 130–138 (2011)Crossref6.Abdulla, M., Simon, R.: The impact of intercontact time within opportunistic networks: protocol implications and mobility models. TechRepublic White Paper (2009)7.Le, T., Gerla, M.: Contact duration-aware routing in delay tolerant networks. In: 2017 International Conference on Networking, Architecture, and Storage (NAS), pp. 1–8. IEEE (2017)8. Akbas, M., Turgut, D.: APAWSAN: actor positioning for aerial wireless sensor and actor networks. In: IEEE 36th Conference on Local Computer Networks (LCN-2011), pp. 563–570, October 20119. Akbas, M., Brust, M., Turgut, D.: Local positioning for environmental monitoring in wireless sensor and actor networks. In: IEEE 35th Conference on Local Computer Networks (LCN-2010), pp. 806–813, October 201010.Melodia, T., Pompili, D., Gungor, V., Akyildiz, I.: Communication and coordination in wireless sensor and actor networks. IEEE Trans. Mob. Comput. **6**(10), 1126–1129 (2007)Crossref11.Inaba, T., Sakamoto, S., Kolici, V., Mino, G., Barolli, L.: A CAC scheme based on fuzzy logic for cellular networks considering security and priority parameters. In: The 9-th International Conference on Broadband and Wireless Computing, Communication and Applications (BWCCA-2014), pp. 340–346 (2014)12.Spaho, E., Sakamoto, S., Barolli, L., Xhafa, F., Barolli, V., Iwashige, J.: A fuzzy-based system for peer reliability in JXTA-overlay P2P considering number of interactions. In: The 16th International Conference on Network-Based Information Systems (NBiS-2013), pp. 156–161 (2013)13.Matsuo, K., Elmazi, D., Liu, Y., Sakamoto, S., Mino, G., Barolli, L.: FACS-MP: a fuzzy admission control system with many priorities for wireless cellular networks and its performance evaluation. J. High Speed Netw. **21**(1), 1–14 (2015)Crossref 14.Grabisch, M.: The application of fuzzy integrals in multicriteria decision making. Eur. J. Oper. Res. **89**(3), 445–456 (1996)Crossref15.Inaba, T., Elmazi, D., Liu, Y., Sakamoto, S., Barolli, L., Uchida, K.: Integrating wireless cellular and ad-hoc networks using fuzzy logic considering node mobility and security. In: The 29th IEEE International Conference on Advanced Information Networking and Applications Workshops (WAINA-2015), pp. 54–60 (2015)16.Kulla, E., Mino, G., Sakamoto, S., Ikeda, M., Caballé, S., Barolli, L.: FBMIS: a fuzzy-based multi-interface system for cellular and ad hoc networks. In: International Conference on Advanced Information Networking and Applications (AINA-2014), pp. 180–185 (2014)17.Elmazi, D., Kulla, E., Oda, T., Spaho, E., Sakamoto, S., Barolli, L.: A comparison study of two fuzzy-based systems for selection of actor node in wireless sensor actor networks. J. Amb. Intell. Hum. Comput. **6**(5), 635–645 (2015)Crossref18.Zadeh, L.: Fuzzy logic, neural networks, and soft computing. ACM Commun. **37**(3), 77–84 (1994)Crossref19.Spaho, E., Sakamoto, S., Barolli, L., Xhafa, F., Ikeda, M.: Trustworthiness in P2P: performance behaviour of two fuzzy-based systems for JXTA-overlay platform. Soft. Comput. **18**(9), 1783–1793 (2014)Crossref 20.Inaba, T., Sakamoto, S., Kulla, E., Caballe, S., Ikeda, M., Barolli, L.: An integrated system for wireless cellular and ad-hoc networks using fuzzy logic. In: International Conference on Intelligent Networking and Collaborative Systems (INCoS-2014), pp. 157–162 (2014)21.Matsuo, K., Elmazi, D., Liu, Y., Sakamoto, S., Barolli, L.: A multi-modal simulation system for wireless sensor networks: a comparison study considering stationary and mobile sink and event. J. Amb. Intell. Hum. Comput. **6**(4), 519–529 (2015)Crossref22.Kolici, V., Inaba, T., Lala, A., Mino, G., Sakamoto, S., Barolli, L.: A fuzzy-based CAC scheme for cellular networks considering security. In: International Conference on Network-Based Information Systems (NBiS-2014), pp. 368–373 (2014)23.Liu, Y., Sakamoto, S., Matsuo, K., Ikeda, M., Barolli, L., Xhafa, F.: A comparison study for two fuzzy-based systems: improving reliability and security of JXTA-overlay P2P platform. Soft. Comput. **20**(7), 2677–2687 (2015)Crossref24.Matsuo, K., Elmazi, D., Liu, Y., Sakamoto, S., Mino, G., Barolli, L.: FACS-MP: a fuzzy admission control system with many priorities for wireless cellular networks and its perforemance evaluation. J. High Speed Netw. **21**(1), 1–14 (2015)Crossref25.Mendel, J.M.: Fuzzy logic systems for engineering: a tutorial. Proc. IEEE **83**(3), 345–377 (1995)Crossref

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773

https://doi.org/10.1007/978-3-319-93554-6_7Efficient Routing in Geographic and Opportunistic Routing for Underwater WSNsGhazanfar Latif1, Nadeem Javaid1 _, Aasma Khan1, Aisha Fatima1, Landing Jatta1 and Wahab Khan2(1)
COMSATS Institute of Information Technology, Islamabad, 44000, Pakistan(2)
Beijing Institute of Technology, Beijing, 100000, China **NadeemÂ JavaidEmail:** nadeemjavaidqau@gmail.com**URL:** http://www.njavaid.comAbstractUnderwater wireless sensor networks (UWSNs) are capable of providing facilities for the wide range of aquatic applications. However, due to the adverse environment, UWSNs face huge challenges and issues i.e., limited bandwidth, node mobility, higher propagation delay, high manufacturer and deployment costs etc. In this paper, we propose two techniques: the geographic and opportunistic routing via transmission range (T-GEDAR) and the geographic and opportunistic routing via the backward transmission (B-GEDAR). Firstly, in the absence of forwarder node, we increase the transmission range to determine the forwarder node. Because of this, we can send packets to the sink; Secondly, when the forwarder node is unavailable in adjustable transmission range. Then, the B-GEDAR is used for determining the forwarder node so that the packet delivery ratio (PDR) can be increased effectively. This is because, our simulation results perform better network performance in terms of an energy efficiency, PDR, and the fraction of void nodes.**1 IntroductionUnderwater wireless sensor networks (UWSNs) are gaining huge interest due to the demanding oceanic applications of natural disaster prevention, military surveillance, aquatic environmental monitoring and resource investigations etc. UWSNs consist of various sensors are deployed in depth of water. However, sonobuoys are deployed at the water surface to perform the collaborative tasks [1]. The UWSNs use in the acoustic channel, which is five orders of magnitude less than the radio channel. The radio channel cannot perform well in the underwater network. This is because, the high propagation delay, limited bandwidth, and interference are in the channel. However, the acoustic channel has some problems to be solved i.e., long propagation delay and limited bandwidth as compared to radio waves. The speed of the acoustic signal is 1500 m/s which is five orders of magnitude less than the radio signal and their speed is 3 x m/s. In UWSNs, the bit error rate (BER) occurs due to the multi-path fading, path loss and low bandwidth [2].It is described in the literature that balanced load distribution (BLOAD) [2], an adaptive hop-by-hop vector based forwarding (AHH-VBF) [3], and balanced routing (BR) [14], that provide the efficient and reliable communications. The BLOAD provides the load distribution among different coronas. In BLOAD, the energy hole problem can be reduced and maximized the lifespan of the network. Moreover, the AHH-VBF ensures the reliability and reducing the void nodes via adaptively adjusting the pipeline radius of the virtual pipeline. While BR provides the balanced routing protocol in which the load distribution is balanced among different coronas. However, It is also to increase the lifespan of network. The energy hole problem occurs near the sink due to imbalance load distribution.The limitation of geographic and opportunistic routing protocol is communication void region. The communication void regions are those regions where the forwarder nodes do not occur in the region. The nodes are located in the void region called the void node. Sometimes the number of the data packet does not transmit due to the void hole problem. The proposed routing protocol transmits the data via the alternative path. Furthermore, the sensor nodes are activated by batteries. After deployment of sensor nodes, it is difficult to recharge because of an adverse environment, especially in the depth of water. So, the energy efficiency is one of the important issues in the deployment of UWSNs.Taking motivation from the above considerations, we have proposed an efficient communication-based routing protocol over sensor nodes geographic and opportunistic routing via transmission range (T-GEDAR) and geographic and opportunistic routing via the backward transmission (B-GEDAR) for UWSNs. In this paper, our proposed routing protocols prevent void nodes during the data forwarding from source to the sink on the surface of the water. We also to increase the PDR with the increasing number of sensor nodes. In this way, the network lifetime can be increased and energy consumption can be**

minimized.Contributions: In this paper, we have proposed two routing protocols named T-GEDAR and B-GEDAR, respectively for UWSNs. The T-GEDAR defines the maximum communication range upon failing the depth adjustment topology. In the topology of T-GEDAR, if the forwarder node is unavailable in the communication range, then the communication range is maximized upÂ to the certain limit and data will be transmitted to sink via adjustable transmission range. However, because of this scheme, the data delivery ratio can be increased but the chance of duplicate packets are generated by the collision. Moreover, it is also to increase the network lifetime by the presence of forwarder node in communication range.Furthermore, we have determined the B-GEDAR scheme for hole avoidance among sensor nodes during the communication of network nodes. The B-GEDAR is performed upon failing the T-GEDAR routing scheme. Because of this, the void nodes decrease and network lifetime is also increased. However, B-GEDAR can determine the T-GEDAR of forwarder node for data transmission among network nodes. By this process, the nodes dissipate energy, so network lifetime, PDR and other parameters can be increased.The rest of the paper is organized as follows. Related work is discussed in Sect.Â 2. The problem statement of our system is given in Sect.Â 3. The system model is explained in Sect.Â 4. The simulation and results are presented in Sect.Â 5. The conclusions are in Sect.Â 6 and finally, references are listed for related work.2 Related WorkRecently, researchers have interested in terrestrial wireless sensor networks (WSNs) due to the distinctive characteristics of UWSNs. In this section, we explain some existing literature in this domain.In [2], authors proposed the routing protocol called the BLOAD. In this paper, there are three types of data fractions i.e., small, medium and large. The advantages of this protocol are avoidance of energy hole problem due to unbalance energy consumption. This work achieves the higher network lifetime and stability period. The limitation of this protocol, the energy consumption is high due to the direct transmission at long distance.Haitao *et al.* proposed the routing protocol called AHH-VBF [3]. In this work, authors investigate the void node problem and increase the data delivery ratio. This article adaptively adjusts the communication range by maximizing the pipeline radius. The simulation results show that the propagation delay and energy consumption can be reduced effectively. This paper achieves to improve the network lifetime. However, their proposed scheme produces the duplicate packets and high manufacturing costs.Jarnet *et al.* proposed the routing protocol called focused beam routing (FBR) in UWSNs [4]. This protocol is to minimize the extra flooding. In this strategy, before transmitting the packets, the nodes increase the transmitting range time-by-time according to adjust the flooding angle and the communication power level via power gradient. Moreover, the nodes need to determine the request to send (RTS) message in the sparse network. Due to this scheme, the wastage of energy consumption and propagation delay are high. However, the flooding angle is affected by the network performance.*Table 1.*State of-the-art-work

Technique (s)	Feature (s)	Achievement (s)	Limitation (s)
BLOAD [2]	Balanced load distribution, energy hole avoidance	Higher network lifetime, stability period is high	Higher energy consumption due to long distance
AHH-VBF [3]	Reduces propagation delay, higher network lifetime	Reliability, energy efficiency	Duplicate packets, high manufacturing and deployment cost
FBR [4]	Focused beam routing, minimize the extra flooding	Due to flooding angle the packet delivery ratio is high	Wastage of energy consumption and propagation delay is high
VBVA [5]	Vector-based void avoidance, vector shift and back pressure	Void node decreases, better network performance	Higher propagation delay
VAPR [6]	Void-aware pressure routing, greedy forwarding strategy	Same as geographic and opportunistic routing, high packet delivery ratio	Higher energy consumption, greater propagation delay
GEAR [7]	Transmission based upon cluster head and multi-hop strategy	Higher network lifetime, energy efficiency	Larger end-to-end delay

BECHA [8]Load distribution is balanced, greater network lifetimeNetwork lifetime, energy efficiencyEnergy hole problem due to load imbalance
EEDBR [9]Energy efficient depth based routing, forwarder is selected on the basis of residual energy and depthNetwork lifetimePacket is neglected due to low energy
WDFAD-DBR [10]Forwarder nodes select upÂ to two hop neighbor, avoidance of void nodesHigher reliability, higher PDR and lower propagation delayHigh manufacturer and deployment cost
EEBET [11]Enhanced efficient and balancing energy technique, solves the deficiencies in balanced transmission mechanismEnergy efficiency, higher network lifetimeEnergy hole problem
RDBF [12]Relative distance based forwarding protocol, fitness factor for appropriate forwarderData delivery ratio, low propagation delay and energy efficiencyLoad is an imbalance In [5], authors introduced the routing protocol called vector-based void avoidance (VBVA). This paper investigates the void hole problem in a mobile-based scenario of UWSNs. There are two methods of this protocol i.e., vector shift and back pressure which are to resolve the void nodes. The vector shift procedure is used for sending data along the routing hole boundary. Moreover, the back pressure technique describes the packet forwarding back in routing path and packet move away from the destination. However, this work achieves to minimize the routing hole and high PDR.Youngtae *et al.* proposed the void-aware pressure routing (VAPR) for UWSNs [6]. This paper knows about the depth knowledge of nodes to forward the packets toward the sink on the sea surface. This protocol just like the geographic and opportunistic routing where the next hop forwarder determines through greedy forwarding approach. In this protocol, every node prevents the void node from sinkâ€™s reachability data disseminated in the network from periodic beaconing. Every node uses this information to make a directional path towards some surface sonobuoy. The next-hop forwarder node is appointed through neighbor nodeâ€™s direction, which is those paths in which there is the same transmitting path with the current forwarder i.e., upward or downward. However, VAPR achieves the high PDR at the cost of high energy consumption and propagation delay as data packets are routed through more hops for the avoidance of void nodes in the networks (TableÂ 1).In [7], authors proposed the routing protocol called gateway based energy-efficient routing protocol (GEAR). In this paper, there are four types of regions. Each region performs different approaches. Firstly, two regions use direct transmission, while other two regions are divided on the basis of cluster head (CH) and perform multi-hop transmissions. This protocol achieves to improve the lifespan of network and minimize the energy consumption.Naeem *et al.* proposed the routing protocol called balanced energy consumption and hole alleviation (BECHA) balances the load distribution among different coronas [8]. The energy balancing is a precious resource for maximizing the lifespan of network. Due to imbalance load distribution, the death of sensor nodes very quickly and it causes the energy hole problem. This scheme resolves, the energy hole problem which is located near the sink due to imbalance load distribution. This strategy is an important to improve the throughput. It is also to balance the load distribution and provide the energy efficiency.In [9], authors proposed the routing protocol called energy efficient depth based routing (EEDBR) for UWSNs. In this paper, the forwarder node is selected on the basis of depth and residual energy. Because of this selection, the energy can be balanced and improved network lifetime. In this work, the sensor nodes retain the data for some time before transmitting. The holding time depends on the residual energy of sensor nodes. In this way, if the residual energy is high then the data is directly transmitted to sink, otherwise, the packet is discarded. The limitation of this paper, the packet is neglected due to the low energy. This protocol does not need to the localization of the network nodes.Haitao *et al.* proposed a weighting depth and forwarding area division depth based routing protocol (WDFAD-DBR) [10]. The forwarder node is selected on the basis of two-hop neighbors. This protocol achieves to high reliability, higher PDR and

lower propagation delay by the increasing number of nodes in the network. However, their proposed scheme produces the high manufacturing cost.In [11], authors proposed the routing protocol called enhanced efficient and balancing energy technique (EEBET) to solve the deficiencies in balanced transmission mechanism (BTM). Similarly, the efficient and balancing energy consumption technique (EBET) achieves to improve the energy efficiency and determine the suitable energy level. By this process, the network lifetime can be increased. The limitation of this work is energy hole problem.In [12], proposed a routing protocol called relative distance based forwarding protocol (RDBF). This paper determines an appropriate forwarder node which acts as a fitness function. It means that the selection of forwarder node via fitness function. This paper achieves the better PDR, an end-to-end delay, and energy efficiency. However, due to the minimum number of hop counts, the load is an imbalance.Latif *et al.* proposed the routing protocol called the energy hole and coverage hole in terms of network lifetime and throughput. By this protocol, the network lifetime and throughput can be maximized. The energy hole and coverage hole problems resolve in depth based routing and the residual energy of each node act as a forwarding metrics for the data packet. A node selects as a forwarder node for the data packet if it has a smaller holding time than other neighbor nodes in order to suppress the retransmission of duplicate packets. Moreover, a hole repair technique is used to maintain the connectivity among sensor nodes in order to maximize the network lifetime. Moreover, an adaptive transmission power level is introduced to improve the energy efficiency of the network. However, the limitation of this protocol is higher propagation delay of the network [13].3 Problem StatementThe communication void region and energy consumption degrade the performance of the network. The data transmission failing upon the absence of forwarder node. It means that the void node is available in the void region creates the problem. In geographic and opportunistic for depth adjustment routing protocol (GEDAR) [1], it avoids the void node region via depth adjustment topology. In this paper, we are mitigating the void node region problem and it is also to increase the PDR. The node located in the void region is known as the void node. Moreover, due to the multi-hop scenario, the energy hole problem occurs closer to the sink located on the water surface. In the presence of void node, the packet gets stuck in a void region. The existing routing protocols should determine to transmit the packet via some proposed techniques.4 Proposed SchemeIn our proposed scheme, the sensor nodes are randomly deployed and the sinks are located on the water surface. The details of network model and proposed schemes are given below:4.1 Network ModelIn this section, the sensor nodes are randomly deployed in an area the size of 1500 m 1500 m 1500 m and the sonobuoys are 45. In our proposed system, we consider a three-dimensional model, where the sensor nodes are randomly deployed.*Fig. 1.*Network model of proposed scheme 4.2 T-GEDARWe determine the maximum communication range upon failing the depth adjustment technique. In this scheme, if the forwarder node is unavailable in the communication range of sensor nodes for data transmission. Then, the communication range is maximized upÂ to the certain distance. However, the data is transmitted to sink by adjustable range. Moreover, in this scheme the data delivery ratio is high and the probability of duplicate packets generated due to sending the multiple copies of the same data packet from the source node. This is because it also to increase the network lifetime.

*Table 2.*Simulation parameters

Control parameters	Values	Units
Area (*A*)	1500 m 1500Â m 1500 m	Meters
Transmission power ()	2	Watts
Reception power ()	0.1	Watts
Idle power ()	0.01	Watts
Number of sensors (*n*)	150â€“	

4.3 B-GEDARWe propose the B-GEDAR scheme for the hole avoidance among sensor nodes during the communication of network nodes. The B-GEDAR is performed upon failing the T-GEDAR routing protocol. This is because of the number of

void nodes decreases and network lifetime increases. However, in B-GEDAR determines the communication range of forwarder node for data transmission among nodes are shown in Fig.Â 1 . By this process, the nodes dissipate energy, so network lifetime, PDR and other parameters can be increased.5 Simulation ResultsIn this section, we evaluate the performance of our scheme and compare the results with existing protocol (GEDAR) in terms of PDR and energy efficiency of the network. The sensor nodes are randomly deployed. The total network area is 1500 m 1500 m 1500 m. We assume that the 45 sinks are located at the surface of the water. The transmission power of sensor node is set to be , the reception power is set to be and idle power is set to be . Let us assume that, the sensor nodes are equal to . The control parameters of this paper are given in TableÂ 2.*Fig. 2.* Fraction of void nodes FigureÂ 2 depicts the fraction of void nodes decreases when the network density increases for both techniques. Similarly, T-GEDAR and B-GEDAR achieve the best performance of results are compared with the GEDAR. When GEDAR is used, the proposed schemes like T-GEDAR and B-GEDAR are to minimize the 33% and 50% fraction of void nodes respectively. However, the overall performance comparison is better for B-GEDAR, because via this scheme achieves approximately 34% is compared with the increase of communication range.*Fig. 3.*Packet delivery ratio FigureÂ 3 depicts the results of PDR. The overall result is to increase in PDR when the number of nodes increases. GEDAR has the high data delivery ratio and better performance due to increase the transmission range of communication and the B-GEDAR. This is because; the T-GEDAR and B-GEDAR are to achieve the 18.6% and 29.1% data delivery ratio among nodes, respectively. However, the overall achievement is 36% through the B-GEDAR.*Fig. 4.*Energy consumption per message per node FigureÂ 4 depicts the results of energy consumption per received message per node. In GEDAR, the energy consumption is high due to the lower node density scenario. However, because of T-GEDAR and B-GEDAR the node density increases then the energy consumption is relatively decreased. Moreover, the proposed schemes are to minimize the 66% and 78% of energy consumption per packet per node respectively. However, the overall performance comparison is better for B-GEDAR because this scheme achieves approximately 15.6% and it is compared to increase the communication range.6 Conclusion and Future WorkIn this paper, we have proposed and evaluated the two techniques called T-GEDAR and B-GEDAR in GEDAR routing protocol. Furthermore, T-GEDAR provides a greater communication range for finding the suitable forwarder node and it is used to avoid the void hole. When the forwarder node is unavailable, then the sensor nodes start the B-GEDAR so that the packets can be received successfully at the sink. Simulation results show that the better performance as compared to the GEDAR Protocol. It is also to improve the energy efficiency and PDR.As future work, we plan to address these major challenges in the UWSNs, considering the various needs for packet delivery. Moreover, we plan to improve the lifespan of the network, so that we balance the energy consumption among various nodes.References1.Coutinho, R.W.L., Azzedine, B., Luiz, F.M.V., Antonio, A.F.L.: Geographic and opportunistic routing for underwater sensor networks. IEEE Trans. Comput. **65**(2), 548–561 (2016)MathSciNetCrossref2.Azam, I., Javaid, N., Ahmad, A., Wadood, A., Almogren, A., Alamri, A.: Balanced load distribution with energy hole avoidance in underwater WSNs. IEEE Access (2017)3.Yu, H., Yao, N., Liu, J.: An adaptive routing protocol in underwater sparse acoustic sensor networks. Ad Hoc Netw. **34**, 121–143 (2015)Crossref4.Jornet, J.M., Stojanovic, M., Zorzi, M.: Focused beam routing protocol for underwater acoustic networks. In: Proceedings of the Third ACM International Workshop on Underwater Networks, pp. 75–82. ACM (2008)5.Xie, P., Zhou, Z., Peng, Z., Cui, J.-H., Shi, Z.: Void avoidance in three-dimensional mobile underwater sensor networks. In: International Conference on Wireless Algorithms, Systems, and Applications, pp. 305–314. Springer, Berlin (2009)6.Noh, Y., Lee, U., Wang, P., Choi, B.S.C., Gerla, M.: VAPR: void-aware pressure routing for underwater sensor networks. IEEE Trans. Mob. Comput. **12**(5), 895–908 (2013)Crossref7.Nadeem, Q., Rasheed, M.B., Javaid, N., Ali Khan, Z., Maqsood, Y., Din, Q.: M-GEAR: gateway-based energy-aware multi-hop routing protocol for WSNs. In: Proceedings of 2013 Eigth International Conference on Broadband and Wireless Computing,

Communication and Applications (BWCCA), pp. 164–169. IEEE (2013)8.Jan, N., Javaid, N., Javaid, Q., Alrajeh, N., Alam, M., Ali Khan, Z., Niaz, I.A.: A balanced energy-consuming and hole-alleviating algorithm for wireless sensor networks. IEEE. Access **5**, 6134–6150 (2017)Crossref9.Wahid, A., Kim, D.: An energy efficient localization-free routing protocol for underwater wireless sensor networks. Int. J. Distrib. Sens. Netw. **8**(4), 307246 (2012)Crossref10.Yu, H., Yao, N., Wang, T., Li, G., Gao, Z., Tan, G.: WDFAD-DBR: weighting depth and forwarding area division DBR routing protocol for UASNs. Ad Hoc Netw. **37**, 256–282 (2016)Crossref11.Javaid, N., Shah, M., Ashfaq, A., Imran, M., Khan, M.I., Vasilakos, A.V.: An enhanced energy balanced data transmission protocol for underwater acoustic sensor networks. Sensors **16**(4), 487 (2016)Crossref12.Li, Z., Yao, N., Gao, Q.: Relative distance based forwarding protocol for underwater wireless networks. Int. J. Distrib. Sens. Netw. **10**(2), 173089 (2014)Crossref13.Latif, K., Javaid, N., Ahmad, A., Khan, Z.A., Alrajeh, N., Khan, M.I.: On energy hole and coverage hole avoidance in underwater wireless sensor networks. IEEE Sens. J. **16**(11), 4431–4442 (2016)Crossref14.Zidi, C., Bouabdallah, F., Boutaba, R.: Routing design avoiding energy holes in underwater acoustic sensor networks. Wirel. Commun. Mob. Comput. **16** (14), 2035–2051 (2016)Crossref

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_8Supporting Online/Offline Collaborative Work with WebRTC Application MigrationFatos Xhafa1 , David Zaragoza1 and Santi Caballé2 (1) Universitat Politècnica de Catalunya, Barcelona, Spain(2) Open University of Catalonia, Barcelona, Spain **FatosÂ XhafaÂ (Corresponding author)Email:** fatos@cs.upc.edu **SantiÂ CaballÃ©Email:** scaballe@uoc.eduAbstractWith the fast development of mobile computing and increasing computing capacities of mobile devices, new collaborative applications and platforms are appearing to support collaboration on the move. Indeed, nowadays, members of a team can be not only geographically distributed but they can also work anytime and anywhere thanks to the use of mobile devices. Often, however, team members would like to work either online or offline on a common project; likewise, they may wish to switch among various devices such as laptops, tablets and mobile phones and still work in the same application environment, sharing the same data, etc. In this paper we present a platform that enables application and services migration at runtime between different platforms using the WebRTC (Web Real-Time Communication) framework. We have studied applications migration both through a central server and through a distributed (Peer-to-Peer) model. Various issues that arise in application migration such as profile matching, application context, data synchronisation and consistency are discussed. The efficiency and scalability of the WebRTC framework and mobile devices (peers) under Android in a real computing infrastructure are studied. Some experimental results on the application migration time according to application state data size are reported.**1 IntroductionApplication migration consists in moving an application from one computing device or environment to another one. Application migration can be useful in various contexts. For instance, in Cloud environments, through migration it is possible to move applications from one Cloud environment (e.g. a VM) to another one; or, in a broader context, to move applications across CloudsÂ [13, 15]. It is also useful for legacy application migration in enterprises, businesses, institutions and alike. Other interesting uses of application migration appear in collaborative work in premises of enterprise environments. Indeed, in this case, different users (employees) can share and use the same application and its *state* in different terminalsÂ [16].In this work we are interested on the usefulness of application migration for supporting collaborative team work *on the move* [18, 19]. Collaboratively working on the move means that team members can work not only geographically distributed but also while changing their locations. In the later case, team members can work online (connected and synchronised to the rest of the team through groupware system) or offline (disconnected from the groupware system). Using**

various computing devices (laptops, tablets and smartphones) on the move has become a common practice, which requires, therefore, that users can switch from one computing device to another one. In this context, we are interested to support application migration among various computing devices in *real-time*.Application migration, in any of its forms, requires addressing several issues due to differences between the original and target computing devices or environments. Generally speaking, applications are developed for concrete computing devices/platforms and are thus bound to operating system, networking, data storage, configurations, etc., of the original computing environment. In our problem setting, additionally, we are interested to migrate not only the application itself but also its *current state* as well as the *data* associated with the application to enable team members to resume and follow up the collaborative work from within another computing devices and complete the migration process in real-time. For instance, we would like to migrate a project management system, which uses a calendar of events or milestones related to a project development and a contact team members lists. To achieve the application migration in real-time, we specify and develop a platform for application migration using WebRTC (Web Real Time Communication) technologyÂ [1], which is a recent technology to support real-time communications for a variety of applications such as video and audio streaming, tele-conferencing, application window sharing, etc. The advantages of using WebRTC are, on the one hand, that it adds real-time communication to the browser and thus solves the problem that native applications cannot be used across different platforms, and on the other, it has a focus on Peer-to-Peer communication. The later feature is particularly useful in the case of collaborative (*peer-group*) teamwork. Also, WebRTC can be used for data sharing by using computing resources on Web browsers, not server resources, through a Peer-to-Peer networkÂ [14].We have therefore studied applications migration both through a central server and through a distributed (Peer-to-Peer) model. Various issues that arise in application migration such as profile matching, application context, data synchronisation and consistency are considered. The efficiency and scalability of the WebRTC framework and mobile devices (peers) under Android in a real computing infrastructure. Some experimental results on the application migration time according to application state data size are reported.The rest of the paper is structured as follows. In Sect.Â 2 we describe main characteristics of WebRTC and the related work using this technology. In Sect.Â 3 we present the main requirements, design and implementation of the prototype. The experimental study is summarised in Sect.Â 4. Finally, in Sect.Â 5 we give conclusions and indications for future work.2 WebRTC and Related WorkWeb Real Time Communication (WebRTC) technologyÂ [1] is a recent technology to support real-time communications for a variety of applications such as video and audio streaming, tele-conferencing, application window sharing, etc. by embedding real-time communications capabilities into Web browsers. The advantages of using WebRTC are, on the one hand, that it adds real-time communication to the browser (without the need for browser plugins) and thus solves the problem that native applications cannot be used across different platforms; different browsers can directly exchange media and data between them, and on the other, it has a focus on Peer-to-Peer communication. It is also reported that WebRTC offers secure communications.There has been several research works in the literature using WebRTC for a variety of applications, all of them having in common the need for a real-time communication and waiving the obstacle of native applications, which cannot be used across different platforms.Jang-Jaccard *et al.*Â [11] presented a WebRTC-based video conferencing service for tele-health, which allows online meetings between remotely located care coordinators and patients at their homes. Their system is aimed to overcome some limitations of current solutions in tele-health domain such as high development and maintenance cost, use of proprietary incompatible technologies, etc. There is also recent interest in exploring WebRTC technology for IoT applications (see e.g., Sandholm *et al.*Â [21]; Janak and SchulzrinneÂ [12]). Edan *et al.*Â [6] and Wang and MeiÂ [24] presented the design and

evaluation of video/multimedia conferencing systems based on WebRTC.Garcia *et al.*Â [7] and Gouaillard and RouxÂ [8] analyse some challenges and practical solutions through testing and validating WebRTC-based applications.In particular, several works address the use of WebRTC in distant learning and virtual campuses (there are many previous works that were based on JXTA library and on Per-to-Peer paradigm, see e.g.Â [3, 9, 17, 25]). Bandung *et al.*Â [2] analyse video-conference quality from the implementation of WebRTC based system for supporting distance learning, actually their work showed that WebRTC is a reasonable solution to address the challenges of real-time video-conferencing on bandwidth limited network. WebRTC can also be used for casting screen images and voices from a host PC to client web browsers on many other PCs in real-time, which can be useful for students to attend class sessions and learning activities either on-premises or remotely. This actually falls within sharing features enabled by WebRTC, which could be data sharing, screen sharing, etc.Â [10]. Using WebRTC it is possible to operate multiple PCs using a single device and share any-application window between PCs.Finally, WebRTC has been exploited for application migration purposes, which is also the objective of this paper. In such context, migrating the application state among various computing environments or devices is a key componentÂ [16, 20]. SchuchardtÂ [23] presented a vision and methodology for moving mobile applications between Android mobile devices seamlessly. Chu *et al.*Â [5] presented Roam System, a framework for making applications migratable that can be executed on different platforms. Their programming platform is somehow specific by creating â€œroamletsâ€• , which are downloaded from a server and will be adapted to the device. Schmidt and HauckÂ [22] introduced SAMProc, a middleware for self-adaptive mobile processes in heterogeneous ubiquitous environments. Belluci *et al.*Â [4] address user interfaces able to migrate across various types of devices while preserving task continuity. They focus on the issue of preserving the JavaScript state while moving from one device to another one.3 Application Migration: Requirements, Design and Implementation3.1 RequirementsIn order to achieve an application migration from one device to another one, it is necessary to migrate at runtime an application defined by its code, states and data (related information) of the application. From this basic definition we can derive the main requirements on a platform to support migratable applications and application migration process.Among such requirements we could distinguish the following ones (corresponding use cases diagrams are omitted here):[R1] The application should be identified by information of its proprietary. Likewise, users allowed to use the application should be identified as well. The application should be able to be used even offline.[R2] The application should know the list of current available connected devices, where migration could take place.[R3] The application state should be readable/interpretable, comparable and updateable.[R4] Associated data with the application should be efficiently stored/saved.[R5] Migration process should be fast so that users will not perceive any interruption effect while working.[R6] Migration should be possible among devices running under different operating systems. The application migrating process usually involves the following three phases:*1.Suspension phase: the application is paused and the application state is saved. 2.Migration phase: the application of the current device is transferred to the new device where we want to run it. 3.Resuming phase: the application is executed in the new device.* Upon successful completion of the above phases, the user can continue the work at the point where he had it left at the former device. A detailed diagram of executing a newly migrated application can be seen in Fig.Â 1. During the process, the user has the option to select the best fit (in terms of dimensions, battery level, etc.) among connected devices where to migrate the application.*Fig. 1.*Diagram of executing a migratable application. 3.2 Communication Models Among Devices: Centralized vs. Peer-to-PeerThe phase 2 above (see Subsect.Â 3.1), can be implemented either according to a centralized model or a distributed one. In the centralised model, a migration server is used where applications are first uploaded from devices and then are downloaded for use in other devices (Fig.Â 2).*Fig. 2.*Communication models among devices:

centralized vs. peer-to-peer. The migration server is in charge of registering users, applications and devices. Applications are stored in a repository/directory and have associated their configuration parameters and their state. Furthermore, various devices can be connected to the server (a registered user can have several devices registered on the server). The entity-relationship diagram can be see in Fig.Â 3.On the other hand, the Peer-to-Peer application migration model is implemented via WebRTC to establish and enable Peer-to-Peer communication among peer Android devices (Crosswalk library and peerjs scripts are used.) As in the case of other Peer-to-Peer protocols, peer communications can be established also for peers in private networks/behind NAT devices.*Fig. 3.*Entity diagram. 4 Experimental StudyAn aspect of interest while implementing platforms for application migration is the migration time among devices. It is therefore interesting to compare the migration time when a migration server is used *vs.* WebRTC-based migration. While measuring the migration time, application state size is taken as a relevant parameter. A simple contacts agenda application (adding, modifying, deleting contacts) was used for the purpose of this empirical study. Various data sizes for application states were generated to measure the migration time.*Fig. 4.*Application migration time (server time, left; peer-to-peer WebRTC time, right). In Fig.Â 4 can be seen the migration time (in the left, migration time via a migration server, upload/download time are also given; in the right, WebRTC migration time, Peer-to-Peer connection time and data transmissions are given). As expected, data upload (for the server migration case) and data transfer (for the WebRTC case) were predominant as compared to download time and Peer-to-Peer connection time, respectively.*Fig. 5.*Comparison of application migration time (server vs. peer-to-peer WebRTC). A comparison of total migration time for server migration and WebRTC Peer-to-Peer migration is shown in Fig.Â 5. As can be seen, for small size of application state (in this experiment, upÂ to 100000 Bytes), migration is more efficient via a migration server than WebRTC migration. The efficiency of the WebRTC is therefore seen more clearly for complex application of larger size states (larger than 100000 Bytes for this experiment).5 Conclusions and Future WorkIn this paper we have presented the requirements, design and implementation for supporting application migration among various computing devices. The aim is to provide members of a teamwork to be able to work online, while connected with other peer members and to change from one devices to another one without interrupting the collaborative work and seamlessly to other peer members. Likewise, team members can work offline and still change from one devices to another one without interrupting their own work. Such kind of application migration platforms are becoming very important at present with the increasing number of multi-devices (laptops, tablets and smartphones) being used by individuals. In particular, application migration supports working *on the move* either on-premise or off-premise environments, during travelling, etc.For comparison purpose, we considered two architectures for the application migration platform: a web server application migration and a WebRTC Peer-to-Peer application migration (WebRTC was selected for its interesting features.) A simple empirical study was also conducted, from which we observed that for small application state size, server migration would be the option, while for larger and more complex applications of larger state size, the WebRTC would be the choice.In our future work, we plan to fully evaluate the proposal in the Virtual Campus of Open University of Catalonia (UOC) for online learning teams of about 5 members working collaboratively. Besides aiming to get more conclusive results, we would like to evaluate the usefulness of the application migration platform to the profile of the students at UOC, where many of them have to switch from on-premise to off-premise collaborative activity during a working day, and quite often have to travel. Also, we would like to extend our platform to enable application migration from one memberâ€™s device to devices of all members of the team, by taking advantage of WebRTC Peer-to-Peer features such as one-to-many connections. Finally, we are evaluating WebRTC as a solution for delivery of educational content in a virtual classroom

of the Virtual Campus. Acknowledgements This research was supported by the European Commission through the project “colMOOC: Integrating Conversational Agents and Learning Analytics in MOOCs” (588438-EPP-1-2017-1-EL-EPPKA2-KA).References1.Barz, H.W., Gregory, A.: Protocols, Design and Applications Wiley Telecom eBook Chapters, Bassett. WebRTC. Multimedia Networks (2016)2.Bandung, Y., Subekti, L.B., Tanjung, D.: Chrysostomos chrysostomou. QoS analysis for WebRTC videoconference on bandwidth-limited network. In: Proceedings of the 20th International Symposium on Wireless Personal Multimedia Communications (WPMC), pp. 547–553. IEEE CPS (2017)3.Barolli, L., Xhafa, F.: JXTA-overlay: a P2P platform for distributed, collaborative, and ubiquitous computing. IEEE Trans. Indus. Electron. **58**(6), 2163–2172 (2011)4. Bellucci, F., Ghiani, G., Paternò, F., Santoro, C.: Engineering javaScript state persistence of web applications migrating across multiple devices. In: Proceedings of the 3rd ACM SIGCHI Symposium on Engineering Interactive Computing Systems (EICS 2011), pp. 105–110. ACM, New York (2011). https://

doi.

org/

10.

1145/

1996461.

19965025.Chu, H., Song, H., Wong, C., Kurakake, S., Katagiri, M.: Roam, a seamless application framework. J. Syst. Softw. **69**(3), 209–226 (2004).
https://
doi.

org/

10.

1016/

S0164-1212(03)00052-96.Edan, N.M., Al-Sherbaz, A., Turner, S.: Design and evaluation of browser-to-browser video conferencing in WebRTC. In: Global Information Infrastructure and Networking Symposium (GIIS), pp. 75–78. IEEE CPS (2017)7.Garcia, B., Gortazar, F., Lopez-Fernandez, L., Gallego, M., Paris, M.: WebRTC testing: challenges and practical solutions. IEEE Commun. Stand. Magaz. **1**(2), 36–42 (2017).
https://
doi.

org/

10.

1109/

MCOMSTD.

2017.

1700005 8.Gouaillard, A., Roux, L.: Real-time communication testing evolution with WebRTC 1.0. In: Principles, Systems and Applications of IP Telecommunications (IPT Comm), pp. 1–8. IEEE (2017)9. Higashino, M., Hayakawa, T., Takahashi, K., Kawamura, T., Sugahara, K.: Management of streaming multimedia content using mobile agent technology on pure P2P-based distributed e-learning system. Int. J. Grid Util. Comput. **5**3, 198–204 (2014). https://doi.org/10.1504/IJGUC.2014.062928 10.Iwata, S., Ozono, T., Shintani, T.: Any-application window sharing mechanism based on WebRTC. In: Proceedings of 6th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI), pp. 808–813. IEEE CPS (2017)11.Jang-Jaccard, J., Nepal, S., Celler, B., Yan, B.: WebRTC-based video conferencing service for telehealth. Computing **98**(1–2), 169–193 (2016). https://doi.org/10.1007/s00607-014-0429-2 12.Janak, J., Schulzrinne, H.: Framework for rapid prototyping of distributed IoT applications powered by WebRTC. In: Principles, Systems and Applications of IP Telecommunications (IPTComm), pp. 1–7. IEEE CPS (2016)13.Kandil, A., El-Deeb, H.: Exploration of application migration to cloud environment. In: Proceedings of 2016 6th International Conference - Cloud System and Big Data Engineering (Confluence), pp. 109–114. IEEE CPS (2016)14.Kohana, M., Okamoto, S.: A data sharing method using WebRTC for web-based virtual world. In: Barolli, L., Xhafa, F., Javaid, N., Spaho, E., Kolici, V. (eds.) Advances in Internet, Data & Web Technologies. EIDWT 2018. Lecture Notes on Data Engineering and Communications Technologies, vol. 17. Springer, Cham (2018)15.Kumar, K.M., Sanil Kumar, D., Sardesai, R.P., Akhil, M.B.S.S., Kumar, N.: Application migration architecture for cross clouds analysis on the strategies methods and frameworks. In: Proceedings of 2017 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM), pp. 107–112. IEEE CPS (2017)16.Lin, J., Feng, Z., Chen, S., Huang, K., Tan, W., Li, X.: ATM: a framework to support application state migration in multiple terminals environment. In: IEEE International Conference on Services Computing (SCC), pp. 188 - 195. IEEE CPS (2017)17.Nejdl, W., Wolf, B., Qu, C., Decker, S., Sintek, M., Naeve, A., Nilsson, M., Palmér, M., Risch, T.: EDUTELLA: a P2P networking infrastructure based on RDF. In: Proceedings of the 11th International Conference on World Wide Web (WWW 2002), pp. 604-615. ACM, New York (2002). https://doi.org/10.1007/s00607-014-0429-2

org/
10.
1145/
511446.
511525 18.Rivadulla, X., Xhafa, F., Caballé, S.: An event-based approach to support A3: anytime, anywhere, awareness in online learning teams. In: CISIS, pp. 947–952. IEEE CPS (2012)19. Roig-Torres, J., Xhafa, F., Caballé, S.: Supporting online coordination of learning teams through mobile devices. In: CISIS, pp. 941–946. IEEE CPS (2012)20.Sato, K., Mouri, K., Saito, S.: Design and implementation of an application state migration mechanism between android devices. In: Fourth International Symposium on Computing and Networking (CANDAR), pp. 696–700. IEEE (2016)21. Sandholm, T., Magnusson, B., Johnsson, B.A.: An on-demand WebRTC and IoT device tunneling service for hospitals. In: International Conference on Future Internet of Things and Cloud, pp. 53–60. IEEE CPS (2014)22.Schmidt, H., Hauck, F.J.: SAMProc: middleware for self-adaptive mobile processes in heterogeneous ubiquitous environments. In: Proceedings of the 4th on Middleware Doctoral Symposium (MDS 2007), Article 11 , p. 6. ACM, New York (2007).
https://
doi.
org/
10.
1145/
1377934.
1377935 23.Schuchardt, V.: Moving mobile applications between mobile devices seamlessly. In: Proceedings of International Conference on Software Engineering. IEEE CPS (2012).
https://
doi.
org/
10.
1109/
ICSE.
2012.
6227028 24.Wang, W., Mei, L.: A design of multimedia conferencing system based on WebRTC Technology. In: Proceedings of 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), pp. 148–153. IEEE (2017)25.Noriyasu, Y.: An improved group discussion system for active learning using smartphone and its experimental evaluation. Int. J. Space-Based Situated Comput. **6**(4), 221– 227 (2016).
https://
doi.

org/

10.

1504/

IJSSC.

2016.

082763

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_9One-to-One Routing Protocols for Wireless Ad-Hoc Networks Considering the Electric Energy ConsumptionEmi Ogawa1 _, Shigenari Nakamura1 _, Tomoya Enokido2 _ and Makoto Takizawa1 _(1)
Hosei University, Tokyo, Japan(2)
Rissho University, Tokyo, Japan **EmiÂ OgawaÂ (Corresponding author)Email:** emi.ogawa.2q@stu.hosei.ac.jp **ShigenariÂ NakamuraEmail:** nakamura.shigenari@gmail.com **TomoyaÂ EnokidoEmail:** eno@ris.ac.jp **MakotoÂ TakizawaEmail:** makoto.takizawa@computer.orgAbstractIn wireless ad-hoc networks, messages have to be energy-efficiently delivered to destination nodes by exchanging the messages among neighboring nodes. In our previous studies, the reactive type EAO, LEU, and IEAO protocols are proposed to unicast messages. In the EAO protocol, the total electric energy of nodes and delay time from a source node to a destination node can be reduced compared with the ESU and AODV protocols. However, a source-to-destination route may not be found if the communication range of each node is shorter. In the IEAO protocol, a route can be found even in short communication range. In the forwarding phase, a node does not necessarily receive an *RQ* messages which sent by a node whose level parameter is bigger than and keeps the information which is contained in the *RQ* messages. Here, by neglecting superfluous *RQ* messages, the electric energy consumption of the forwarding phase can be reduced. In this paper, we propose an IEAO2 protocol by improving the IEAO protocol so that the electric energy consumption is reduced in the forwarding phase. In the evaluation, we show the information which each node keeps can be reduced in the IEAO2 protocol compared with other protocols.**1 IntroductionWireless ad-hoc networks [4, 10, 11] are widely used in various types of applications, especially in vehicle-to-vehicle (V2V) communication [15] and delay-tolerant network (DTN) [2]. Nodes forward messages to neighbor nodes in wireless networks. In flooding protocols [12], the number of messages transmitted by nodes exponentially increases as the number of nodes increases. In the multi-point relay (MPR) protocols [12], on receipt of a message, only relay nodes forward the message to their first-neighbor nodes. Protocols for energy-efficiently broadcasting messages in a group of multiple nodes are also proposed [1, 13, 14].In this paper, we would like to discuss a unicast type of energy-efficient ad-hoc routing protocol to energy-efficiently deliver messages from a source node to a destination node in wireless ad-hoc networks. In our previous studies [9], reactive type [10] ad-hoc routing protocols, ESU (Energy-Saving Unicast routing) [8], EAO (Energy-Aware One-to-one routing) [5], LEU (Low-Energy Unicast Ad-hoc routing) [6], and IEAO (Improved EAO) [7] protocols are proposed. In the ESU protocol, the electric energy consumed by each node can be reduced but the length of a route is larger since nearer neighbor nodes are selected in the neighbor nodes. In the EAO protocol, the total electric energy consumed by nodes and the route length can be reduced. However, a source-to-destination route may not be found if the communication range of each node is shorter. In the LEU protocol, a source-to-destination route can be**

found with the shorter communication range of each node but the electric energy consumed by nodes is bigger than the EAO protocol. In the IEAO (Improved EAO) protocol, not only a source-to-destination route can be found even in the shorter communication range but also the electric energy consumption of nodes can be reduced. However, superfluous *RQ* messages are transmitted in the forwarding phase. In these protocols, it is assumed each node does not spend electric energy to receive a message. In reality, even if the communication device of each node just consumes small electric energy, the node consumes electric energy to perform the protocol module. In this paper, we propose an IEAO2 protocol by improving the forwarding phase of the IEAO protocol to reduce the number of *RQ* messages transmitted and received. Here, each node consumes the electric energy to send and receive messages.We evaluate the IEAO2 protocol compared with the IEAO [7], EAO [5], and AODV [10] protocols in the simulation. We show the electric energy of the forwarding phase consumed by nodes in the IEAO2 protocol is smaller than the IEAO protocol and the other protocols. We also show the information which each node keeps can be reduced in the IEAO2 protocol compared with other protocols.In Sect.Â 2, we present a system model. In Sect.Â 3, we propose the IEAO2 protocol. In Sect.Â 4, we evaluate the IEAO2 protocol.2 System ModelA network *N* is composed of *n* ( ) nodes , ..., which are cooperating with one another by exchanging messages in wireless networks [3]. Let be the distance between a pair of nodes and . In this paper, we assume the distance between every pair of nodes and is *a priori* known. Each node does not move, i.e. stays at fixed location.Let show the maximum electric energy [J] consumed by a node to send a message. () shows the maximum communication range of a node . A node can receive a message sent by a node if the node is a node of a node , i.e. (). Otherwise, a node cannot receive the message from a node . We assume the maximum communication range () of each node is the same. This means, the maximum electric energy [J] consumed by each node is also the same, i.e. *maxSE*.In the forwarding phase, each node is in one state, 1 or 2 on receiving a message. At state 1, a node receives an *RQ* message *q* and checks the level parameter which is contained in the message *q*, i.e. *q.l*. Here, the electric energy consumed by a node to receive the message *q* and check the level parameter *q.l* is *rcE* [J]. At state 2, the node finishes the state 1 and stores the data of the *RQ* message into the memory. A node is assumed to consume the electric energy *dE* [J] to process the data. In the forwarding phase, shows the electric energy [J] consumed by a node . Therefore, of a node of state 1 is *rcE*. At a node of state 2 is *rcE* *dE*.3 IEAO ProtocolIn this paper, we newly propose an *IEAO*2 (*Improved Energy-Aware One-to-one routing*) protocol for a source node to unicast messages to a destination node so that the electric energy consumed by the forwarding phase can be reduced and the information which each nodes keeps also can be reduced.3.1 OverviewThe IEAO2 protocol is composed of two phases, forwarding and backtracking phases as discussed in the IEAO [7] and EAO [5] protocols. At first, a source node initiates the forwarding phase to find a shortest route to a destination node to exchange messages. Here, each node obtains information of first-neighbor nodes in the network *N* by flooding *RQ* (request) messages to the destination node in a similar way to the EAO [5] and AODV [10] protocols. A shortest route from the source node to the destination node is found by using the first-neighbor information. Here, a directed link shows that the node is a first neighbor node of the node , i.e. receives an *RQ* message *q* from . If the destination node receives an *RQ* message *q*, a shortest route is obtained as the forwarding route. Here, the forwarding phase terminates.Then, the destination node initiates the backtracking phase to find a more energy-efficient route by backtracking the forwarding route from the destination node . Here, suppose a directed link from a node to a node is found in the forwarding phase by the forwarding phase. For the node , a common first-neighbor node of the nodes and is checked if a path consumes smaller electric energy than the original path as shown in Fig.Â 1. If so, the route is newly taken as a new route from to . Then, for the node , it is checked if there is another node such that in the same way. Until the source node is found, the backtracking procedure

is iterated. Thus, a new route from the source node to the destination node is found. In our previous studies, only electric energy to send a message is considered. Here, the electric energy to send a message from a node to is given . Hence, if < , the path spends smaller electric energy than .In our experiment, a node consumes so large to perform the protocol modules that the electric energy consumed by communication devices can be neglected. Since a node selects a first-neighbor node which the level parameter is smaller than and has an uncover neighbor node is selected as a prior node to male a route, the node does not necessarily keep the information of nodes which the level parameter is bigger than . This means, the node neglected the *RQ* message *q* which is sent from the nodes if *q.l* > in the forwarding phase. Suppose there are three nodes , , and . , , and . Here, we focus on the node . In the EAO protocol, each node receives and keeps all the *RQ* messages. Nodes are all on the state 2 which the electric energy consumed by nodes is *RE* = *rcE dE*. Hence, the node receives and processes the message from the nodes and . The electric energy consumed by the node is in the EAO protocol. In the IEAO2 (improved IEAO) protocol, the node neglects the message *q* which the level parameter *q.l* is bigger than the level parameter of the node. The node which neglects the *RQ* message is on the state 1. The electric energy *RE* of state 1 is *rcE*. Therefore, the node neglects the message from the node and receives the node . The electric energy consumed by the node is in the IEAO2 protocol.*Fig. 1.*Backtracking phase. Each node manipulates the following variables to find a route. = level parameter of the node , initially 0. = set of first-neighbor nodes of the node , initially . = set of first-neighbor nodes of each first-neighbor node of the node , initially does not exist. = set of nodes which are not only first-neighbor nodes of the node but also first-neighbor nodes of a first-neighbor node of the node , i.e. (), initially . A variable is created and = if the node finds a node to be a first-neighbor node of the node , i.e. in the forwarding phase.An *RQ* message *q* sent by a node is composed of the following fields: level parameter of the source node , i.e. . set of first-neighbor nodes of the source node , i.e. . source node . destination node . 3.2 Forwarding PhaseFirst, a source node would like to deliver messages to a destination node in the network *N*. Here, = 0 and = . The source node sends an *RQ* message *q*. In the forwarding phase, the source node first sends an *RQ* message *q* to every first-neighbor node with the maximum electric energy = *maxSE*. Here, (= 0) and (=). Then, the node sends an *RQ* message *q* where *q.l* = 1. Thus, *RQ* messages are forwarded to nodes in a flooding manner and the destination node eventually receives an *RQ* message. Here, an *RQ* message *q* sent by a node carries a level parameter *q.l* and a set *q.FN* of first-neighbor nodes which the node knows.[Source node] A source node would like to communicate with a destination node . *1. = 0; = ; 2.q.l = (= 0); q .FN = (=); ; 3.send an RQ message q to every first neighbor node with the maximum electric energy ;* As presented here, a node receives an *RQ* message *q* from a node . If = 0 and is not the source node, the level parameter *q.l* is stored in the variable and then the variable is incremented by one. The variable shows that the node is at one level higher than the node . If the node had already received the *RQ* message *q* from another node, i.e. *q.l* 0, the node compares the level parameter with *q.l*. Here, if the level parameter is bigger than *q.l* (> *q.l*), the variable is changed with . Otherwise, the variable is not changed.The *RQ* message *q* carries the field *q.FN* which is a set of first-neighbor nodes of the node which the node knows. Here, the node knows that the node is a first-neighbor node of the node . If or (0) *q.l*, = {}. Then, the node sends an *RQ* message *q* to the first-neighbor nodes where *q.l* = and *q.FN* = .A node may receive *RQ* messages from multiple nodes. Each time the node receives an *RQ* message *q* from a node , the node knows the node is a first-neighbor node. Then, the node checks the level parameter *q.l* in the message *q*. If or (0) *q.l*, . The *RQ* message *q* also carries the information of first-neighbor nodes of the node in the field *q.FN*. The node keeps in record of *q.FN* in a set variable . Initially, no variable exists for any node . On receipt of a message from a node , a variable is created. Then, . Nodes in *q.FN*, i.e. a set of first neighbor nodes of the node are stored in the variable , i.e. *q.FN*. Thus, the variable stands for first-neighbor nodes of a first-neighbor node which a

node knows. The variable includes the information of the nodes which are not only the first-neighbor nodes but also the second-neighbor nodes of the node , i.e. = ( ). *Fig. 2.*On receipt of an *RQ* message *q*. Suppose there are three nodes , , and as shown in Fig.Â 2. The level parameter of the nodes and is 1 and 2, respectively. The level parameter of the node is 0 before receiving the *RQ* message *q* from another node. First, the node sends the *RQ* message *q* to the node , i.e. and . The node receives the message *q* and checks the level parameter *q.l*. Here, () < *q.l* . The node keeps the data which is contained in the message *q*. = {}. The *RQ* message *q* also carries the information of first-neighbor nodes of the node in the field *q.FN*. The node keeps in record of *q.FN* in a set variable . Then, the node receives the *RQ* message *q* from the node . The level parameter *q.l* of the message *q* is bigger than the node and . Therefore, is not changed and the node does not keep the information which is contained in the message *q* from the node . The node deletes the message *q* from the node after checking the level parameter *q.l* compared with itself.Eventually, the destination node receives an *RQ* message *q*. Suppose a node is a first-neighbor node of a node . Here, the node precedes the node () iff is a first-neighbor node of the node and .4 EvaluationWe evaluate the IEAO2 protocol in terms of electric energy consumption of nodes in the forwarding phase compared with the IEAO [7], EAO [5] and AODV [10] protocols. In the evaluation, *n* (1) nodes are uniformly deployed on an mesh network *N*. In the evaluation, we consider a 128 times 128 mesh network, i.e. . We randomly select pairs of a source node and a destination node in the *n* nodes. Here, the maximum communication range of each node is the same *maxd*. Then, IEAO2, IEAO, EAO, and AODV routes are found for each pair of a source node and a destination node on the mesh network in the IEAO2, IEAO, EAO, and AODV protocols, respectively, on each deployment of nodes in the mesh network. We assume the communication range of each node is the same *maxd*.*Fig. 3.*Number of messages which are kept in each node. FigureÂ 3 shows the number of messages which are kept in each node in the IEAO2, IEAO, EAO, and AODV protocols for 30 where 30 *maxd* 90. The number of messages kept in each node of the IEAO2 protocol is fewer than the other protocols. The smaller the communication range gets, the fewer number of messages is kept in each node. For example, the number of messages in the IEAO2 protocol is about of the IEAO, EAO, and AODV protocols where the communication range *maxd* is 30.*Fig. 4.*Electric energy ratio of the forwarding phase. FigureÂ 4 shows the electric energy consumption ratios of the forwarding phase in the IEAO2 route to the IEAO, EAO, and AODV routes for and the communication range *maxd* is 30 to 90. The electric energy consumption of the IEAO2 protocol is smaller than the other protocols. The larger the communication range *maxd* gets, the larger electric energy is consumed. For example, the electric energy consumption of the forwarding phase in the IEAO2 protocol is about of the IEAO, EAO, and AODV protocols for .5 Concluding RemarksIn this paper, we newly proposed the forwarding phase of the IEAO2 protocol to deliver messages from a source node to a destination node in a wireless ad-hoc network. In the IEAO2 protocol, information of first-neighbor nodes from a source node to a destination node is collected by flooding *RQ* messages in a similar way to the AODV protocol. Then, starting from the destination node as a current node, a more energy-efficient prior node is tried to be found for each current node. We evaluated the IEAO2 protocol compared with IEAO, EAO, and AODV protocols. We showed the electric energy consumed by nodes in the forwarding phase and the number of messages which are kept in each node can be reduced compared with the IEAO, EAO, and AODV protocols. In the IEAO protocol, the superfluous *RQ* messages are transmitted and processed by nodes in the forwarding phase. In the IEAO2 protocol, the data of the superfluous *RQ* message is not kept in each node. This means, the electric energy consumed by nodes to perform the protocol module can be reduced. We are now designing the backtracking phase of the IEAO2 protocol.
AcknowledgementsThis work was supported by JSPS KAKENHI grant number 15H0295.References1.Aikebaier, A., Enokido, T., Takizawa, M.: Reliable and efficient way to broadcast messages in a group by Trust-based Broadcast (TBB) scheme. Comput. Inform. (CAI) **30**

(6), 1001–1015 (2011)MATH2.Cerf, V., Burleigh, S., Hooke, A., Torgerson, L., Durst, R., Scott, K., Fall, K., Weiss, H.: Delay-tolerant network architecture (2007).
https://
tools.

ietf.

org/

html/

rfc48383.Clausen, T., Hansen, G., Christensen, L., Behrmann, G.: The optimized link state routing protocol, evaluation through experiments and simulation. In: Proceedings of the IEEE Symposium Conference on Wireless Personal Mobile Communications (2001)4.Jacquet, P., Muhlethaler, P., Clausen, T., Laouiti, A., Qayyum, A., Viennot, L.: Optimized link state routing (OLSR) protocol for ad hoc network (2003).
https://
www.

ietf.

org/

rfc/

rfc3626.

txt5.Ogawa, E., Nakamura, S., Enokido, T., Takizawa, M.: An energy-aware one-to-one routing protocol in wireless ad-hoc network. In: Proceedings of the 20th International Conference on Network-Based Information Systems (NBiS-2017), pp. 102–113 (2017)6.Ogawa, E., Nakamura, S., Enokido, T., Takizawa, M.: A low-energy unicast ad-hoc routing protocol in wireless networks. In: Proceedings of the 12th International Conference on Broad-Band Wireless Computing, Communication and Applications (BWCCA-2017), pp. 173–184 (2017)7.Ogawa, E., Nakamura, S., Enokido, T., Takizawa, M.: Unicast routing protocols to reduce electric energy consumption in wireless ad-hoc networks. In: Proc. of IEEE the 32st International Conference on Advanced Information Networking and Applications (AINA-2018), pp. 1162–1168 (2018)8.Ogawa, E., Nakamura, S., Takizawa, M.: An energy-saving unicast routing protocol in wireless ad-hoc network. In: Proceedings of the 11th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2017), pp. 110–120 (2017)9.Ogawa, E., Nakamura, S., Takizawa, M.: A trustworthiness-based ad-hoc routing protocol in wireless networks. In: Proceedings of IEEE the 31st International Conference on Advanced Information Networking and Applications (AINA-2017), pp. 1162–1168 (2017)10.Perkins, C., Belding-Royer, E., Das, S.: Ad hoc On-Demand Distance Vector (AODV) routing (2003).
https://
www.

ietf.

org/

rfc/

rfc3561.

txt11.Perkins, C.E., Bhagwat, P.: Highly dynamic Destination Sequenced Distance Vector routing (DSDV) for mobile computers. In: Proceedings of ACM SIGCOMM 1994, pp. 234–244 (1994) Crossref12.Qayyum, A., Viennot, L., Laouiti, A.: Multipoint relaying: an efficient technique for flooding in mobile wireless networks. Technical report 3898, Inria (2000)13.Sugino, M., Nakamuara, S., Enokido, T., Takizawa, M.: Energy-efficient broadcast protocols in wireless networks. In: Proceedings of the 18th International Conference on Network-Based Information Systems (NBiS-2015), pp. 357–364 (2015)14.Sugino, M., Nakamuara, S., Enokido, T., Takizawa, M.: Protocols for energy-efficiently broadcasting messages in wireless networks. In: Proceedings of the AINA-2016 Workshops (WAINA-2016), pp. 286–293 (2016)15.Yang, X., Liu, J., Zhao, F., Vaidya, N.H.: A vehicle-to-vehicle communication protocol for cooperative collision warning. In: Proceedings of the 1st Annual for International Conference on Mobile and Ubiquitous System: Networking and Services, pp. 114–123 (2004)

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_10Virtual Machine Migration Algorithms to Reduce Electric Energy Consumption of a Server ClusterRyo Watanabe1 , Dilawaer Duolikun1 , Tomoya Enokido2 and Makoto Takizawa1 (1)
Hosei University, Tokyo, Japan(2)
Rissho University, Tokyo, Japan **RyoÂ WatanabeÂ (Corresponding author)Email:** ryo.watanabe.4h@stu.hosei.ac.jp **DilawaerÂ DuolikunEmail:** dilewerdolkun@gmail.com **TomoyaÂ EnokidoEmail:** eno@ris.ac.jp **MakotoÂ TakizawaEmail:** makoto.takizawa@computer.orgAbstractIn this paper, we discuss a virtual machine migration approach to reducing the electric energy consumption of servers. In our previous algorithms, one virtual machine migrates from a host server to a guest server. While the electric energy consumption of servers can be reduced by migrating some number *b* of processes, there might not be a virtual machine with the same number *b* of processes on a host server. In this paper, we propose an ISEAM2T algorithm where multiple virtual machines can migrate from a host server to a guest server. Here, multiple virtual machines on a host server are selected so that the total number of processes on the virtual machines can be more easily adjusted to the best number *b* of processes. In the evaluation, we show the total electric energy consumption and active time of the servers and the average execution time of processes can be reduced in the proposed algorithm.**1 IntroductionWe have to reduce electric energy consumption of servers in clusters like cloud computing systems [2] in order to realize eco society [4]. Energy-efficient hardware devices like CPUs [3] are developed in the hardware-oriented approach. On the other hand, we aim at reducing the total electric energy consumed by a server to perform application processes in our macro-level approach [8â€“10]. Here, types of power consumption and computation models are proposed [8â€“10].If an application process is issued to a cluster of servers, one energy-efficient server is selected to perform the process in types of server selection algorithms [10â€“12]. Furthermore, an application process performed on a host server migrates to a guest server which is expected to consume smaller electric energy than the host server in the migration approach [6, 7]. By using virtual machines [5], a cloud computing system supports applications with virtual computation service which is independent of locations and heterogeneity of servers. In addition, a virtual machine with application processes can easily migrate from a host server to another guest server without suspending the processes like the live migration [5]. Energy-efficient migration algorithms of virtual machines [15â€“17, 19] are so far proposed to migrate virtual machines on host servers to energy-efficient guest servers. Here, one virtual machine is selected to migrate. In papers [19, 20], the mathematical relation among the electric energy consumed by a host server and a guest server and the number of processes to**

migrate is discussed. By using the relation, we can find such number *b* of processes to migrate from a host server to a guest server that the total electric energy to be consumed by the servers and is minimized. However, it is not easy to find a virtual machine on a host server by migrating which the electric energy consumption of the host and guest servers can be mostly reduced. In this paper, we proposed an ISEAM2T algorithm where multiple virtual machines can migrate from a host server to a guest server where the total number of processes on the virtual machines is near to the best number *b*.We evaluate the ISEAM2T algorithm in terms of the total electric energy consumption and active time of servers and the average execution time of processes compared with other non-migration algorithms and migration algorithms.In Sect.Â 2, we present a system model. In Sect.Â 4, we propose the ISEAM2T algorithm. In Sect.Â 5, we evaluate the ISEAM2T algorithm.2 System ModelA cluster *S* is composed of servers , ..., (*m* 1) and supports applications on clients with virtual service on computation resources by using virtual machines , ..., (*v* 1) [5]. If a client issues an application process , one virtual machine is selected to perform the process . is a set of resident processes on the virtual machine at time . Here, shows the size of a virtual machine . A virtual machine is *active* if , else *idle*. An active server hosts at least one active virtual machine. A server which hosts at least one virtual machine is *engaged*, otherwise *free*. A virtual machine is *smaller* than a virtual machine () iff (if and only if) .In this paper, a *process* means a computation type of application process which uses CPU on a server. In the SPC (Simple Power Consumption) model [10], the electric power consumption is given as follows: (1)That is, a server consumes the electric power [W] if at least one process is performed, otherwise . The total electric energy consumed by a server from time *st* to time *et* is defined to be [W tu].Each process is performed on a host server . It takes time units [tu] to perform a process on a thread of a server . If only a process is performed on a server without any other process, the execution time of the process is shortest, i.e. . In a cluster *S* of servers , ..., (1), shows a shortest one of , ..., . If , a thread of a server is *fastest* and the server is *fastest*. We assume one virtual computation step [vs] is performed on a thread of a fastest server for one time unit [tu], i.e. the computation rate of the thread is one [vs/tu]. The total number of virtual computation steps of a process is defined to be [tu] [vs/tu] = [vs]. The maximum computation rate of a process on a server is [vs]/ [vs/tu] (1). In the SC (Simple Computation) model [10], the computation rate of a server is given as follows: (2)The server computation rate is fairly allocated to each process of *n* current processes. The process computation rate [vs/tu] of a process with processes on a server is .If a process starts at time *st* and ends at time *et*, Â = [vs]. shows the total number of computation steps to be performed by a process . At time a process starts, Â = . Then, is decremented by the computation rate , i.e. at each time . If and 0, the process terminates at time .3 Estimation Model3.1 Expected Electric Energy ConsumptionA client issues a process to a set *VM* of virtual machines , ..., (*v* 1) in a cluster *S* of servers . We assume the total number of virtual computation steps of each process to be a constant, . Suppose *n* processes are currently performed on a server and *k* new processes are issued to the server . The total amount of computation to finish the *n* current processes is assumed to be *n*/2. The total computation to finish the *k* new processes is *k*. The expected termination time [tu] and expected electric energy consumption [W tu] of a server to perform *n* current processes and *k* new processes are given as follows: (3) (4)Let be the number of processes performed on each server . First, suppose no virtual machine on the server migrates to the server . The servers and consume electric energy by time and by to perform and current processes, respectively. The servers and totally consume the electric energy until every current process on and terminates: (5)Next, suppose a virtual machine on the host server migrates to the guest server . Here, processes are performed on the server while processes on the server . The servers and totally consume the electric energy by time and the electric energy , respectively, to perform every process. That is, the servers and consume electric energy and to perform all the current processes, respectively. Hence, the servers and totally

consume the electric energy as discussed in formula (5): (6)If , the virtual machine can migrate from the host server to the guest server . If there is no virtual machine on the server such that , no virtual machine migrates to the server .3.2 Selection of a Virtual MachineIf no virtual machine migrates from a host server to a guest server , the expected termination time is [tu] and the expected electric energy consumption is [W tu] for for a host server . and for a server .Next, suppose a virtual machine with processes migrates from a host server to a guest server . The expected termination time is and the expected electric energy consumption is for the host server . is and is for a guest server . The expected termination time and of the servers and are and , respectively. The total electric energy consumption of the servers and is given for the size of the virtual machine : (7) (8) (9) (10) (11) (12) (13) *Fig. 1.* and . In Fig.Â 1, the straight line shows the expected termination time and the dotted line indicates . If , for every number of processes on a virtual machine . Otherwise, there is some value such that : (14)For , . Here, the guest server terminates before the host server if a virtual machine of size migrates from the host server to the guest server . For , .If and , the total electric energy consumption linearly increases as the size of a virtual machine increases. If and , linearly decreases as increases. If and , is minimum. If a virtual machine migrates whose size is , the electric energy consumption of the servers and can be minimized as shown in Fig.Â 2. If and , or is minimum and is maximum.*Fig. 2.*Energy consumption . 4 Energy-Efficient Selection and Migration Algorithms4.1 VM Selection AlgorithmFirst, suppose a client issues a process to a cluster *S* of servers with a set *VM* of virtual machines at time .[VM selection] A client issues a process to a cluster *S*. *1.select an engaged host server where at least one virtual machine resides in a selection algorithm. 2.select a smallest virtual machine on the selected host server . 3.perform the process on the virtual machine of the host server .* As discussed in the SGEA algorithm [14], not only a host server of a new process but also the other servers consume electric energy even if the servers are idle. Here, let and be the expected termination time and expected electric energy consumption of a host server , respectively, where a new process is assumed to be performed. Here, and . Let and be the expected execution time and expected electric energy of a server , respectively, where only current processes are performed. The expected electric energy consumption of another server () for a host server of a process is given by , which another server is expected to consume by the time : (15)The expected total electric energy consumption of the servers for a host server is .[Server selection algorithm SGEA]*1.select a server where is minimum; 2.select a smallest virtual machine on and perform the process ;* 4.2 VM Migration (VMM) AlgorithmEach engaged server is periodically checked. For each server , a virtual machine on the server is selected where the total electric energy expected to be consumed by a pair of the servers and is minimum: Here, a subset of virtual machines on a host server are selected for each guest server , where is nearest to . Then, a server is selected where expected electric energy consumption is minimum. If a guest server is found, the virtual machines in migrate to the guest server . Otherwise, no virtual machine migrates from the host server .5 EvaluationWe consider a cluster *S* of four homogeneous servers , , , and ($m = 4$), respectively, in our laboratory and 40 virtual machines , , ($v = 40$). A virtual machine is on a host server where module 4 . Initially, each server hosts ten virtual machines. The performance parameters like and electric energy parameters like of each server are shown in TableÂ 1. In the simulation, the total electric energy consumption and total active time of each server are obtained for each server . The total active time of a server is time when the server is active, i.e. at least one process is performed.In the cluster *S*, n (> 0) processes , , are performed. The starting time of each process is randomly taken from time 0 to . Here, *xtime* is 1,000 time units [tu]. In this paper, 3*n*Â /Â 4 processes are randomly taken from time 0 to . Then, of each process of the other *n*Â /Â 4 processes is randomly taken from *xtime*Â /Â 4 â€“ 10 to *xtime*Â /Â 4 + 10. In fact, one time unit [tu] shows 100 [msec] [13]. The minimum execution time is randomly taken from 5 to 20 [tu].

The number of virtual computation steps of each process is 5.0 to 20.0 [vs]. The parameters of each process are shown in TableÂ 2. Each process starts at time and terminates at time which is obtained in the simulation. The execution time of a process is + 1 [tu]. The simulation ends at time *etime* when every process terminates, i.e. . The electric energy consumption of each server is .We consider the random (RD), round robin (RR), SGEA [14], ISEAM [15], ISEAM2 [19], and ISEAM2T algorithms. In the RD, RR, and SGEA algorithms, virtual machines do not migrate. In the ISEAM and ISEAM2 algorithms, a smallest virtual machine migrates to a more energy-efficient server. In the ISEAM algorithm, at most one virtual machine migrates. In the ISEAM2T algorithm, multiple virtual machines migrate. The average execution time *AT* is .The simulation is time-based. Initially, the electric energy consumption variable and active time variable are 0 and a variable is for each server . At each time , if a process states, i.e. , one server is selected in a selection algorithm and . Then, is incremented by the electric power when *n* . is also incremented by one if *n* . For each process , is decremented by the computation rate /*n*. If , terminates, i.e. and . The simulation is implemented in SQL [1] on a database.FigureÂ 3 shows the total electric energy consumption *TEE* [W tu] of the four servers in the cluster *S* for number *n* of processes. The total electric energy consumption *TEE* of the ISEAM2T algorithm is smallest. For example, the *TEE* of the ISEAM2T is about 35% smaller than the RD and RR algorithms and about 15% smaller than ISEAM and ISEAM2 algorithms for 2,000.FigureÂ 4 shows the total active time *TAT* [tu] of the four servers. The *TAT* of the ISEAM2T algorithm is the shortest compared with the other algorithms. Servers are less loaded in the ISEAM2T algorithm than the other algorithms.FigureÂ 5 shows the average execution time *AT* [tu] of the *n* processes. The *AT* of the ISEAM2T algorithm is shortest compared with the other algorithms.*Table 1.*Parameters of servers.

ParametersDSLab2 ()DSLab1 ()Sunny ()Atira ()
2111
8864
3216128
[vs/tu]1.01.00.50.7
[vs/tu]321665.6
[W]126.1126.187.241.3
[W]301.1207.3131.289.5
[W]30301615
[W]5.65.63.64.7
[W]0.80.80.91.1

*Table 2.*Parameters of processes.**

ParametersValues
n number of processes , ...,
[tu]minimum computation time of a process
[vs]5.0 20.0 Â Â Â (=)
[tu]starting time of (0 < *xtime* - 1)
xtime [tu]simulation time (= 1,000 (= 100[sec]))

*Fig. 3.*Total electric energy consumption (*m* = 4, *v* = 40). *Fig. 4.*Total active time (*m* = 4, *v* = 40). *Fig. 5.*Average execution time of processes (*m* = 4, *v* = 40). 6 Concluding RemarksIn this paper, we newly proposed the ISEAM2T algorithm where multiple virtual machines migrate to more energy-efficient servers. In the evaluation, we showed the total electric energy consumption of servers in the ISEAM2T algorithm is smallest in the other algorithms. We also showed the active time of servers and the average execution time of processes in the ISEAM2T algorithm can be most reduced compared with the other algorithms.**AcknowledgmentThis work was supported by JSPS KAKENHI grant number 15H0295.References1.Datebase managiment system sybase. http://
infocenter.

sybase.

com/
help/
index.
jsp2.Google, google green.
http://
www.
google.
com/
green/
3.Intel xeon processor 5600 series: The next generation of intelligent server processors white paper.
http://
www.
intel.
com/
content/
www/
us/
en/
processors/
xeon/
xeon-processor-e5-family.
html4.United nations climate change conference (COP21).
https://
en.
wikipedia.
org/
wiki/
20155.A virtualization infrastructure for the linux kernel (kernel-based virtual machine).
https://
en.

wikipedia.

org/

wiki/

Kernel-based Virtual Machine6.Duolikun, D., Enokido, T., Takizawa, M.: Asynchronous migration of process replica in a cluster. In: Proceedings of IEEE the 29th International Conference on Advanced Information Networking and Applications (AINA-2015), pp. 271–278 (2015)7.Duolikun, D., Enokido, T., Takizawa, M.: Asynchronous migration of process replica in a cluster. In: Proceedings of the 9th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2015), pp. 118–125 (2015)8.Enokido, T., Aikebaier, A., Takizawa, M.: A model for reducing power consumption in peer-to-peer systems. IEEE Syst. J. **4**(2), 221–229 (2010)Crossref9.Enokido, T., Aikebaier, A., Takizawa, M.: An integrated power consumption model for communication and transaction based applications. In: Proceedings of IEEE the 25th International Conference on Advanced Information Networking and Applications (AINA-2011), pp. 627–636 (2011)10.Enokido, T., Aikebaier, A., Takizawa, M.: Process allocation algorithms for saving power consumption in peer-to-peer systems. IEEE Trans. Indus. Electron. **58**(6), 2097–2105 (2011)Crossref11.Enokido, T., Takizawa, M.: Energy-efficient delay time-based process allocation algorithm for heterogeneous server clusters. In: Proceedings of IEEE the 29th International Conference on Advanced Information Networking and Applications (AINA-2015), pp. 279–286 (2015)12.Kataoka, H., Duolikun, D., Enokido, T., Takizawa, M.: Evaluation of energy-aware server selection algorithm. In: Proceedings of the 9th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2015), pp. 318–325 (2015)13.Kataoka, H., Duolikun, D., Enokido, T., Takizawa, M.: Power consumption and computation models of a server with a multi-core CPU and experiments. In: Proceedings of IEEE the 29th International Conference on Advanced Information Networking and Applications Workshops (WAINA-2015), pp. 217–223 (2015)14.Kataoka, H., Duolikun, D., Enokido, T., Takizawa, M.: Simple energy-aware algorithms for selecting a server in a scalable cluster. In: Proceedings of IEEE the 31st International Conference on Advanced Information Networking and Applications Workshops (WAINA-2017), pp. 146–153 (2017)15.Watanabe, R., Duolikun, D., Cuiqin, Q., Enokido, T., Takizawa, M.: A simple energy-aware virtual machine migration algorithm in a server cluster. In: Proceedings of the 19th International Conference on Network-Based Information Systems (NBiS -2017), pp. 55–65 (2017)16.Watanabe, R., Duolikun, D., Enokido, T., Takizawa, M.: An energy-efficient migration algorithm of virtual machines in server clusters. In: Proceedings of the 11th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2017), pp. 94–105 (2017)17.Watanabe, R., Duolikun, D., Enokido, T., Takizawa, M.: A simply energy-efficient migration algorithm of processes with virtual machines in server clusters. J. Wirel. Mob. Netw. Ubiquitous Comput. Dependable Appl. (JoWUA) **8**(2), 1–18 (2017)18.Watanabe, R., Duolikun, D., Enokido, T., Takizawa, M.: Simple models of processes migration with virtual machines in a cluster of servers. In: Proceedings of IEEE the 32nd International Conference on Advanced Information Networking and Applications (AINA-2018), pp. CD–ROM (2018)19.Watanabe, R., Duolikun, D., Qin, C., Enokido, T., Takizawa, M.: A simple migration algorithm of virtual machine in a server cluster. In: Proceedings of the 12th International Conference on Broadband and Wireless Computing, Communication and Applications (BWCCA-2017), pp. 149–160 (2017)20.Watanabe, R., Duolikun, D., Qin, C., Enokido, T., Takizawa, M.: Eco migration algorithms of processes with virtual machines in a server cluster. In: Proceedings of the 6th International Conference on Emerging Internet, Data and Web Technologies (EIDWT2018), pp. 130–141 (2018)Crossref

Leonard Barolli, Fatos Xhafa, Nadeem Javaid and Tomoya Enokido (eds.)Innovative Mobile and

Internet Services in Ubiquitous ComputingAdvances in Intelligent Systems and Computing773
https://doi.org/10.1007/978-3-319-93554-6_11Evaluating Motion and Heart Rate Sensors to Measure Intensity of Physical ActivityMiguel A. Wister1 , Pablo Pancardo1 and Ivan Rodriguez1 (1)
Academic Division of Information Technology and Systems, Juarez Autonomous University of Tabasco, Cunduacan, Tabasco, Mexico **MiguelÂ A.Â WisterÂ (Corresponding author)Email:** miguel.wister@ujat.mx **PabloÂ PancardoEmail:** pablo.pancardo@ujat.mx **IvanÂ Rodriguez Email:** jesucito.cukin@gmail.comAbstractUsing a device for measuring the intensity of a physical activity when a person carries out their daily routines is an important support to monitor their health, especially if this person is overweight or obese since it exists risk for their health when demanding a lot of energy while performing physical activities. To confront this problem, there are new generation devices for measuring physical activity, that can be used to know physical intensity levels and consequently, establish exercise programs if were necessary to lose weight or maintain a certain level of training derived from a medical prescription. This paper evaluates the relationship between values of a motion sensor and heart rate sensor for measuring the intensity of physical activity of overweight or obese people. We propose to use these two sensors to determine the correlation between both so that at a given time, the motion sensor can be a useful alternative to measure the intensity of physical activity. This option makes easier for people to measure physical intensity with a conventional device equipped with an accelerometer, many people that use smartphones might avoid going to an expert to keep track of physical exercises.

This book presents the latest research findings, methods and development techniques related to Ubiquitous and Pervasive Computing (UPC) as well as challenges and solutions from both theoretical and practical perspectives with an emphasis on innovative, mobile and internet services.

With the proliferation of wireless technologies and electronic devices, there is a rapidly growing interest in Ubiquitous and Pervasive Computing (UPC). UPC makes it possible to create a human-oriented computing environment where computer chips are embedded in everyday objects and interact with physical world. It also allows users to be online even while moving around, providing them with almost permanent access to their preferred services. Along with a great potential to revolutionize our lives, UPC also poses new research challenges.

Â

Innovative Mobile and Internet Services in Ubiquitous - Programmers find the system easy to use: more than ten thousand distinct. the 2011 IEEE/ACM 12th International Conference on Grid Computing, p.82-89,... service-oriented computing with software mobility, Proceedings of the A case for MapReduce over the internet, Proceedings of the 2013 ACM Innovative Mobile and Internet Services in Ubiquitous - dblp -

SIGMOBILE Mobile Computing and Communications Review. Jan. Riekki, J. (2007) RFID and smart spaces, Int. J. Internet Protocol Technology, Vol. International Journal on Advances in Networks and Services, ISSN 1942-2644.. Proc IEEE/RSJ/GI International Conference on Intelligent Robots and Citation Report - Books æœªå‘½å•• 1 - Books Twitter related academic papers - CentAUR - In: Proceedings of Third International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies Tracking in the book selling industry: where to attach rfid tags in the supply chain? in the Innovation Processes of the Industrial Enterprises Prague (MITIP) , 12-14 November 2008, Czech Republic. Innovative Mobile and Internet Services in Ubiquitous - ... graph,â€• International Journal of Innovative Computing, Information & Control â€œA secure group-based mobile chat protocol,â€• Journal of Ambient Intelligence and strongly t-diagnosable systems under the PMC model,â€• International Journal of. 12th International Conference on Innovative Mobile and Internet Services in A Semantic Web Primer - ACM Digital Library - Mother's Day Books & Gifts. Books. Innovative Mobile and Internet Services in Ubiquitous Computing: Proceedings of the 12th International Conference on of the 12th International Conference on Innovative Mobile and Internet Services in Series: Advances in Intelligent Systems and Computing , #773. Innovative Mobile and Internet Services in Ubiquitous - SIGMOBILE Mobile Computing and Communications Review. Jan. Riekki, J. (2007) RFID and smart spaces, Int. J. Internet Protocol Technology, Vol. International Journal on Advances in Networks and Services, ISSN 1942-2644.. Proc IEEE/RSJ/GI International Conference on Intelligent Robots and Innovative Mobile and Internet Services in Ubiquitous - Books Citation Report - International Journal of Innovative æœªå‘½å•• 1 - ... and Computing) book online at best prices in India on Amazon.in. Read Innovative Mobile and Internet Services in Ubiquitous Computing: Proceedings of the 12th International Conference on Innovative Mobile and Internet in Intelligent Systems and Computing) book reviews & author details and more at Amazon.in.

---

econometrics pdf

[DOWNLOAD] - Download book God's Nature: A 21st Century Analysis of the Judeo-Christian God -Volume II-

---

[DOWNLOAD] - Download book Beyond the Red Sky free
