

# **2016 12th International Conference on Mobile Ad-Hoc and Sensor Networks (MSN 2016)**

**Hefei, China  
16-18 December 2016**



**IEEE Catalog Number: CFP1630F-POD  
ISBN: 978-1-5090-5697-2**

**Copyright © 2016 by the Institute of Electrical and Electronics Engineers, Inc  
All Rights Reserved**

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

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

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

|                         |                   |
|-------------------------|-------------------|
| IEEE Catalog Number:    | CFP1630F-POD      |
| ISBN (Print-On-Demand): | 978-1-5090-5697-2 |
| ISBN (Online):          | 978-1-5090-5696-5 |

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

**PROCEEDINGS**

**12th International Conference on  
Mobile Ad-Hoc and Sensor Networks**

**— MSN 2016 —**

**16–18 December 2016  
Hefei, Anhui, China**



**Los Alamitos, California  
Washington • Tokyo**



PROCEEDINGS

# 12th International Conference on Mobile Ad-Hoc and Sensor Networks

— MSN 2016 —



IEEE computer society  
CELEBRATING 70 YEARS

科大国创软件股份有限公司  
GUOCHUANG SOFTWARE CO., LTD.

Lang 状元郎科技  
教育装备供应商

CREARO 创世

中兴继远

科大讯飞  
IFLYTEK

360  
www.360.com

中国科学技术大学  
University of Science and Technology of China

西普教育  
SIMPLEWARE

# 2016 12th International Conference on Mobile Ad-Hoc and Sensor Networks

## MSN 2016

### Table of Contents

|                                      |     |
|--------------------------------------|-----|
| Welcome Message from the Chairs..... | xii |
| Organizing Committee.....            | xiv |
| Technical Program Committee.....     | xv  |

---

#### Session 1: Best Paper Candidates

|                                                                                                      |    |
|------------------------------------------------------------------------------------------------------|----|
| The Roles of Social Network Mavens .....                                                             | 1  |
| <i>Hussah Albinali, Meng Han, Jinbao Wang, Hong Gao, and Yingshu Li</i>                              |    |
| Accurate Combined Keystrokes Detection Using Acoustic Signals .....                                  | 9  |
| <i>Jian Wang, Rukhsana Ruby, Lu Wang, and Kaishun Wu</i>                                             |    |
| Understanding the Link-Level Behaviors of a Large Scale Urban Sensor<br>Network .....                | 15 |
| <i>Jiliang Wang and Wei Dong</i>                                                                     |    |
| Leveraging Topic Model for CSI Based Human Activity Recognition .....                                | 23 |
| <i>Kun Zhao, Wei Xi, Zhiping Jiang, Zhi Wang, Hongliang Luo, Jizhong Zhao,<br/>and Xiaobin Zhang</i> |    |

#### Session 2: Wireless Sensor Networks (I)

|                                                                                                     |    |
|-----------------------------------------------------------------------------------------------------|----|
| BRR-CVR: A Collaborative Caching Strategy for Information-Centric Wireless<br>Sensor Networks ..... | 31 |
| <i>Bo Chen, Liang Liu, Zhao Zhang, Wenbo Yang, and Huadong Ma</i>                                   |    |
| Scalable Video-on-Demand Streaming for Heterogeneous Clients in Wireless<br>Network .....           | 39 |
| <i>Li Zhou, Xiaohua Tian, Xiaoying Gan, Hui Yu, and Xinbing Wang</i>                                |    |
| Data Aggregation with Principal Component Analysis in Big Data Wireless<br>Sensor Networks .....    | 45 |
| <i>Jun Li, Songtao Guo, Yuanyuan Yang, and Jing He</i>                                              |    |

|                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------|----|
| Low Delay and Interference Aware Data Gathering Scheme for Battery-Free<br>Wireless Sensor Networks ..... | 52 |
| <i>Lijing Li, Yi-Hua Zhu, Xianzhong Tian, Kaikai Chi, and Lin Xu</i>                                      |    |

### **Session 3: Wireless Sensor Networks (II)**

|                                                                                                     |    |
|-----------------------------------------------------------------------------------------------------|----|
| Revisiting Practical Energy Harvesting Wireless Sensor Network with Optimal<br>Scheduling .....     | 58 |
| <i>Xunpeng Rao, Panlong Yang, and Yubo Yan</i>                                                      |    |
| A Novel Approach for Path Plan of Mobile Chargers in Wireless Rechargeable<br>Sensor Networks ..... | 63 |
| <i>Feiyu Chen, Zhiwei Zhao, Geyong Min, and Yulei Wu</i>                                            |    |
| Cross-Layer Protocol Design for Wireless Communication in Hybrid Data<br>Center Networks .....      | 69 |
| <i>Zhenhua Han, Yupeng Li, Haisheng Tan, Rui Wang, and Yong Zhang</i>                               |    |
| An Energy-Efficient Position Transformation Approach .....                                          | 76 |
| <i>Keming Tang, Yong Xu, Hao Yang, Yue Ye, and Weipeng Lv</i>                                       |    |

### **Session 4: Resource Management and Wireless QoS Provisioning (I)**

|                                                                                                      |    |
|------------------------------------------------------------------------------------------------------|----|
| Based Point of Interest and Experience to Task Assignment<br>on Location-Based Social Networks ..... | 81 |
| <i>Shiyan Wang, Xiulan Wang, Yue Yang, and Haibin Cai</i>                                            |    |
| A New Fragmentation Strategy for Video of HTTP Live Streaming .....                                  | 86 |
| <i>Xiaorui Li, Lei Wang, Jingwu Cui, and Baoyu Zheng</i>                                             |    |
| Quality-Driven Proactive Caching of Scalable Videos over Small Cell Networks .....                   | 90 |
| <i>Zhen Tong, Yuedong Xu, Tao Yang, and Bo Hu</i>                                                    |    |
| QoS-Aware and Fair Resource Allocation with Carrier Aggregation in LTE-A<br>Networks .....           | 97 |
| <i>Peisheng Yan, Xin Chen, Zhuo Li, and Yudong Jia</i>                                               |    |

### **Session 5: Resource Management and Wireless QoS Provisioning (II)**

|                                                                                                  |     |
|--------------------------------------------------------------------------------------------------|-----|
| HD-MAC: A Throughput Enhancing TDMA-Based Protocol in High Dynamic<br>Environments .....         | 105 |
| <i>Tianyi Wang, Xiong Wang, Xiaohua Tian, and Xiaoying Gan</i>                                   |     |
| Maximizing Uniform Multicast Throughput in Multi-Channel Dense Wireless<br>Sensor Networks ..... | 110 |
| <i>Xianlong Jiao, Guirong Chen, Xiaodong Wang, Yuli Chen, and Li Yang</i>                        |     |

|                                                                                                          |     |
|----------------------------------------------------------------------------------------------------------|-----|
| Toward 5G: A Novel Sleeping Strategy for Green Distributed Base Stations<br>in Small Cell Networks ..... | 115 |
| <i>Yiwei Xu, Jin Chen, Ducheng Wu, and Wanru Xu</i>                                                      |     |
| Virtual Page Behavior Based Page Management Policy for Hybrid Main<br>Memory in Cloud Computing .....    | 120 |
| <i>Jie Huang, Xuan Zhang, Guangjie Han, Gangyong Jia, Huizi Liyou, and Jian Wan</i>                      |     |
| Adaptive Packet Length Strategy to Minimize End-to-End Latency<br>for Time-Varying Channels .....        | 125 |
| <i>Xiaoxia Chen and Jipeng Zhou</i>                                                                      |     |

## Session 6: Security and Privacy

|                                                                                                      |     |
|------------------------------------------------------------------------------------------------------|-----|
| Privacy Inference on Knowledge Graphs: Hardness and Approximation .....                              | 132 |
| <i>Jianwei Qian, Shaojie Tang, Huiqi Liu, Taeho Jung, and Xiang-Yang Li</i>                          |     |
| Dynamic Virtualization Security Service Construction Strategy for Software<br>Defined Networks ..... | 139 |
| <i>Zhenji Wang, Dan Tao, and Zhaowen Lin</i>                                                         |     |
| User-Demand-Oriented Privacy-Preservation in Video Delivering .....                                  | 145 |
| <i>Haohua Du, Taeho Jung, Xuesi Jian, Yiqing Hu, Jiahui Hou, and Xiang-Yang Li</i>                   |     |
| Privacy-Preserving Recoverable Photo Sharing in Mobile Social Network .....                          | 152 |
| <i>Huaibo Sun, Hong Luo, and Yan Sun</i>                                                             |     |
| Ensuring Semantic Validity in Privacy-Preserving Aggregate Statistics .....                          | 160 |
| <i>Junze Han, Taeho Jung, Xiang-Yang Li, and Lili Du</i>                                             |     |

## Session 7: Architecture and Applications

|                                                                                                                            |     |
|----------------------------------------------------------------------------------------------------------------------------|-----|
| Human Movement Detection and Gait Periodicity Analysis Using Channel<br>State Information .....                            | 167 |
| <i>Zijuan Liu, Lin Wang, Wenyuan Liu, and Binbin Li</i>                                                                    |     |
| Design of P2P Application Layer Protocol .....                                                                             | 175 |
| <i>Yujie Ma, Lei Wang, Jingwu Cui, and Baoyu Zheng</i>                                                                     |     |
| A Quality-Aware Attribute-Based Filtering Scheme for Participatory Sensing .....                                           | 179 |
| <i>Jianwei Chen and Dong Zhao</i>                                                                                          |     |
| Which Is the Greenest Way Home? A Lightweight Eco-Route<br>Recommendation Framework Based on Personal Driving Habits ..... | 187 |
| <i>Huihui Chen, Bin Guo, Zhiwen Yu, Alvin Chin, Jilei Tian, and Chao Chen</i>                                              |     |
| Design and Implementation of Adaptive MAC Framework for UAV Ad Hoc<br>Networks .....                                       | 195 |
| <i>Weijun Wang, Chao Dong, Hai Wang, and Anzhou Jiang</i>                                                                  |     |
| A Survey on Motion Detection Using WiFi Signals .....                                                                      | 202 |
| <i>Linlin Guo, Lei Wang, Jialin Liu, and Wei Zhou</i>                                                                      |     |

## Session 8A: Routing and Network Protocol

|                                                                                                             |     |
|-------------------------------------------------------------------------------------------------------------|-----|
| Software Defined Networking Based On-Demand Routing Protocol in Vehicle<br>Ad Hoc Networks .....            | 207 |
| <i>Baihong Dong, Weigang Wu, Zhiwei Yang, and Junjie Li</i>                                                 |     |
| Conflict-Aware Network State Updates in SDN .....                                                           | 214 |
| <i>Ningning Li, Chungang Yan, Xin Wang, and Cheng Wang</i>                                                  |     |
| Traces and t-Distribution Based Multi-Copy Routing in Delay Tolerant<br>Networks .....                      | 222 |
| <i>Ding Li, Kaoru Ota, Mianxiong Dong, and Ying Li</i>                                                      |     |
| A Node Performance and Encountering Probability-Based Adaptive Routing<br>for Delay Tolerant Networks ..... | 228 |
| <i>Fang Lu and Jianbo Li</i>                                                                                |     |
| Implementing Forward and Drop Policies for Improving PROPHET's Routing<br>Performance .....                 | 236 |
| <i>Salem Sati, Christopher Probst, and Kalman Graffi</i>                                                    |     |

## Session 9A: Smart Phone and Sensing Application

|                                                                                             |     |
|---------------------------------------------------------------------------------------------|-----|
| An Efficient Energy-Saving Approach for Smartphones .....                                   | 243 |
| <i>Zhengwei Zhu, Xiaozhu Huang, Chen Liu, Huafu Liu, Yanping Zhu,<br/>and Yongqiang Fan</i> |     |
| Infrared Optical Wireless Communication for Smart Door Locks Using<br>Smartphones .....     | 251 |
| <i>Kaustubh Dhondge, Kaushik Ayinala, Baek-Young Choi, and Sejun Song</i>                   |     |
| Look into My Eyes: Fine-Grained Detection of Face-Screen Distance<br>on Smartphones .....   | 258 |
| <i>Zhuqi Li, Weijie Chen, Zhenyi Li, and Kaigui Bian</i>                                    |     |
| Pattern-Sensitive Web Service Access for Dual-Mode Mobile Network .....                     | 266 |
| <i>Zhibin Zhao, Xintian Guan, and Lan Yao</i>                                               |     |

## Session 10: Social Networks and Recommendations

|                                                                                                    |     |
|----------------------------------------------------------------------------------------------------|-----|
| Influence Equilibrium Problem Research Based on Common Interests<br>in Mobile Social Network ..... | 271 |
| <i>Jinbao Li, Yue Han, and Jinghua Zhu</i>                                                         |     |
| Incentive Mechanism for Crowdsourced Mobile Video Offloading .....                                 | 279 |
| <i>Yufeng Zhan, Yang Liu, Yuanqing Xia, Liping Yan, Fan Li, Ning Zhou,<br/>and Hongyi Wu</i>       |     |
| Home-Based Multi-Copy Routing in Mobile Social Networks .....                                      | 284 |
| <i>Tao Jing, Yangyang Liu, Yan Huo, and Yingkun Wen</i>                                            |     |

|                                                                                             |     |
|---------------------------------------------------------------------------------------------|-----|
| Modeling Interest-Driven Data Dissemination in Online Social Networks .....                 | 290 |
| <i>Cheng Wang, Zhenzhen Zhang, Jieren Zhou, Yuan He, Jipeng Cui,<br/>and Changjun Jiang</i> |     |

## **Session 8B: Signal Processing and Pattern Recognition**

|                                                                                                                           |     |
|---------------------------------------------------------------------------------------------------------------------------|-----|
| BER-Based Comparison between AF and DF in Three-Terminal Relay<br>Cooperative Communication with BPSK Modulation .....    | 296 |
| <i>Xianru Liu and Wenhao Du</i>                                                                                           |     |
| S-Mirror: Mirroring Sensing Signals for Mobile Robots in Indoor Environments .....                                        | 301 |
| <i>Qiang Zhai, Fan Yang, Adam Champion, Chunyi Peng, Junda Zhu, Dong Xuan,<br/>Biao Chen, Yuan F. Zheng, and Wei Zhao</i> |     |
| TA3C: Teaching-Oriented Adaptive Wi-Fi Authorized Access Control Based<br>on CSI .....                                    | 306 |
| <i>Fu Xiao, Jing Chen, Xiaohui Xie, Lijuan Sun, and Ruchuan Wang</i>                                                      |     |
| Efficient Filter and Refinement for the Hadoop-Based Spatial Join .....                                                   | 313 |
| <i>Jiamin Lu, Ralf Hartmut Güting, and Jun Feng</i>                                                                       |     |
| Error Scene Restoration with Runtime Logs of Wireless Sensor Networks .....                                               | 320 |
| <i>Shuo Lian, Xiuzhen Guo, Zheng Guo, and Xu Zhao</i>                                                                     |     |

## **Session 9B: Miscellaneous**

|                                                                                                                                  |     |
|----------------------------------------------------------------------------------------------------------------------------------|-----|
| Bandwidth-Delay-Constrained Least-Cost Multimedia Broadcasting Based<br>on Heuristic Genetic Algorithm on Overlay Networks ..... | 325 |
| <i>Ting Lu, Shan Chang, and Wenjing Guo</i>                                                                                      |     |
| On Minimizing Network Coding Resource: A Modified Particle Swarm<br>Optimization Approach .....                                  | 330 |
| <i>Huanlai Xing, Fuhong Song, Zhaoyuan Wang, Tianrui Li, and Yan Yang</i>                                                        |     |
| An Optimal Controller Design for CPS with Stochastic Time Delay .....                                                            | 335 |
| <i>Leilei Lou, Xu Zhang, and Dongbin Wang</i>                                                                                    |     |
| Internet-Based Urban Bus Travelling Data Acquisition and Missing Data<br>Recovery .....                                          | 343 |
| <i>Chang-Fei Tong, Yu Xu, Jun Li, Ying-Ying Xu, and Huai-Zhong Li</i>                                                            |     |

## **Workshops**

## **Resource Management and Service Providing in the Networks of the Future World (RMSPinNet)**

### **Session 1**

|                                                              |     |
|--------------------------------------------------------------|-----|
| Graph Based Content Delivery in Mobile Social Networks ..... | 348 |
| <i>Jintian Li, Qifan Qi, Qichao Xu, and Zhou Su</i>          |     |
| The Coverage of Dynamic Area in Mobile Sensor Networks ..... | 353 |
| <i>Ying Deng, Wei Wang, and Min Li</i>                       |     |

## **Workshop on Security and Incentives in Mobile Applications (SIMA 2016)**

### **Session 1**

|                                                                                                |     |
|------------------------------------------------------------------------------------------------|-----|
| A Stable Defense Reference for Cooperative Spectrum Sensing and Its Performance Analysis ..... | 360 |
| <i>Guangming Nie, Linyuan Zhang, and Guoru Ding</i>                                            |     |
| Camera-Recognizable and Human-Invisible Labelling for Privacy Protection .....                 | 365 |
| <i>Dong Li, Danhao Guo, Weili Han, Hao Chen, Chang Cao, and Xiaoyang Sean Wang</i>             |     |
| Privacy Preserving Distance Learning with Smart Phones .....                                   | 370 |
| <i>Yu Li, Baojia Zhang, and Yue Ji</i>                                                         |     |
| Visual Secret Sharing Scheme with (k, n) Threshold Based on QR Codes .....                     | 374 |
| <i>Song Wan, Yuliang Lu, Xuehu Yan, and Lintao Liu</i>                                         |     |
| A Progressive Threshold Secret Image Sharing with Meaningful Shares for Gray-Scale Image ..... | 380 |
| <i>Lintao Liu, Yuliang Lu, Xuehu Yan, and Song Wan</i>                                         |     |

### **Session 2**

|                                                                                                          |     |
|----------------------------------------------------------------------------------------------------------|-----|
| Parallel Implementation of ECC Point Multiplication on a Homogeneous Multi-Core Microcontroller .....    | 386 |
| <i>M.S. Albahri, Mohammed Benaissa, and Zia Uddin Ahamed Khan</i>                                        |     |
| Ocean Barrier: A Floating Intrusion Detection Ocean Sensor Networks .....                                | 390 |
| <i>Hanjiang Luo, Kaishun Wu, and Feng Hong</i>                                                           |     |
| Energy Preserving Detection Model for Collaborative Black Hole Attacks in Wireless Sensor Networks ..... | 395 |
| <i>Muhammad Umar Farooq, Xingfu Wang, Robail Yasrab, and Sara Qaisar</i>                                 |     |

|                                                                                        |     |
|----------------------------------------------------------------------------------------|-----|
| Game Based Wireless Fronthaul C-RAN Baseband Function Splitting<br>and Placement ..... | 400 |
| <i>Dong Wang, Ying Wang, Sachula Meng, and Xiangyang Zhang</i>                         |     |

## Software Defined Wireless Networks (SDWN)

### Session 1

|                                                                                            |     |
|--------------------------------------------------------------------------------------------|-----|
| Adaptive Broadcast Times for Program Codes in Software Defined Wireless<br>Networks .....  | 405 |
| <i>Xiao Liu, Anfeng Liu, and Zhetao Li</i>                                                 |     |
| Coverage Hole Bypassing in Wireless Sensor Networks .....                                  | 409 |
| <i>Shaohua Wan and Yin Zhang</i>                                                           |     |
| Cross-Layer Resource Management in Software Defined Ultra Dense Wireless<br>Networks ..... | 412 |
| <i>Shichao Li, Gang Zhu, Siyu Lin, Qian Gao, and Xiaoyu Qiao</i>                           |     |
| Cross-Domain Wireless Software Defined Network Based Recommendation .....                  | 417 |
| <i>Irina Lebedeva, Fan Wu, and Guihai Chen</i>                                             |     |
| Resource Analysis for Wireless Industrial Networks .....                                   | 424 |
| <i>Changqing Xia, Xi Jin, and Peng Zeng</i>                                                |     |

### Session 2

|                                                                                               |     |
|-----------------------------------------------------------------------------------------------|-----|
| System Design of High Speed Ad Hoc Networking with Directional Antenna .....                  | 429 |
| <i>Borui Ren, Xu Zhang, and Xuerong Gou</i>                                                   |     |
| Neighbor Discovery in Wireless Network with Double-Face Phased Array<br>Radar .....           | 434 |
| <i>Ningxin Liu, Laixian Peng, Renhui Xu, Jin Zhang, Wendong Zhao, and Jun Zhu</i>             |     |
| Distributed Beamforming and BS Sleep under Small Cell Network .....                           | 440 |
| <i>Yang Qiao, Lihua Li, Zhi Wang, Hui Tian, and Xin Su</i>                                    |     |
| User Identification and Authentication Using Keystroke Dynamics<br>with Acoustic Signal ..... | 445 |
| <i>Qianqian Zhou, Yanni Yang, Feng Hong, Yuan Feng, and Zhongwen Guo</i>                      |     |
| Near Field Service Initiation via Vibration Channel .....                                     | 450 |
| <i>Zhejie Shen, Xiaojun Zheng, and Haijiang Xie</i>                                           |     |
| Author Index .....                                                                            | 454 |