Guest Editors' Introduction: Special Section on Mobile Cloud Computing

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MOBILE computing refers to the computing device being used within a non-fixed setting. The primary advantage is that it allows the devices to be employed without constraints upon mobility or time, creating a revolution on a grand scale. The cost of this increased mobility can be seen within the constrained resources of the device, such as central processing units (CPUs), memories, and others. Whilst mobile computing (e.g., smartphones and tablets) is arguably the end-user computing usage paradigm of choice, cloud computing is arguably becoming the foremost computing paradigm for service infrastructure and delivery. Being an evolutionary form of utility computing, cloud delivery models provide resources in the form of a utility. Mobile Cloud Computing (MCC) is the inevitable aggregation of the aforementioned paradigms. It is believed that through enabling this model, a number of current barriers within mobile and cloud computing could be breached, and having a positive impact upon society. However, there are several challenges faced in the area of Mobile Cloud computing, such as energy consumption, security, performance, communication, trust, to mention but few.

Therefore, this special section comes really timely for relevant research communities, and provides a valuable contribution to this emerging field. In this Special Section, nine papers have been selected. The selected papers address a variety of interesting topics covering different aspects of Mobile Cloud, such as process offloading, work sharing, performance enhancement of Mobile Clouds, security issues in Mobile Clouds, and applications of Mobile Clouds. An overview of the selected papers is given as follows.

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The first paper, "Optimal Joint Scheduling and Cloud Offloading for Mobile Applications," proposes the idea of wireless aware joint scheduling and computation offloading (JSCO) for multi-component applications. This approach takes into account the wireless parameters while making scheduling and offloading decision, leading to a scheme that is more adaptable with wireless conditions and suitable for Mobile Clouds. Significant energy consumption reduction is demonstrated in the experiments.

The second paper, "Selective Mobile Cloud Offloading to Augment Multi-Persona performance and Viability," presents a novel Mobile Cloud offloading-based approach that is capable of augmenting personas performance and viability on mobile terminals. The approach first monitors the components running in each persona using per persona profiler, and then determines their optimal execution environment using a generic and adaptable decision model formulated as multi-objective optimization problem. The results show reduction in resource usage in various aspects including CPU, memory and energy consumption.

The third paper, "Computing with Nearby Mobile Devices: A Work Sharing Algorithm for Mobile Edge-Clouds," introduces a work-sharing model called Honeybee that supports peer-to-peer (P2P) work sharing among dynamic mobile nodes. Honeybee works in an environment where external computation and storage resources are offered by other mobile devices. A programming framework for Honeybee is presented to illustrate the P2P work-sharing concept in Mobile Clouds. Efforts are also made in improving work stealing algorithm to address the bottlenecks in the transmission of large job data.

The fourth paper, "Using Crowdsourcing to Provide QoS for Mobile Cloud Computing," focuses on improving the Quality of Service (QoS) in Mobile Clouds and proposes seeking crowdsourcing approach to improve the QoS evaluation works and ultimately delivering a higher mobile user satisfaction. Crowdsourcing platform can help the system to quickly establish information from users and solve the complex cloud services discovering faster than individual. As a result, the QoS evaluation can take richer inputs and execute shorter time. The authors report reduced cloud service discovery time when crowdsourcing approach is used.

The fifth paper, "Coordinate Memory Deduplication and Partition for Improving Performance in Cloud Computing," presents a coordinated memory deduplication and partition approach for improved performance in virtualization in the

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aspect of memory usage and interference. The method adapts a lightweight page behaviour-based memory deduplication technique to reduce futile page comparison overhead and detect page sharing opportunities efficiently. Their experimental results show overall better performance in several aspects including interference reduction, memory usage and futile rate reduction without incurring much overhead.

The sixth paper, "Follow-Me Cloud: When Cloud Services Follow Mobile Users," introduces Follow-Me Cloud to offer mobile users to be always connected via the optimal data anchor and mobility gateways for improved user experience. To realize this design, it is necessary to achieve service continuity and also efficient migration to maintain services. The authors show their high-level architectural design and introduce the service migration process. Seeking Markov Decision Process, tradeoff between Cloud service migration cost and benefits in terms of user experience is studied and optimal migration policies are derived.

The seventh paper, "A Modified Hierarchical Attribute-Based Encryption Access Control method for Mobile Cloud Computing," deals with security aspect of Mobile Clouds and introduces a hierarchical access control method using modified hierarchical attribute-based encryption and a modified three-layer structure. This structure makes the design suitable for Mobile Clouds to protect the data privacy and defend unauthorized access.

The eighth paper, "Using Socio-Spatial Context in Mobile Cloud Process Offloading for Energy Conservation in Wireless Devices," proposes a social-aware cloud offloading scheme aiming to prolong the lifetime of mobile devices, while at the same time maximizes the efficiency of running energy and process intensive applications. The method allows computation intensive applications to be efficiently offloaded using a social model and communication oriented diversities so that energy on mobile devices can be conserved. Performance benefits are illustrated by emulation experimentations.

The last paper, "Energy Efficiency Using Cloud management of LTE Networks Employing Fronthaul and Virtualized Basedband Processing Pool," presents an approach to use Cloud for energy efficient operation in LTE networks. Introducing cloud management for mobile network offers better network resource management and reduces unnecessary resource consumption. The work demonstrates the use of cloud management in mobile network to improve energy efficient operation of the system. In particular, using graph-coloring model that switches off the virtual machine clusters with low traffic, the work shows significant power saving achievement.

We hope the special section brings together the state of the art in Mobile Clouds and helps the community in determining the future goals for successful integration of mobile computing and cloud computing and adoption of mobile clouds. The Guest Editors would like to thank all the authors and the reviewers for their contributions. We would also like to express our gratitude to the Editor-in-Chief and the Editorial Assistant for their support. We hope you will enjoy reading the collection of papers in this Special Section.

Chuan Heng Foh received the MSc degree from Monash University, Australia, in 1999 and the PhD degree from the University of Melbourne, Australia, in 2002. After his PhD, he spent six months as a lecturer with Monash University, in Australia. In December 2002, he joined Nanyang Technological University, Singapore as an assistant professor until 2012. He is now a senior lecturer with the University of Surrey. His research interests include protocol design and performance analysis of various computer networks including wireless local area and mesh networks, mobile ad hoc and sensor networks, Internet of Things, 5G networks, and data center networks. He has authored or co-authored more than 100 refereed papers in international journals and conferences. He actively participates in IEEE conference and workshop organization. He is currently an associate editor for the *IEEE Access*, the *IEEE Wireless Communications*, and the *International Journal of Communications Systems*. He was the former vice-chair (Europe/Africa) of IEEE Technical Committee on Green Communications and Computing (TCGCC). He is a senior member of the IEEE.

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Jinsong Wu received the PhD degree from the Department of Electrical and Computer Engineering, Queen's University at Kingston, Canada. He is currently in the Department of Electrical Engineering, Universidad de Chile, Santiago, Chile. He is elected vice-chair, technical activities, IEEE environmental engineering initiative, a pan-IEEE effort under IEEE Technical Activities Board (TAB). He was the founder and founding chair of IEEE Technical Committee on Green Communications and Computing (TCGCC). He is also the co-founder and founding vice-chair of IEEE Technical Committee on Big Data (TCBD). He received 2017 IEEE Systems Journal Best Paper Award, and he also received three 3 best paper awards for IEEE conference papers. He received IEEE Green Communications and Computing Technical Committee 2017 Excellent Services Award for Excellent Technical Leadership and Services in the Green Communications and Computing Community. He has been editorial boards on IEEE Series on Green Communication and Computing Networks in the *IEEE Communications Magazine*, the *IEEE Transactions on Green Communications and Networking*, the *IEEE Journal of Selected Areas on Communications (JSAC)* Series on Green Communications and Networking, the *IEEE Systems Journal*, the *IEEE Communications Surveys and Tutorials*, and the *IEEE Access*. He was the leading editor and co-author of the comprehensive book, entitled "Green Communications: Theoretical Fundamentals, Algorithms, and Applications", published by CRC Press, in September 2012.

Burak Kantarci received the MSc and PhD degrees in computer engineering from Istanbul Technical University, in 2005 and 2009, respectively. He is an assistant professor in the School of Electrical Engineering and Computer Science, University of Ottawa. From 2014 to 2016, he was an assistant professor in the ECE Department, Clarkson University, where he currently holds a courtesy appointment. He received the Siemens Excellence Award, in 2005 for his studies in optical burst switching. During his PhD study, he studied as a visiting scholar with the University of Ottawa, where he completed the major content of his thesis. He has co-authored more than 130 papers in established journals and conferences, and contributed to 11 book chapters. He is the co-editor of the book entitled Communication Infrastructures for Cloud Computing. He has served as the Technical Program co-chair of seven international conferences/symposia/workshops. He is an associate editor of the *IEEE Communications Surveys and Tutorials*, the *IEEE Transactions on Green Communications and Networking*, and the *IEEE Access*. He also serves as the vice-chair of the IEEE ComSoc Communication Systems Integration and Modeling Technical Committee. He is a member of the ACM and a senior member of the IEEE.

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Elhadj Benkhelifa is a professor of computer science with the Staffordshire University. He is the founding head of the Cloud Computing and Applications Research Lab and the Cybersecurity Research Lab. He was the faculty director of the Mobile Fusion Applied Research Centre (2014-2016). His research interest include cloud computing, IOT, Software Engineering, and applied soft computing. He is a member of several research committees within the university and externally. He has co-founded and chaired a number of international conferences and workshops and edited a number of conference proceedings and journals special section.

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