Mobile Cloud Computing in 5G: Emerging Trends, Issues, and Challenges


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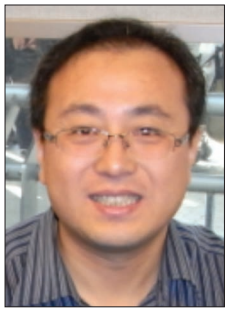
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Mobile computing, wireless networks, and cloud computing are three technologies that are converging into a rapidly growing field of Mobile Cloud Computing (MCC). With the dramatically increased capacities of the 5th generation (5G) mobile networks, MCC services are expected to witness a period of rapid development and become a new hotspot of mobile services. It is anticipated that people's work patterns and life styles in a future networked society will be dramatically changed by MCC. IBM predicts that there will be 1 trillion cloud-ready devices by 2015, and most Internet users will work primarily through cyberspace-based applications on remote servers accessed through networked devices. Through future applications enabled by 5G, MCC will have profound impacts on almost every aspect of our future digital lives.

Recently MCC based on 5G has attracted growing attention and research efforts in both academic and industry communities. An increasing demand for resource management, data storage, and mobile sensing has motivated the development of MCC architectures in 5G that focuse on mobility/network management, resource offloading, and sensing services in various MCC application domains. MCC research in 5G emerges as a key paradigm, receiving increasing attention and departing from the traditional mobile computing and cloud computing.

However, many technical challenges still remain to be addressed in the related areas, ranging from MCC architecture/5G network design, resource/mobility management, security enhancement and privacy protection, to networking protocol development and new MCC service provisioning.

The objective of this special issue, "Mobile Cloud Computing in 5G: Emerging Trends, Issues, and Challenges," is to address the technical challenges that current cloud computing or mobile computing technologies alone cannot effectively or efficiently address. The submissions received for this special issue include articles on surveys, theoretical, practical, as well as experimental studies, from both academia and industry, related to many aspects of MCC in 5G. Topics of the ten accepted papers can be classified into the following categories:

- Design and analysis of 5G networks in supporting MCC.
- 5G enabled MCC architecture design.
- Security and privacy issues in 5G MCC.
- Energy consumption in 5G MCC.

The special issue opens with the article "System Architecture and Key Technologies for 5G Heterogeneous Cloud Radio Access Networks." In this article, a heterogeneous cloud radio access network (H-CRAN) is presented as the advanced wireless access network paradigm, where cloud computing is used to fulfill the centralized large-scale cooperative processing for suppressing co-channel interferences. The authors also provide an overview of the state-of-the-art of architecture design and key technologies for H-CRANs.

In the second article, "SoftNet: A Software Defined Decentralized Mobile Network Architecture Towards 5G," a software defined decentralized mobile network architecture is proposed in 5G for an efficient and scalable network. The merits of SoftNet include dynamically defined architecture, decentralized mobility management, distributed data forwarding, and multi-RATs coordination, through which SoftNet has improved system capacity and performance of 5G.

In the third article, "Link-Level Access Cloud Architecture Design Based on SDN for 5G Networks," the authors revisit the packet core architecture of mobile networks and propose a hierarchical SDN-based design for 5G. Their goal is to provide low latency and scalable Ethernet-like support to terminals and MTC devices including mobility management. The authors examine the link-level challenges in terms of network scalability and mobility support, and propose an architecture that addresses those challenges.

The next two papers focus on MCC design and applications. The fourth article, "EMC: Emotion-Aware Mobile Cloud Computing in 5G," proposes a new class of rich user-centric mobile applications and services enabled by 5G. In this article, resource intensive affective computing with mobile applications has been integrated, while leveraging the MCC to enhance the capability of mobile devices. The goal is to provide personalized, human-centric, intelligent emotion-aware services in 5G through maximizing users' QoE while optimizing resource allocation among the mobile terminal, the local cloudlet, and the remote cloud, under dynamic network environments.

In the fifth article, "Mobile Cloud Sensing, Big Data, and 5G Network Make an Intelligent and Smart World," the authors proposed mobile cloud sensing in meeting the growing need of big data analysis. Intuitive architecture design for mobile cloud sensing, along with its limitations, have been dis-

cussed. These challenges, however, will hopefully be solved with the emergence of 5G coupled with the analysis of big data, which will help to improve our quality of life.

Security and privacy issues are discussed in the next two articles. In the sixth article, "Secure Sharing and Searching for Real-Time Video Data in Mobile Cloud," an infrastructure that allows mobile users to securely share and search for their real-time video data has been investigated. Specifically, the proposed infrastructure takes the advantages of the cloud platform and 5G technology to achieve the goal of secure cloud services, where mobile users (connected with some external video taking device) can share their real-time video with their friends or families through the 5G enabled cloud.

The seventh article, "Proof of Ownership in Deduplicated Cloud Storage with Mobile Device Efficiency," aims to minimize both the server side and user side latency in MCC. An alternative proof of ownership is proposed in addressing the problem of unauthorized file downloading in deduplicated cloud storage.

The next three papers are focused on energy consumption issues in MCC. The eighth article, "Toward Energy-Efficient Cloud Computing: Prediction, Consolidation, and Overcommitment," discusses the key challenges and opportunities for saving energy in cloud data centers. The authors conclude that significant energy savings can be achieved by turning more servers into lower power states and by increasing the utilization of the already active ones. Three different, but complementary, approaches could be used to achieve these savings: workload prediction, VM placement and workload consolidation, and resource overcommitment.

In the ninth article, "Performance Analysis of Bayesian Coalition Game-Based Energy-Aware Virtual Machine Migration in Vehicular Mobile Cloud," smooth execution of mobile cloud computing is dealt with through a proposed Bayesian coalition game as a service for intelligent context-switching (BICS) of virtual machines to support different services in the vehicular mobile cloud. As a result, both performance and energy consumption are improved. The authors have used the concepts of learning automata (LA) and game theory in which LA are assumed as the players such that each player has an individual payoff based upon the energy consumption and load on the VM.

The last article, "Green Data Centers for Cloud-Assisted Mobile Ad-Hoc Networks in 5G," investigated green data centers providing data services for cloud-assisted mobile ad-hoc networks in 5G. A practical and powerful energy saving mechanism to decrease searching and routing transactions in cloud data servers has been proposed based on the observation that transactions consume much more energy when mobile links are lost.

In closing, we sincerely thank all contributing authors and the anonymous reviewers, who allowed us to improve the quality of the special issue through their invaluable suggestions to the authors for improving the content and presentation of their articles. We believe that the research findings presented in this special issue will stimulate further research and development of mobile cloud computing in 5G.

Biographies

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