

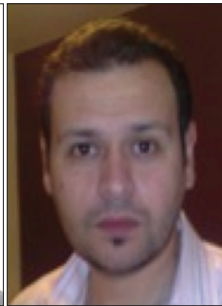
## RESEARCH AND STANDARDS: ADVANCED CLOUD AND VIRTUALIZATION TECHNIQUES FOR 5G NETWORKS (PART II)



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The evolution of mobile network architecture is an essential part in the development process of the fifth generation (5G) of cellular mobile systems, and that is through the incorporation of advanced cloud technologies and network function virtualization techniques. The new network architecture needs to support a wide range of high data rate applications and services, offering capacities of up to multiple gigabits per second, yet meeting extremely stringent latency and reliability requirements under a diverse variety of scenarios. Thus, the automation of network control and overall system management to achieve such an ambitious set of performance targets became crucial. Significant global effort for the necessary new technologies has been initiated.

Emerging paradigms, such as and not limited to, Software-Defined Networking (SDN) and Network Function Virtualization (NFV), represent a first concrete step toward this direction, catalyzing the idea of decoupling the software defined control plane from the hardware driven data plane, and thus the virtualization of network functions on general purpose hardware. There is an increasing trend toward implementing more and more functions of mobile communications systems in software, e.g. for signal and protocol processing. This will significantly influence the future development of 5G technologies and architectures. In addition to savings in both operational and capital expenditures, the introduction of logically centralized controllers enables the employment of various intelligent control algorithms. However, how to leverage the benefits of NFV in both the Radio Access Network (RAN) and the mobile Core Network (CN) is yet to be investigated fully.

The aim of this special issue is to highlight the 5G requirements and how they can be met through novel mobile network architecture designs. The special issue mainly focuses on new technologies being researched that have great potential to impact standards. Original contributions were solicited on topics of relevance to the evolution of mobile network architectures, and particularly on SDN, NFV and cloud computing.

In Part I of the special issue [1], the main reported research contributions were: Computation Offloading at Ad Hoc Cloudlet [2], Software Defined Networking (SDN): Architecture for Virtualized Wireless Access for Cellular Network Secu-

rity [3–5], 5G visions: Network Architecture, Virtual RATs and Flexible Tailored Radio Access Network, Cloud Assisted HetNets, Content Distribution over Content Centric Mobile Social Networks [6–9]. In Part II of the special issue, the following set of papers have been accepted.

In “An Effective Approach to 5G: Wireless Network Virtualization,” Feng *et al.* present a layered model of wireless network virtualization. Correspondingly, they design a hierarchical control scheme to support their proposed model. Finally, two use cases have been analyzed to show the efficiency of their schemes. Their methods might be a feasible solution to realize wireless network virtualization in 5G systems.

In order to guide the deployment strategy of virtualized mobile networks, the authors of “Cost Analysis of Initial Deployment Strategies for a Virtualized Mobile Core Network Functions” compared two constraint-based heuristic approaches for the deployment of virtualized Evolved Packet Core (vEPC) and Virtualized Network Functions Component (VNFC). Also, the impacts of these deployment strategies on the cost are analyzed.

Meanwhile, another new way to improve the efficiency of 5G networks consists in device-to-device (D2D) communications. In the third article, “Buffer-Aided Device-to-Device Communication: Opportunities and Challenges” Zhang *et al.*, propose a dynamic graph model for D2D communication underlying cellular networks. Then they analyze the system constraints to form a weighed directional graph optimization. The influence of the helper to subscriber ratio is discussed as well as the allocation of the system bandwidth to cellular and D2D communications on the achievable system performance.

In the fourth article, “Benefits and Challenges of Virtualization in 5G Radio Access Networks,” the authors present their views on the benefits, challenges, and limitations that accompany virtualization in 5G radio access networks (RANs). The implementation requirements and the cost are also analyzed. They discuss their impact on standardization such as in 3GPP.

In the last article, “XG-FAST: The 5th Generation Broadband,” experts from Alcatel-Lucent, Bell Labs give us the new picture to use the software defined networking (SDN) tech-

nique. In this article, they first discuss the role of XG-FAST in future mobile network architectures. Then, the XG-FAST system concept is introduced with the improved techniques. The measurements are performed on several short copper cables to show the effectiveness of the XG-FAST technology. Finally, they present the next step to put it into practice.

As Guest Editors, we would like to thank all the authors for their submissions to this Feature Topic. The interest and quality of submissions were beyond our imagination. We are also grateful to the reviewers for the timely responses and their valuable comments to improve the quality of the articles. We appreciate the support from both Mr. Glenn Parsons, current Editor-in-Chief of *IEEE Communications Magazine Supplement on Communications Standards*, and Dr. Osman S. Gebizlioglu, Editor-in Chief of *IEEE Communications Magazine*. We also appreciate the help of Joseph Milizzo, Jennifer Porcello, and Charis Scoggins throughout the publication process. Finally, our hope is that the readers of *IEEE Communications Magazine Supplement on Communications Standards* enjoy the articles of this Feature Topic, and would consider contributing to future editions.

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