Survey Paper

Wireless software-defined networks (W-SDNs) and network function virtualization (NFV) for 5G cellular systems: An overview and qualitative evaluation

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Abstract
Cellular network technologies have evolved to support the ever-increasing wireless data traffic, which results from the rapidly-evolving Internet and widely-adopted cloud applications over wireless networks. However, hardware-based designs, which rely on closed and inflexible architectures of current cellular systems, make a typical 10-year cycle for a new generation of wireless networks to be standardized and deployed. To overcome this limitation, the concept of software-defined networking (SDN) has been proposed to efficiently create centralized network abstraction with the provisioning of programmability over the entire network. Moreover, the complementary concept of network function virtualization (NFV) has been further proposed to effectively separate the abstraction of functionalities from the hardware by decoupling the data forwarding plane from the control plane. These two concepts provide cellular networks with the needed flexibility to evolve and adapt according to the ever-changing network context and introduce wireless software-defined networks (W-SDNs) for 5G cellular systems. Thus, there is an urgent need to study the fundamental architectural principles underlying a new generation of software-defined cellular network as well as the enabling technologies that supports and manages such emerging architecture. In this paper, first, the state-of-the-art W-SDNs solutions along with their associated NFV techniques are surveyed. Then, the key differences among these W-SDN solutions as well as their limitations are highlighted. To counter those limitations, SoftAir, a new SDN architecture for 5G cellular systems, is introduced.

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1. Introduction

Existing commercial wireless networks are inherently hardware-based and rely on closed and inflexible architectural designs. Such inflexible hardware-based architectures typically lead to a 10-year cycle for a new generation of wireless networks to be standardized and deployed, impose significant challenges into adopting new wireless networking technologies to maximize the network capacity and coverage, and prevent the provision of truly-differentiated services able to adapt to increasingly growing, uneven, and highly variable traffic patterns. In particular, for 5G cellular system requirements, the ultra high capacity should have 1000-fold capacity/km² compared to LTE, the user-plane latency should be less than 1ms over the radio access network (RAN), and...