# Cross-Layer Software-Defined 5G Network

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**Abstract** In the past few decades, the world has witnessed
a rapid growth in mobile communication and reaped great
benefits from it. Even though the fourth generation (4G)
mobile communication system is just being deployed world-
wide, proliferating mobile demands call for newer wireless
communication technologies with even better performance.
Consequently, the fifth generation (5G) system is already
emerging in the research field. However, simply evolving
the current mobile networks can hardly meet such great
expectations, because over the years the infrastructures
have generally become ossified, closed, and vertically con-
structed. Aiming to establish a new paradigm for 5G mobile
networks, in this article, we propose a cross-layer software-
defined 5G network architecture. By jointly considering
both the network layer and the physical layer together, we
establish the two software-defined programmable compo-
nents, the control plane and the cloud computing pool,
which enable an effective control of the mobile network
from the global perspective and benefit technological inno-
vations. Specifically, by the cross-layer design for software-
defining, the logically centralized and programmable con-
trol plane abstracts the control functions from the network
layer down to the physical layer, through which we achieve
the fine-grained controlling of mobile network, while the
cloud computing pool provides powerful computing capa-
bility to implement the baseband data processing of multiple
heterogeneous networks. The flexible programmability fea-
ture of our architecture makes it convenient to deploy cross-
layer technological innovations and benefits the network
evolution. We discuss the main challenges of our architec-
ture, including the fine-grained control strategies, network
virtualization, and programmability. The architecture signif-
icantly benefits the convergence towards heterogeneous net-
works and enables much more controllable, programmable
and evolvable mobile networks. Simulations validate these
performance advantages.

**Keywords** Software defined network · Network
virtualization · Network Architecture · 5G

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## 1 Introduction

With the rapid growth of mobile demands and the ever-
increasing use of smart phones, mobile network has been
one of the fastest growing technologies that impact major
aspects of our life [1]. In recent years, 4G mobile commu-
nication system is being deployed worldwide, leading to a
rapid growth in the mobile network capacity, which further