Abstract

The evolution of Beyond 5G (B5G) networks is set to transform connectivity by supporting applications like extended reality, HD video streaming, smart healthcare, and industrial Internet of Things (IoT). These applications demand diverse Quality of Service (QoS) parameters such as data rate, latency, and reliability. Network slicing, enabled by virtualization and Software Defined Networking (SDN) techniques, addresses these requirements. However, the growing diversity in applications, devices, and access technologies poses significant challenges for Network Service Providers (NSPs), compounded by dynamic wireless channel conditions, fluctuating traffic patterns, and limited communication resources.

This thesis tackles key challenges faced by NSPs in efficiently allocating resources for diverse service requests, with several innovative contributions:

The first contribution is the Efficient Network Selection and Resource Allocation (E-NSRA) scheme, a low-complexity solution designed to improve the Quality of Experience (QoE) in urban environments. It focuses on mitigating frequent outages in mmWave-based small cells overlaid on macro cells. E-NSRA is particularly effective in dense network environments, meeting data rate demands for applications like SHVC video streaming.

The second contribution introduces the Sigmoid Envelop Modeling Approach (SEMA), which addresses limitations in current resource allocation strategies under dynamic channel conditions. SEMA models the maximum achievable throughput across varying channel conditions, enabling the efficient use of limited spectrum resources and providing optimal solutions in dense network scenarios.

Next, the Priority Aware Resource Sharing (PARS) scheme is presented for resource allocation in slice-based services with specific QoS requirements in edge networks. This heuristic method aims to maximize user admission in resourceconstrained environments, prioritizing delay-sensitive users, such as those in healthcare, while ensuring that all users' rate and latency needs are met.

Finally, the thesis explores the dynamism between network resource states and the types of slice requests admitted to the network. It proposes a multistage resource allocation scheme for dynamic admission control using reinforcement learning. This approach allows the system to learn and prioritize slice requests effectively, improving user admission and QoE in multi-edge network scenarios.

By integrating these solutions, the thesis aims to optimize resource allocation and user admission in B5G networks, addressing the critical challenges of next-generation applications.

Keywords: Beyond 5G networks, Mobile Edge Computing, Network Slicing, Quality of Service, Reinforcement Learning, Resource Allocation, User Admission, Virtual Network Functions.