Ph.D. in Information Technology: Thesis Defense

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Optimization Framework for Resource Management of Mobile Edge Computing Networks

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Abstract:

In the 5G and beyond mobile networks, Mobile Edge Computing (MEC) brings cloud-computing capabilities to the edge of the mobile networks, especially in close proximity to mobile users, making it possible to simultaneously address the stringent latency requirements of critical services and ensure efficient network operation and service delivery.

However, MEC services, on one hand, require significant investments from both network operators and service providers in terms of deploying, operating and managing edge clouds, and on the other hand, provide limited computational and storage resources by design. Besides, due to the large amount of tasks from users with high demands during peak hours, the latency requirements of different services can hardly be guaranteed. This issue can be tackled by massively deployed edge clouds that are attached to the base stations and connected to each other in a specific topology, as ultra-dense 5G-and-Beyond networks are built.

In this thesis, we leverage cooperation among interconnected multiple MEC units and investigate joint resource optimization considering multiple aspects of network operations, with the target of enhancing the utilization efficiency of resources to further satisfy improved QoS and reduce network operation cost. Specifically, aggregated mobile traffic and user requests are considered based on their types (e.g., video, web, game, etc.) associated with different QoS requirements. We jointly optimize 1) where to process the traffic and requests, 2) how to route network flows and 3) how to allocate and schedule the required resources w.r.t. communication, computation and storage. We formulate these problems into multiple mathematical models and propose both centralized and decentralized approaches to tackle them efficiently. We evaluate the performance in real-size network scenarios including both random geometric graphs and a realistic mobile network topology,

showing the impact of the considered parameters (e.g., tolerable latency, network topology and bandwidth, computation, storage, etc.) on both the optimal and approximate solutions.

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