Commentary

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Evolution of Fifth-Generation (5G) Cellular Networks

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Description

With the rapid advancement in wireless communication technology, almost the entire world depends on mobile devices for communication and accessing various services, including some computationally intensive and bandwidth-consuming multimedia services. However, due to the enormous computation demands of mobile multimedia applications and services from mobile users, the current network faces some difficulty. In recent years, the evolution of fifth-generation (5G) cellular networks is becoming one of the significant drivers in providing mobile users higher capacity and high Quality of Service (QoS) to run computationally intensive mobile multimedia applications. 5G provides lucrative features such as 10 Gbps data rate, 1 ms latency, up to 100x number of device connection than 4G, higher mobility range, 90% energy reduction, and higher network capacity. Moreover, technologies like Network Function Virtualization (NFV) improves the functionalities of 5G network architecture using virtualization, which helps the user to separate the network functions of a mobile application from the hardware and executes these functions on the cloud rather than on specified hardware devices.

5G Providing Real-Time Mobile Multimedia Services

Furthermore, in recent years, AI has made a significant contribution to developing the architecture of the 5G edge network. 5G is gaining popularity for providing real-time mobile multimedia services like augmented reality, online video gaming, self-driving car, video conferencing, telesurgery, and Tactile Internet applications. Executing applications on distant clouds require higher latency and suffer from getting real-time services. Thus, leveraging cloud infrastructure to mobile edge network results in Mobile Edge Cloud (MEC), which minimizes the total response time significantly and operates time-sensitive multimedia applications successfully in a 5G network system compared to the distant cloud. A typical 5G edge network consists of several Edge Nodes (ENs). When a mobile user moves from any source to the destination location, it connects to different ENs along the path, which requires the migration of its multimedia service instances among the ENs. A key challenge in such cases is to ensure Quality-of-Experience (QoE) of the user. Users can take services from the previous EN where his/her multimedia service instance is running or migrating the service instance from the previous EN to the current one. The first case increases the communication delay. The second case increments the migration time as well as response time, which also drastically degrades user QoE.

Investigating the Problem of Path Oriented Proactive Placement of Multimedia Service

Real-time multimedia applications like video conferencing, Internet telephone, interactive video gaming require interactivity between the end-users and tolerate less than 1 s delay. Thus, to ensure faster response time and higher QoE for each user's multimedia applications, replication of the service instance mechanism, and faster migration technique should be adopted. We investigate the problem of Path Oriented Proactive Placement of multimedia service instances, namely POPP, aiming to make a trade-off between user QoE and deployment cost. The former parameter is defined as the number of proactive instances in which the nodes have a higher handover probability by leveraging accurate path prediction models. The latter is defined as the resource cost incurred by the service instances during its deployment period. This paper introduced a framework for optimal placement of service replicas proactively in the 5G edge network. To achieve higher QoE of the users, we deployed the multimedia service instances on the trajectory ENs by integrating the user's path prediction model. Deployment cost was also increased for achieving higher QoE. Therefore, this work provided an optimal deployment technique that traded-off between maximizing the QoE and minimizing the deployment cost.