Recent Study of UAV-enabled MEC System in Vehicular Network

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***Abstract*— UAV-enabled MEC servers in vehicle networks are emerging as promising technologies for handling computational-intensive and latency-sensitive tasks in environments where computing resource of ground infrastructure is limited or where tasks to be processed are temporarily increasing. This system, which is users' movement is dynamic and battery capacity of UAV is limited, requires an efficient load balancing technology in consideration of the battery state of the UAV server. Therefore, we first look at recent trends in load balancing techniques for UAV-enabled MEC systems in vehicle networks, and then discuss the outstanding problem of load balancing techniques.**

Keywords—mobile edge computing, unmanned aerial vehicle, load balancing

I. Introduction

With the development of the Internet of Things, it has become an important issue to process computationally intensive and latency-sensitive tasks. In addition, in vehicle environments where user mobility is highly dynamic, the efficient allocation of limited computing resources is one of important issues in determining system performance. To solve this problem, research on a mobile edge server which is geographically close to users is being conducted. However, a new technology is needed to effectively respond to the temporarily increasing request for task processing, such as commuting time. Recently, research has been conducted to provide more computing resources on the system by deploying additional UAV(Unmanned Aerial Vehicle)-enabled MEC (Mobile Edge Computing) servers[1]. In this environment, a load imbalance among servers may occur due to vehicle movement and the limited battery capacity of UAV. Thus efficient load balancing algorithm is needed in consideration of dynamic mobility of vehicles and limited battery capacity of the UAV. In this paper, we present the recent trend of load balancing technology for UAV-enabled MEC systems in vehicular network and discuss future research directions.

II. Recent Trend of Load Balancing Technology for UAV-enabled MEC Systems in Vehicular Network

In this section, we aim to look at the key techniques for load balancing in UAV-enabled MEC system in vehicular network that have recently been studied.

A. Task Offloading Algorithms

The first step of load balancing is to determine whether to offload considering the load state of the MEC server(MECS). At this time, considering the UAV's limitation that its battery capacity is limited, an offload is determined by reflecting the UAV's energy state as well as the load state. In [1] the greedy heuristic based dynamic scheduling framework is proposed to minimize the total time delay and the energy consumption. In [2], it has been proposed of the offloading strategy based on DRL(Deep Reinforcement Learning) algorithm to achieve the load balance and minimization of delay and energy consumption. However, if only offloading is considered in an environment where user mobility exists, the problem of not being able to receive the completed task if the vehicle leaves the scope of the MEC that offloaded the task.

B. Task Migration Algorithms

Research is being conducted on a technique for migrating tasks between MECs to solve the problem of not being able to receive completed tasks when the vehicle is outside the scope of the MEC where the task was offloaded. When the migration is performed, the time and energy required for communication are consumed more than when only offloading is performed. Therefore, algorithms that can minimize latency and energy due to migration are needed. Therefore, research has recently been conducted with consideration of the energy of UAVs, throughput, and delay time[3][4].

C. UAV Trajectory Planning Algorithms

The determination of the moving path and location of UAVs is emerging as an important problem for the UAV-enabled MEC system. Considering the movement and flight energy of UAVs, UAVs should fly in the most efficient path and be placed in the most suitable position to achieve load balancing. In [5], it has proposed that a DRL-based energy-efficient strategy to obtain optimal UAV flight trajectories and optimal hovering locations based on traffic situation recognition.

III. Future Research Directions and Discussions

In this paper, we have presented the recent trend of load balancing technologies for the UAV-enabled MEC system in vehicular network. For more realistic and efficient load balancing, in-depth research on the technology that combines all three aforementioned technologies is needed. In a highly dynamic environment where both users and MECSs have mobility, it is very important to select an appropriate load balancing technique considering each other's location. Thus, further research is needed on a technique that minimizes UAV energy and task latency by predicting task occurrence and vehicle movement path. We hope that this paper will accelerate the research activities of load balancing techniques for UAV-enabled MEC system in vehicular network.

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