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Availability-aware Service Function Chain Placement in Mobile Edge Computing

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***Abstract*—Mobile Edge Computing (MEC) is an emerging network architecture that provides computing capabilities at the edge of the mobile network. Recent approaches tend to deploy MEC applications in the Network Function Virtualization (NFV) network. In the MEC-NFV environment, mobile network services are deployed as service chains, also known as Service Function Chains (SFCs). In this paper, we focus on the SFC placement problem in the MEC-NFV environment while guaranteeing availability. We design a backup model to improve SFC availability. Besides, we propose a Dynamic Programming (DP)-based algorithm to place SFC. Evaluation results show that our proposed solutions outperform the existing approaches in terms of availability guarantee and resource optimization.**

***Keywords*-Network service; Availability; Service function chain; Placement; Mobile edge computing**

I. Introduction

Mobile Edge Computing (MEC) [1] and Network Function Virtualization (NFV) [2] are two emerging technologies, which are important to 5G and IoT environments. MEC is an emerging network technology that can push computing capabilities and network control to the edge of the mobile network. As figure 1 shows, the three-layer MEC architecture consists of the core layer, edge layer, and user layer.

NFV is an emerging technology that decouples network functions from expensive and dedicated hardware. The network functions in NFV are implemented as software-based entities, also known as Virtualized Network Functions (VNFs). By providing flexible management of VNFs, NFV effectively reduces the CAPital EXpenditure (CAPEX) and OPerating EXpense (OPEX) [3].

Traditionally, VNFs are deployed in virtual machines in the cloud data center. Recent studies combine MEC and NFV to provide low-latency network applications with limited resources at the edge devices. In the MEC-NFV environment, mobile network services are described as Service Function Chains (SFCs), which contains an ordered set of VNFs.

As Figure 1 shows, we describe the SFC placement problem in the MEC-NFV environment. We present an SFC consisting of three VNFs running on the edge servers. In this paper, we place the SFC on the servers in the edge layer. Different from the traditional SFC placement in the cloud data center, mobile network services running on the resource-limited edge devices are computation critical and latency-sensitive. Besides, the mobile network services in the telecom network need to meet higher availability requirements than traditional IT services. Therefore, the availability-aware SFC placement problem in the MEC network becomes a critical but difficult research issue. To efficiently solve the placement problem, most existing approaches propose heuristic algorithms. However, there are still some problems needed to be solved:

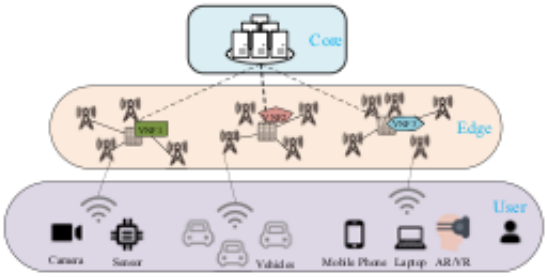

Figure 1. SFC Placement in the MEC-NFV environment.

- Most of the previous approaches often consider VNFs failures ignoring physical nodes failures. However, the failures of a physical node can also lead to the unavailability of VNFs running in this physical node [4]. Thus, we take both VNF failures and physical nodes failures into account.
- Most of the existing solutions provide backup for working VNFs to improve SFC availability in data center networks. However, providing backups will result in increased resource consumption [5]. In MEC networks, SFC runs in a resource-limited edge network. The resource optimization is an important problem.
- Both in data center networks and MEC networks, most of the existing approaches propose heuristic algorithms. However, the heuristic algorithm requires a long execution time and finds a near-optimal result. For delay-sensitive MEC networks, too long execution time is unacceptable.

Given these facts, we define a backup model to improve SFC availability while reducing resource consumption. And we propose a Dynamic Programming (DP)-based algorithm to solve the SFC placement problem in the MEC-NFV environment.

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