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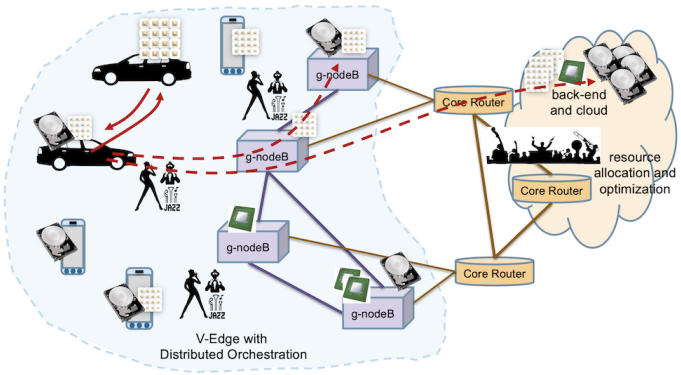
Master Thesis

Optimal task allocation in vehicular environments for virtualized edge computing

Abstract

Mobile edge computing refers to the idea to offload tasks from end devices to servers at the "edge of the network", usually assumed to be co-located with 5G base stations. Given the very limited deployment of such 5G edge servers, the idea of virtualized edge computing was introduced [1]. In short, the concept allows to use end systems temporarily as servers, e.g., automated cars that have significant CPU and GPU capacities.



Optimizing task offloading in such a scenario poses a resource allocation problem where users and their generated tasks are dynamic as well as the servers processing these tasks. In previous work, we looked at sub-problems such as data management in such dynamic edge systems and the co-called dwell time, i.e., the time a car is actually available while driving through the edge location [2].

Content

The objective of this project is to study the resource allocation problem using an optimization approach. By formulating it as a Markov decision process, we can find optimal allocation of tasks to the dynamic edge servers. Given the inherent dynamics of the system (mobility, task generation), we will eventually have to find heuristics to find a solution. Conceptually, the approach by Knorn at el. [3] can be used as a starting point.

This thesis is in collaboration with Prof. Knorn (Control, Fak. III).

Requirements

It will be helpful to have a basic understanding of *Telecommunication Networks*, *Network Simulation*, and *C++ or Python*. In case you are not familiar with these requirements, you will need to familiarize yourself during the thesis.

References

1. Falko Dressler, Carla Fabiana Chiasserini, Frank H. P. Fitzek, Holger Karl, Renato Lo Cigno, Antonio Capone, Claudio Ettore Casetti, Francesco Malandrino, Vincenzo Mancuso, Florian Klingler and Gianluca A. Rizzo, "V-Edge: Virtual Edge Computing as an Enabler for Novel Microservices and Cooperative Computing," IEEE Network, vol. 36 (3), pp. 24–31, May 2022.
2. Gurjashan Singh Pannu, Seyhan Ucar, Takamasa Higuchi, Onur Altintas and Falko Dressler, "Dwell Time Estimation at Intersections for Improved Vehicular Micro Cloud Operations," Elsevier Ad Hoc Networks, vol. 122, pp. 102606, November 2021.
3. Steffi Knorn, Subhrakanti Dey, Anders Dahlen and Daniel E. Quevedo, "Optimal Energy Allocation in Multisensor Estimation Over Wireless Channels Using Energy Harvesting and Sharing," IEEE Transactions on Automatic Control, vol. 64 (10), pp. 4337–4344, October 2019.

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