An Optimization of Computational Resources Allocation for Multi-MEC and Cloud Networks

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Abstract

Mobile edge computing (MEC) technology has been studied for several years[1] and is still attracting more attentions. The optimization of MEC with cloud computing targets on improving efficiency of resources. In this work we consider a practical MEC application case in mobile video surveillance and analytics. By investigating some real application systems and using a simple model to analyze an optimization issue, we obtained some numerical results using MATLAB. The results shows that it is possible to improve the system performance in terms of energy saving and efficiency improving by balancing the workload between MEC and the cloud.

Introduction

This work is part of my technology study project required by our high school education program. I chose a topic related to mobile communication as I noticed many mobile applications coming out day by day around me. After reading some papers under supervisor's guidance, I started to focus on this mobile edge computing (MEC) area as an easy entry and tried to address optimization issue because of my strong interest in math. My goal is to learn how to solve practical problems by using whatever I learnt.

Background

It has been studied that an optimization of MEC with cloud computing can satisfy not only enough computing power to end-user applications but also with low latency[2]. We started from a simple practical model as shown in Fig.1, where the edge node (EDGE) is an AI chip enabled device handling multiple number of video cameras, and transmitting/receiving video streams and signals to a 4G or 5G base station (BS), and then the BS is communicating with the cloud center via optical fiber.

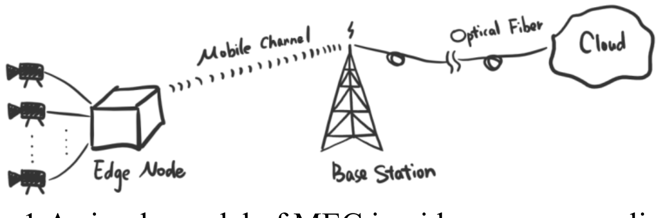

Fig. 1 A simple model of MEC in video camera application

The EDGE device provides multi-functions including decoding of compressed video streams from multiple cameras, abstracting features of images, classifying, recognizing, target identifying, and many other intelligent analytics and executions etc. On the other hand, if we offload some functions to the cloud center where the computing capability is much stronger, the number of streams, that is, the number of cameras handled, can be increased, and the overall latency could also be improved. This is our expected value of balancing MEC and cloud computing.

Process

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As an entry stage, we have only done the initial part of the project. Based on our investigation on some real mobile video surveillance systems used for public traffic or public security, we set up a simple system model using some real system parameters, and tried an optimization method to analyze the quantitate relations amongst the overall system processing delay, the MEC/Cloud offload ratio, and the communication channel signal-noise ratio (SNR). We obtained some numerical results using MATLAB. Due to the page limitation of this short description, we leave out those math analysis to our poster and only give the numerical results here in Fig. 2 and Fig.3.

Results

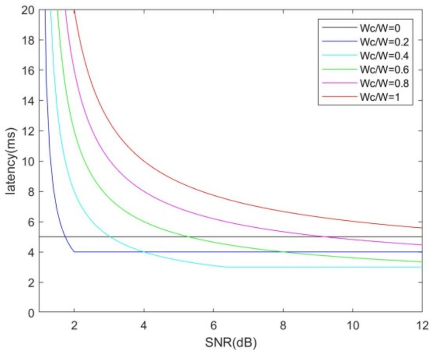

Fig. 2 Overall Latency vs SNR

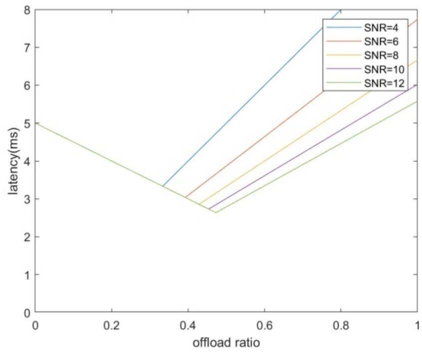

Fig. 3 Overall Latency vs Offload Ratio

From Fig. 2 we found that for different offload ratio Wc/W, there is a point at which the latency reaches its floor, and thereafter, increasing SNR value is meaningless. While when SNR is small, comparing the different lines in Fig. 2, the maximum latency decreases as the offload ratio increases, but it requires much bigger SNR to reach the floor point. Overall, to ensure a given latency, say smaller than 5ms in this case, offloading more computations up to the cloud center requires less signal-noise value, and thus consumes less energy.

According to Fig. 3, there is an inflection point for each line that represents the minimum overall latency for each given SNR. This implies that we can design and reach different maximum affordable number of streams for EDGE node in a given situations, to make the full use of resources.

Future work

As our project is still on a theoretical level, we plan to verify the results on real application situations. Also, we plan to study more about both the MEC and the optimization algorithms by considering more factors and resources in different conditions.

References

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[2] S. Sardellitti, G. Scutari, and S. Barbarossa, “Joint optimization of radio and computational resources for multicell mobile-edge computing”, IEEE Transactions on Signal and Information Processing over Networks, vol. 1, no. 2, pp. 89 – 103, June 2015.

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