# Time-Optimized Task Offloading Decision Making in Mobile Edge Computing

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Computation offloading in Mobile Edge Computing (MEC) environment faces several challenges. The most significant one is the decision of when (what time should the user offload) and where (which MEC server) to offload data to perform a computing task while the user is on the move. The decision making of tasks/data offloading is of high importance as it is expected to directly affect the Quality of Service (QoS) of the user application including the inherent latency due to the current MEC server load and the transmission /communication status between the mobile node and the MEC server.

We consider mobile nodes who desire to offload data to an edge server, and there are many deployed MEC servers in the user path as considered in [1]. The deployed MEC servers are sequentially observed as candidates and the mobile node has to decide which server is the best in terms of total delay[1] to offload the tasks/data.

We are challenged to determine the best offloading strategy that minimizes the expected total delay. We abstract this problem into the context of sequential decision making whether to offload the tasks/data to the currently available MEC server or not. The deal with the above-mentioned strategy, we rely on the Optimal Stopping Theory (OST) to determine an *optimal offloading rule* for the mobile node.

In our context, let X be the total delay of a MEC server, we attempt to find the t-th MEC server that minimizes the expected delay by observing them sequentially, that is, the mobile node offloads tasks at the first t*-th MEC server such that the following infimum is attained:

$$\operatorname{ess}\inf_{t} \mathbb{E}[X_t] \qquad (1)$$

Hence, our expected minimum delay is $\mathbb{E}[X_t]$ with $t = \inf\{t : X_t < \mathbb{E}[X_{t+1}]\}$

In this work, we extend our previous model [3] (to be presented in the Wireless Days 2019 Conference in Manchester, UK) and evaluate the proposed model in a competitive setting where many users try to offload to the same server at the same time in terms of the average waiting ratio. Moreover, we compared the OST-based offloading model, i.e. the HS presented in [3], with two task offloading decision making models: (1) the Random selection model and (2) the $p$-model, for different probability values $p$. In the Random model, we randomly selected a server to offload the data/task to it for each user, while in the $p$-model, for each MEC server, we assigned a probability of offloading $p \in \{0.1, 0.3, 0.5, 0.8\}$.

We compared the results from all models, OST based models, Random, and $p$-model with respect to the ground truth, that is to the Optimal model, where, for each user, we select the server with the minimum total delay. The closer a model is to the optimal, the better the model performs in terms of the task/data offloading decision making. We run all previous models on a real data set [4] to evaluate our OST-based offloading models.

A summary of results is shown in Fig. 1. We can see that the average total delay of the HS is the closest one to the optimal. Also, the average waiting ratio of the HS is the closest one to the optimal. In the p-model with $p = 0.8$, the mobile node tends to offload at the first encountered MEC server. This kind of decision has the highest total delay and the highest average waiting ratio.

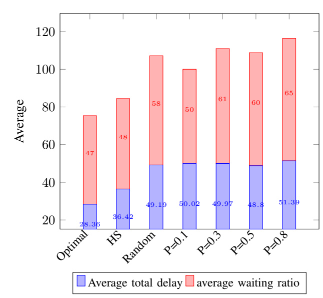


Fig. 1: Average total delay and average waiting ratio of all models

[1]Total delay includes transmission time, processing time at the MEC server and time to receive the data from MEC server to the mobile node [2].

## References

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