

I. IDENTIFICATION DATA

Thesis title:	Offloading computing tasks to multi-access edge computing via multiple relaying nodes
Author's name:	Arman Džubur, BSc
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Telecommunication Engineering
Thesis reviewer:	Ing. Jan Plachý, Ph.D.
Reviewer's department:	T-Labs, Deutsche Telekom AG

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	ordinarily challenging
<i>How demanding was the assigned project?</i>	
The assignment is ordinarily challenging, as the student had to study computation offloading and propose a simple algorithm for selecting jointly relaying nodes to minimize the overall energy consumption of the offloading device and the potential relays while guaranteeing the maximum processing delay. This requires studying the state of the art, design of a simple algorithm and evaluation via simulations. These are common tasks in master theses.	

Fulfilment of assignment	fulfilled with minor objections
<i>How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.</i>	
The task has been fulfilled with minor objections, as the constraint of maximum processing delay is often not met, when the relaying is utilized. The relaying concept should be able to satisfy the maximum processing delay even in cases, when direct communication cannot achieve this. This is caused by the way the communication bandwidth and maximum processing delay are split between communicating devices.	

Methodology	correct
<i>Comment on the correctness of the approach and/or the solution methods.</i>	
The approach of solving the problem at hand is correct.	

Technical level	C - good.
<i>Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?</i>	
The technical level is good with some minor issues. One of them is the derivation of transmission power, where in Eq. 4.30 the student has inverted $g_{m,b}$ and $g_{n,m}$. In Simulation results, the first scenario is the optimal one that shows the upper bound of the relaying. However, in the second one, it is not clear how are the devices placed and what are inter-device distances.	

Formal and language level, scope of thesis	C - good.
<i>Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?</i>	
The formalisms and notations are used properly. Nevertheless, on multiple occasions defined symbols are not described, such as below Eq. 2.1 $p_{n,b}$ where b is not explained. Throughout the thesis there are several grammar typos and issues. To name a few: on page 2 "One of the main drawbacks of multi-relay offloading is the optimal algorithm to find the most suitable relays for the offloading...", or in page 4 below Eq. 2.1 "... and I_b is the background interface from the UEs located in the adjacent cells". Overall the language level is good and the thesis is understandable.	

Selection of sources, citation correctness	C - good.
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Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

The selection of sources is correct, but at some places it would be good to add additional references. Moreover, there are couple of statements without supporting reference, such as on page 2 "Sometimes, relays can be an expensive part of the network for mobile operators." Another, statement is on page 3 "Additionally, the majority of these papers only consider offloading using half duplex (HD) [7], [9], [11] while the advantages provided by the full duplex (FD) are not analyzed as of yet.", however, such works already exist, e.g., Z. Wen, K. Yang, X. Liu, S. Li and J. Zou, "Joint Offloading and Computing Design in Wireless Powered Mobile-Edge Computing Systems With Full-Duplex Relaying," in IEEE Access, vol. 6, pp. 72786-72795, 2018, doi: 10.1109/ACCESS.2018.2879334. or Xu, Z., Lv, Y., Liu, J., Zou, J., Wen, Z.: Joint offloading and beamforming design in full-duplex multi-hop SWIPT MEC systems under non-linear energy harvesting model. IET Commun. 16, 2171–2182 (2022). <https://doi.org/10.1049/cmu2.12470>.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

Overall, this is good thesis, but it would greatly benefit from a bit of additional work. The proposed solution could be improved to avoid high complexity, while the bandwidth and offloading time constraint could be divided in more suitable fashion to show the benefits of the relaying. Then, we should see that the multi-relay offloading enables offloading time is within the time constraint.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

As stated before, the thesis itself is good, but could be easily improved to overcome its current limitations to show the true performance of the multi-relay offloading.

Questions:

1. In the Future work the student mentioned machine learning that could be applied to the given problem. How would you do this?
2. How would you decrease the computation complexity of the proposed solution?
3. How would you integrate the proposed solution and multi-relay offloading into the mobile network?

The grade that I award for the thesis is **C - good**.

Date: **5.6.2023**

Signature: