THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Bluetooth Low Energy Positioning on FPGA**
Author's name:	**Jan Kreisinger**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Microelectronics
Thesis reviewer:	Ing. Tomáš Dresler
Reviewer's department:	STMicroelectronics Design and Application s.r.o.

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **ordinarily challenging**

How demanding was the assigned project?

The project assignment required the author to understand the FPGA design, programming and validation and the Bluetooth Low Energy protocol. Further, the author had to master the data processing algorithms in the Matlab environment and decide for the right method of evaluation of the device positioning.

Fulfilment of assignment **fulfilled**

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.

All tasks prescribed in the thesis objectives were fulfilled. Required adaptations of existing solution were implemented (enhancement of the Celeste project), the BER measurements were made on different channels and combined, BLE protocol well explained and the design adapted for better signal quality reception.

Methodology **correct**

Comment on the correctness of the approach and/or the solution methods.

The step-by-step and iterative approach (re-tuning I/Q sampling part based on sampling theorem) brought improvements in the signal reception quality. Design mistakes were found and corrected (flagging insufficiently filled buffers, keeping FIFOs empty before measurement). Data-based decision on measurement methodology (how to choose beacons depending on their strength, which BLE channel(s) to use for reception and RSSI calculation) was made on measured data. Matlab environment for data analysis (fit) and collection (Python) count as modern methods for such task.

Technical level **A - excellent.**

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?

The thesis shows author's excellent knowledge of the topics, counting BLE, synthesis of programmable logic arrays and data processing. The work is described in logical steps and the thesis explains the whole process and reasoning.

Formal and language level, scope of thesis **A - excellent.**

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?

The thesis is organized in logical blocks, well structured and presented. The grammar and style are clear of mistakes and very well understandable. The work has adequate length, all required parts clearly explained.

Selection of sources, citation correctness	**A - excellent.**
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 thesis refers to previous sources (esp. because it is based on them) often and is clearly distinguished from them, so the reader recognizes original addendum to the previous work. The literature referred in the text is well formatted and the list of the sources is comprehensive and listed according to the citation criteria.	

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.
The thesis enhances previous works and adds the means and methods for indoor position estimation using BLE beacons using dedicated device, with interest in low power implementation. Other carriers (Wi-Fi) and devices (mobile phones) were shortly discussed and found unsatisfactory. Commercial solutions were compared and found in the same precision category.

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.

Although the thesis' topic is not directly my expertise, I found very interesting the way of decoding and evaluation of the correctness of received BLE packets within the FPGA in the form of isolated peripheral and its further processing in the Soft Core. As a microcontroller expert, I'd like to place following questions to the author:

a) What is the consumption of the FPGA solution in Stand-by and active calculation modes and estimated battery lifetime?
b) Did author consider the process of adaptation to new rooms or areas?
c) Is there a plan for standalone operation or is there a need for continuous PC-Matlab connection?
d) Are there any other working MCU-based solutions for positioning, i.e. from nRF, Microchip, STM known to the author?

The grade that I award for the thesis is **A - excellent.**

Date: **24.8.2020** Signature: