

I. IDENTIFICATION DATA

Thesis title:	CAN FD Support for Space Grade Real-Time RTEMS Executive
Author's name:	Bc. Michal Lenc
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering
Thesis reviewer:	Ing. Pavel Píša, Ph.D.
Reviewer's department:	Department of Control Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
The design of new communication subsystem for real-time system used in critical military and space application for more than 30 years is demanding and requires precise analysis and high quality implementation to fulfill review criteria to be candidate for mainlining. CAN/CAN FD is gaining momentum in space/satellite/probes/rovers applications and RTEMS has been missing general solution. The project implements generic infrastructure with POSIX API, support for multiple applications to open the driver as well as actual support for CTU CAN FD IP core on FPGA SoC and PCI platforms.	

Fulfilment of assignment	fulfilled
<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>	
All goals has been fulfilled. The submitted code represents almost 3k lines of code and 1k lines in headers. The project together with test applications includes over 7k lines of code. The implemented innovative solution of "Scheduling of CAN Message Transmission when Multiple FIFOs with Assigned Priorities are Used in RTOS Drivers" has been presented by Michal Lenc at international CAN Conference 2024 in Baden-Baden and gained interest from global community and alternative CAN FD and XL controllers designers. The combination with pycoder RTEMS experimental port has been demonstrated later as well.	

Activity and independence when creating final thesis	A - excellent.
<i>Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.</i>	
The student has invested lot of time and effort to deliver sound implementation. The project has been demanding and to achieve required quality level there has been lot of feedback sessions and knowledge and ideas collected by me over more than 25 years in the CAN and other industrial communication fields as well as professional experience with architecting medical instruments using RTEMS system has been passed to the student. He has been able to absorb the knowledge base and use it for the project design.	

Technical level	A - excellent.
<i>Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?</i>	
I believe that the production quality for ESA and NASA projects has been achieved, the solution is under review by experts from embedded brains GmbH, Gedare Bloom, Director, Embedded Systems Security Lab Department of Computer Science University of Colorado at Colorado Springs and On-Line Applications Research (OAR) Corporation - main governors of RTEMS system development. The merge request location https://gitlab.rtems.org/rtems/rtos/rtems/-/merge_requests/49 , the local CTU project pages https://gitlab.fel.cvut.cz/otrees/rtems/rtems-canfd	

Formal level 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?

I consider project well organized. The overall documentation planned for submission into RTEMS project manual can be found at <https://otrees.pages.fel.cvut.cz/rtems/rtems-canfd/doc/can/can-html/can.html>, generated source documentation <https://otrees.pages.fel.cvut.cz/rtems/rtems-canfd/doc/doxygen/html/index.html>. The details has been already discussed with RTEMS core developers <https://lists.rtems.org/pipermail/devel/2024-April/thread.html#77761>, <https://lists.rtems.org/pipermail/devel/2024-May/thread.html#77781>

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?

I consider work with sources as correct, the licenses has been negotiated with original sources authors and has been adapted into form acceptable for use of the project in RTEMS in actual version and prepared to be reused for NuttX RTOS as well as base to enhance Linux SocketCAN infrastructure and Linux kernel CTU CAN FD driver.

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 demonstrated mechanism to solve problem of head-of-line blocking/priority inversion prevention for multiple software FIFOs and applications accessing CAN bus through single CAN controller is significant achievement and demonstrated fast propagation of higher priority class messages to the bus confirms algorithmic as well as implementation quality including low latency base of RTEMS system core.

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.

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

Date: 10.6.2024

Signature: