COL788: Advanced Topics in Embedded Computing

Semester I, 2022-2023

Assignment-2: Real-Time Scheduling

October 27, 2022

Objective

The goal of this assignment is to help you understand the challenges in the real-time scheduling of messages on an automotive CAN.

Background

We will follow the analysis presented in [1] for this assignment. Note that the schedulability analysis in this paper is flawed, and we are following this only to learn the nuances of real-time schedulability in a simple setting.

[1] Ken Tindell and Alan Burns, "Guaranteeing message latencies on control area network (CAN)," Proceedings of the 1st International CAN Conference, 1994.

Tasks

1. Regenerate the worst-case response results shown in the last table in [1].
2. Analyze the impact of including a message authentication code (MAC) in each message. Assume that the MAC length is 2 bytes, the MAC generation takes 0.5 ms and MAC verification takes 0.5 ms.
    - Considering only the communication overhead (i.e., the additional 2 bytes in each message), calculate the worst-case response results.
    - Considering only the computational overhead (i.e., an additional 0.5 ms at the sender and 0.5 ms at the receiver), calculate the worst-case response results.
    - Considering both the computational and communication overhead, calculate the worst-case response results.
3. Are there some scenarios where some messages in the presence of MACs are unschedulable? If so, discuss one mechanism that can help you successfully schedule messages and calculate the worst-case response results for that mechanism.

Submission

You should submit the following on Gradescope.

- `source_code:` This should contain the code which can take command line inputs for various scenarios discussed in the above tasks.
- `report:` This should be the pdf file containing all the necessary details about your work. For instance, it should explain the steps to build and execute your code. It should have screenshots to demonstrate that your code works as desired. It should also contain the results and the corresponding discussion.

Grading

We will schedule a demo session where you can demonstrate the functionality of your code. The final grading rubrics will be published on Gradescope.

Late Submission Policy

The late submission penalty will be 25% for submitting within one day after the submission deadline. It will be 50% for submitting after the first day but before the second day beyond the deadline. We will not accept any submission after two days beyond the submission deadline.