Assignment 4

Issued on: 18.05.2007
Due dates: G1-30.05.2007, G2-06.06.2007

The FlexRay Protocol

The FlexRay bus protocol is part of a communication system for advanced automotive control applications. It specifies a time-triggered communication procedure by which tasks running on different processors in a car exchange information via a field bus.

In this assignment, you are asked to:
1. Become familiar with FlexRay principles and main protocol features.

2. Write a concise description of the FlexRay's time synchronization method.

3. Resolve the following exercise:
Three processors (denoted by A, B, and C) are interconnected by a common FlexRay bus. Processor A runs two time-triggered tasks, T1 and T2, where T1 is executed with a period of 9ms, while T2 is executed with a period of 7ms. In other words, T1 is invocated every 9ms and T2 is invocated every 7ms. The real execution durations of T1 and T2 are not precisely known, but they are less than 9ms and 7ms, respectively. Assume that a suitable scheduling and runtime system exist such that, for both T1 and T2, every task invocation leads to a complete execution of the task before its next invocation takes place. Processor B runs a task T3 with period 1ms and processor C runs a task T4 with period 2ms.
The output of task T1 is an 8-byte value that is needed by task T3. Thus, this value must be sent over the bus from node A to node B. Assume that T1 updates its ouput variable every time it is executed. The output of task T2 is composed of two values, each of which has 8 bytes, that are used by T4 - hence, both values must be sent from A to C. T2 updates these values at every execution.

This exercise requires you to:
a) Determine the main characteristics of the FlexRay bus schedule (i.e., the main structure of the communication cycle) such that:
- The communication latency between T1 and T3 is minimal. In other words, the time delay between an instant when the output value of T1 is updated (by T1) and the instant when this value is available at node C should be as small as possible.
- The period of the communication cycle is as large as possible, given the above constraint. Thus, unnecessary communication over the network should be avoided.

b) Given the task periods and the bus schedule, find the minimum and maximum communication delays between T1 and T3, as well as between T2 and T4.
c) Provide the main structure of the data frames that are sent over the network.

Remarks:
- This assignment requires no implementation work. You should submit a Word or PDF file with your solution clearly written.
- Try to be as focused as possible. Write only about FlexRay parameters that are directly relevant to the exercise.
- The FlexRay specification is available here. Special attention should be given to Chapters 4, 5, 7 and 8.