Control over CAN and Flexray

Embedded Control Systems

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Introduction

Chapter 1

Part 1

1.1 Introduction

1.2 Response Time analysis

1.2.1 Response time analysis per processing unit

Table 1.1: By running the Matlab script ResponsetimeAnylsis_FPP.m with the different parameters given for PU1 and PU2 these response times are obtained for each of the tasks. These files are then delivered as PU1.m PU2.m

PU1	T_1	T_2	T_3	T_4 (T_s)
Matlab (ms)	0.1	2.1	4.1	7.2

PU2	T_5	T_6	T_7	T_8
Matlab (ms)	6	3	9	5

1.2.2 Response time analysis for the CAN bus messages

Table 1.2: Response times for the CAN bus messages

CAN	m_2	m_1	m_3	m_8
Matlab (ms)	2	3	4	4

1.3 System model

1.4 Design decision

1.5 Results

Firstly: Response time analysis
Secondly: Control system input and output

Chapter 2

Part 2

2.1 Introduction

Analyzing and confirming broad analysis done on paper and in Matlab allows us to confirm the hypothesis made about the behavior of the CAN bus and its specific tasks from Part 1. This analyses is done in Inchron, which allows us to explore the real-time behavior of this embedded system in full detail. Some exploration on how the system should work has already been done in Part 1, Add Table reference to periods and priorities , this is used here by feeding the settings of the embedded system to the tool. The settings included is the hierarchy of the Processing Units (PUs) and their tasks which each have different periods, execution time and priority. The tree view, Figure 2.1, shows the details of the hierarchy from the Inchron's perspective.

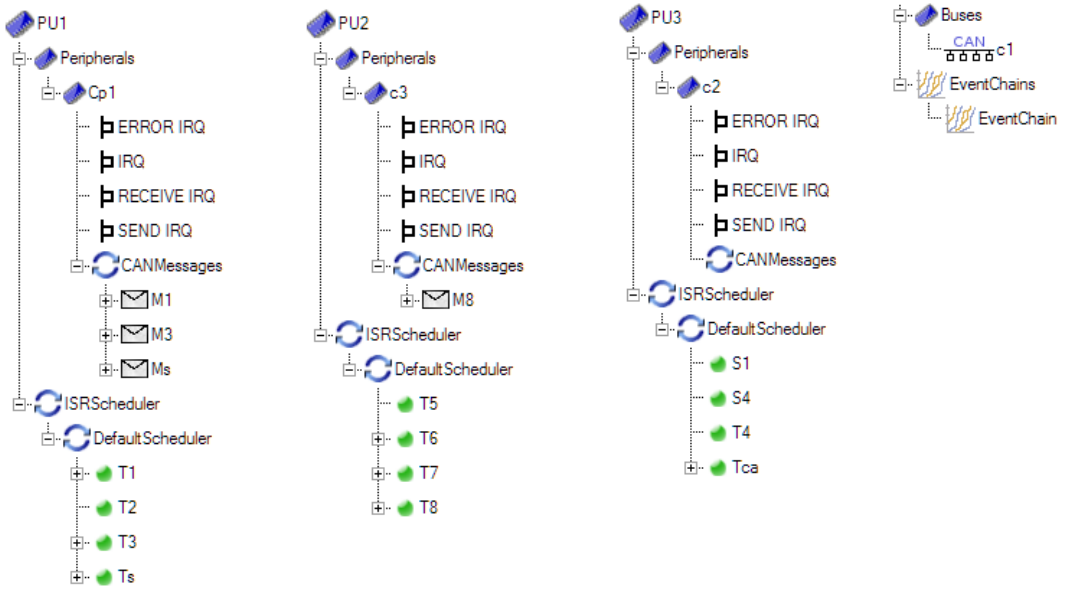

Figure 2.1: This shows the coarse grain hierarchy of the system ported into Inchron for verification and simulation of the real time components of our embedded system.

2.2 Response Time analysis

2.2.1 Response time analysis per processing unit

For this analysis all details have to be imported to Inchron as stated earlier. Now paying special attention to the messages which transfer the packets between controllers which make a full system.

When validating and simulating the model with the settings mentioned in Part 1 and Figure 2.1 and 2.5 we can observer the response times for each task when inserting the Worst Case Execution Time into the tool. Next each processing unit and their Worst Case Response Time (WCRT) will be investigated and then compared to the Matlab model (Response Time analysis). The resulting figures were obtained after several tries with various settings until the correct configuration of the tool was found, e.g. setting the schedule as preemptive was not set as it was not found in the first try.

PU1

For PU1 a fixed preemptive priority scheme with four tasks T1,T2,T3 and Ts. Now when validating the model, Figure 2.2 is obtained showing the results and they are compared to the Matlab response times in Table 2.1.

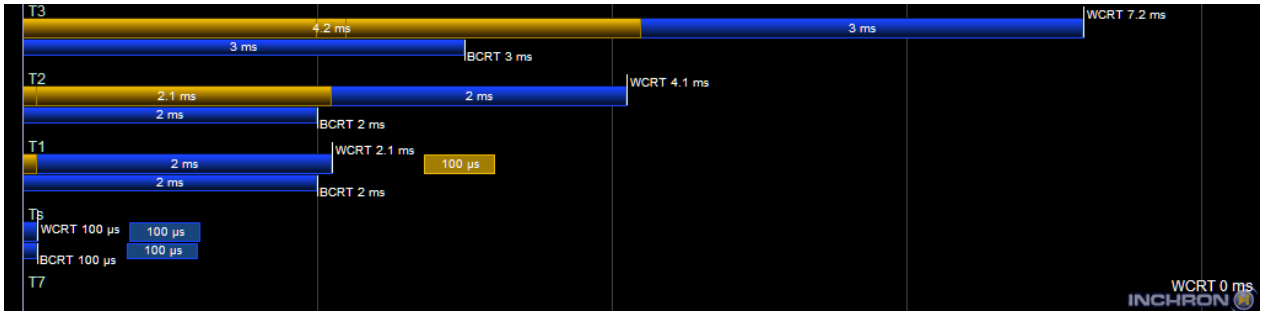

Figure 2.2: Showing the WCRT analysis for PU1. The Results can be read from each horizontal bar.

PU2

Now PU2, has the same sheme as PU1, fixed preemptive priority, with four tasks T5,T6,T7 and T8. Now when validating the model, Figure 2.3 is obtained showing the results and they are compared to the Matlab response times in Table 2.1.

PU3

Allthough PU3 has a time division multiplexing (TDM) its tasks will still be analyzed here, shown in Figure 2.4. It is important to state that T4 is not a real-time task as it is sending a message *out to the blue* but T_{ca} is an important task, actuating on the sensor value and completing the sensor to actuator delay.

2.2.2 Response time analysis for the CAN bus messages

PU1 and PU2 are the only units within the system that are sending messages, shown for clarity in Figure 2.5, but PU3 contains the computing and actuating task which will receive the m_s message and mark the end of the sensor to actuator delay.

Figure 2.3: Showing the WCRT analysis for PU2. The Results can be read from each horizontal bar.

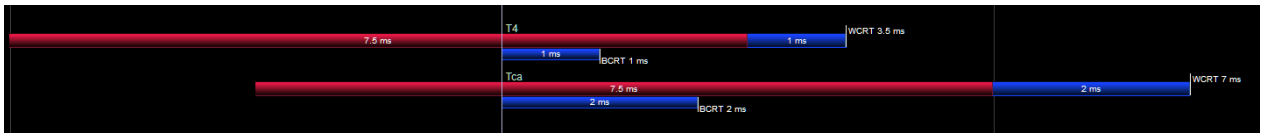

Figure 2.4: Showing the WCRT analysis for PU3 (TDM). The Results can be read from each horizontal bar

Table 2.1: By running the Matlab script ResponsetimeAnylsis_FPP.m with the different parameters given for PU1 and PU2 these response times are obtained. These files are then delivered as PU1.m and PU2.m

PU1	T_1	T_2	T_3	T_4 (T_s)
Matlab (ms)	0.1	2.1	4.1	7.2
Inchron (ms)	0.1	2.1	4.1	7.2

PU2	T_5	T_6	T_7	T_8
Matlab (ms)	6	3	9	5
Inchron (ms)	6	3	9	5

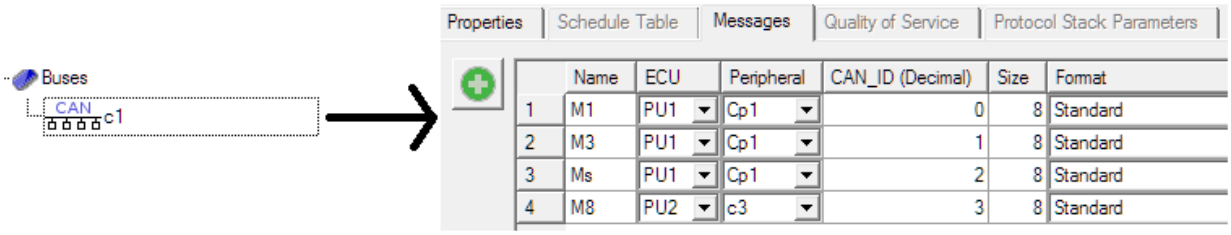

Figure 2.5: All can messages in the system, indicating PU source, individual CAN id and message size in bytes

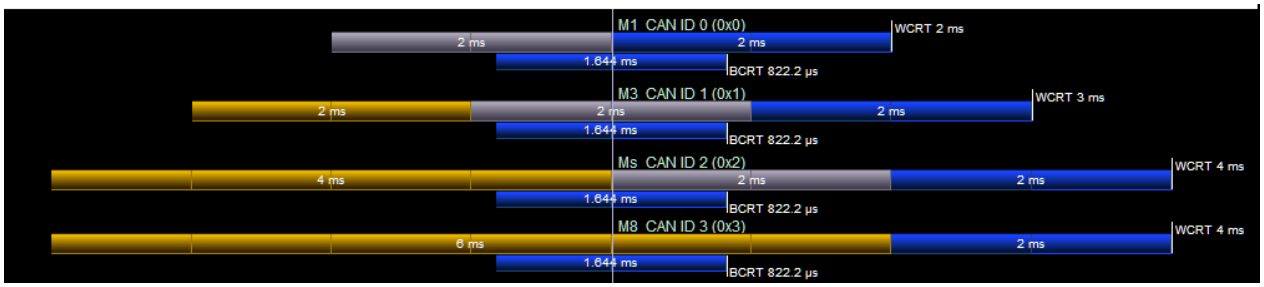

Figure 2.6: Showing the WCRT analysis for the CAN messages. The Results can be read from each horizontal bar and is compared in Table 2.2.

Table 2.2: CAN messages of the system compared from the Inchron tool suite and Matlab. Showing identical results

CAN	m_2	m_1	m_3	m_8
Matlab ms	2	3	4	4
Inchron	2	3	4	4

2.3 Optimisation for sensor-to-actuator delay

2.4 System model

2.5 Design decision

2.6 Results

Firstly: Response time analysis
Secondly: Plots from chronVIEW (before and after optimization)
Last: Control system input and output

2.7 Conclusions

Chapter 3

Part 3

3.1 Introduction

3.2 Answer all the questions

3.2.1 Theoretical analysis versus actual implementation

3.3 Design decision

3.4 Results

Firstly: Solution to the design problem. (Include the parameters you have chosen)
Secondly: from chronVIEW for your design

3.5 Conclusions

3.6 Results

3.7 Conclusion