General Information

This document sets the task for the Bachelor Thesis of Nathan Loretan

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Location	Trondheim, Norway
Professor CH	Medard Rieder, HES-SO Valais
Professor NO	Dag Roar Hjelme, University of Trondheim
Contact at Nordic	Heggebø Torstein
Duration	14 weeks (29.5.2017 – 8.9.2017)

Schedule

Calendar Week	Date	Week #	Activity
21	22.05.17	1	Arrival
22	29.05.17	2	Thesis week 1
23	05.06.17	3	Thesis week 2
24	12.06.17	4	Thesis week 3
25	19.06.17	5	Thesis week 4
26	26.06.17	6	Thesis week 5
27	03.07.17	7	Thesis week 6
28	10.07.17	8	Thesis week 7
29	17.07.17	9	Thesis week 8
30	24.07.17	10	Thesis week 9
31	31.07.17	11	Thesis week 10
32	07.08.17	12	Thesis week 11
33	14.08.17	13	Thesis week 12
34	21.08.17	14	Thesis week 13
35	28.08.17	15	Thesis week 14
36	04.09.17	16	Departure
37	11.09.17	17	Reserve

Task Setting

The Bachelor thesis of Nathan has as goal to find behavioral differences and performance limitations of the NRF52840 Bluetooth Low Energy chip under different conditions.

Two systems that are implemented differently but that are doing the same task are compared against each other. Interrupt latency time as well as the power consumption are the indicators of principal interest and must be measured and compared.

The difference of the systems consists of the fact that one is implemented using the Zephir RTOS and the other is implemented without using an RTOS (bare metal).

The hardware setup, the software engineering of both systems as well as the measurements must be documented precisely. A final report must resume the technical elements as well as compare the two systems.
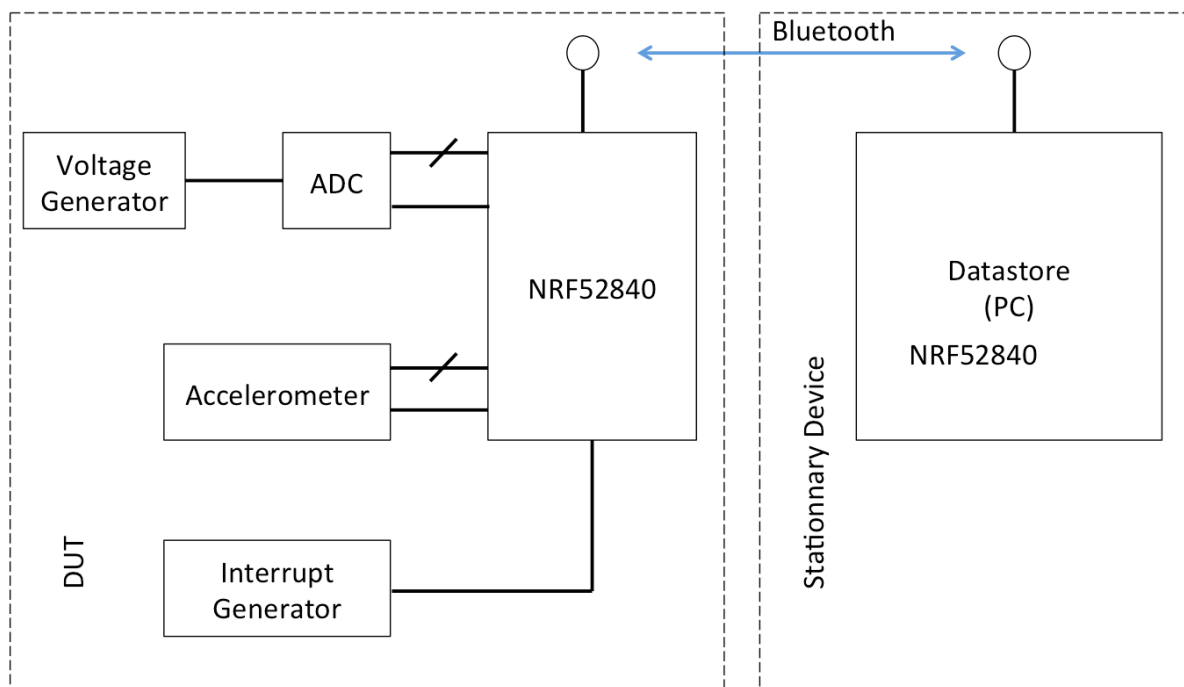
The following block diagram shows the systems of interest:

Figure 1: Proposed Test Setup

Remarks:

The test setup is building on a Nordic development kit for the NRF52840. Using a small extension board, an external high resolution ADC as well as an accelerometer is connected to the NRF52840. A generic Input pin can also be used as an interrupt generator. The voltage generator may be a function generator or a sensor of the team of Dag Roar Hjelme. The acquired data must be sent from the DUT (device under test) to the stationnary device (datastore), which normally will be a PC using a Nordic Bluetooth dongle and the Nordic central device or a similar software.

USE CASE

The following use case is principally proposed, but may be altered as needed or even replaced by another useful use case:

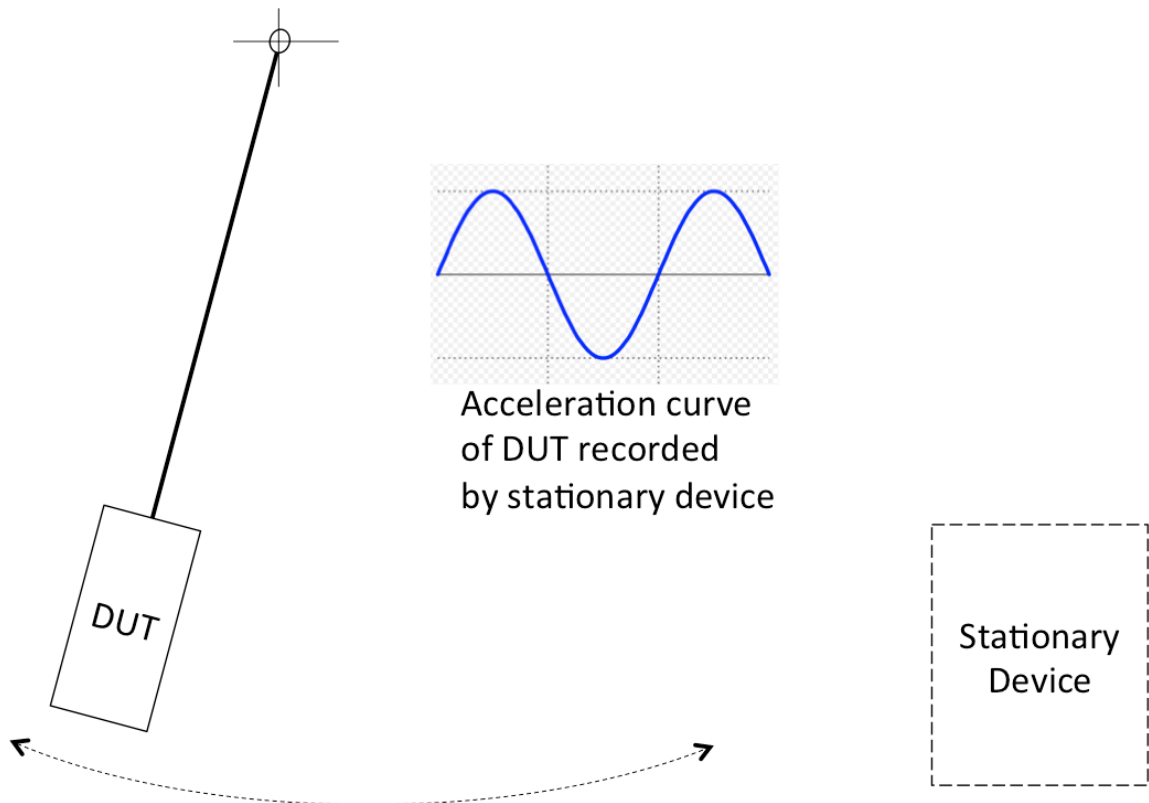The DUT is hung up as a pendulum using a stiff wire as shown by the figure below.

Figure 2: Use Case

This should produce a sine wave shaped acceleration curve. The firmware in the DUT must measure and transmit the acceleration values and the stationary device will record them to a file that later will be compared. Other parameters of interest would be the latency time as well as the power consumption. The latency time measure will require the introduction of some system wide timestamps.

Other use cases may be defined for different measurements.

Thesis steps

A rough planning of the thesis is show below. This planning may be changed according to the final task setting.

1. Design and build the electronics of the sensor (BT1-BT2)
   - Bloc diagram
   - Schematic
   - Layout
   - PCB fabrication, soldering
   - Smoke test
   - Documentation

2. Data acquisition (BT3)
   - Specification of sample rate and data precision
   - Implementation of sensor driver
   - Test
   - Documentation

3. Data Transfer (BT3 -BT4)
   - Bandwidth estimation
   - Definition of BTLE profile for data transfer (+ understand BTLE)
   - Documentation

4. Bare Metal Controller (BT5-BT7)
   - Design of Controller
   - Implementation of sensor firmware
   - Test
   - Documentation

5. Zephir Controller (BT8-BT11)
   - Design of Controller
   - Implementation of sensor firmware
   - Test
   - Documentation

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6. Comparison (BT12-BT13)
   - o Definition of the comparison criteria
   - o Definition of the measurements to compare the 2 systems
   - o Measurement setup
   - o Measurements of criteria
   - o Documentation of measurements
   - o Comparative report qualifying and quantifying the criteria

7. Documentation (BT14)
   - o Thesis report resuming the different reports established during the thesis work
   - o Final presentation of the results

Final thoughts

The final presentation will be organized as well as in Trondheim as well as in Sion.

Sion, May 2017

Medard Rieder