

Real Time Embedded System Assignment – 3 Measurement in Zephyr RTOS

Team - 12

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In this assignment, our aim is to measure the two important metrics namely Interrupt Latency and Context Switching overhead of Zephyr Project. It is a scalable real-time operating system (RTOS) supporting multiple hardware architectures, optimized for resource constrained devices, and built with security in mind. The Zephyr OS is based on a small-footprint kernel designed for use on resource-constrained systems.

Interrupt latency is the time that elapses from when an interrupt is generated / asserted to when the source of the interrupt is serviced. **Context Switching Overhead** is the delay involved in Context Switch process i.e., saving the context of the executing thread, restoring the context of the new thread, and starting the execution of the new thread.

Application developed measures the Interrupt latency and Context Switching Overhead of Zephyr RTOS on Galileo Gen 2 Board. When the program is run, user can choose to proceed with one of the measurements out of the 3 different measurements we perform on Zephyr:

- 'measure 1': to measure the context switching overhead.
- 'measure 2': to measure the interrupt latency without background computing.
- 'measure 3': to measure the interrupt latency with background computing.

For each of these measurements 500 samples are collected and saved in a buffer.

- ➔ Context switch between two threads is achieved using the 'k_yield' function call.
- ➔ To generate interrupts, we made use of General Purpose I/O Pin 7 to output pulse signals. This is looped back into Interrupt Enabled GPIO Pin 2.
- ➔ Background task which happens in 'measure 3' is message passing operation between two threads via a message queue.

Based on the 500 samples taken for each of the measurements, we plot Histograms. Histogram gives a better idea of Time taken by each of the samples and how probable a given delay is. X – Axis is the Time Measured in Nano-seconds and Y-Axis is the amount of Probability (measure of how likely that delay is going to be measured).

Measurements for each of the Cases:

For 'measure 1': (Context Switching Overhead)

The Average context switch time for one trial was found to be = 1390ns (1.39 micro seconds).

A histogram of the context switch times for 500 samples is shown below:

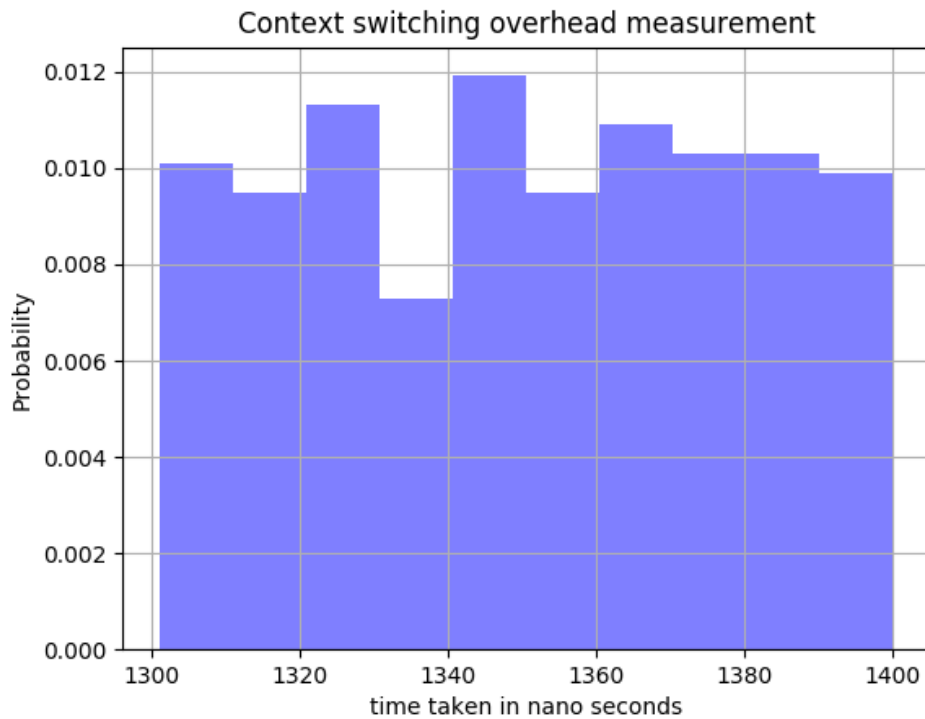


Fig. Histogram of the Measurements for Context Switch Overhead (500 Samples)

For 'measure 2': (Interrupt Latency without background computing)

The Average latency without background task for one trial was found to be = 2970 ns (2.97 micro seconds)

A histogram of the context switch times for 500 samples is shown below:

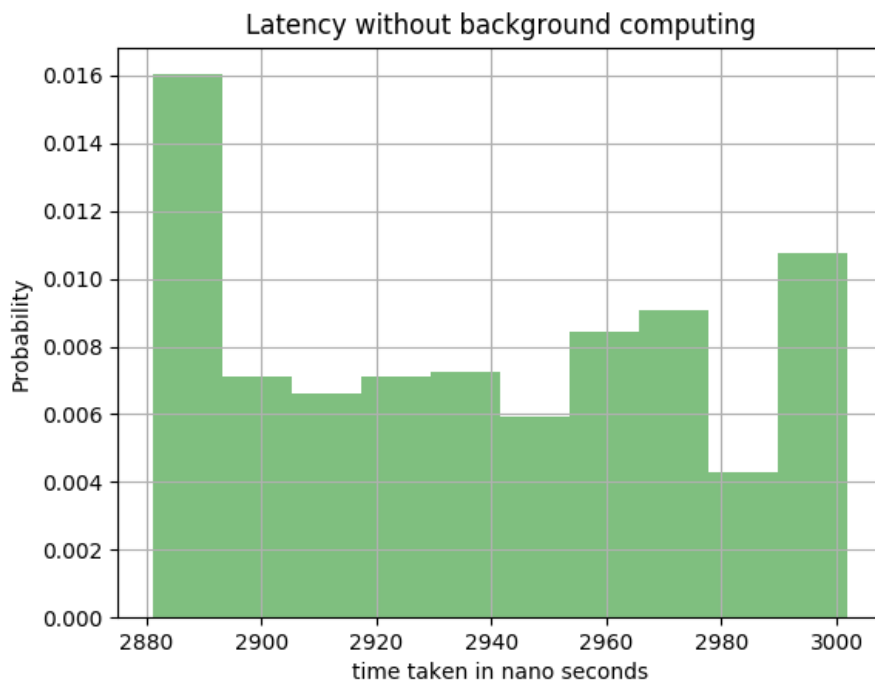


Fig. Histogram of the Measurements for Interrupt Latency without background computing (500 Samples)

For 'measure 3': (Interrupt Latency with background computing)

The Average latency with background task for one trial was found to be = 3053 ns (3.053 micro seconds)

A histogram of the context switch times for 500 samples is shown below:

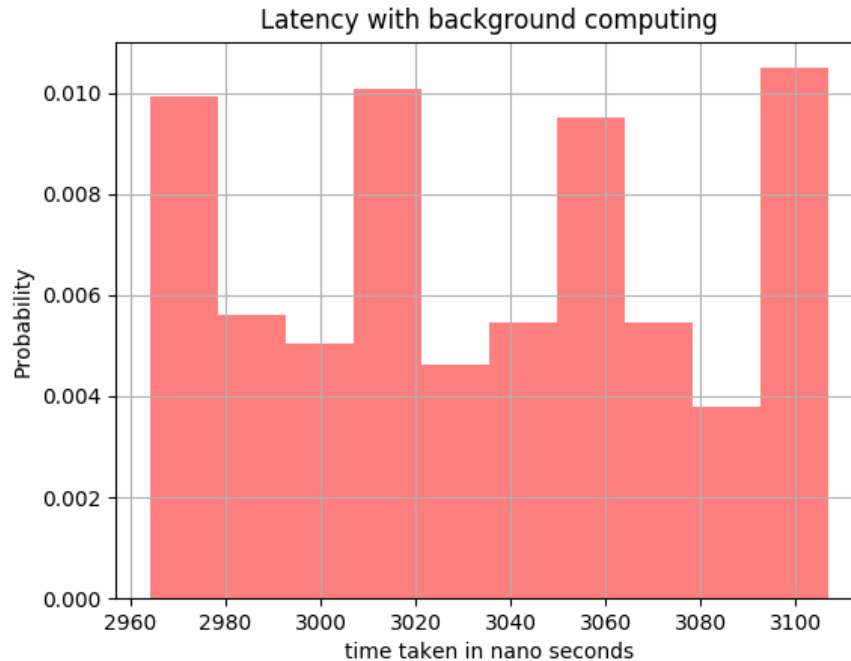


Fig. Histogram of the Measurements for Interrupt Latency with background computing (500 Samples)