

Case Study

Software optimization doubles
battery life

Goal

Improve the battery life of the Bluetooth FF1502 beacon sensor tag. Optimize the product's hardware and software design, with the aim of reducing cost and inconvenience for end users of this product.

Solution

L-Tek developed the Bluetooth beacon based on the Arm Cortex-M0 processor because of its exceptionally small silicon area and low power capability. Using Arm Keil MDK Professional and ULINKplus debug probe, L-Tek were able to optimize this beacon further, developing a better product. Achieved a significantly improved battery life from around 360 days to around 860 days.

Benefits

Arm Keil MDK:

- Fully integrated development environment including device support for more than 5,000 microcontrollers
- High performance and energy efficient C/C++ code compilation
- Test, verify, and debug your algorithms with power awareness.

ULINKplus:

- Simple-to-use and supports all classic debug features such as simple and complex breakpoints, SWV trace, and multi-core debugging
- When used with System Analyzer in MDK, it shows the correlation of software execution with power consumption allowing optimization of the energy profile of embedded systems.

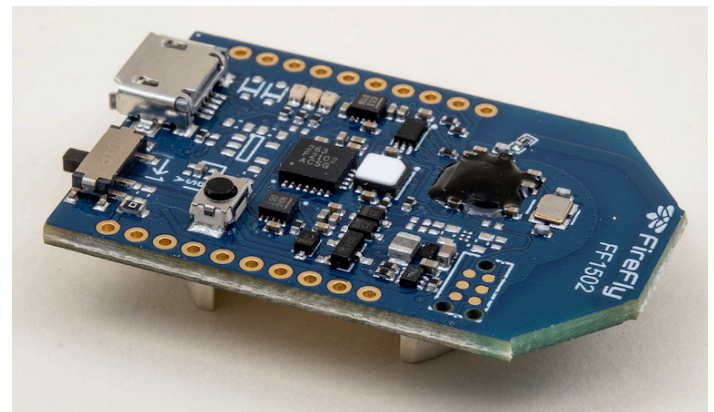
Meeting customer demand

Family owned company L-Tek prides itself on being a technological innovator, specializing in the research, development and production of electronic modules, electromechanical components and software solutions for a wide variety of industries producing complex goods. Working individually with each client, L-Tek aims to provide optimized solutions specific to individual needs. Flexibility and the ability to provide bespoke solutions is the basis for its success.

When L-Tek wanted to improve its Bluetooth FF1502 beacon to meet the market demand for a low-energy component to be used in sensor devices, it turned to Arm.

The L-Tek FF1502 is a Bluetooth Low Energy (BLE) based sensor tag that operates as a broadcaster. Beacons are typically low power devices that sleep most of the time and wake-up briefly to broadcast a message to nearby portable electronic devices. This device can be powered by a single CR2032 coin cell battery or via USB and is based on the Nordic nRF51822 microcontroller (Arm Cortex-M0 based) with an integrated Bluetooth radio.

Various sensors are connected to the microcontroller via I2C: temperature and humidity, light, accelerometer, gyroscope and magnetometer. The USB connector and battery are connected to a DC/DC switch which provides power to the complete circuit (including the capacitor network). While running, the application lies in an idle state most of the time with the MCU and all sensors being in low power mode. Every 10 seconds, the device wakes-up and reads the sensor data, broadcasts the data via BLE and goes back to sleep again.



Getting the most out of battery life

Optimizing embedded applications for overall efficiency should be an integral part of the development process as it is important to understand how peripherals, software algorithms, and power saving modes work together. L-Tek wanted to analyze the battery lifetime of an application running on the beacon to increase battery life.

“Our goal was to develop a Bluetooth based building block for IoT applications with low power consumption to ensure long battery life,” says Matej Slapsak, Head of Research and Development, L-Tek. “The initial requirements were to obtain one year battery life but when we got in touch

into the operation of their microcontroller applications, highlighting which parts of the application code consumed more power and helping them verify the usage of low-power configurations.

Compared to oscilloscopes, ULINKplus does not require complex configuration settings and shows a higher dynamic range allowing you to spot small current differences. It synchronizes the power measurement data with the program execution information when using trace or event annotations.

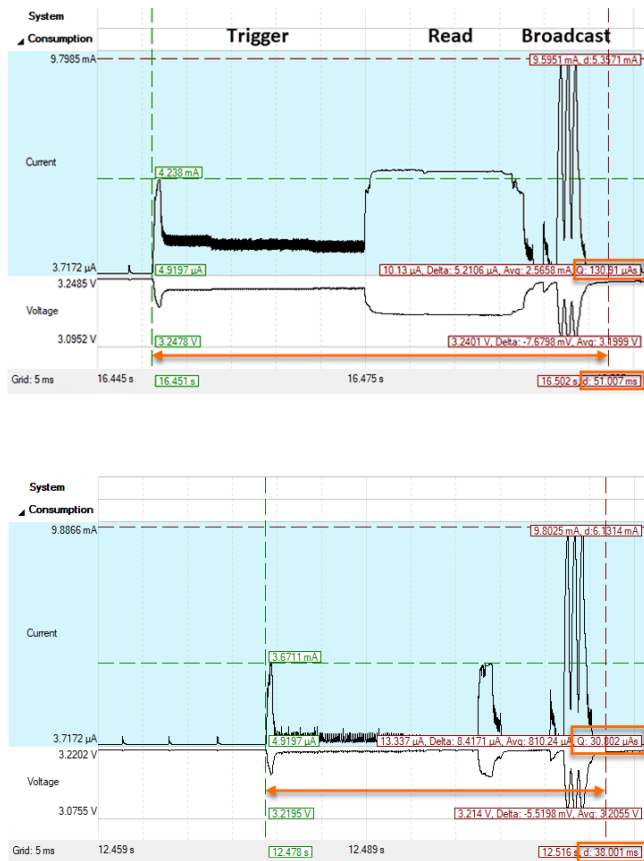
The software investigations showed that a bug in the software had caused an unexpected high current during the sensor trigger phase and a long I2C transfer time during sensor read phase. After the unnecessary code was removed, the current significantly dropped for both the Triggering Sensors phase and Reading Sensor Data phase. The software of the reference design was updated. The I2C write operation bug was fixed and event-driven communication was introduced.

The hardware design was also analyzed using ULINKplus to determine the source of the additional current consumption during the sleeping phase. Once the problem was detected and a diode replaced, the extra current eliminated.

Improved battery life = new business

The results were impressive, dramatically decreasing power consumption and improving battery life from around 360 days to around 860 days. Matej says L-Tek secured new projects in the field of ambient monitoring solutions and agriculture as a direct result of the project. And the team at L-Tek are already using Arm Keil MDK and ULINKplus for other projects.

“We believe ULINKplus in combination with Arm Keil MDK is one of the best professional software development tools in the world,” Matej says. “To produce any device is a challenge, but in real-time applications you must know what is going on with microprocessors and currently the best option for this is ULINKplus in combination with Arm Keil MDK. We are intending to use ULINKplus in the future for sure.”



with Arm they were quite sure that we could get more out of it.”

The L-Tek team used Arm’s flagship software development solution for Cortex-M based microcontrollers, Arm Keil MDK together with the ULINKplus debug adapter to analyze the device - with the aim of using the findings to improve the hardware design and to optimize the software.

Small current differences make a big impact

ULINKplus is a universal debug and trace adapter that supports power measurement. Together with Arm Keil MDK, this debug unit gave the team at L-Tek clear insights

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