IIoT Weighing Device Demonstrator

Extending METTLER TOLEDOS's Embedded Software Platform with Industrial Internet of Things (IIoT)

Graduate

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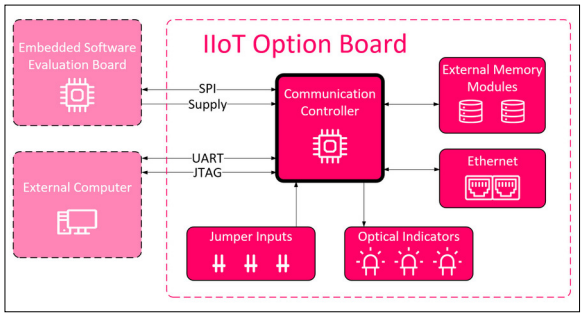
Introduction: METTLER TOLEDO (MT) is popular for high precision scales and other complex laboratory devices. In today's industry, devices like those are often interconnected to automate processes. Some of MT's devices have Ethernet connectivity to serve different industrial field buses and others do not. All have in common that they cannot connect directly to the Industrial Internet of Things (IIoT) with protocols like MQTT and OPC UA. Today, a customer needs to buy an additional gateway to connect a scale, for example, with MQTT to the IIoT.

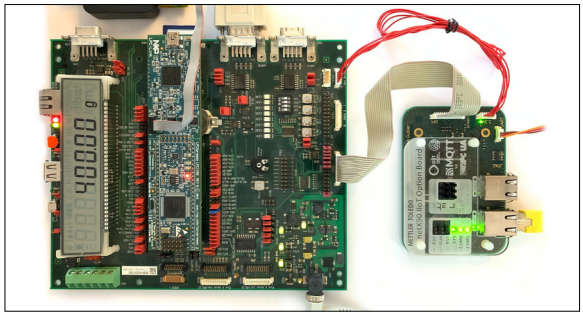
Definition of Task: As mentioned above, several devices from MT already include the ability to communicate on industrial Ethernet. Some of those devices use a specific communication chip for this purpose. By the beginning of 2022, the manufacturer of this chip released a new firmware version that also supports MQTT and OPC UA. Consequently, this chip (extended with some external memory) should now be able to omit the necessity of an expensive gateway. The goal of this thesis was to develop an extension to MT's embedded software platform. This option board should consist of the mentioned chip equipped with the required memory modules for its IoT functionality. The corresponding software extension in MT's software platform was also part of the thesis. Furthermore, some minimal client applications should be developed to provide a demonstrator of the whole functionality from the scale to the values on MQTT and OPC UA.

Result: The developed hardware is compact, practical, and even refined and protected with a nice cover. This cover presents the most important information in an intuitive way so that the software developers from MT should never need to consult the board's schematic. The board provides LEDs and jumpers for everything that helps in the daily development process of IoT applications. The main goal of the layout – apart from its mechanical goals – was to minimize any issues of electromagnetic interference and power integrity right from the start. This results in a stable and reliable option board that should leave nothing to be desired. The developed firmware module shows an easy and understandable way of using the chip manufacturer's new software release in MT's software platform to communicate over MQTT and OPC UA. The documentation helps to understand in detail what happens in the whole communication chain. Furthermore, this thesis shows all limitations of using the chip for IIoT applications, and it presents some workarounds.
Much time was spent finding some mistakes that could always happen during such a development process. The effort that was made to find those problems always resulted in a deeper understanding of all procedures, which improved the documentation. All points from the original task could be answered and completed to MT's satisfaction – even more could be answered than asked in the original task.
Finally, MT is happy with the results of this thesis. It was said that the task was not just fulfilled but surpassed.

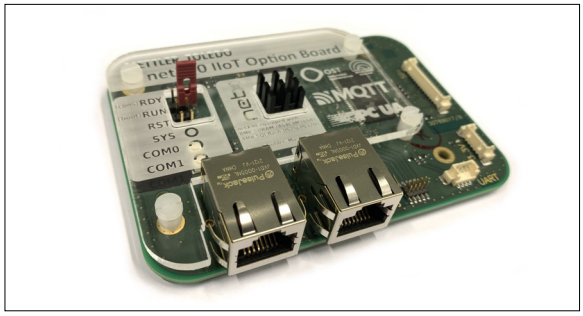
Block diagram of the whole circuit and its peripheral connections
Own presentment



The whole setup with the software evaluation board
Own presentment



The IIoT Option Board
Own presentment



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