# Zephyr IoT Platform for Control, Configuration and Test of an I/O-Module


## Students

**Jeremy Allenspach**

**Jeremy Truttmann**


Initial Situation: A current I/O module shall be expanded into a new Zephyr-based module which uses a dedicated ASIC and communicates via Ethernet. The goal of this semester thesis is to develop a comprehensive proof-of-concept IoT platform for controlling, configuring and testing the new I/O modules. This Zephyr IoT Platform should be able to control the ASIC and implement 10BASE-T1S compliant networking capabilities as in the test setup shown in Figure 1.

Approach: In a first step, sufficient background knowledge about the Zephyr RTOS has been acquired and a functional development environment was set up using VSCode. A system overview was created next based on the requirements specification. During creation of the system overview, two Ethernet interfaces were identified: one based on standard Ethernet and one based on 10BASE-T1S Single Pair Ethernet. Two demo applications were created to test them. A custom Zephyr device driver for interfacing the ASIC was implemented based on a provided Linux driver. For the hardware, a modified I/O module was used. Eventually, as illustrated in Figure 2, an application combining the previously developed elements was created to run the Zephyr IoT Platform demonstrator. Driver and system tests were carried out on different levels, using Zephyr's testing framework.

Result: The result is an IoT platform that allows for deployments as shown in Figure 1 and Figure 3. The platform is capable of steering actuators and reading out sensors that support a variety of signal types while communicating with other platforms over 10BASE-T1S. The driver created uses 4.7 kB of memory, which is comparable to existing Zephyr drivers and has a CPU utilization of less than 1%.

Using VSCode and GitLab, a modern development environment was set up, which leverages Zephyr's configuration, build and test system. Zephyr's modularity and configurability was demonstrated by the integration of different 10BASE-T1S chips. The developed IoT platform demonstrates that Zephyr is well suited for the new I/O modules, with the proof of concept showing promising results.

**Figure 1: 10BASE-T1S test setup with two Zephyr IoT Platform units communicating with each other.**
Own presentment

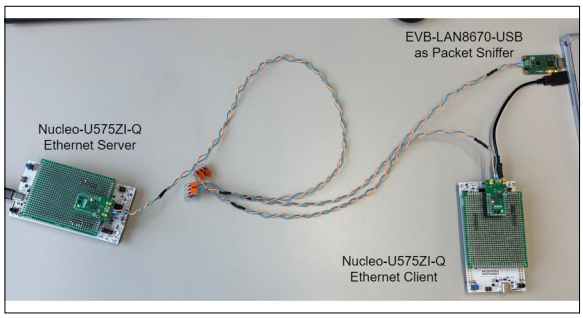



**Figure 2: Firmware architecture of the Zephyr IoT Platform (including components specific to controller or module).**
Own presentment

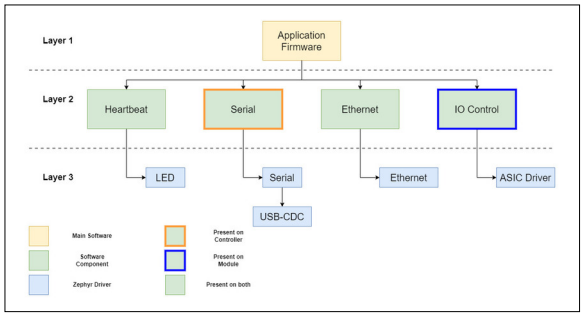
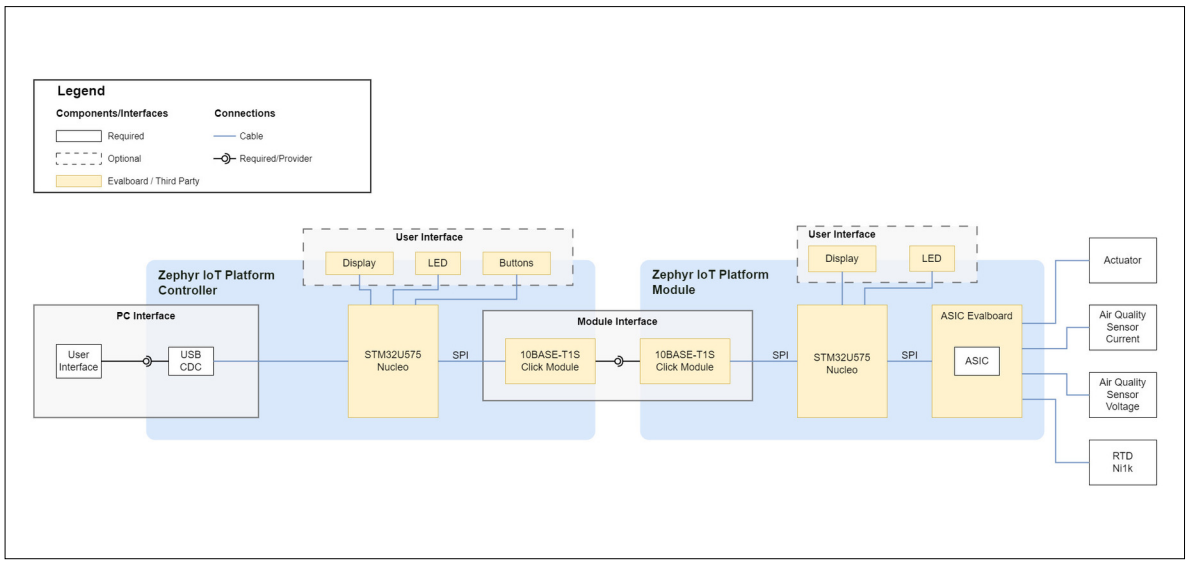



**Figure 3: System overview of the demonstrator, showing a link from PC via IoT platform to sensing and actuator nodes.**
Own presentment





## Advisors

**Prof. Dr. Andreas Breitenmoser, Jan Wendler**


## Subject Area

**Embedded Systems**