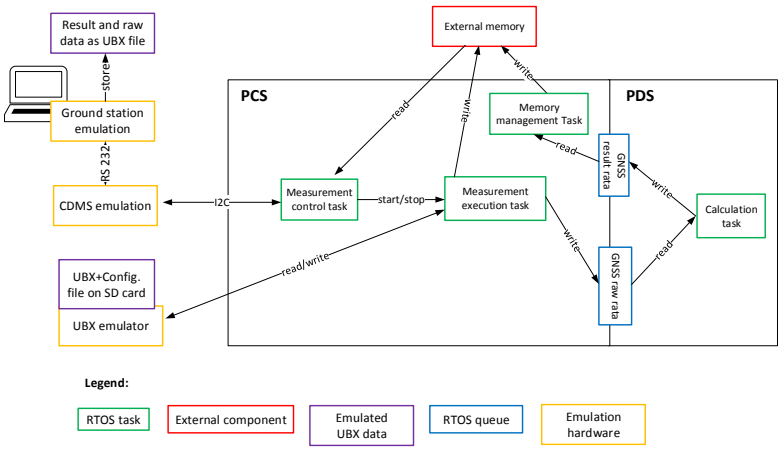
Swiss Space Center
EPFL Lausanne

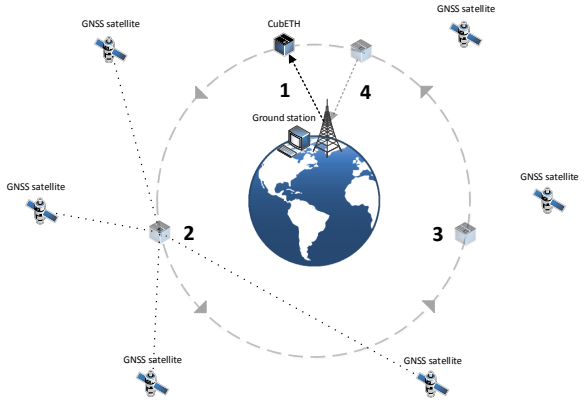
Lucerne University of
Applied Sciences and Arts
HOCHSCHULE
LUZERN
Technik & Architektur
FH Zentralschweiz

Bachelor-Diplomarbeit Elektrotechnik

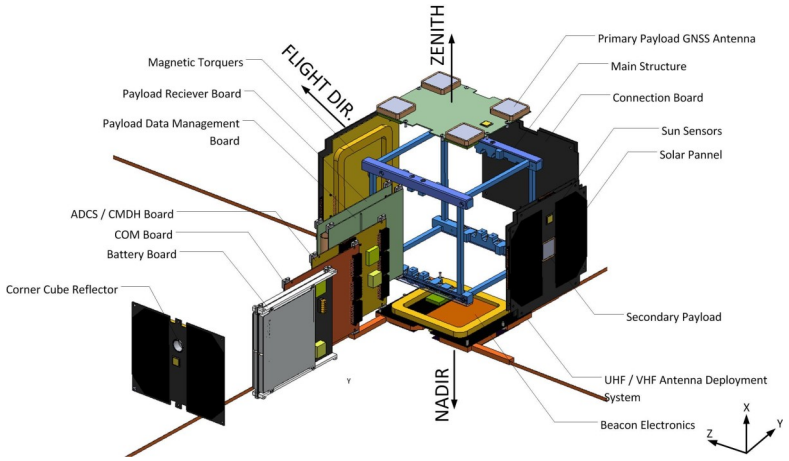
CubETH - Satellite Payload Application Continuation



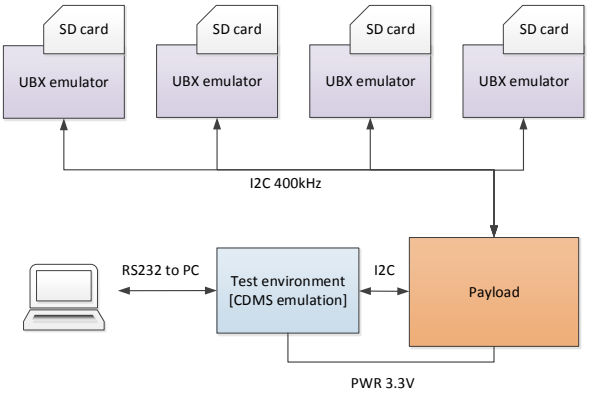
Interaction of payload software with the test environment



CubETH operation: 1.Upload measurement configuration, 2.Execute measurement, 3. Standby mode after measurements, 4. Data is sent to ground station



Explosion drawing of the CubETH with all subsystems visualized



Basic set up of test environment with UBX emulators

Problem Statement
The CubETH project was initiated by the Geodesy and Geodynamics Lab of the ETH Zurich with the goal of determining the correct altitude and orbit of a CubeSat pico-satellite. The Lucerne University of Applied Sciences and Arts has been assigned the task of designing the payload of the satellite which carries out the scientific experiment. For the development of the algorithm calculating the desired scientific result data from the data gathered by the GNSS receivers, a test utility is needed which allows the payload to be fed with raw data expected in space. A test environment should be able to execute automated tests of the payload. The functionality of the watchdog needs to be updated and tested. To preserve energy, the use of a sleep mode, alongside other concepts for energy efficiency, have to be implemented. In order to make software updates during the mission, a multi-level boot loader must be implemented.

Solution
A UBX emulator which emulates the data interface of a GNSS receiver is created. The emulation is carried out on a separate hardware for each receiver to be emulated. The data is read from an SD card which makes the handling of the UBX emulator easy. The emulator software is driven by an operating system and allows for request based and real time synchronization. For the test environment, all elements needed for testing are assembled to a single test utility to guarantee simpler handling. Moreover, a ground station emulation allows the operation of the payload by sending requests for scenarios and test operations to be executed. The software running on the payload was enhanced by functions which simplify the handling of the data received from the GNSS receivers. A new boot loader concept reduces the amount of data transmitted for a software update in space. It does this by only sending the changes made to the code instead of the whole code for the application. Multiple methods were found which reduce the power consumed by the payload.

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