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MQTT Communication between Embedded Linux Devices for Signal Processing of a Ground Penetrating Radar

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The man-made climate change has become more and more serious in recent decades. The occurrence of climatological events and their impact on the flora of the earth have increased. The question arises which plants can continue to thrive under these conditions. In particular crop plants are of great importance when it comes to providing food for mankind. The Plant Time Machine of the IBG-3 could be the answer to this question. In the current state of the project the machine can measure the humidity at set points in the soil. A Ground-Penetrating Radar is under development at the ZEA-2 for a precise 3D tomograph of the electrical permittivity and conductivity of the lysimeter, which is the container of the soil. This Ground-Penetrating Radar consists of different hardware, one Masterboard and 39 Baseboards. These 39 Baseboards are directly connected to antennas that read out data for the tomograph. For precise data the Baseboards have to work correctly, therefore the different components of the Baseboards have to be monitored. In addition, the Baseboards have to be centrally controlled. The monitoring data cannot be stored on the Baseboards themselves. A solution to this problem is a temporary storage and analysis of the data on the Masterboard. Moreover the Masterboard should control the Baseboards. For all these steps MQTT is a suitable solution. Within MQTT messages are sent with topics, which are strings, that are separated by slashes. That gives them a hierarchical tree structure. An overview of different topics, that need to be implemented, is given and illustrated in a topic tree. A possibility to cross-compile MQTT clients and a broker for the specific architecture of the Masterboard and the Baseboards is realized. That is done in a PetaLinux environment and the OpenEmbedded repository. Three MQTT clients implement two different topics and are compiled with PetaLinux. One topic is used to send temperature data of the Trenz module from two Baseboards to the Masterboard. The other topic is used to trigger a startup command of one HMC from the Masterboard on the Baseboards. At the end the corresponding executables of the clients and libraries are successfully tested on the Masterboard and two Baseboards.

Primary author: VAN BAAL, Lasse (ZEA-2, FZJ)

Co-authors: Prof. VAN WAASEN, Stefan (ZEA-2, FZJ); Mr MESTER, Achim (ZEA-2, FZJ); Dr BEKMAN, Ilja (ZEA-2, FZJ); Mr BACHNER, Mathias (ZEA-2, FZJ); Mr KRENZ, Eric (ZEA-2, FZJ)

Presenter: VAN BAAL, Lasse (ZEA-2, FZJ)

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