Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

HSB
Hochschule Bremen
City University of Applied Sciences

Master 2018

Stephan Kleesiek

Machbarkeitsstudie zur Zeitsynchronisation von Sonar Antennen mithilfe des Precision Time Protocolls (PTP) und Synchronous Ethernet (SyncE).

Feasibility study on time synchronization of sonar antennas using Precision Time Protocol and Synchronous Ethernet.

ABSTRACT - Masterthesis

Sonar antennas, which differ depending on the field of application in construction and topology often consist of many individual hydrophones, which must be sampled synchronously in order to correctly superimpose the measured data for achieving a high resolution of the target area. Time differences in the sampling of the individual sensors lead to additional noise in the processing of the measured data and thus have a negative effect on the obtainable resolution. Currently, the data transmission of the sensor elements via Ethernet is carried out with separate clock lines for synchronization. These could be saved if in addition to the data exchange also a time synchronization via Ethernet takes place. The IEEE-certified Precision Time Protocol (PTP) describes such a time synchronization method with a high synchronization accuracy, which can theoretically be increased in connection with a clock recovery from the physical layer (synchronous Ethernet). The aim of this work is a feasibility study on time synchronization of sonar antennas with these synchronization methods. It starts with a literature search on the theoretical basis and the achievable synchronization accuracy. The subsequent development is initially on an Xilinx evaluation board with the type designation ZC702. The built-in SoC (System on Chip) not only has programmable logic but also an integrated Gigabit Ethernet MAC with PTP frame detection, enabling efficient implementation of the intended implementation. The goal is a hybrid solution with a C code-based implementation of the PTP network protocol in software and the associated time stamp unit in hardware (VHDL). The communication between software and hardware, for the transmission of the received timestamps and for the transmission of status information, should take place via the AXI bus interface. Verification of the implementations is first performed using a test board. The next step is to investigate the effects of Synchron Ethernet on synchronization accuracy and to evaluate the achievable accuracy in various network topologies by means of measurements. The limit criteria result from the specifications of the sensor boards developed in the context of projects and the ZYNQ7 modules and transceivers installed on them.