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Project Work, Bachelor
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Evaluation of Time Synchronization Accuracy in Wireless and Ethernet Sensor Networks using the IEEE 1588 Protocol

Abstract

Time synchronization is a concept that is increasingly topical in modern times. Thereby, different fields of topic have different work requirements concerning the accuracy. In automation processes, especially in distributed systems some precise systems require the synchronization to be in the sub-microsecond range.

The Savonia University of Applied Sciences has set up a project named "Lange Project" which employs several students investigating different protocols in terms of time accuracy. The aim of the project is to have a solution for various companies which have very specific requirements in their automation processes.

The task of this project is the analysis of the "1588™ - IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems". It consists of two main tasks: Firstly, reference measurements need to be done. Secondly, advanced measurements have to be done to see where the limits of the protocol are.

To solve this problem, four different test setups were examined. First, two laptops were connected via Ethernet / WLAN through a Switch / Router. This experiment showed already the approximated quality of the Precision Time Protocol, which is good with Ethernet, but rather poor with WLAN. Next, three laptops connected via Ethernet / WLAN through a switch / router were investigated. This revealed that the accuracy gets a little bit worse, if the master has to synchronize two slaves. But the accuracy between the two slaves, which is worse than that of slave to master, corresponds to the specifications of the project with Ethernet connection. WLAN brings again bad results. The third experiment examined the influence of the router. This shows that the router has an impact on the accuracy. Without a router, the slave-to-slave accuracy is better than with router. The other values remain approximately the same. Finally, the impact of traffic between two laptops was investigated. The result is that the specifications of the project are reached with an Ethernet connection. But with WLAN connection it comes not even close to the requirements.

The research has shown that one can use the protocol for Ethernet applications without changes to the source code or specific hardware and still achieve a synchronization accuracy of a few microseconds. For wireless applications some parts of the source code need to be changed and specific hardware to achieve the required accuracy should be used. By these measurements, the weaknesses of the Precision Time Protocol were identified so that it can now be investigated further in this direction.

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