

## Abstract

The aim of this thesis was to study the time synchronization in wireless sensor networks which are based on standards NTP and IEEE1588. Time synchronization is timekeeping which requires the coordination of events to operate a system in unison. This can be compared to the conductor of an orchestra keeping the orchestra in time. Another purpose was then to compare the differences of three synchronization protocols.

First, three types of synchronization protocols and standards were studied. The main idea was to compare the differences between RBS, FTSP and IEEE1588. Previous experiments and their results were collected and compared.

As a result of this thesis, the three tests on these protocols show the differences in many ways, like in drift, error and offset. They are helpful in understanding time synchronization in depth.

## Summary

As in many other distributed systems, time synchronization is an important service in wireless sensor networks. Particularly, wireless sensor networks make extensive use of synchronized time in many contexts (e.g. for data fusion, TDMA schedules, synchronized sleep periods, etc.). Most wireless sensor network applications are targeted at retrieving information from surrounding environments. In many situations, the temporal property of a physical event is critical to wireless sensor network applications. Existing time synchronization methods were not designed with wireless sensors in mind. It needs to be extended or redesigned. The solution centers on the development of a deterministic time synchronization method relevant to wireless sensor networks. Highly related for sensor networks, it also provides tight, deterministic bounds on both sides of the offsets and clock drifts

In this thesis, some common uses of synchronized time in sensor networks were described. It was also described how synchronized time is a critical service in sensor networks. It is a basic requirement for virtually all algorithms that seek to reason about time-varying observations made by distributed sensors.

After studying time synchronization for wireless sensor network, the standards of IEEE1588, NTP and PTP were studied. Time synchronization protocols that were mentioned in the thesis are all based on these standards. Time Synchronization in wireless networks is extremely important for basic communication, but it also provides the ability to detect movement, location, and proximity.

There are many synchronization protocols and they do not differ much from each other. As with any protocol, the basic idea is always there, but improving on the disadvantages is a constant evolution. In this thesis, three protocols which are the major timing protocols currently in use for wireless networks were studied. They are IEEE1588, Reference Broadcast Synchronization (RBS) and Flooding Time Synchronization Protocol (FTSP).

Through the experiments, the main idea was to compare the differences of these three protocols. Depending on different situations, the users can choose any of these protocols to measure the exact time stamp in wireless sensor network.

In this thesis, I learned how to synchronize time in wireless sensor networks and the three protocols. I collected results from the experiments by using the different protocols. All the graphs and tables showed the delays, offsets and drifts. As we known, there were many methods of synchronization, like sender to receiver synchronization and receiver to receiver synchronization. By comparing the differences of the results, we got the advantages of each protocol. Then for different situations, we can choose a different protocol.