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Time Synchronization Techniques in Wireless Network : A Survey

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Abstract—The time synchronization procedure is very important for power saving in wireless ad hoc network and method used by the synchronization that method chooses a particular node and gives priority for transmitting a signal to that node. All the Other nodes synchronize to the selected node according to Time Synchronization Function. Here increasing research focus on designing synchronization algorithms specifically for sensor networks. This paper look for reviews of time synchronization problem and the need for synchronization in sensor networks, then presents in detail time synchronization methods explicitly designed and proposed for sensor networks and AD-HOC networks.

Key Words- Ad hoc networks, time synchronization, time process.

1. INTRODUCTION

Ad hoc networks [1] are networks of mobile wireless computing devices. They have limited range for communication in wireless technology nodes of the network form spontaneous connections when they are brought within the communication range of each other, providing a symmetrical link for communication so message exchange is possible in both directions. The limited communication range and the that is without infrastructure, such as fixed Base Station(BS) and Access Point(AP). Nodes can communicate each other such networks. However, most of the nodes that comprise ad hoc networks use a limited-capacity battery because of the nodes mobility. In order to maintain the network for a long time, efficient use of energy is essential. Among the many factors that consume energy in a mobile node, the energy cost for communication accounts for the largest proportion. Therefore, using an energy-efficient communication protocol can reduce energy consumption, and networks can be supported for a long time [2][3].

A time synchronization method is needed to perform power saving and protocols. One way to achieve time synchronization is through from the Global Positioning System (GPS)[4]. However, all nodes would need additional equipment, and would have to rely on GPS to obtain time information. So, it suffers high cost and energy consumption. As alternative time synchronization protocols have been proposed. These methods receive time information contained in a beacon signal, additional cost or energy is not needed. Because of the advantages

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of time synchronization using beacon signals, such protocol has been widely studied.

The most popular time synchronization technique is Timing Synchronization Function (TSF) in the IEEE 802.11 standard [5]. In the TSF algorithm, a node adopts timing information only when the received time information is faster than its own. The advantage of this method is a simple procedure, but it may encounter beacon contention problems. When the number of nodes is increased, the fastest node cannot transmit its beacon due to beacon contention. As a result, scalability problems occur. To solve the beacon contention problem, algorithms that give priority to fast time information nodes have been proposed. In one paper, Adaptive Timing Synchronization Procedure(ATSP) was proposed [6]. Similar to IEEE 802.11 TSF, ATSP adds the parameter that decides on the participation of the contention window. Using the parameter, a node that has fast timing has high priority to transmit a beacon, and slower timing nodes beacon transmission frequencies are reduced. However, ATSP still does not overcome the scalability problem, and the additional parameter determines the time synchronous convergence time and accuracy. Another study proposed Tiered Adaptive Timing Synchronization Procedure(TATSP) to improve the synchronization accuracy of ATSP and to reduce the synchronous convergence time [7]. A method was proposed involving fast timing nodes and slow timing nodes splitting into two groups, and quickly identifying a small set of fastest nodes and giving them higher priority to transmit beacons. These previously proposed algorithms only considered single-hop networks. When these are extended to multi-hop ad hoc networks, synchronization accuracy and synchronous convergence time are still an issue because of reliance on a particular node. To overcome this problem, Automatic Self-time correcting Procedure(ASP) was proposed [8].

High priority was also given to fast timing nodes. But, when a slower node receives enough information to accomplish synchronization by itself, its beacon transmission priorities are increased. Many solutions have been proposed to overcome IEEE 802.11 TSFs problems through giving priority to fast timing node. In these methods, a long time is needed to check the timing order since time information is only received through the beacon signal when the fast timing node leaves.

Timing Synchronization Problem: We can understand the Timing synchronization by following problem: A person, e.g., Rohan, is a normal commuter. Rohan don’t like any late for work and wishes to always catch the train his wants. To achieve this, Rohan time that is available at the train station and adjusts his watch to show the same time. imperfections in 3 Rohan's look, it does not measure time intervals accurately . Maintain synchronization with the time at the train station, Rohan must periodically synchronize. Using this example, time synchronization is more accurate the more often a local clock (i.e., John's watch) is synchronized, But if that resource is unavailable, synchronization can only be achieved by communication between two or more entities, e.g." if Rohn and J only have access to personal times and are able to communicate through. In such a scenario, synchronization can be achieve if Rohn and were this to send Jane the reading on his watch, and J then adjusts her own watch based on either the time or the time offset between their clocks, too, periodic synchronization needed, since both Rohn's and

2. TIMESYNCHRONIZATION

Distributed systems are the system, and for these system time is very important and time is the beigest issue. Every node of network should have internal clock of its own and the time can drift differently from one node to another for several reasons. In Mobile Ad-Hoc Networks, nodes are moving, involving various disconnections in the network over time or we can see, that there is not always ensurity that a communication is always possible between two nodes. Therefore, making one (or several) of these nodes a central time synchronization agent (as for NTP) is not suitable.

Most of the previous studies focus on mobile nodes do not address the problem of time synchronization between nodes. if communication protocols involve time they usually consider that time is synchronized by a global entity [9] [10] [11]. Even in this case, it is possible for a node to loose for an arbitrary time the connection with the global timing agent. Moreover, a large part of mobile robots and connected objects are not equipped with synchronization owing to energy, bandwidth, hardware and unstable connections constraints.

Three main approaches reduce time drift problem in distributed systems. The relative ordering orders events without time reference. In this scheme, communications between robots don’t contain any direct time reference (i.e., date or clock value). In the relative timing, nodes take into account the disparity of drift time from the others. In this scheme, communications between robots usually contain time deviation values (i.e., delta) instead of absolute dates. Finally the global timing ensures that all clocks are synchronized by using a global timing agent (e.g., NTP) [12]. In this paper, we present three versions (i.e., one per synchronization mechanism) of a distributed collaborative system for a swarm of heterogeneous robots and we study their efficiency differences through a park cleaning scenario.

3. THE NEED FOR SYNCHRONIZATION IN SENSOR NNETWORKES

There are reasons for focus the synchronization problems in sensor networks. First, sensor nodes need to coordinate with their operations and collaborate to achieve a complex sensing task. And example is Data fusion for such coordination in which data collected at different nodes are aggregated into a meaningful result. For example, in a vehicle tracking application, Clearly, if the sensor nodes lack a common timescale (i.e., they are not synchronized) the estimate will be inaccurate. Second, synchronization can be used by power saving schemes to increase network lifetime. For example, sensors may sleep at appropriate times, and wake up when necessary.

Whenever using power-saving modes, the nodes should sleep and wake-up at coordinated times, because coordination is very important such that the radio receiver of a node is not turned off when there is some data directed to it. This requires a precise 4timingbetween sensor nodes. There are Scheduling algorithms like TDMA can be used to the transmission medium in the domain of time that for remove collisions and save energy. synchronization schemes are NTP or GPS but they are not good and will not fit for use in sensor networks because issues. NTP works well synchronizing the computers on the

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Internet, but is not designed with the energy and computation limitations of sensor nodes in mind.

Issue with GPS device is very expensive to attach on cheap sensor devices, and services of the GPS may not be available everywhere, may be inside the buildings or under the water. And in adversarial like environments, the GPS signals may not be trusted.

4. LITERATURE REVIEW

In paper [1] In this paper, they discussed previous algorithms on time synchronization method that chooses a particular node and gives priority to transmitting a beacon signal to that node. And rest of the node synchronize to the selected node according to methods like the IEEE 802.11 Time Synchronization Function. They conclude methods have problems in the accuracy in multi-hop networks. Paper shows new time synchronization algorithm. In which focus on nodes do not depend on a specific node, and they use all the received beacon signals and perform the time synchronization on their **own.** This paper concludes that They have improved upon the disadvantages of IEEE 802.11 TSF. Utilizing the time information of a particular node, if the number of nodes is increasing and a node moves out of network coverage, the accuracy of time synchronization is reduced, and it takes a long time. The TSPTA algorithm uses the time information through the received beacon signal instead of particular nodes information.

In paper [3]computing environments are based on ad hoc networks. The data can be sensed by good things which can then be combined to derive knowledge about the environment, which in turn enables the smart things to “react” intelligently to their environment. For this sensor fusion, temporal relationships which can be (X happened before Y) and real–time issues (X and Y happened within a certain time interval) play important role. physical time and clock synchronization such environments. The characteristics of sparse ad hoc networks, classical clock synchronization algorithms are not applicable in this setting. This paper focused on time synchronization scheme of that is appropriate for ad hoc networks. And then finally paper conclude that problem of physical time synchronization in sparse ad hoc networks giving reasons one is classical clock why synchronization algorithms failin this environment.

Paper [4] Many applications of sensor networks need local clocks of nodes of sensor that can be synchronized, requiring precision of degrees. Some intrinsic properties of sensor networks energy resources are limited , and storage, the computation, and the bandwidth, combined with potentially high density of nodes make traditional synchronization methods unsuitable for these networks. there is an increasing research focus on designing synchronization algorithms specifically for sensor networks. This paper survey reviews on the problem of time synchronization and the need for synchronization in sensor networks, then presents in detail the basic synchronization methods explicitly can designed and proposed for sensor networks. In this paper they have conclude that Two synchronization algorithms, RBS and TPSN, both report very high precisions, on the orders of few µ secs, though they use completely different approaches.

The[6, 9] offline algorithms presented that allow offline time synchronization, i.e., after the distributed computation is finished or after a certain amount of data has been collected. However, these offline algorithms assume a constant message delay and that the actual clock drift is a linear function in time and therefore only produce approximations.

Logical time algorithms such as [12, 14] provide a solution for causal ordering of events, but they require that causal dependencies between event generating entities manifest themselves in a network message exchange between these entities. This assumption does not hold here, since we are talking about causal relationships in the real world.

There has been much work on physical clock synchronization in the past [10,13]. most of the proposed synchronization algorithms, including the well known Network Time Protocol [15] [16], rely on a network that is not partitioned and where it is always possible to produce good estimations for the message delay. As pointed out in section 3, this is not the case for sparse ad hoc networks. Furthermore, some of the algorithms do not have the correctness property pointed out in section 5, possibly resulting in claiming false properties on a set of time stamps.

5. CONCLUISON

As development of the technology grows, the need for quality of the service also gets grow. The routing protocol is most important in any communication. While talk about any wireless communication then energy efficiency also play critical role. To achieve the energy efficiency in any routing protocol, there is need of time synchronization. This article is all about the time synchronization along with the various works done in this field.

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