A Novel Time Synchronization Scheme for Mobile Underwater Sensor Networks

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ABSTRACT: This paper proposes a novel time synchronization scheme for mobile underwater sensor networks. Distinguishes itself from previous approaches for terrestrial WSN by considering spatial correlation among the mobility patterns of neighboring UWSNs nodes. This enables synchronization to accurately estimate the long dynamic propagation delays. Simulation results show that synchronization outperforms existing schemes in both accuracy and energy efficiency Time synchronization is an important requirement for many services provided by distributed networks. A lot of time synchronization protocols have been proposed for terrestrial Wireless Sensor Networks (WSNs). However, none of them can be directly applied to Underwater Sensor Networks (UWSNs). A synchronization algorithm for UWSNs must consider additional factors such as long propagation delays from the use of acoustic communication and sensor node mobility . These unique challenges make the accuracy of synchronization procedures for UWSNs even more critical. Time synchronization solutions specifically designed for UWSNs are needed to satisfy these new requirements.

Index terms:-UWSNs, synchroniz ation, s ensor node

I.Introduction:-

IN recent years, Underw at er Sensor N etworks (U WSNs) have gained s ignificant att ention from academic and industrial res earchers due to the potent ial benefits and unique challenges p os ed by the water environment [1], [2], [3], [4]. UWSNs have allow ed a host of applications to become both

feasible and effective, including coastal s urveillance, envir- on ment al monitoring, unders ea exp loration, dis ast er prevent- tion, and mine reconnaiss ance. H ow ever, due to the high att enuat ion of radio waves in water, acoustic communication is emerging as the most suit able media. Several charact eristics specific to underw at er acoustic communications and net- w orking int roduce addit ional design complexity into almost every layer of the net work protocol stack [1], [2], [3], [4], [5]. For examp le, low communicat ion bandw idth, long prop aga- tion delays, higher error probability, and s ensor nodemobility are concerns that must be confront ed . This paper address es the time synchroniz at ion problem, acritical service in any sensor net work. Nearly all U WSN app licat ions dep end on time synchroniz ation service. For example, data mining requires global time informat ion, TDM A, one of the most commonly used M edium A ccess Cont rol (M AC) prot ocols, often requires nodes to be sy nchroniz ed. Furthermore, most of the localization algo - rithms for underw at er [6], [7], [8], [9] and terrestrial s ens or netw orks [10], [11], [12], [13], [14] assume the availability of time synchronization service.

II.Existing System:

In Existing addresses the time synchronization problem, a critical service in any sensor network. Nearly all UWSN applications depend on time synchronization service. For example, data mining requires global time information, TDM A, one of the most commonly used M edium Access Control (M AC) protocols, often requires nodes to be synchronized.

Furthermore, most of the localization algorithms for underwater and terrestrial sensor networks assume the availability of time synchronization service. Numerous time synchronization protocols for terrestrial Wireless Sensor Networks (WSNs) have been proposed in the literature. Their synchronization accuracy and energy efficiency for land-based applications is cogent.

This lack of serviceability imposes even more stringent requirements. The UWSN will need to be energy efficient. These sets of distinguishing characteristics introduce new challenges into the design of time synchronization schemes for UWSNs.

III.Proposed System:

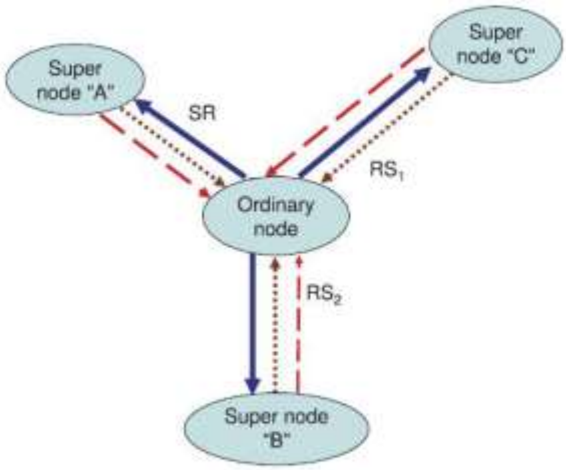
To overcome the limitations of existing approaches, this paper proposes Synchronization a high energy efficient time synchronization scheme specifically designed for mobile UWSNs. The distinguishing attribute of Synchronization is how it utilizes information about the spatial correlation of mobile sensor nodes to estimate the long dynamic propagation delays among nodes. The time synchronization procedure consists of three phases:

- Delay estimation,
- Linear regression, and
- Calibration.

Advantages:

1. Low communication bandwidth
2. Long propagation delays,

3. Higher error probability, and
4. Sensor node mobility .



Modules

1. Network Design
   a. Surface buoys
   b. Super nodes
   c. Ordinary nodes
2. Spatial Correlation
3. M essage Exchange

V.Architecture :

Modules Description

1. Network Design

In this Module, we consider hierarchical underwater sensor network architecture.

a. Surface buoys

Surface buoys are equipped with GPS to obtain global time references and perform localization. They serve as the “satellite” nodes in underwater environment.

b. Super nodes

Super nodes are powerful sensor nodes, working as reference clocks, as they always maintain synchronization with surface buoys. M oreover, super nodes can perform moving speed estimation as they can directly communicate with the surface buoys to obtain real time location and global time information.

c. Ordinary nodes

Ordinary nodes are the sensor nodes aiming to become synchronized. They are inexpensive and have low complexity, cannot make direct contact with surface buoys and can only communicate with their neighboring ordinary nodes or super nodes. The lifetime of ordinary node is restricted by its limited battery supply .

2. S patial Correlation

In this module, the performance of wireless communication systems can be improved by having multiple antennas at the transmitter and the receiver. The idea is that if the propagation channels between each pair of transmit and receive antennas are statistically independent and identically distributed, then multiple independent channels with identical characteristics can be created by pre coding and be used for either transmitting multiple data streams or increasing the reliability (in terms of bit error rate). In practice, the channels between different antennas are often correlated and therefore the potential multi antenna gains may not always be obtainable.

3. Message Exchange

In this M odule, message exchanges among sensor nodes for the case where there are three super nodes available to assist t he ordinary node perform time synchronization. A single run of the message exchanged between the ordinary node and each super node.

The synchronization procedure starts when an ordinary node initializes the synchronization process by broadcasting the synchronization request message SR to its neighboring super nodes. SR contains the sending time-stamp T1 obtained at the MAC layer, immediately before it departs from the ordinary node. Upon receiving SR, super nodes mark their local time.

V.Related Work

In the lit erat ure, there are various time synchroniz ation protocols for distribut ed syst ems like terrestrial radio sensor netw orks, in which ordering of events is crucial. A landmark pap er in comp ut er clock synchroniz at ion is Lamport’s work [26] that elucidat es the imp ort ance of virt ual clocks in systems w here caus ality is more imp ortant than abs olut e time. It has emerged as an important influence in sensor works, in which many applications only require relative time inst ead of absolute time.

The N etw ork Time Protocol (NTP) [27] is a widely us ed hierarchical protocol imp lemented to synchroniz e clocks in large netw orks like the Int ernet. NTP provides accuracy in the order of milliseconds by typically using GPS to achieve synchronizat ion to external sources that are organiz ed in levels called strat ums. H ow ever, in underw at er s ens or netw orks, GPS may Not be available for all the s cenarios . Addit ionally, one -w ay delay estimat ed as one half of the round trip trans it Time brings significant errors due to the long p ropagat ion delay in U WSNs.

Reference Broadcast Synchroniz ation (RB S) [15] is a well-know n receiver-receiver synchroniz ation algorithm. It com-pletely kills errors that derive from the sender side, and it adopts the concept of postfact o synchronizat ion, allow ing the time synchroniz ation process to happ en after dat a collection rather than ahead of time. H ow ever, RBS requires extra mess age exchange to communicat e the local time- st amps betw een any two nodes which int end to become synchronized. The major idea of the RBS algorithm greatly dep ends on immediat e reception of reference mes sages

VI.CONCLUSIONS AND FUTURE WORK

This paper pres ents a novel time sy nchroniz ation scheme for mobile UWSNs. Synchronization is the first time algorithm to utilize t he spatial correlation charact eristics of underw at er

objects, improving the synchroniz ation accuracy as well as the energy efficiency . The simulation res ults show that this new approach achieves higher accuracy with a lower mess age overhead.

In the future, the work will be ext ended in two direct ions: explore other underw ater mobility patterns , including one that involves vertical movement to examine the suit ability of our des ign and; 2) investigate the influence of errors on sup er node localiz ation as well as velocity estimation, and also the influence on M AC layer activities such as packet loss and re-trans mis sion

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