Parallel Path Calculation in Node Architecture using RTSP

Vanisha Preethi Santhmayor, PG Student, Dept. of CSE, AIET, Moodbidri, India

Mahesh K.Kaluti, Asst. Prof, Dept.of CSE, AIET, Moodbidri, India

Abstract: The packet transmission in the node architecture is a tedious task. The network may contain the node failure or link failures. Hence the alternative path is calculated in parallel with forwarding the packet in the allocated path across the network. The networks need accurate time synchronization for coordination and data consistency. The existing algorithms for time synchronization offer very good accuracy. A Recursive Time Synchronization Protocol (RTSP) will accurately synchronize all the nodes in a network to a global clock. The proposed technique will take less time when compared to existing path finding technique.

Keywords: Time Synchronization, RTSP, Accuracy, Link failure

I. INTRODUCTION

Wireless Sensor Networks (WSNs) need time synchronization in less than microseconds. There are many in which time synchronization is achieved. Time synchronization can be local synchronization or global synchronization. Wireless sensor network are deployed in hazardous environment. Hence it cannot be charged or batteries cannot be replaced. Sensor nodes will use their energy for idle listening, message transfer and by clock synchronization [2].

The network is mainly used for sending or receiving the packets. These packets are transferred across the nodes from source to destination. While reaching the destination there might be obstacles like link failure or node failure. The network has to find the solution to overcome this type of problem. Hence, the best alternative path is found to deliver the packet successfully. So it may uses the routing algorithms like RIP (Routing information protocol) and OSPF (Optimal shortest path first). The nodes are synchronized using time synchronization protocol.

The network requires accurate time synchronization for many reasons, such as exact time-stamping of messages, signal processing, cooperative communication, data coordination, and to save the energy of nodes. There are several ways to achieve synchronization. The synchronization can be ordering of events, local synchronization, and global synchronization. Many applications are synchronized using global time. In this all the nodes are synchronized with one global clock. The maximum energy consumed by time-synchronization protocol depends on the no of messages transferred during the communication.

II. RELATED WORK

The packet is forwarded to the destination in the network. In the case of link failure or node failure, the packet is dropped. Hence the alternative path is found by the node. Hence it takes the time to calculate the alternative path. This uses different type of time synchronization protocol. The protocols are GPS based synchronization [8], Network time protocol [3], Precision Time Protocol (PTP) [4], Time synchronization protocol for wireless sensor networks (TPSN) [6] and Flooding time synchronization protocol (FTSP). These protocols will take more time for accuracy and energy inefficient.

In GPS based synchronization, it can provide an accuracy of 1μs. It is energy-inefficient, infeasible in obstructed environments and costly. The NTP (Network Time Protocol) is mainly used in the networks of traditional computer networks. NTP is not suitable for WSNs because of its very low accuracy, energy inefficiency and high complexity [9]. The RBS (Reference Broadcast Synchronization) uses receiver-receiver synchronization to produce an average accuracy of 29.1μs for a single hop network [5]. This accuracy is not sufficient for WSNs which requires a better accuracy [10] [11]. Instantaneous clock correction, including forward correction and backward correction, results in time discontinuity. This will tends to serious faults in distributed system. RBS applies instantaneous synchronization and thus face the problem of time discontinuity.

The FTSP (Flooding Time Synchronization Protocol) is the most commonly used protocol for clock synchronization in WSNs [7]. The messages are broadcasted with timing information from a single sender to several receivers

without any exchange among them. It dynamically elects a reference node which regularly floods its current timestamp into the network. The MAC-layer time-stamping eliminates all kind of random delays except propagation delay at both sender and receiver sides. The timestamps are made at the end of each byte after Start of Frame Delimiter (SFD), normalized, averaged, error corrected. Then final timestamp is embedded into the message. A node waits for sufficient data points of two nodes. After collecting the global and local timestamps it estimates the offset and skew. Any node that is fully synchronized with the reference node begins flooding its own calculated estimation of the global clock. Hence the FTSP provides an accuracy of 1.48 µs for single hop case and about 0.5µs per hop in a multi-hop network.

III. METHODOLOGY

The proposed system is used to find the alternative path in parallel with forwarding the packet to the destination. In case of link failure this alternative path will immediately forward the packet without wasting the time. The time synchronization protocol RTSP (Recursive time synchronization protocol) is used for synchronizing the nodes. The nodes in the network are synchronized using RTSP (Recursive Time Synchronization Protocol). The following methods are used in RTSP [1].

TIME STAMPING:

This time-stamping approach is simpler, faster, and more accurate than that of FTSP. Here timestamps are made at the end of each byte after SFD byte. These are normalized, averaged, error corrected, and then final timestamp is embedded into the message. Therefore a mechanism is introduced in the RTSP algorithm to find and compensating the propagation delays to achieve high accuracy of time synchronization.

RTSP MESSAGES:

The RTSP algorithm achieves time synchronization by exchanging messages among nodes. The RTSP uses mainly three types of messages for the time synchronization of nodes. They are ERN i.e., enquiry/election of the reference node, REQ i.e., request for time synchronization, and REP i.e., reply for time synchronization. RTSP-ERN message with a negative value is treated as an enquiry for the reference node. RTSP-ERN with a non-negative value is treated as a contest. A node will request for time synchronization by sending an RTSP-REQ message to the reference node. The reference node on the request-path replies with RTSP-REP to the requested node.

RECURSION AND MULTI-HOP SYNCHRONIZATION:

The RTSP algorithm will work with flat and clustered network topology. A time synchronization request is initiated by any node in the network. This request is forwarded recursively to the reference node. The synchronized node or any reference node on the request path will replies with timing information. This is sent back to the requesting node through the same path. It is important that the propagation delay is also calculated at each hop before forwarding the reply.
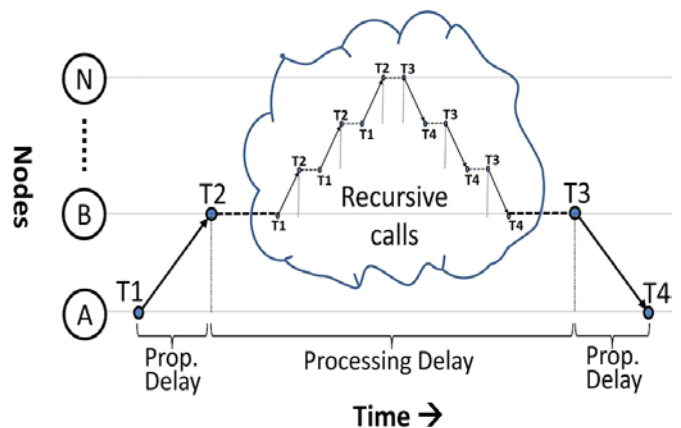

Figure 1: Request and Reply mechanism

The Figure 1 explains the request-and-reply mechanism in RTSP. The node A in a multi-hop network sends request at T1 to the reference node through another node B that receives it at timeT2. The node B, if not synchronized, forwards this request to another node in a recursive manner until it reaches the reference node or a fully synchronized node N which replies with the timing information that is forwarded to node B through the same path. The node B at time T3 forwards this reply to node A which receives it at time T4.

IV. RTSP

After the network is setup, the nodes in the network broadcast an RTSP-ERN enquiry message to ask their neighbors about the identification of reference node, wait for the period T or until a reply is received, run repeatedly the RTSP algorithm that takes care of the dynamic election of a single reference node with the smallest ID. This process is shown in the flowchart Figure 2 and Figure 3.
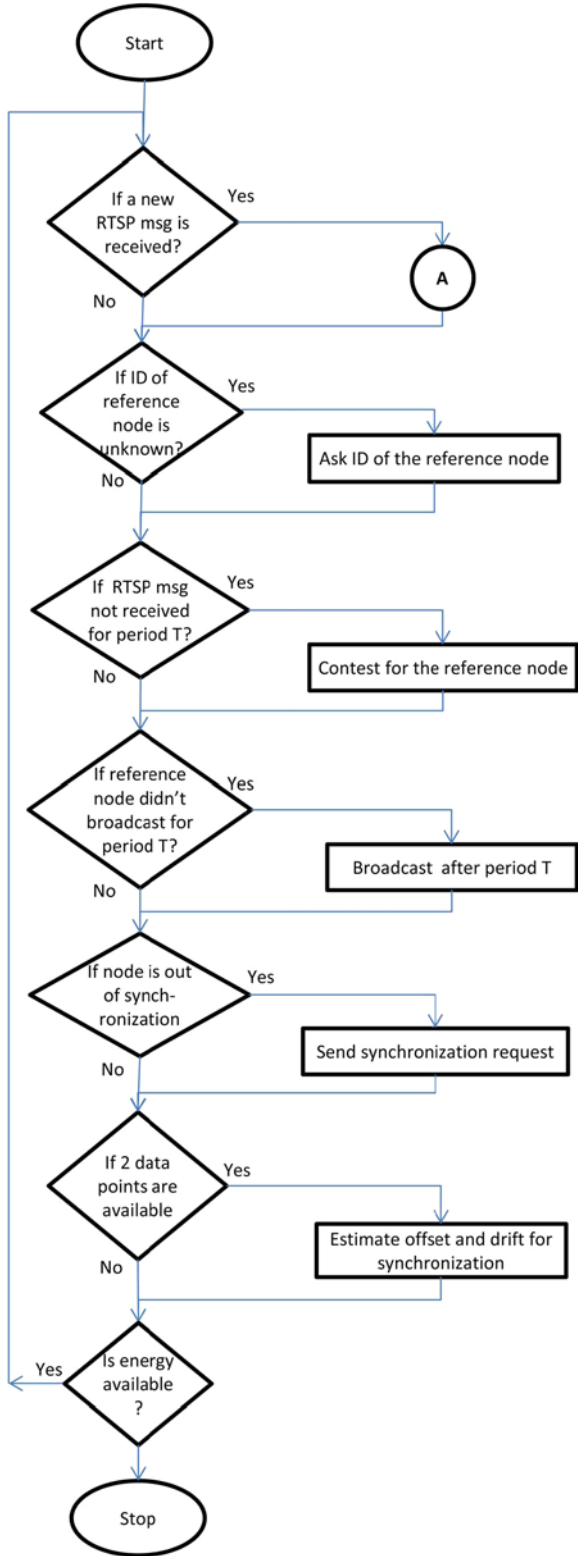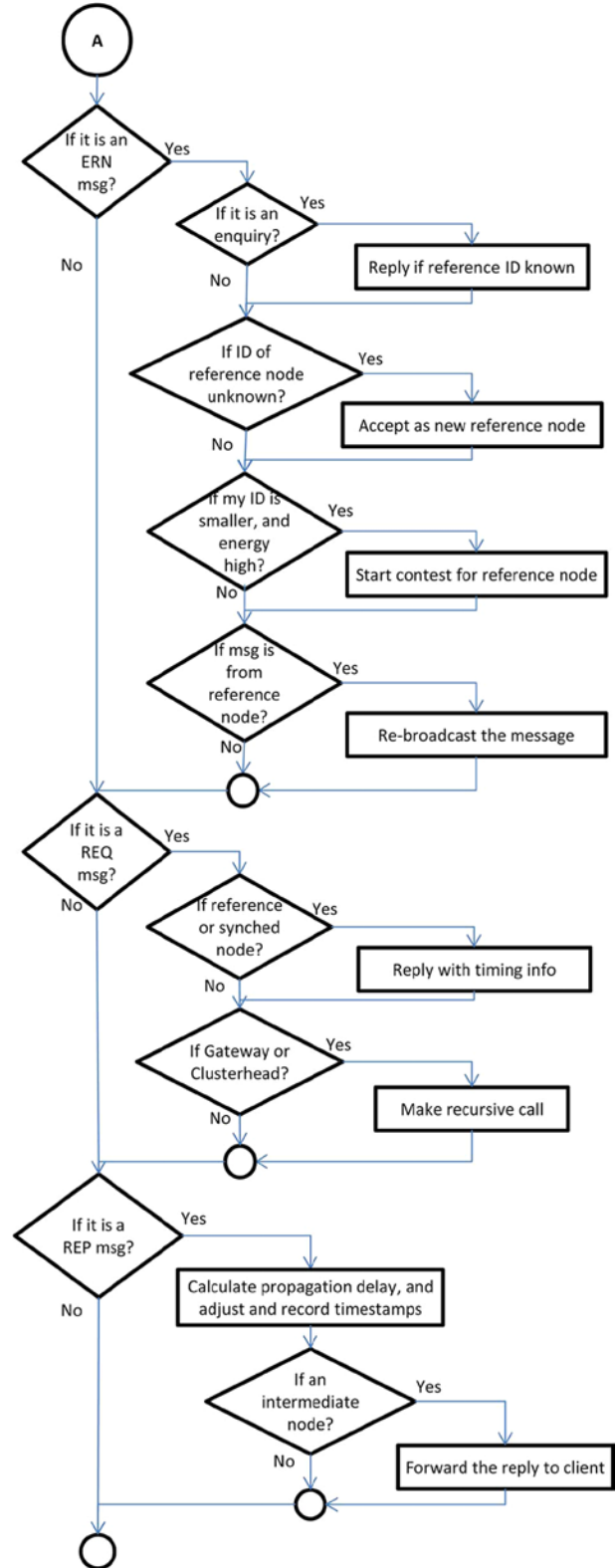
Figure 2: Recursive Time Synchronization Protocol (RTSP)

Figure 3: Segment-A of the RTSP algorithm.

V. CONCLUSION

The packet forwarding in the network will make use of different protocols for optimal path. This optimal path may contain link failures. At this time alternative path is calculated in parallel with packet transmission. This proposed system will make use of less energy consumption and less time when compared to the already existing systems. Further improvement in accuracy is gained by the compensation of propagation delay and adjustment of the time stamps at each hop. The RTSP algorithm achieves energy efficiency by using the techniques like reducing the number of time synchronization requests through the adaptive re-synchronization interval and aggregation of synchronization requests.

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