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# TBEL Protocol for Sensor Localization in WSN & MANET

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**Abstract:** ***Wireless sensor network consists of inexpensive sensing devices with limited resources. In most cases, sensors are not equipped with GPS-like receiver due to its cost. And GPS units do not function well in environmental difficulties. The Knowledge about geographic position of sensors is critical in many tasks such as event detection, network management and routing. This forces to develop an accurate, efficient and fast localization technique. Traditional localization techniques like relative localization require an arbitrarily long period of time. Time is an essential factor in the localization of sensors in wireless network. The efficiency of location based applications depends on the time taken to determine the position of sensors in the network. In the case of industrial and military applications where human participation is impossible, sensors play a big role. The first step of these applications is to determine the position of sensors in the network. The time taken to locate the sensors should be minimum so that location based applications can be started as soon as possible. Traditional method of localization requires first finding the position of the nodes in their own local coordinate systems and finally converting it into global coordinate system. It increases the number of rounds of communication. Thereby it increases the time to locate the sensors. We present a new protocol TBEL for localization of sensors in WSN & MANET within a given time bound by using 2 hop technology and the results are analyzed using simulation studies***

**Keywords:** sensor, localization, position, time, wireless network, node, distance, neighbor, and table

## 1. Introduction

Localization is the process of determining the position of sensor nodes in the network. The position of node can be described in terms of absolute locations such latitude, longitude and altitude or in terms of relative to other sensor positions. The traditional relative localization is the process that terminates when all the sensors obtain their locations in the same coordinate system. Initially sensor nodes calculate its positions under local coordinate systems and it is transformed into the global coordinate system for localization. It increases the communication overhead. Many applications like robotic war require that the localization of sensors must be accomplished within a short period of time. Localization is carried out through message exchanges between the sensors. Sensor has to position itself before sending the monitored data with its location. In the case of physical localization, there must exist multiple anchor nodes to localize within a time bound. Due to the high cost of anchor nodes, small numbers of anchor nodes are preferred. This paper defines a time bounded localization technique using essential localizability. We propose a new protocol called TBEL to implement the distributed algorithm for time bounded localization in wireless network.

### 1.1 Theoretical Perspective

A sensor network can be represented as a graph G (V, E), where V is the sensor nodes and E is the edge connecting the sensor nodes.E1 is an edge between the two vertices v1 and v2 if and only if v1 and v2 are within the communication range with each other.

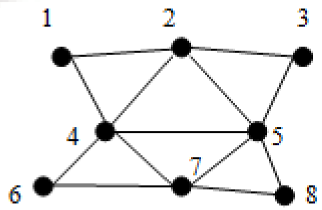


Figure shows a sensor network with 8 nodes.

### 1.2 Multilateration Based Localization

1. Each sensor measures its distance with the neighbouring sensors and stores the measured distance in a distance table.
2. Each node broadcast its distance table to all of its neighbours.
3. Each sensor computes its relative position to its neighbours based on its distance table and the distance table based from neighbouring nodes.

In multilatertion based localization, each localized node should broadcast its position to help its neighbour's localization process. The to-be-localized nodes have to wait for one or more rounds in order to get the position information of 3 non-collinear neighbours.

**Table 1:** Distance table, Neighbour Table, Position Table, LCS Table,

Distance Table LCS table

| Node ID |
|---|
| |
| |
| |

| Node ID | Distance |
|---|---|
| | |
| | |
| | |

Neighbour Table

| Node ID | NeighborID | distance |
|---|---|---|
| | | |
| | | |
| | | |

Location Table

| Node ID | Distance | x | y | time |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

## 2. Literature Survey

An important problem in sensor networks is localization of sensor nodes within a time found. Physical localization of sensors have been studied using mathematical algorithms such as Semi definite Programming [9] and Multidimensional Scaling [7] for estimating the sensor locations. The coordinate-system stitching techniques cited in [10], [11] divide the network into overlapping regions, nodes in each region being positioned relatively to the region's local coordinate system. The local coordinate systems are then combined together to form a global coordinate system. Localization accuracy can be improved by using a set of beacons and extrapolate unknown node locations from the beacon locations [12], [13], [14].Most current techniques assume that the distance between two neighbour nodes can be measured, typically via a ranging procedure. For example, pair-wise distance can be estimated based on Received Signal Strength Indication (RSSI) [Whitehouse (2002)], Time Difference of Arrival (TDoA) cited in [15], [16]. In the case of industrial and civil applications, it is necessary to determine the physical position of the nodes [1]–[4]. It can specify in terms of absolute locations such as a combination of latitude, longitude, and altitude or relative ones. Many techniques attempt localization in a distributed manner. The relaxation-based techniques cited in [5],[6] start with all the nodes in initial positions and keep refining their positions using algorithms such as local neighbourhood multilateration and convex optimization. To avoid the cost of ranging, range-free techniques have been proposed in [17]. It [18] assumes that a node can hear from a large number of beacons. Spotlight requires an aerial vehicle to generate light onto the sensor field. A mobile node can be used [16] to assist pair-wise distance measurements until converged to a "global rigid" state where the sensor locations can be uniquely determined. DV-Hop and Diffusion are localization techniques requiring neither ranging nor external assisting devices. A novel distributed data storage protocol is proposed [19] in addressing on-demand warning in sensor networks is proposed. It avoids query and response overheads. The drawback is storage space is large.

## 3. Proposed Method

For a given sensor network topology, localization may require an arbitrarily long period of time according to the traditional definition, but indeed it only needs the time of transmitting a short message before allowing every pair of nodes to have their positions automatically transformed into one coordinate system. We propose an efficient distributed algorithm for time-bounded localization over a sensor network and evaluate the performance of the algorithm with analysis and extensive simulation studies.

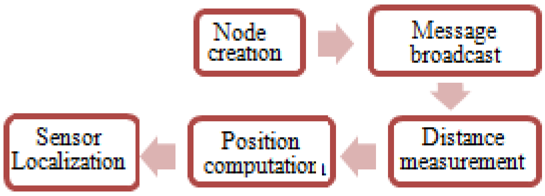



**Figure 1:** Block diagram

## 4. Algorithm

Each node maintains 3 tables, LCS identification table, Position table and routing table. The following steps are repeated for a given time bound.

Step 1: Node Creation

1) Define the topology of the network and design antenna, access points, common nodes etc

Step 2: Message Broadcast & Collecting

1) If the LCS identification table has been updated, then broadcast the updates of the LCS identification table.
2) If the position table has been updated, then broadcast the update of the position table.
3) If the routing has been updated, then broadcast the update of the routing table.

Step 3: Localization

1) Updates the LCS identification table
2) Updates the position table
3) Combines the routing table with the received messages.
4) Select a BLCS.
5) Updates the routing table.
6) Whenever the position table has been updated, update the routing table.

Finally outputs the position table and the routing table.

## 5. Simulation Set Up

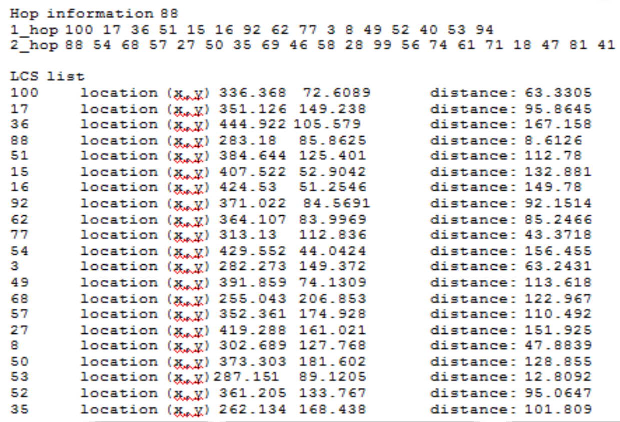
Simulations have been carried out in a frame work developed under NS2.This environment is defined on a square area 500x500.In this simulation HELLO messages are used for neighbor discovery. Nodes send HELLO message with own x and y locations. Receiving neighbor nodes store the sender location in neighbor table and compute the distance to the sender and store it into the distance table. Neighbor nodes store the location, distance and time in location table. All nodes run localization algorithm, for all neighbor nodes in location table. By using the last location and the current location, angle of movement and distance are computed. Nodes identify the non localized nodes from the last hello message received time. For each non-localized node by using localization algorithm, angle of movement and distance both are estimated. From distance and message received time duration speed of the node is estimated. From these values average angle, average distance and average speed are estimated. From these average values exact location for next iteration is estimated for each node. Computed location is stored in location table for future iterations. All nodes maintains preprocessing timer to broadcast neighbor distance to all neighbors, neighbor distance is computed in hello message. Receiver nodes maintain 2-hop neighbor list with

**Table 2:** Simulation Parameters

| *No. of Item* | *No. Item Description Parameter* | *No. Item Description Parameter* |
|---|---|---|
| 1 | Simulation Area | 500X500 |
| 2 | No. of Nodes | 101 |
| 3 | Radio Propagation Model | Two ray ground |
| 4 | Channel Type | Channel/ Wireless channel |
| 5 | Antenna Model | Antenna/Omni antenna |
| 6 | Interface Queue Type | Queue/Drop Tail/PriQueue |
| 7 | Link Layer Type | LL |
| 8 | Energy Model | EnergyModel |
| 9 | Routing protocol | TBEL |

neighbor id and its location. And nodes initiate the round process. At the first round nodes send its own location. Its neighbor nodes store information in 1-hop neighbor table and its LCS table. During 2nd round nodes send its neighbor location. Receiver nodes maintains 2hop neighbor list. Complete network is partitioned into a number of sub networks. Sub network is formed by using location information of all nodes in the network. Once partition is complete nodes determines it own sub network and apply localization. Localization is applied up to the end of simulation.

## 6. Screen Shots



```
Hop information 88
1_hop 100 17 36 51 15 16 92 62 77 3 8 49 52 40 53 94
2_hop 88 54 68 57 27 50 35 69 46 58 28 99 56 74 61 71 18 47 81 41

LCS list
100     location (x,y) 336.368  72.6089     distance: 63.3305
17      location (x,y) 351.126 149.238      distance: 95.8645
36      location (x,y) 444.922 105.579      distance: 167.158
88      location (x,y) 283.18   85.8625     distance: 8.6126
51      location (x,y) 384.644 125.401      distance: 112.78
15      location (x,y) 407.522 52.9042      distance: 132.881
16      location (x,y) 424.53   51.2546     distance: 149.78
92      location (x,y) 371.022  84.5691     distance: 92.1514
62      location (x,y) 364.107 83.9969      distance: 85.2466
77      location (x,y) 313.13   112.836     distance: 43.3718
54      location (x,y) 429.552 44.0424      distance: 156.455
3       location (x,y) 282.273 149.372      distance: 63.2431
49      location (x,y) 391.859 74.1309      distance: 113.618
68      location (x,y) 255.043 206.853      distance: 122.967
57      location (x,y) 352.361 174.928      distance: 110.492
27      location (x,y) 419.288 161.021      distance: 151.925
8       location (x,y) 302.689 127.768      distance: 47.8839
50      location (x,y) 373.303 181.602      distance: 128.855
53      location (x,y)287.151   89.1205     distance: 12.8092
52      location (x,y) 361.205 133.767      distance: 95.0647
35      location (x,y) 262.134 168.438      distance: 101.809
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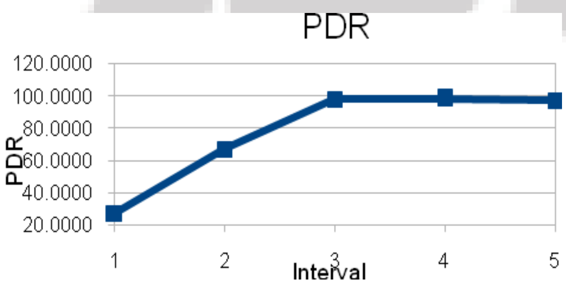


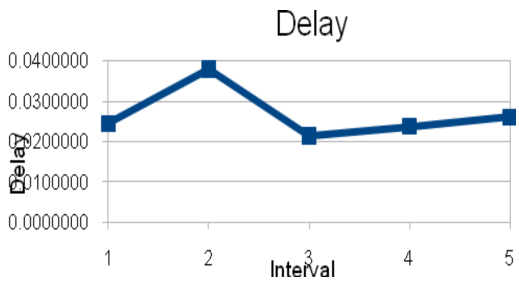


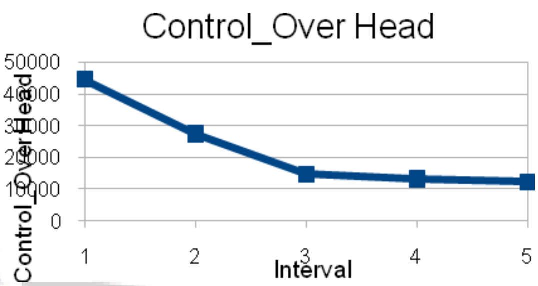


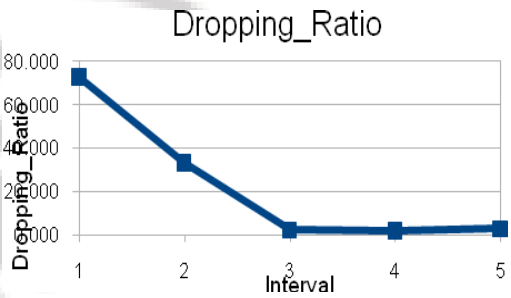


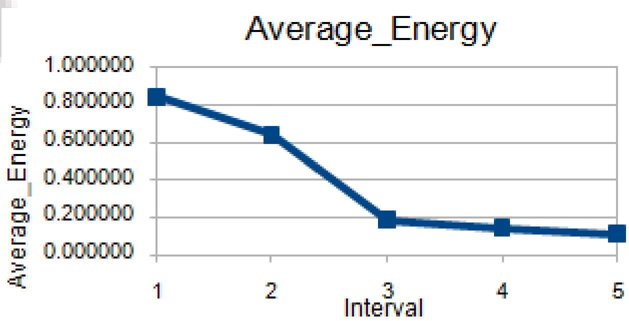


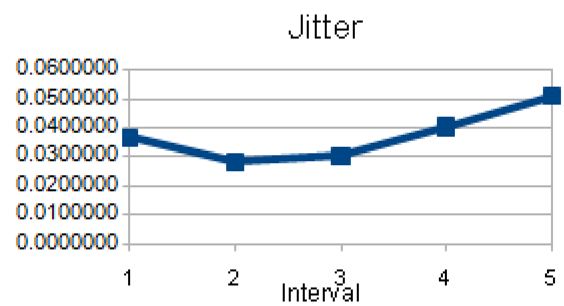

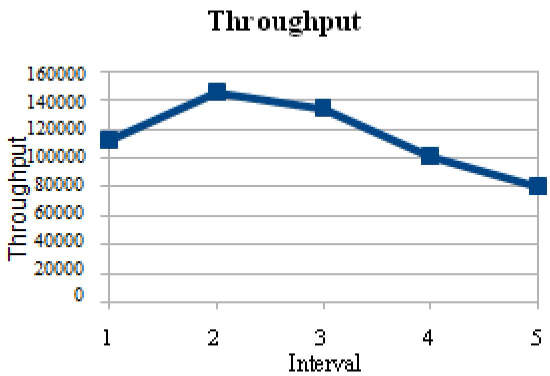


## 7. Conclusion

We present an efficient distributed algorithm for time bounded localization in wireless sensor network. It reduces the unnecessary communication overhead by reducing the number of rounds of communication for localization. Thereby reducing the time for localization of sensors in wireless sensor network and in MANET.

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