A Survey of Energy Aware Location Based Data Accuracy Estimation in Wireless Sensor Networks

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Abstract- A wireless sensor network (WSN) is made out of remote sensor nodes and a sink node. The nodes are remotely interconnected with one another and with the sink. WSNs have many applications, for example, assistant living, habitant monitoring, visual surveillance, and intelligent transportation to give some examples. Nodes catch information and forward it to the sink. On the off chance that a node isn't in an immediate correspondence scope of the sink, the information is accounted for in the multi-hop manner. The paper discussing about different types of MAC protocols and routing protocols for extensive scale wireless sensor networks to prolong the network lifetime. The types of WSN networks namely, Available bandwidth estimation (ABWE), Cluster based data accuracy estimation (CDAE), Received based MAC protocols (R-MAC), and Location aware sensor routing (LASeR).This paper presents a Literature survey of the algorithms explaining the concepts of multi-hop MAC routing protocols in WSN. Various routing algorithms have been studied by authors to improve the network lifetime, decrease the end to end delay, and reliability.

Keywords- WSN, distributed clusters, data accuracy, energy consumption, MAC, bandwidth, ABWE, CDAE, R-MAC, AND LASeR.

I. INTRODUCTION

A wireless sensor network (WSN) is made out of remote sensor nodes and a sink node. The nodes are wirelessly interconnected with one another and with the sink. WSNs have many applications, for example, colleague living [1], habitant checking [2], visual reconnaissance [3], and intelligent transportation [4] to give some examples. Nodes catch information and forward it to the sink. On the off chance that a node isn't in an immediate correspondence scope of the sink, the information is accounted for in the multi-hop manner. A routing protocol forwards data from the source to the sink, therefore the state of relaying nodes on a data forwarding paths w.r.t. different metrics, for example, available bandwidth, congestion, delay, and so on affects the performance of applications running over WSNs. A WSN can also generate real-time data, for example, real-time multimedia data. The multimedia data requires bounded delay and soft bandwidth guarantees. A routing protocol can only select the best path, therefore generally, it does not give guarantee to satisfy the requirements of a flow. However, a stream confirmation control calculation can be utilized to satisfy the requirements by admitting only those flows whose requirements can be satisfied.

There are a huge number of uses for MWSNs, including natural life checking [5], surveillance [6] or observing air defilement [7]. In applications, for example, these, the upsides of utilizing portable nodes are in enabling the entire system to move with an objective, the simplicity of redeployment and in the expanded territory they can cover [8]. The inspiration for this work is in this rapidly growing number of applications, which will all require individually tailored solutions.

The crude information gathered by the sensor nodes are commonly spatially connected [9] among other sensor nodes in the physical condition. As the thickness of the sensor nodes expands the spatially proximal sensor perception among the sensor nodes are much corresponded [10] in the sensor field. The sensor nodes frame conveyed clusters [11] in the sensor field because of high information relationship among the sensor nodes. Arrangement of circulated groups limits information gathering cost [12]. LEACH [13] gives a reasonable thought regarding the arrangement of conveyed dynamic groups in the sensor field as per priori likelihood. Every unique conveyed groups have a cluster head (CH) [14, 16] node which gathers the watched information and transmits it to the sink node. Like LEACH, SEP [15] shapes disseminated clusters in the heterogeneous systems.

II. RELATED WORK

In general, existing routing protocols for WSNs can be sorted into reactive and proactive protocols. Proactive protocols can further be categorized into opportunistic and cost-function-based protocols. In whatever is left of this section we briefly review the best in class routing protocols in each of the listed categories.

In [17-19], author proposed reactive routing protocols establish an information sending way from the source to the sink on demand using controlled flooding of a route request message. Most of the reactive routing protocols forWSNs use any one or combination of the following routingmetrics: hop-count, reliability, energy, delay, and congestion.For the most part, after getting the route request message, the sink selectsa path. On the off chance that the sink gets various duplicates of the message through various ways, it chooses the best way. The routing protocols displayed as model responsive directing conventions for WSNs. The time required to set up the path is the maindisadvantage of the reactive routing protocols.

In [20-23], author proposed routing protocols presented fall into the category of opportunistic routing protocols. Before starting an information packet's transmission, opportunistic routing protocols decide hopeful downstream nodes, that is, nodes giving progression towards a sink node.

In [24], author proposed MANET conventions are frequently characterized as proactive or responsive. The proactive conventions, for example, optimized link state routing (OLSR), endeavor to guarantee that every node has a functioning way to each other node.

In [25], author proposed mobility based clustering (MBC), works also to LEACH-M aside from that itutilizes a more complex method of cluster head decision, which considers assessed connection time,residual energy, the cluster heads node degree and distance. These measures are utilized to produce a reasonableness metric, which enables nodes to settle on an educated decision about which cluster head to connect with.

III. PROACTIVE ROUTING PROTOCOL DESIGN

Farooq, M.O., Kunz, T. [26] presents expound on the structure of the proactive directing convention for WSNs.

To analyze the effect of route length on the routing protocol's performance, we present a variantof the proactive protocol that trades-off the end-to-end availablebandwidth against the path length. Hereafter, the variant of theproactive routing protocol is referred as the modified proactiveprotocol. Moreover, to analyze the impact of route length on theeffectiveness of a flow admission control algorithm, we integrated a state-of-the-art admission control algorithm with the routing protocols presented in this paper and with the shortest hop-count-based protocol.

A. Available bandwidth estimation algorithm:

The available bandwidth estimation algorithm is the same as the bandwidth estimation algorithm. The average available bandwidth at a particular node n inside a network is denoted by ωn. The net bandwidth available at any node n inside a network is Bn, and it is equal to the minimum average available bandwidth at nodes within the interference range of a node, including the node n. As considerable increase in the data traffic load results in an increased MAC layer overhead. In the design of the routing protocol, we do not consider the impact of the additional MAC layer overhead with an increased data load because it requires information about the anticipated increase in the data load. Anticipating the increase in the data load in a network is not typically associated with the role of routing protocols, as the role is to find data forwarding path that best suits the requirements of the data being forwarded. For example, if a data packet requires high reliability, it selects a path that offers highest reliability.

B. Available-bandwidth-based routing protocol

The goal of the available bandwidth-based proactive routing protocol is for every node in a system to discover an information sending way (if present) towards each sink node in a system with the end goal that the chose way has the most elevated available bandwidth, and it should not include loops.

To incrementally build and maintain routing tables, each sink node inside a network broadcasts its network layer address and sink sequence number alongside the data required by the available bandwidth estimation algorithm in a HELLO message. A sink node broadcasts HELLO messages periodically with an incremented sequence number. Each node inside a network maintains a sink table, a single record in the sink table stores information about a sink node present inside a network. A record in a sink table stores the sink node's address, the sink sequence number, maximum available bandwidth on a selected data forwarding path towards the sink node, and the next hop address. On the gathering of the HELLO message, each immediate neighbour of the sink node extracts the information about a sink node. It matches the sink node address with the sink node' tends to display in its sink table. If the sink node address does not match, the direct neighbour adds a new record to its sink table. Otherwise, the direct neighbour compares the stored sink succession number with the got sink grouping number. If the received sink sequence number is greater, the record is updated with the received information, otherwise the sink information present in the HELLO message is ignored. Periodically, each node inside a network broadcasts HELLO messages (the same HELLO message as described in citeBEAR). The additional information apart from the data required by the available bandwidth estimation module is about the sink nodes the node has discovered. With each discovered sink node's information, the node advertises end-to-end minimum available bandwidth (minimum of Bn and the minimum available bandwidth stored in the node's sink table pertaining to the sink node) towards the sink node along with the sink sequence number extracted from the node's sink table.

A record in the forwarding table is removed if any one of the following cases happen:

(i) A node does not receive a data packet for the flow for a pre-defined interval of time,

(ii) A flow's next hop is expelled from the immediate neighbour table, and

(iii) A record in the sink table containing the sink node and the next hop that is being used by the flow times out. The last two cases require route repairs.

The proactive routing protocol uses the sink sequence number;normally sink/destination sequence numbers are not used in proactive routing protocols. The reason for using sink sequence number is because of the proactive routing protocol's goal to avoid loops. Loops (even if they are short lived) in the proactive routing protocol can be harmful, as in the proactive routing protocol we fix the data forwarding paths for the flows. Therefore, in the event that another stream shows up in a system, and around then there was a circle on the best accessible information sending way, the new stream's information won't achieve the sink node, because of the fact that the information sending way is fixed.

C. Cluster based Data Accuracy Estimation algorithm

Karjee, J., Jamadagni, H[27] presentsthegoal of this algorithm is to reduce thenumber of sensor nodes per cluster in the distributednetwork by finding a tradeoff between data accuracy andenergy consumption in probabilistic approach.

Initially sensor nodes are randomly deployed in the sensor field. On the off chance that we continue sending the sensor nodes, the sensor node thickness increments and the spatial relationship of the watched information among the sensor nodes likewise increments in the sensor field. Since the spatial connection of information increments among the sensor nodes, we get increasingly exact watched information from the sensor nodes. In any case, as the quantity of sensor nodes builds, the hub sending cost and the vitality utilization in the system likewise increments. Consequently we need to lessen the node organization cost by diminishing the quantity of sensor nodes to such an extent that we likewise accomplish better precise watched information from the sensor nodes with less vitality utilization in the system. In this area, we talk about a scientific establishment for the spatial connection of information among sensor nodes to frame non-covering circulated groups in the sensor field. Once the non-covering circulated groups are built in the sensor field, we explore to what degree the exact information are separated by sensor nodes in each appropriated cluster in the sensor systems. At long last the exact information are transmitted to the sink node by each dispersed group in the sensor network.

IV. DISTRIBUTED CLUSTERING ALGORITHM

We form distributed non-overlapping clusters of irregular shape and size among the sensor nodes in the sensor field using a distributed clustering algorithm. We construct the distributed clustering algorithm as follows:

Notations used in the algorithm:

M =Set of sensor nodes deployed in the field

ℂ = Set of cluster where each element c €ℂ is of the from $c=(a_c,b_c)$ where a denotes the CH node of the cluster c and b denotes the associated nodes (non-CH nodes)of the cluster c.

R=Radius of data correlation range.

A. Algorithm:

1. Start
2. Set W=M
3. ∀i € W ,let G(i)-{j € W: d(i,j) ≤ R,i+j}
   Where d(i,j) is the Euclidean distance between i and j sensor nodes.
4. S-{j € M:G(j)},i € M , we define $d_{max}(i)= \max d_{j€G(i)}(i,j)$
   where d(i,j) is the Euclidean distance between i and j sensor nodes.
5. Let $K=\text{argmin}_{i€S} d_{max}(i)$
6. ℂ = ℂ ᵕ{K,G(K)}
7. W=W-{K}-G(K)
8. If W≠ {ϕ} go to step 3
9. Stop

At last non-covering dispersed clusters are shaped in the sensor field. Presently we are intrigued to play out the information precision estimation for each dispersed cluster in the sensor field which we explain in the next part.

B. Clustering algorithm based Data accuracy Estimation

As distributed non-overlapping clusters are formed in the sensor field using the clustering algorithm, we perform data accuracy estimation for each distributed cluster. Each distributed cluster can measure a single tracing point of the same event in sensor field. We calculate the information exactness for the deliberate information at the CH node of the separate cluster in the sensor field. The data accuracy is performed to check the estimated data received at the CH node from all the sensor nodes in the cluster are accurate and don't contain any redundant information.

V. RECEIVED BASED MAC PROTOCOL

Akhavan, M.R., Aijaz, A., Choobkar, S. [28] presents the goal of this algorithm is to evaluate the multi-hopperformance of RB-MAC and adaptive RB-MACtechniques in the state-of-the-art RPL routing protocol. Notethat RB-MAC can be applied to any gradient based routingprotocols including geographic routing protocols. This outcomes in a cross-layer approach in which routing choices can be made dependent on MAC-layer functionalities.

A. Preamble sampling MAC protocol (PS-MAC)

In preamble sampling approach every node chooses its rest/wakeup plans freely of different nodes. Sensor nodes invest the vast majority of their time in rest mode to spare vitality and wake up for a brief length called clear-channel-assessment (CCA) each checking interval (CI) to check whether there is a continuous transmission in the channel. The sender node transmits a long preface with indistinguishable length from CI, trailed by the information packet, to ensure that all beneficiaries distinguish the prelude and after that acquire the information outline. By tuning CI and CCA, normal obligation cycles of underneath 1% can be accomplished with no requirement for planning or synchronisation. In some literature different terminologies have been used for Preamble Sampling approach, for example, cycled receiver and channel polling.

Based on the forwarding mechanisms in sensor nodes, we categorise preamble-sampling MAC protocols into two groups: SB-MAC and RB-MAC. First, we explain the operation of a typical sender-based protocol; we then explain RB-MAC followed by adaptive RB-MACs. In this paper we assume that all sensor node are aware of their distance (or hop-count distance) from the sink. This can be done in the network initialisation stage.

B. Sender based MAC (SB-MAC)

In SB-MAC, a sensor node that has a packet to send, selects a receiver from its neighbor table, includes the receiver's address in the packet header and transmits the packet. This procedure requires creating and maintaining the neighbor table in all the sensor nodes which not energy efficient in lossy networks owing to dynamic. In addition many retransmissions (up to seven times in IEEE 802.15.4) may occur because of dynamicity of the network, which consume considerable amount of energy and cause delay.

C. Receiver based MAC (RB-MAC)

In RB-MAC, a sender node transmits its data without defining a particular node as a receiver. All the neighboring nodes within communication range of the sender node receive the data packet. Based on the information received from the micro-frame in the preamble (i.e. sequence number of the data, how many micro-frameremains before the actual data arrive and distance of the sender to the sink), each individual node decides if it is 'eligible' (it is closer than sender node to the sink or it has higher energy than a threshold) to participate in forwarding the data. Receivers compete in an 'election' process to forward the message to the next node and the winner of thiscompetition, forward the data to the next hop towards sink. Figure. 1shows the timeline of RB-MAC protocol. In this figure sender node S tries to forward its data to its neighbors. First, it senses the channel to ensure that there is no ongoing transmission (performs CCA). If the channel is free, it starts transmitting the preamble followed by the data. All nodes within communication range of node S detect and sample a few micro-frames of the preamble. They all extract the information in the micro-frame (hop-count distance of the sender, sequence number of the data, and importantly it serves as countdown). In this figure, only three neighboring nodes of node S are eligible torelay data towards the sink node (e.g. they are closer to the sink than node S). They all wake up to receive the data from sender S. If the received data packet is detected to be erroneous, it is simply discarded.

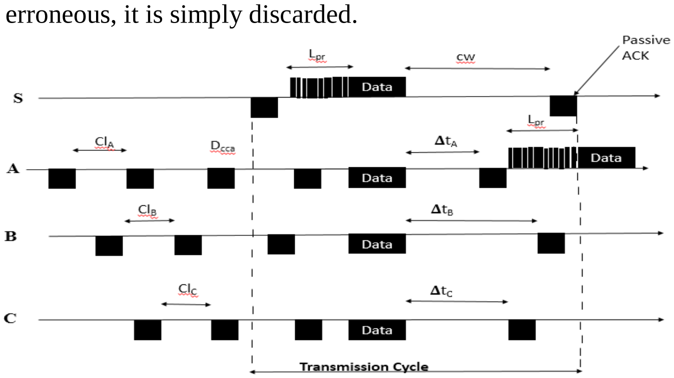

Fig.1: Timeline of RB-MAC

The nodes which successfully received the data, do not send anyAcknowledgment (ACK) message, however, they set a timer (Δt) before forwarding the data to the next hop. The set time is, for example, relative to the receivers' distance to the sink. The node with the shortest timer is the one that will forward the data towards the sink. Right after expiry of the timer, each relay node (such as B and C in Fig. 1) performs CCA. If the channel is detected as busy, it checks the sequence number of the detected micro-frame and compares it with its own. If the sequence numbers are equal it means that the same data is being transmitted by another node. Therefore it discards the data packet. Otherwise, a free channel indicates that this node is the winner and canstart sending preamble frames (A in Fig. 1). The above scenario continues and node A tries to send data towards the sink node using the same election process. If none of the participating nodes in the contention window (CW) period are successful to forward the data packet, the sender node (S) can realise this by performing CCA just before ending CW (passive ACK). Only in this case the sender node will re-transmit the data. According to RB-MAC outperforms typical sender based MAC protocol in terms of energy and delay because of more retransmissions in sender-based protocol. To avoid hidden terminal problem and prevent forwarding multiple copies of packet by the receiver nodes that have received the data packet without error, we assume that channel detection range of sensors is larger than their transmission range; in this case all the receiver nodes within transmission range of the sender node can detect the preamble. Therefore when a winner neighbour forwards the packet to all other neighbours can detect the forwarding preamble (during passive ACK). Hence, we would have only one forwarder and one route from source to destination.

D. Adaptive preamble MAC (ap-MAC)

The ap-MAC is a RB-MAC protocol with similar mechanisms described in RB-MAC section. In ap-MAC all the nodes have fixed CI values and sample the channel in equal time intervals. In contrast to RB-MAC, a sender node can define shorter preamble size based on one or more metrics (e.g. energy level of the sender node, data delivery delay, density of network and so on). The main objective of shortening the preamble size is to reduce (filter) the number of neighboring nodes within communication range of the sender node that can detect the preamble. By reducing the preamble size the number of nodes that receive the data packet will be less than that of RB-MAC. Consequently shorter preamble size can lead to energy saving in the sender node and lower data delivery delay to the next hop. Moreover, the adaptive preamble scheme can be used in a deadline/energy budget scenario, in which end-to-end delay/ energy should not exceed a predefined time. In this approach, each sender node can determine its preamble size based on the remaining time/energy budget. This issue is part of our future research.

E. Adaptive sampling MAC (as-MAC)

The adaptive sampling MAC (as-MAC) is a RB-MAC protocol in which sensor nodes can voluntarily participate in forwarding the packets based on their individual metrics. In as-MAC the size of the preamble is considered to be fixed whereas each sensor node independently adapts its own CI based on its residual energy, energy harvesting rate or any combinations of different metrics. In this scheme, nodes with higher (lower) harvesting rate or higher (lower) residual energy are likely to sample the channel more (less) frequently. In this case, the probability of detecting the sender's preamble and participating in the competition for high (low) power nodes will be high (less). In multi-hop scenario, the immediate sensor node to the sink will send the data packet instantly without preamble, because the sink is presumed to be active all the time.

F. Location aware sensor routing (LASeR)

Hayes, T., Ali, F.H[29] presents Location aware sensor routing (LASeR) protocol is a novel geographic routing protocol shows in figure 2, which uses location information to encourage a technique for inclination routing in portable conditions. LASeR utilizes daze sending to proliferate information through the system, which characteristically makes route diversity. Thus, on the off chance that one of the routes was to fail, there would be another accessible to convey the packet.

The use of territory mapping expects nodes to autonomously accumulate geographical data and report this to the sink. The information should be joined by some type of area data so it very well may be mapped. This means that the nodes will be equipped with some method of localisation.

LASeR takes advantage of the available location information in order to route packets. In addition, it is likely that the nodes will be deployed to map an area for a certain time period. This means that as long as each node has enough power to last for the duration of the mission, the number of nodes will remain fixed. The traffic rate will also be relatively periodic as nodes will generate data based on a given resolution. The packet structure used and n is the total number of sensor nodes, L is the length of one side of the square network area and QL is the quantisation level in meters.

VI. GRADIENT METRIC

The location information can be from any available geographic positioning technique, which may be application specific. Though it should be noted that some of these techniques require significant energy cost and their accuracy can be unreliable. For the purposes of this paper the location information is assumed to be perfect. This is to isolate the routing protocol such that its performance may be analysed Without the added effects of an imperfect localisation technique.

A. Forwarding Data

LASeR utilizes blind sending to transmit packets, which implies that the choice to forward a packet is made by the getting node, instead of the transmitting node. Hence, when a node receives a packet it stores it in a queue until its next opportunity to transmit. Then the node will decide if any of the packets in the queue should be forwarded. If so, it will blindly transmit the packet to all of its one-hop neighbours, otherwise it will drop the packet.

The choice to forward a message is made dependent on the received packets gradient metric. In this way, there are three possible actions to take based on a received packets' location information:

- If the location information indicates that the packet has come from a node that is further away from the sink, then it should be forwarded.
- If the packet has come from a node that is the same distance away from the sink, then it should be forwarded, with the priority bit clear, which will be discussed in the next section.
- If the packet has come from a node that is closer to the sink, then it should be dropped.

A. Packet priority

Packets with the priority bit set are designated as priority packets, whereas packets with the priority bit cleared are designated as diversity packets. A diversity packet is one that has been forwarded by a node with the same location index as the one that transmitted it. For example, a node with a location index of 3 broadcasts a priority packet to its neighbors. The neighbors with a location index of 2, store the packet for forwarding and the neighbors with a location index of 4 simply drop the packet. The neighbors that also have a location index of 3 clear the priority bit and store the packet for forwarding. The use of the priority bit increases the route diversity of the protocol and also helps to alleviate the dead-end problem.

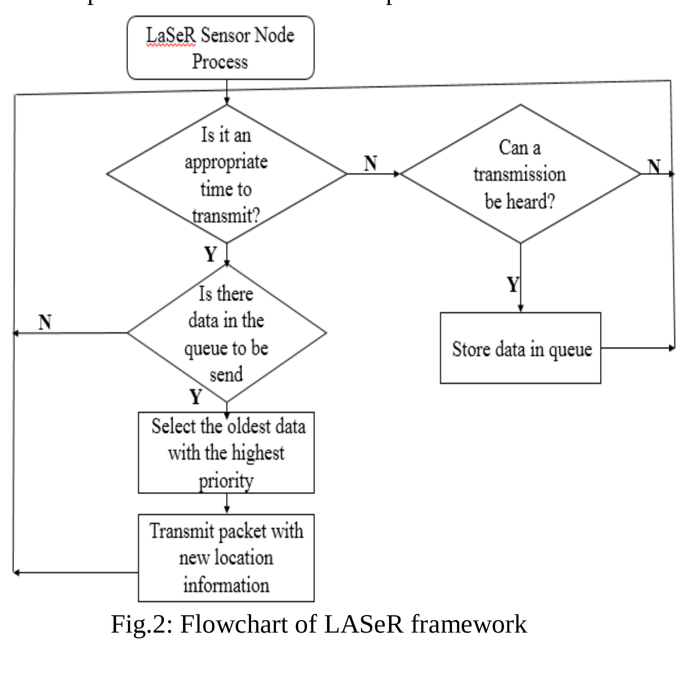

Fig.2: Flowchart of LASeR framework

VII. COMPARISON OFENERGY AWARE LOCATION BASED SCHEMES IN WIRELESS SENSOR NETWORKS

S.NO.	Author	Title	Analysis
1.	Farooq, M.O., Kunz, T.	'Impact of route length on the performance of Routing and flow admission control algorithms in wireless sensor networks'.	End-to-End Delay is reduced, High Packet Delivery Ratio, End-to-End available Bandwidth
2.	Karjee, J., Jamadagni, H	'Energy aware node selection for cluster-based data accuracy estimation in wireless sensor networks'.	.Data Accuracy, Energy consumption is less, Node Deployment cost and Energy cost are reduced, Network lifetime is increased.
3.	Akhavan, M.R., Aijaz, A., Choobkar, S., et al.	'On the multi-hop performance of receiver based MAC protocol in routing protocol for low-power and lossy networks-basedlow powerand lossywireless sensor networks'.	End-to-End energy efficiency, Reliability and Delay, End-to-End Delay is reduced, More Energy saving.
4.	Hayes, T., Ali, F.H.	'Location aware sensor routing protocol for mobile Wireless sensor networks'.	High Reliability, Low Latency requirements of emerging applications, High Packet Delivery Ratio, Energy consumption is less.

VIII. CONCLUSION

This paper presents a detailed literature of the energy aware location based data accuracy estimation algorithms in WSN.We illustrate the probabilistic approach by which the sensor nodes can be operated for active mode and sleep mode using the trade-off between information precision and vitality utilization in each dispersed group in the system. The utilization of visually impaired sending inalienably enables numerous courses for packets to go along, making an exceptionally powerful technique for routing that is perfect for adapting to visit topology changes. We presented the protocol operation and improve the network life time based energy levels. Simulation results shows energy consumption for the aggregate number of sensor nodes conveyed in the sensor region decays much faster than the ideal number of sensor nodes chose with respect to time. This increases life time of the network. Moreover our data accuracy estimation model performs better than information accuracy model in each distributed cluster with respect to data accuracy.

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