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A Survey on DRINA: a Lightweight and Reliable Routing Approach for In-Network Aggregation in Wireless Sensor Networks

Atul R. Toke[1], Prof. Hashmi S.A.[1]
[1] MGM College of Engineering, SRTM University, India, atulrajtoke@gmail.com
[2] MGM College of Engineering, SRTM University, India, hashmisa@rediffmail.com

***ABSTRACT**: WSN's (Wireless Sensor Networks) in a large amount of nodes will be deployed for different areas for perfect monitoring arrangement. due to the more quantity of mobile nodes in these networks, it is likely that superfluous data will be found when sensing the event of each node Since energy saving is important issue in WSNs, data must be aggregation and fusion should be exploited in transmitting of data to the sink node (base station)in order to energy saving. Under the Data aggregation the size and number of packets transformed to reduce the intermediate nodes for decreasing communication energy and price. In to this work, we propose a Data Routing for In-Network Aggregation, called DRINA, or routing algorithm , building the hop tree and cluster formation and leader election algorithm, route repair mechanism, route development. Suggested DRINA algorithm was extensively compared to two other known solutions: Shortest Path Tree (SPT) algorithms and the Information Fusion-based Role Assignment (InFRA).suggested dynamic LEACH protocol to improve the low energy adaptive cluster head calculation to calculate the data from the head node using the NS2 and Ns3 answer and. Result clearly indicates that it is the best and perfect aggregation quality as compared other algorithms. Obtained results show that our suggested solution outperforms these solutions in different scenarios and in different key aspects required by Wireless Sensor Networks.*

Keywords: wireless sensor network, routing algorithm, data aggregation.

1. INTRODUCTION

A Wireless Sensor Network (WSN) nodes, devices are distributed in different design spaces of location for continuously sensing the physical or environmental conditions, such temperature, humidity, vehicular movement, lightning condition, pressure, soil makeup, noise levels, the presence or absence of certain kinds of objects, mechanical stress levels on attached objects, and the current characteristics such as speed, direction, and size of an object at different geography [1], [2]. In Wireless sensor networks are always used in applications such perfect environmental monitoring, communications, manufacturing, and many other applications that can be critical to save lives and benefits [3], [4], [5]. Sensor nodes are energy-constrained devices and the energy consumption is generally associated with the amount of gathered data, since communication is often the most expensive activity in terms of power. For that reason, algorithms and protocols designed for WSNs should consider the energy consumption in their design. further, WSNs are data-driven networks that usually produce a large amount of information that needs to be routed, often in a multi hop fashion, toward a sink node, which works as a gateway to a monitoring in middle. Way of route plays an important role in the data gathering process.

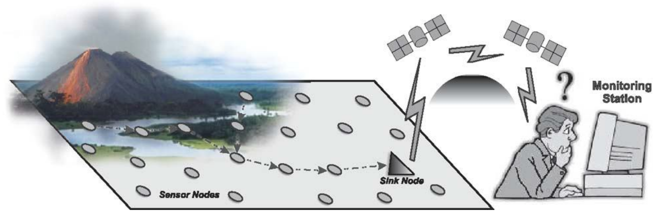

Figure 1: Data aggregation aware routing, a key algorithm for data-driven WSNs

A possible strategy to optimize the routing task is to use the available processing capacity provided by the intermediate sensor nodes along the routing ways. These are known as data-centric routing or in-network data gathering. Knob or Nodes are energy-constrained devices and the energy consumption is generally associated with the amount of gathered data, since communication is often the most expensive activity in terms of power. from figure 1 For that reason, algorithms and protocols designed for WSNs should consider the energy consumption in their design. WSNs are data driven networks that usually produce a large amount of information tat needs to be routed, often in a multi hop fashion, toward a sink knob. Given this scenario, routing plays an important role in the Data gathering process. Thus, various algorithms have been proposed to provide data aggregation during the routing in WSNs. Some of them are tree-based algorithms and try to solve some variation of the Steiner tree problem; others are cluster-based algorithms while others are simply structure-less. Various algorithms have been proposed to provide data aggregation during the routing in WSNs. Some of them are tree-based algorithms, cluster-based algorithms while others are simply structure-less arrangement modules [6][7].

DATA AGGREGATION TYPES

Data aggregation requires an ideal forwarding model, different from the classic routing, typically including the shortest path by some specific metric to forward data toward the base part. different the classic routing approach, in data aggregation routing algorithms, the packets are routed based on their content and the nodes choose the immediate next hop that maximizes the overlap of routes in order to promote in network data collection in one route areas. This protocol can be categorized into two parts: tree-based data aggregation protocols and cluster-based data aggregation protocols.

A. Tree- Based Approach

In the tree-based approach, aggregation is done by constructing an aggregation tree, which could be a minimum spanning shoetree. In which sink is consider as root and source nodes are considered as branches. particular children node has a parent node to forward its sensed information. Data flow starts from leaves nodes up to the sink and there data aggregation is done by parent nodes.

B. Cluster- based Approach

In cluster-based approach, whole network is divided in to several clusters. Cluster is defined as group of sensor nodes. Each cluster has a cluster-head which is selected on the bases of high energy level among cluster members. The role of aggregator is done by the Cluster- heads which aggregate data received from cluster nodes locally and then transmit the result to observer (sink).

2. DRINA: DATA ROUTING FOR IN-NETWORK AGGREGATION FOR WSN's

The main goal of DRINA is to make a routing tree and find out the shortest path which connects all source nodes to the sink, while maximizing the data gathering. In DRINA following roles are consider for building the routing tree.

1.Collaborator: It is node which detects an event(synchronization mechanism) and reports the collected data to the Coordinator node.

2.Coordinator: It is collaborator node detects an event but after using election algorithm it become a coordinator. This node is responsible for aggregating the collected data received from other collaborator and send results to the sink node.

3.Relay node : This node which is in route between coordinator and sink node, and forwards the data to the sink.

4.Sink Node :This node is interested in receiving the data from set of coordinator nodes & collaborator node [8][9].

DRINA algorithm is divided into three phase.

- Building Hop tree from sensor nodes to the sink node.
- Forming Cluster and electing a cluster head among the collaborator which becomes a coordinator.
- Route formation .

3.PROPOSED SYSTEM

The main goal of our proposed system is to build a hop tree with the shortest paths to connect all source nodes to the sink for the maximum data aggregation or gathering process.

THERE ARE 3 PARTS IN DATA AGGREGATION

- In part 1, Construction the hop tree from the sensor nodes to the sink node is built. In this stage, the sink node starts constructing the hop tree that will be used by Coordinators for data forwarding purposes.
- part 2 consists of creation of cluster and cluster head election among the nodes that detected theoccurrence of a new event in the network.
- part 3 is responsible for both setting up a new route for the reliable delivering of packets and updating the hop tree.

PART 1: STRUCTURE OF HOP TREE

In this stage, the distance from the sink to each node is calculated in hops. This stage is started by the sink node Sending message, the Hop Configuration Message (HCM) to all network nodes. Hop to Tree is the distance, in hops, by which an HCM message has passed. The Hop to Tree value is started with value 1 at the sink, which forwards it to its neighbors. Each node, upon receiving the message HCM, verifies if the value of Hop to Tree in the HCM message is less than the value of Hop to Tree that it has stored. If that condition is true then the node updates the value of the Next Hop variable with the value the Hop to Tree variable, and the values in the fields and HopToTree of the HCM message. Otherwise, if that condition is false, which means that the node already received the HCM by a shorter distance, then the node discards the received HCM message. The steps described above occur repeatedly until the whole network is configured. Before the first event takes place, there is no established route and the HopToTree variable stores the smallest distance to the sink. On the first event occurrence, HopToTree will still be the smallest distance; however, a new route will be established. After the first event, the HopToTree stores the smaller of two values: the distance to the sink or the distance to the closest already established route[10].

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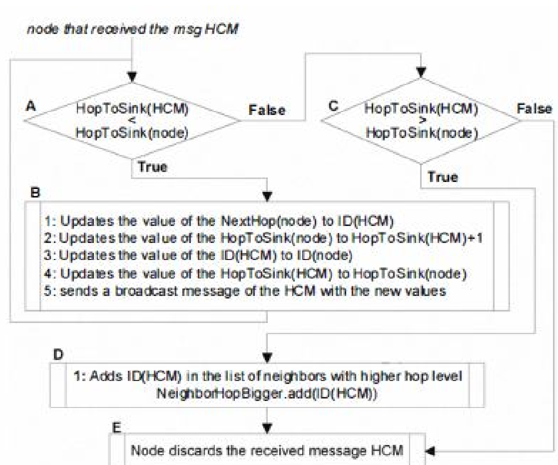

Figure 2: Building the hop tree and storing information about neighboring nodes

ALGORITHM

In the setup phase, the sink node or base station(BS) transmits a level-1 message with the minimum power. All nodes which receive the message set their level as 1. After that the base station increases its power to attain the next level and transmit a level-2 message. This procedure continuous until the base station transmits corresponding messages to all level [10]. BS broadcast a hello message, figure (1). This message contains the information of upper limit and lower limit of each level and each node calculates the distance from the BS based on received signal strength [13].

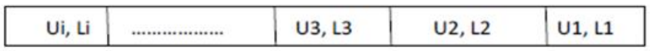

Figure 3 : Structure of a hello message packet

Algorithm for structure of hop tree:

Number of mobile nodes N
BS or sink node can transmit i levels; i _1
1. For each level i, message transmitted by BS
2. If(Nodes does not assign previous level and receive new message or BS transmit level i=1)
3. Assign level i
4. End if
5. End for
6. BS broadcast hello message, which contains the information of upper limit and lower limit of each level.
7. Each node calculates the distance from the BS based on received signal strength.

PART2: CLUSTER FORMATION AND LEADER ELECTION

With probability p and advertises itself as a clusterhead to the sensors within its radio range frequencies . We call these clusterheads the volunteer clusterheads . This advertisement is forwarded to all the sensors that are no more than k hops away from the clusterhead. (Figure 4)Any sensor that receives such advertisements and is not itself a clusterhead joins the cluster of the closest clusterhead. Any sensor that is neither a clusterhead nor has joined any cluster itself becomes a clusterhead; we call these clusterheads the forced clusterheads. Because we have limited the advertisement forwarding to k hops, if a sensor does not receive a CH advertisement within time duration t (where t units is the time required for data to reach the clusterhead from any sensor k hops away) it can infer that it is not within k hops of any volunteer clusterhead and hence become a forced clusterhead. Moreover, since all the sensors within a cluster are at most k hops away from the cluster-head, the clusterhead can transmit the aggregated information to the processing center after every t units of time. (Figure 5)This limit on the number of hops thus allows the cluster-heads to schedule their transmissions. Note that this is a distributed algorithm and does not demand clock synchronization between the sensors. The energy used in the network for the information gathered by the sensors to reach the processing center will depend on the parameters p and k of our algorithm. Since the objective of our work is to organize the sensors in clusters to minimize this energy consumption, we need to find the values of the parameters p and k of our algorithm that would ensure minimization of energy consumption. We derive expressions for optimal values of p and k in the next subsection.

Clustering means dividing sensor nodes in virtual group according to some rules (called cluster) and then, sensor nodes belonging in a group can execute different functions from other nodes [11,12, 13].

CLUSTERING DEFINITION

Clustering is involving grouping nodes into clusters and selecting a Cluster-Head (CH) [13, 14],
Members of a cluster can communicate with their CH directly or multi-hop;
CH can forward the aggregated data to the Sink through other CHs or directly,

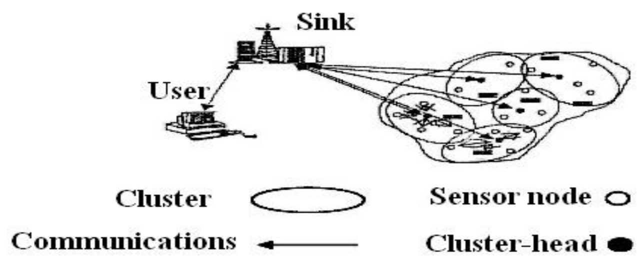

Figure 4: Cluster formation and leader election algorithm

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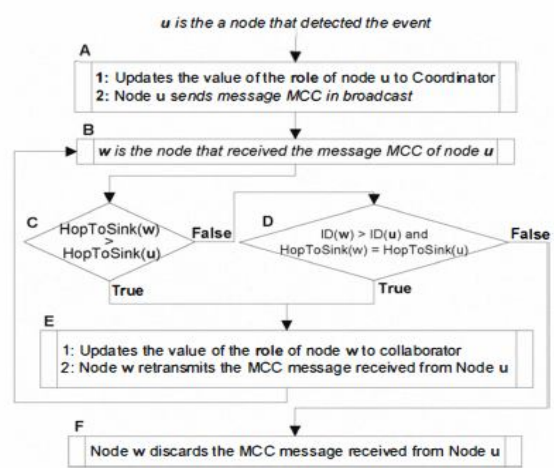

Figure 5 : Cluster formation and leader election

$$T(n) = \begin{cases} P/(1 - P\left(r \bmod \left(\frac{1}{P}\right)\right)), & n \epsilon G \\ 0 & otherwise \end{cases}$$

Where G are the nodes contesting for the CH position and r is the round of interest.

ALGORITHM

Step 1: Network Initialization
- Base Station broadcasts a low cost control messages for header selection to all nodes.
- All nodes send location and energy information to Base Station.

Step 2: Cluster Head **-** Set Selection
- BS selects a node with the greatest remaining energy becomes the first header for Cluster Head Set.
- Header Send the Advertisement
- Other Nodes reply to the header with Ack.
- Three Nodes with Maximum Energy are selected as a head set member. (figure 6)

Step 3: Path Chain Formation & Leader Selection
- End Cluster active head sends the TOKEN to Next Cluster.
- Leader sends the TOKEN to Base Station
- Base Station broadcasts the 'chain completion' message.

Step 4: Data Transfer
- Member nodes of each cluster send data to Active Cluster Head.
- Active Cluster Heads collect the data.
- Active Cluster Heads send the collected data to the leader through the chain.
- Leader node sends the final gathered data to Base Station.

Step 5: Changing Active Header

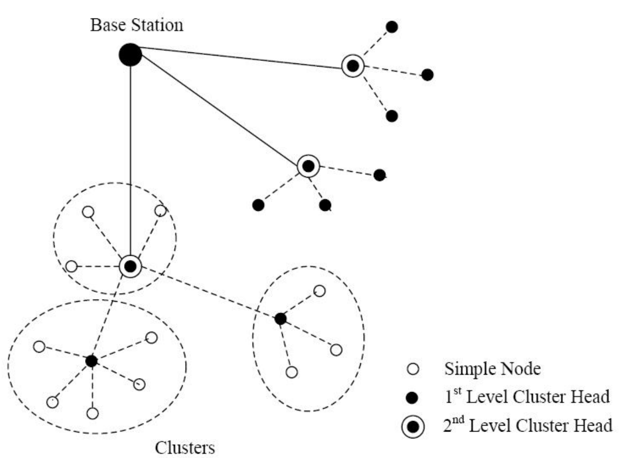

Figure 6 : Cluster-based Hierarchical Model

PART 3: ROUTE FORMATION AND HOP TREE UPDATES

Every node in the WSN, finds the trustworthiness with its neighbor nodes based on the said geometric mean based Trust Evaluation method. Every node maintains the database of different trust metric parameters of its neighbors. (figure 7) Similarly, every node (except Base Station) runs the Trust dependent LSR Protocol (it doesn't require to run Dijsktra's algorithm or any other algorithm to find the shortest path from node to sink because, highest route trust route automatically evaluates shortest path), and finds the best Route to the Base Station. Depending on the application, this will be done periodically by the all nodes to maintain different routes with different route trusts. The source node it means the node which has the packet/message of data to be transmitted to the Base Station, also runs the Trust dependent LSR Protocol and gets the Trustworthy routes given by its neighbor nodes or knobs. after the source node selects one best Trustworthy Route among many, depending on the neighbor nodes Trust (Ts) and the Route Trusts (RTs) given by them using the following algorithm. All the nodes in WSN should run the following algorithm (from step 1 to step 3) periodically for finding Trusts for their neighbor nodes and evaluate the trusted routes to the sink node or knobs. so the step 4 should run by the nodes those are participating in the trustworthy routing (i.e. all the nodes of the trustworthy route starting from source node except sink node.

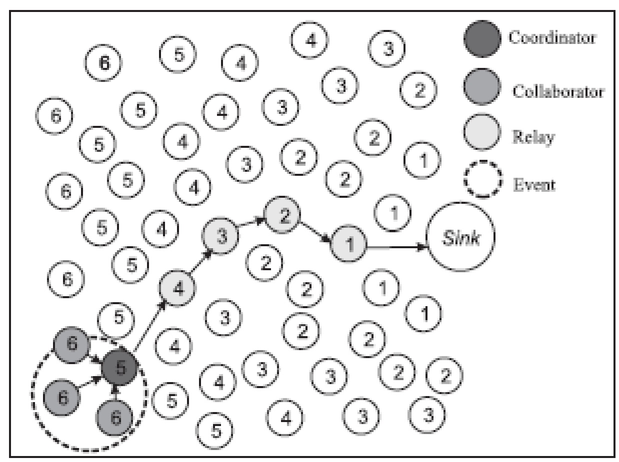

Figure 7: Route formation

CONCLUSION

Node clustering is a useful topology-management approach to reduce the communication overhead and exploit data aggregation in sensor networks area. so we have classified the different clustering approaches according to the clustering criteria and the entity responsible for carrying out the clustering areas. we have focused on distributed clustering approaches, which are more suitable for large-scale sensor networks areas. We highlighted some of the basic challenges that have hindered the use of clustering in current uses. We surmise that the most compelling challenges are how to schedule concurrent intracluster and intercluster transmissions, how to compute the optimal cluster size, and how to determine the optimal frequency for CH rotation in order to maximize the network moretime. Aggregation aware routing algorithms play an important role in event-based WSNs areas. In this work, we presented the DRINA algorithm, reliable Data Aggregation Aware Routing Protocol for WSNs areas. Our proposed DRINA algorithm was extensively compared to two other known routing algorithms, the InFRA and SPT, regarding scalability and confidentially.

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MR. PROF. HASHMI S.A. :working as a Head of the department of IT in M.G.M. college of Engineering, Nanded since 1999. Worked as computer Engineer for 5 years in ACS ltd. In Saudi Arebia responsible for network design, installation and maintaince of servers and infrastructure his research interest inCBIR ,computer network, mobile and wireless communication, dataware house and data mining. Hashmisa@rediffmail.com

MR. ATUL R. TOKE: is currently a PG scholar in of computer science and engineering at M.G.M. college of engineering Nanded. He received his bachelor degree in computer engineering from P.G.M.C.O.E. Wagholi, Pune his research areas include in wireless sensor network security. Atulrajtoke@gmail.com