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A Data Centric in Drina: Network Aggregation in Wireless Sensor Networks

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ABSTRACT**:** ***Inexpensive wireless communication, computation and sensing is now need of the Wireless Sensor Network (WSN) in the aggregation of data. Wireless sensor networks (WSNs) comprises huge counting of wireless sensor nodes which can sense and aggregate data in the environment in a periodic system. To make effective utilization of energy resources of a sensor node, communication protocols can be designed precisely. Collection and cluster formation in the sensor nodes is one of the best techniques to achieve this goal. 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. using the NS2 and Ns3 analysis of 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: Data aggregation, communication, network aggregation ,routing algorithm.

1. INTRODUCTION

A wireless sensor networks of the near future are envisioned to consist of hundreds to thousands of inexpensive wireless nodes, each with some computational power and sensing capability, operating in an unattended mode. They are intended for a broad range of environmental sensing applications from vehicle tracking to habitat monitoring [2], [1], [2]. The hardware technology for these networks - low cost processors, miniature sensing and radio modules are here today, with further improvements in cost and capabilities expected within the next decade [3], [2], [4], [8], [9]. The applications networking principles and protocols for these systems are just beginning to be developed [7], [8], [10], [12]. Sensor networks are quintessentially event-based systems. A sensor network consists of one or more “sinks” which subscribe to specific data streams by expressing interests or queries. The sensors in the network act as “sources” which detect environmental events and push relevant data to the appropriate subscriber sinks. For example, there may be a sink that is interested in a particular spatiotemporal phenomenon. They publish information toward the subscribing sink if and when they detect the indicated phenomenon. Because of the requirement of unattended operation in remote or even potentially hostile locations, sensor networks are extremely energy-limited. However since various sensor nodes often detect common phenomena, there is likely to be some redundancy in the data the various sources communicate to a particular sink or knob. So In-network filtering and processing techniques can help conserve the scarce energy resources.(figure 1) Data aggregation has been put forward as an essential paradigm for wireless routing in sensor networks [9], [13]. The idea is to combine the data coming from different sources eliminating redundancy, minimizing the number of transmissions and thus saving energy. This paradigm shifts the focus from the traditional address centric approaches for networking (finding short routes between pairs of addressable end-nodes) to a more data centric approach (finding routes from multiple sources to a single destination that allows in-network consolidation of redundant data). In this paper we study the energy savings and the delay tradeoffs involved in data aggregation and how they are impacted by factors such as source-sink placements and the density of the network. 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.

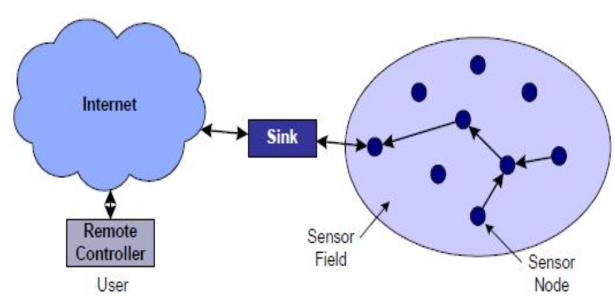

Figure 1: Sensor Network Architecture.

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

Classic routing strategies [12, 13] are usually based on a hierarchical organization of the nodes in the network. In fact, the simplest way to aggregate data flowing from the sources to the sink is to elect some special nodes that work as aggregation points and define a preferred direction to be followed when forwarding data. In addition, a node may be marked as special depending on many factors such as its position within the data gathering tree [14], its resources [15], the type of data stored its queue [16,], or the processing cost due to aggregation procedures .

B. Cluster- based Approach

LEACH [1] [2] and PEGASIS [9] are representatives of this family. In [1], the authors propose the LEACH protocol to cluster sensor nodes and let the cluster-heads aggregate data and communicate directly with the base station. To distribute energy consumption evenly among all nodes, the cluster-heads are randomly elected in each round. LEACH-C uses the base station to broadcast the cluster-head assignment, thus further spreading out the cluster heads evenly throughout the network and extending the network lifetime. Based on LEACH, [10] refines the cluster-head election algorithm by letting every node broadcast and count neighbours at each setup stage, where qualified potential nodes bid for the cluster head position.

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

The main goal of Drina is to build a routing tree with the shortest routes (in hops) that connect all source nodes to the sink maximizing data aggregation. Drina considers the following roles for the routing infrastructure creation:

•**COLLABORATOR NODE**: a node that detects events around the mobile node

•**COORDINATOR NODE**: a node that collects events from Collaborator nodes and identify them.

•**SINK NODE**: a node interested in receiving data from a set of Coordinator and Collaborator node.

•**RELAY**: path of a node that forwards data towards the sink node.

Drina is performed in four phases. Phase 1 constructs the hop tree from the sensor nodes to the sink, collects and delivers information about the nodes' positions to the sink node path. The sink node starts building the hop tree that will be used in Phase 3 by Coordinators to notify the sink on the occurrence of the event and request information about route for data transmission. Phase 2 consists of the cluster formation and the election of a cluster-head among the nodes that detected the occurrence of a new event in the network. Phase 3 is responsible for setting up the new route for delivering data packets. Finally, Phase 4 is responsible for sending the collected data to the sink node in a reliable way.

DRINA algorithm is divided into three phase.

- Construction of Hop tree from sensor nodes to the sink node.
- Forming Cluster and electing or choosing a cluster head among the collaborator which becomes a coordinator.
- Route or path making .

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 4 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 the occurrence 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 4 consists if any node is failure the it will make another route for data forwarding.

PART 1: STRUCTURE OF HOP TREE

The sink node floods the network with an HCM message, sets the HopToSink value to 0 and forwards it to its neighbours (at the beginning all nodes set the distance to the sink as infinity). Each node, upon receiving the message HCM, verifies if the value of HopToSink in the HCM message is less than the value of HopToSink that it has stored, as shown in point A of Figure 1. If that condition is true then the node updates the value of the Next Hop variable with the value of the field 10 of message HCM, the value of the HopToSink variable, the values in the fields 10 and HopToSink of the HCM message and relays the HCM message as shown in point B of Figure 1. Otherwise, the condition in point C of (Figure 1) is verified and if that is the case then the node stores the 10 of the node that sent the HCM message in its list of neighbours with the higher hop level and discards the received message. If it is not the case, the node discards the received message. The steps described above occur repeatedly until the whole network is configured.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.(Figure3) 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. 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].

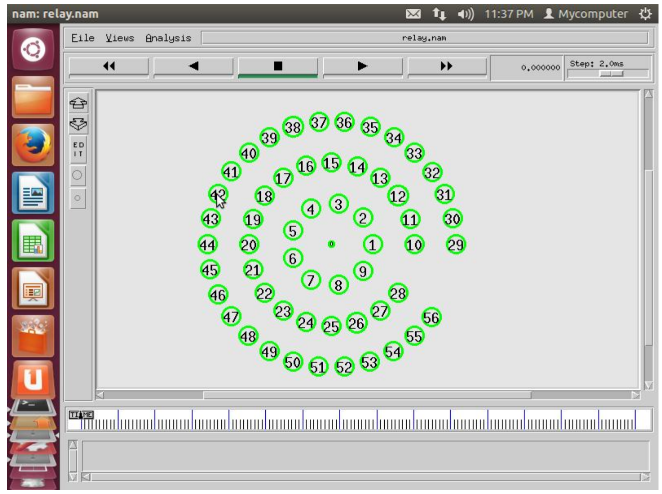

Figure 2 : Constructing the Hop tree and keeping Information about Neighboring Nodes

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].

Ui, Li	....	U3, L3	U2, L2	U1, L1

Figure 3: Structure Of a Hello Message Packet

PART 2: CLUSTER FORMATION AND LEADER ELECTION

In WSN grouping sensor nodes into clusters has been widely adopted by the research community to satisfy the above scalability objective and generally achieve high energy efficiency and prolong network lifetime in large-scale WSN environment areas. then corresponding hierarchical routing and data gathering protocols imply cluster-based organization of the sensor nodes in order that data fusion and aggregation are possible, thus leading to significant energy savings. In the hierarchical network structure each cluster has a leader, which is also called the cluster head (CH) and usually performs the special tasks referred above (fusion and aggregation), and several common sensor nodes (SN) as members. The cluster formation process eventually leads to a two-level hierarchy where the CH nodes form the higher level and the cluster-member nodes form the lower level. The sensor nodes periodically transmit their data to the corresponding CH nodes or knob. (Figure 2)

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]. CH nodes aggregate the data (thus decreasing the total number of relayed packets) and transmit them to the base station (BS) either directly or through the intermediate communication with other CH. because the CH nodes send all the time data to higher distances than the common (member) nodes, they naturally spend energy at higher calculation. So a common solution in order balance the energy consumption among all the network nodes, is to periodically re-elect new CHs (thus rotating the CH role among all the nodes over time) in each cluster. A typical example of the implied hierarchical data communication within a clustered network . The BS is the data processing point for the data received from the sensor nodes, and where the data is accessed by the end user. It is generally considered fixed and at a far distance from the sensor nodes. The CH nodes actually act as gateways between the sensor nodes and the BS. The function of each CH, as already mentioned, is to perform common functions for all the nodes in the cluster, like aggregating the data before sending it to the BS. In some way, the CH is the sink for the cluster nodes, and the BS is the sink for the CHs.

CLUSTERING DEFINITION

SENSOR NODE: A sensor node of a WSN, a core component, can take on multiple roles in a network, such as simple sensing,
data processing, data storage and routing,
CLUSTERS: Clusters for WSNs, is an organizational unit, the dense nature of these networks needed to be broken down into clusters to simplify tasks such a communication.
CLUSTER-HEADS: Cluster-heads of a cluster, are the organization leader, often organize the various activities in the cluster such as data-aggregation and organizing the communication schedule of a cluster .
BASE STATION: The base station of the hierarchical WSN, acts as communication link between the sensor network and the end-user.
END USER: who generates the query for sensor network, which depend on the application. Some of cluster based algorithms which are energy constraint protocols are: TEEN [7], APTEEN [8], PEGASIS [9], LEACH [13], InFRA[21] etc. In the Low-Energy Adaptive Clustering Hierarchy (LEACH) [13] algorithm, clustered structures are exploited to perform data aggregation. Cluster-heads (CHs) can act as aggregation points and will communicate directly to the sink node.(Figure4) LEACH-based algorithms assume that the sink can be reached by any node in only one hop, which limits the size of the network for which such protocols can be used. In the Information Fusion-based Role Assignment (InFRA) [18], the algorithm which aims at building the shortest path tree to maximizes information fusion. **(**Figure 6)

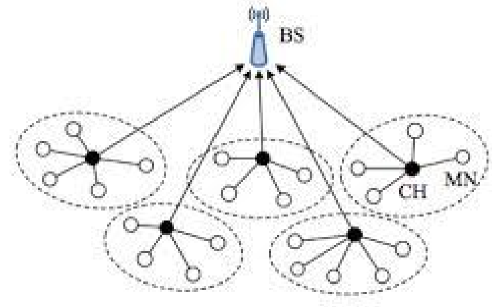

Figure 4: Cluster Formation and Leader Election Algorithm

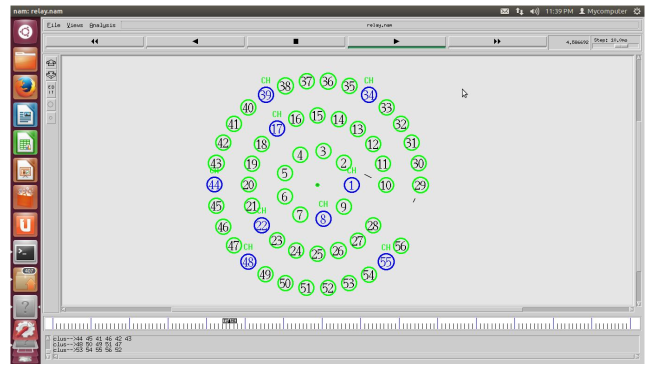

Figure 5: Cluster Formation and Leader Election as CH

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

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

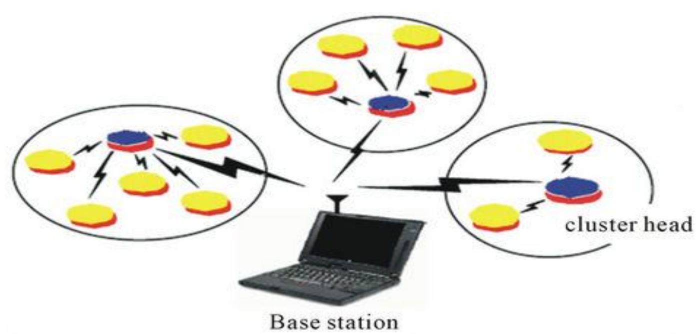

Figure 6 : Cluster-Based Model

PART 3 ROUTE FORMATION AND HOP TREE UPDATES

Wireless Sensor Networks offer solutions which covers wide range of applications. Depending on the application, their deployment environment may be hazardous, unattended and some times dangerous. The Cryptographic Security Systems in WSNs can not detect the node physical capture, the malicious or selfish nodes. Hence, new security systems are required for secure routing of message from source to BS (sink) of WSNs. A new way of getting security without using cryptography is Trust based security in WSNs. Trust [2] is "The degree of Reliability" of other node in performing actions and can be formed by maintaining a record of the transactions with other node directly as well as indirectly. From this record a trust value will be established. Trust management system for WSNs, is a mechanism that can be used to support the decision-making processes of the x network [2]. It aids the members of WSN to deal with uncertainty about the future actions of other participants (trustees). Many researches on trust related in WSN are processed, but it is required to design and develop a light weight trust management system that takes the less resources of the node in evaluation and management of trust between/among the nodes. The trust management of the WSN should be as simple as possible, i.e. without constraints on energy consumption, software, hardware.

Route discovery is based on query and reply cycles, and route information is stored in all intermediate nodes along the route in the form of route table entries. Nodes do not have any route information, the route discovery process can be initiated by each node by sending a route request packet, to find neighboring nodes those are one hop away from this node . source node will maintain routing table containing information . Each node can get to know its neighborhood by using local broadcasts, so-called HELLO message. Nodes neighbors are all the nodes that it can directly communicate with this node. The HELLO messages will never be forwarded because they are broadcasted with TTL = 1. After a message has been broadcasted, a node will wait for route reply message packet. So As soon as source node receives route reply message from nodes, it will update its routing table entry destination ID of a node. Sequence number will keep account of the fresh routes form. So Battery status will give information regarding energy levels of the nodes in that field. So Visit field will help in tracing a route from a source point to a destination node or knob. So we will use the TTL =1, in order to find neighboring nodes who are one hope away. Only those nodes who have there energy level greater than defines threshold level will take part in data transfer part.

Source ID	Destination ID	Node_ Status	Sequence nos	Battery Status	Visit	TTL

Figure 8: Route Table

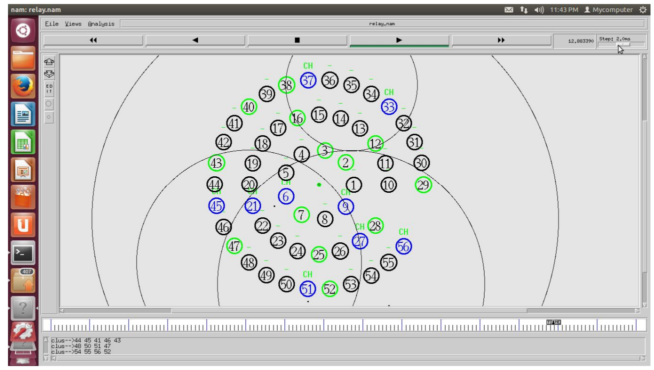

Figure 9: Root Formaion in NS2

4. EXPERIMENTAL RESULTS

For evaluating the performance of proposed algorithm, we compare it with LEACH protocol by performing simulation of both algorithms in NS2. Our network consists of 50 wireless sensor nodes where each node is distributed randomly in the area of 500*500m. The Base Station position i.e. X and Y co-ordinate of BS is (25,120). All nodes start with the initial energy of 1 Joules. Size of each data packet is 500 bytes.

5.CONCLUSION:

Node clustering is a useful topology-management approach to reduce the communication overhead and exploit data aggregation in sensor networks area. In this work we proposed a simple scheme to construct a skeleton for WSN immediately after network deployment. Our technique relies on the existence of a single sink node that is capable of transmitting directional and omnidirectional . We also built a simulator of the proposed construction protocol. Simulation results showed that the proposed protocol can construct a strongly connected skeleton that is well distributedWSNs 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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