ISSN(Online) : 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 4, April 2016

Device and Energy Aware Routing Protocol Based C-MIMO to Improve Network lifetime of WSN using Game Theory

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ABSTRACT: One of the major issues is to reduce the energy consumption by the sensor nodes as energy is the major constraint. Wireless nodes typically operate with small batteries for which replacement, when required is very difficult and expensive. Thus, in order to increase the network lifetime, minimization of the energy consumption is a very important design consideration. Cooperative techniques need to be incorporated to avoid this problem. In the proposed technique, clusters are formed using DEAR approach, and selects cooperative nodes in a network using MIMO. Transmit power is reduced considerably through C-MIMO thus the overall performance is enhanced. Through the proposed technique, unnecessary transmissions by the non-cooperative nodes are avoided. The proposed scheme offers better performance in terms of Energy efficiency.

KEYWORDS: Energy consumption, DEAR,MIMO,C-MIMO.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) often considered as a self-structured network of fewer power & least cost sensor nodes have been typically designed to examine monitor for chemical and physical changes in the environment, climatic conditions and disaster regions .The sensor nodes are light and portable sensible device, this can be sense while communication and processing all in critical applications. WSNs find out the route and sense different activities of network with configuration of ad hoc manner for communication. Wireless Sensor Networks (WSN) is research oriented field since long years. The physical cost of WSN system is very low which can gathered full information from every corner of network environment. Each device is collection of sensor having dear-less processor & with low-power telecommunication, lies in using and coordinating a vast number of such devices and allows the implementation of very large sensing activities.

Issues with wireless sensor network: The sensors in the network are with less powered battery. These sensors are distributed over large and sometimes not easily reachable areas. So sensors have major issue with power consumption. The major constraint for the power consumption of the wireless sensor networks are as following: A. Data overheating: Data overheating happens when node receives the irrelevant or redundant data. Radio processing: This happens when there is inefficiency in the coding, modulation, power transmission and antenna direction. C. Transmission or routing: The traffic overheating and collision due to improper transmission and routing technique is used. D. Idle listening: It happens when a node does not know when it will receive the data . In this case, the node keeps its radio on in waiting of potential data frames. The amount of energy wasted when the radio is on is considerable even when it is neither receiving nor transmitting data.

Energy conservation is an important issue in ad hoc networks as nodes are usually battery powered. Even though a node may not have any message of its own to transmit, its battery is drained when it acts as a router and forwards packets for other nodes. Energy aware routing (EAR) protocols have been proposed in response to the energy conservation requirement[14]. An early goal of EAR is to minimize the total energy consumed by the network. The basic approach is to minimize the average energy consumed per packet or per unit flow. One serious drawback of this approach is that nodes will have a wide difference in energy consumption. Nodes on the minimum energy paths will quickly drain out while the other nodes remain intact. This will result an early death of some nodes.

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The MIMO energy-efficiency transmission scheme is particularly useful for Wireless Sensor Network (WSN) where each wireless node has to operate without battery replacement for a long time and energy consumption is the most important constraint. However, the direct application of multi-antenna technique to WSN is impractical due to the limited physical size of sensor nodes that can typically support a single antenna. Fortunately, some individual sensor nodes can cooperate for the transmission and the reception in order to set up a cooperative-MIMO scheme. Power minimization strategies in different layers of the protocol stack of cooperative network have motivated intensive research interests in recent years. In particular, energy-efficient design in various aspects of communication systems, such as modulation, coding and routing.

II. RELATED WORK

They analyze the best modulation and transmission strategy to minimize total energy consumption required to send a given number of bits [4]. It is shown that traditional belief of MIMO systems being more energy-efficient than SISO systems in Rayleigh fading channels may be misleading when both the transmission energy and the circuit energy consumption are considered. The paper demonstrates that in short-range applications, especially when the data rate and the modulation scheme are fixed, SISO systems may outperform MIMO systems as far as energy efficiency is concerned. Nevertheless, if constellation size is optimized then MIMO outperforms SISO even for short distances. In [5] the authors have implemented a simple cooperative node selection algorithm to achieve higher energy gains in the MIMO approach, and examined how their algorithm affects the calculated thresholds. Moreover, authors have reached expressions to estimate threshold values regarding the channel conditions, the distance between source and destination nodes, and the network density, which determine the areas where the MIMO structure is more energy-efficient. The authors show that if channel conditions are unfavorable, multihop SISO approach proves to be more energy-efficient. They further argue that as the network density increases, gains are achieved due to multihop transmission. However, for large networks, single hop MIMO may not be practical. This work does not cover clustering aspect in sensor networks. Clustering is important for scalability and offers a reduced communication flow that is important for saving energy. In [10], authors propose a multilayer hierarchical architecture to cover more sensing area and to distribute energy across the network. The work focuses on hierarchy creation in the network without incorporating benefits of a scheme like cooperative MIMO suitable for long-range wider area coverage. Further, various aspects such as cluster-head rotation and scaling with number of nodes have not been addressed. Forero et al. [11] provide a clustering mechanism for spatially distributed data in wireless sensor networks using deterministic and probabilistic approaches to unsupervised learning. Again, the work is distinctive for its focus on distributed data aggregation and clustering than energy efficiency and long-range cooperative MIMO communication.

III. PROPOSED SYSTEM

Figure1 shows the architecture of our proposed method. It mainly includes Network initialization, Cluster formation, selection of Co-operative nodes, data transmission.

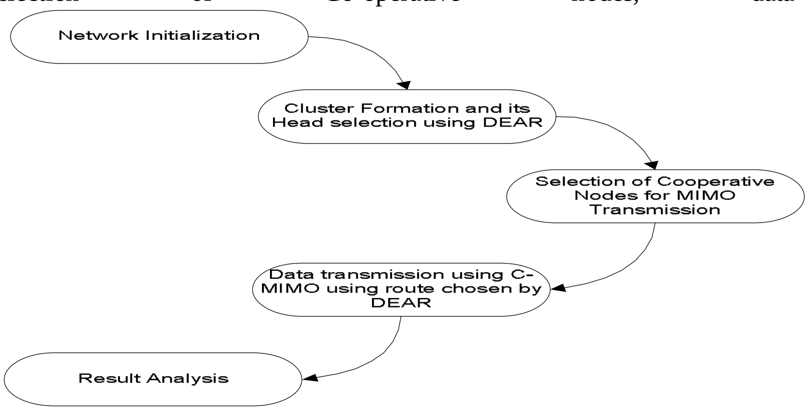

Figure 1: Proposed Architecture.

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a) Network Initialization:

Network initialization will be done with specified area and nodes are defined.

b) Cluster Formation :

Clustering is the grouping of similar instances/objects, some sort of measure that can determine whether two objects are similar or dissimilar is required. There are two main type of measures used to estimate this relation: distance measures and similarity measures. Many clustering methods use distance measures to determine the similarity or dissimilarity between any pair of objects. It is useful to denote the distance between two instances x_i and x_j as: d (x_i, x_j). A valid distance measure should be symmetric and obtains its minimum value (usually zero) in case of identical vectors.
The Euclidean distance between the two points is the hypotenuse of the triangle ABC:

$$D(i,j) = \sqrt{A^2 + B^2} = \sqrt{(x_{1i} - x_{1j})^2 + (x_{2i} - x_{2j})^2} \quad (1)$$

c) Cluster Head selection using DEAR protocol:

Using DEAR protocol we determine the most powered node for each cluster and consider it as Cluster head, we determine it to all the clusters and data packets will transmit based on this powered nodes from source to destination.
DEAR stands for Device and Energy Aware Routing [15]. A node is said to be device aware if it can distinguish between two states: it is powered by its internal battery or it is powered by an external source. We assume that the cost of using a node powered by an external source as zero. Thus we incorporate a redirect scheme in DEAR that actively redirects the packets to the powered nodes for power saving operations. We also assume that an external powered node has the capability to increase its transmission power to a higher level so that it can reach any other node in the network in one hop. The device aware redirect scheme is designed as follows. A conventional routing table entry should include at least the following fields: destinationAddr, cost, nextHop. An additional binary field, deviceType, is added to this structure for device awareness. A 0 indicates the node destinationAddr running on its own battery and a 1 indicates an externally-powered node. Each node maintains a routing table and an additional redirect table. The redirect table entry has the following structure: destinationAddr, redirectToAddr, indicating where (redirectToAddr) the packet leaving the current node to destination destinationAddr should be redirected. A –1 in field redirectToAddr indicates no redirection is needed. Whenever a routing table update is received, it updates its routing table as done in EAR or DBF. After updating its routing table, the node browses through its routing table and determines the shortest cost to reach any externally powered device. Let C represent this cost and let P be the id of the corresponding device. The redirect table will be updated as summarized in Figure 5. That is, for each entry in the redirect table, if the cost to that destination is bigger than C, packets to that destination will be redirect to P, correspondingly the field redirectToAddr will be set to P. Otherwise, the field redirectToAddr will be set to –1, indicating that packets to that destination should follow the routing table, but not be redirected. Whenever a node gets a packet to be forwarded, it gets the destination address from the header and it looks at the corresponding entry in the redirect table. If the entry in the redirect table is –1, the node just forwards the packet to the nextHop according to the routing table for that particular destination. If the entry in the redirect table is the id of some other node, it redirects the packet to that particular node. Once a powered node receives a packet, it checks if the destination of the packet is one of its neighbors (single hop nodes). If so, the node unicasts it to that particular destination. If not, it boosts its transmit power to cover the entire network and unicasts the packet to its destination. So it is just a single hop from a powered node to the destination. Since the node is externally powered it can boost it's transmit power to cover any distance.

d) Selection of co-operative nodes for MIMO transmission:

After the cluster formation, each cluster head will select J cooperative sending and receiving nodes for cooperative MIMO communication with each of its neighboring cluster head. Nodes with higher energy close to the cluster head will be elected as sending and receiving cooperative nodes for the cluster. At the end of the phase, the cluster head will broadcast a cooperative request (COOPERATE-REQ) message, which contains the ID of the cluster itself, the ID of the neighboring cluster head y, the ID of the transmitting and receiving cooperative nodes and the index of cooperative nodes in the cooperative node set of each cluster head to each cooperative node. The cooperative node on receiving the COOPERATE-REQ message stores the cluster head ID and sends back a cooperate-acknowledgement (ACK) message to the cluster head.

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e) Data transmission using C-MIMO:

To reduce the transmit energy in long distance (d) transmission between source node S and destination node D the route is selected by DEAR protocol we use cooperative MIMO communications .On the transmit side, node S can cooperate with its neighbors and exchange its data (the Distance between cooperating nodes dc << d as shown in Figure 2).

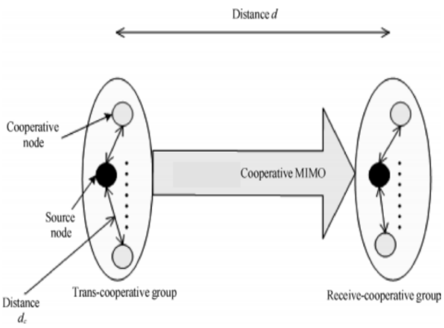

Figure 2:Data transmission using C-MIMO.

MIMO techniques are then employed to transmit their data simultaneously to the destination node (or multi-destination cooperative nodes) like a multi-antenna diversity system (each cooperative node plays a role of one antenna of MIMO system). In the reception side the cooperative neighbors of destination node D receive the MIMO modulated symbols and respectively retransmit them to the destination node D for joint MIMO signals combination. However, if the C-MIMO scheme can exploit the energy-efficient transmission of MIMO technique, the local data transmission at TX and RX sides of C-MIMO scheme costs extra transmission energy due to the extra circuit consumption of the cooperative nodes and the more complex MIMO digital signal processing.

IV. Results and Discussion

In this section explains the results of the proposed system.

- Residual Energy: The residual energy for cooperative nodes is remaining energy after transmission. The residual energy is given by,

$$E_{res} = E_{res0} + b_t E_{TXL} - M_r b_t E_{RXL} - b_t M_t E_{TXL} \quad (2)$$

WhereE_{res0} is remaining energy in previous round for cooperative node,$b_t$is the bit size, M_t is the number of transmitting nodes, E_{TXL} and $E_{TXL}$are the required energy per bit for intermediate communication and long haul communication respectively at transmitter side. E_{RXL} is the energy required per bit at receiver side.

- End-to-End Delay: The delay means time taken by the packets to reach destination node from source node over a number of hops. The link delay depends on number of hops and channel condition.

$$D_N = \frac{(T_E - T_S)}{\sum N_h} \quad (3)$$

Where, T_S is the sending time of packet and T_E is the receiving time of packet.
Below shows the comparison graphs for our proposed method to existing method.

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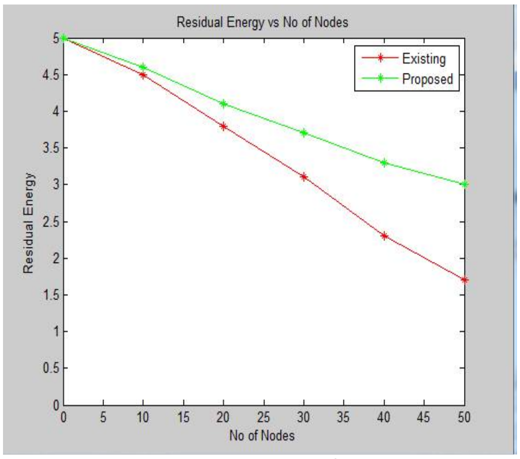

Figure 3: Shows comparison graph for Residual Energy.

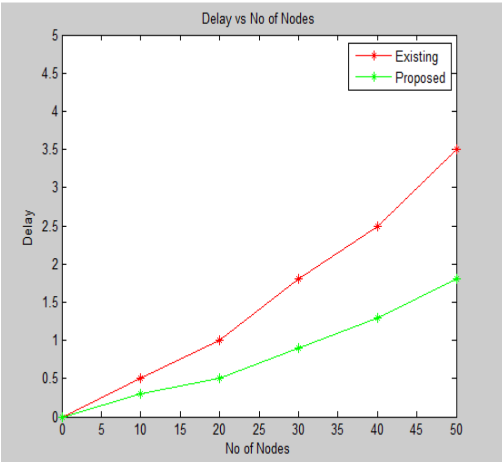

Figure 4: Shows comparison graph for Delay.

V. CONCLUSION

Energy efficient is a primary challenges for WSN. In our proposed method use of MIMO for packet transmission have been shown to have potential of greatly increasing the channel capacity.MIMO based structure has been proposed to offer enhanced energy saving in WSNs.The Co-operative MIMO leads to higher link reliability and lower retransmission rate. Graphs show more residual energy and less delay.

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