



Review of Routing Protocols in Wireless Sensor Networks

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Abstract: *In this research paper, methodology used in wireless sensor networks is reviewed. Wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions and to cooperatively pass their data through the network to a Base Station. Clustering is a critical task in Wireless Sensor Networks for energy efficiency and network stability. Clustering through Central Processing Unit in wireless sensor networks is well known and in use for a long time. Presently clustering through distributed methods is being developed for dealing with the issues like network lifetime and energy-means is a prototype based algorithm that alternates between two major steps, assigning observations to clusters and computing cluster centers until a stopping criterion is satisfied. This is a survey paper which show that distributed clustering is efficient than centralized clustering*

Keywords: *WSN, hierarchial routing, cluster formation*

I. INTRODUCTION

A sensor network is defined as being composed of a large number of nodes with sensing, processing and communication facilities which are deployed either inside the phenomenon or very close to it. Each of these nodes collects data and route the information back to a sink. In Current years, Wireless sensor networks becomes the furthermost exciting networking technologies to offer the sensed collected data to the base station with restricted power ability . Sensor nodes are battery driven devices with restricted energy resources. Once installed, the minor sensor nodes are usually unapproachable to the operator, and thus auxiliary of the energy source is not practicable. Stretching network lifespan for these nodes is a vital issue Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, and acoustic and radar. Applications of the WSNs include to monitor a wide variety of ambient conditions like temperature, humidity, vehicular movement, lightning condition, pressure, soil makeup, noise levels, In Military for target field imaging, Earth Monitoring, Disaster management Fire alarm sensors, Sensors planted underground for precision agriculture, intrusion detection and criminal hunting [5].

II. CLASSIFICATION OF ROUTING IN WSN

In general, routing in WSNs can be divided into *flat-based* routing (*data-centric* routing), *hierarchical-based* routing, and *location-based* routing depending on the network structure. In hierarchical-based routing, nodes will play different roles in the network. The main aim of hierarchical routing is to efficiently maintain the energy consumption of sensor nodes by involving them in multi-hop communication within a particular cluster.

III. GOALS OF WSN

The basic goals of WSNs are as follows [11]

- a) Determine the physical variable at a given location
- b) Detect the occurrence of events of interest, and estimate parameters of the detected event or events.
- c) Classify a detected object and also track an object.

IV. ROUTING CHALLENGES AND DESIGN ISSUES IN WSN

There are different parameters are there which provides a very challenging criterion in routing for WSN and they are as follows [11]

1. Node deployment in the sensor network.
2. Energy Consumption in the network should occur Without losing of accuracy of the network.
3. Data reporting Method should be configured in the network.
4. Node/Link Heterogeneity of the network.
5. Scalability of the network.
6. Network Dynamics.
7. Transmission Media should be fault tolerance
8. Coverage area of different sensor nodes in the network.

9. Data Aggregation process within the clusters in the network.
10. QOS policies of the networks

V. ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORK

A WSN can have network structure based or protocol operation based routing protocol. Routing protocols in WSNs might differ depending on the application (Protocol-Operation-based) and network architecture (Network-Structure-based) [11, 2].

Depending on protocol operation WSN can be classified into

A. Multipath-based routing: It uses multiple paths rather than a single path in order to enhance network performance. For instance the fault tolerance can be increased by maintaining multiple paths between the source and destination at the expense of increased energy consumption and traffic generation.

B. Query-based routing: The destination nodes propagate a query for data from a node through the network. A node with this data sends the data that matches the query back to the node that initiated it.

C. Negotiation-based routing: This negotiation based routing is done in order to eliminate redundant data transmissions. In this communication decisions are also made based on the resources available in the network scenario.

D. QOS-based routing: When delivering process of data in ongoing with the help of this routing, balances the network in between energy consumption a data quality through certain QOS metrics such as delay, energy or bandwidth.

E. Coherent-based routing: The entity of local data processing on the nodes is being distinguished between the coherent (minimum processing) and the non-coherent (full processing) routing protocols. Depending on the network structure Routing Protocols can also be classified into

F. Flat-based routing: In this routing protocol each node plays the same role and sensor nodes collaborate to perform the sensing task.

G. Hierarchical-based routing: In this type of routing, the nodes having the higher-energy are used to process and send the information, while the nodes having the low-energy are used to perform the sensing in the proximity of the target. The process of creation of clusters and assigning special tasks to cluster heads can efficiently increase the overall system scalability, lifetime, and energy efficiency. Hierarchical routing is an efficient way to lower the energy consumption within a cluster with the help of performing data aggregation and fusion within the different clusters in order to decrease the number of transmitted messages to the sink node.

H. Location-based routing: In this type of protocol sensor nodes are addressed by means of their locations. The distance between neighboring nodes can be estimated on the basis of incoming signal strengths from the source nodes. Relative coordinates of neighboring nodes can be obtained by exchanging such information between neighbors or by communicating with a satellite using GPS. To save energy, some location-based schemes also suggest that nodes should go to sleep if there is no activity to perform in a definite time.

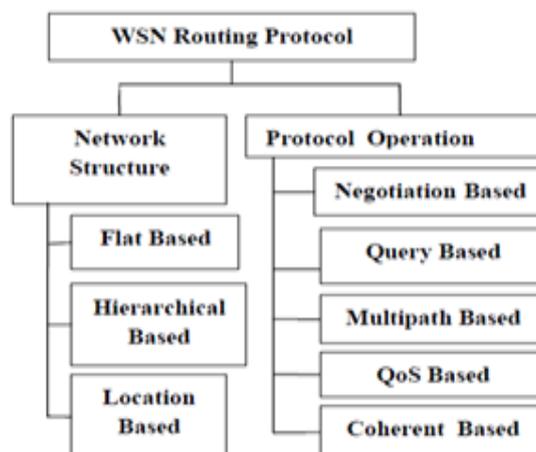


Fig.1. Routing protocols classification for WSNs

VI. CHALLENGES OF WIRELESS SENSOR NETWORKS

1. In some of the cluster based routing algorithm distribution of the cluster heads is concentrated to One area only.
2. Some cluster based routing algorithms are not efficient for time critical application.
3. All available Cluster based routing algorithms are top down approach, which interns requires Reclustering when deployed in some mission critical application.

4. Some cluster based routing algorithms allows all the CHs to send the aggregated information to Base station that leads to more energy dissipation in the network.
5. Few of the cluster based routing algorithms uses probabilistic approach while processing and Communicating of information in the network which does not consider residual energy in the Network nodes and those results in early dyeing of CHs.

VII. ADVANTAGES OF CLUSTERING OVER DIFFERENT CLASSES OF ALGORITHMS

1. Minimization of energy consumption of intra cluster and as well as inter cluster network.
2. Scalability of the network.
3. Network life time prolonging.
4. Reduction of information packet delay.
5. Handling heterogeneity of network

VIII. HIERARCHIAL ROUTING PROTOCOL

Among the issues in WSN the consumption of energy is one of the most important issues [11]. Traditional routing protocols for WSN may not be optimal in terms of energy consumption [paper Energy]. Hierarchical routing protocols are found to be more energy efficient than other protocols [11]. Hierarchical routing follows the clustering mechanisms. Clustering techniques can be cluster, higher energy nodes. By the use of a clustering technique they minimize the consumption of energy greatly in collecting and disseminating data [11]. This is neither but the process of fusion and aggregation process. Hierarchical routing protocols minimize energy consumption by head (CHs) can be used to process and send the information to the base station while low energy nodes i.e. the cluster members can be used to perform the sensing in the proximity of the target and send to its cluster head. This means that creation of clusters and assigning special tasks to cluster heads can greatly contribute to overall system scalability, lifetime, and energy efficiency, reduces the size of the routing table by localizing the route setup within the clusters, and conserves communication bandwidth of network [11]

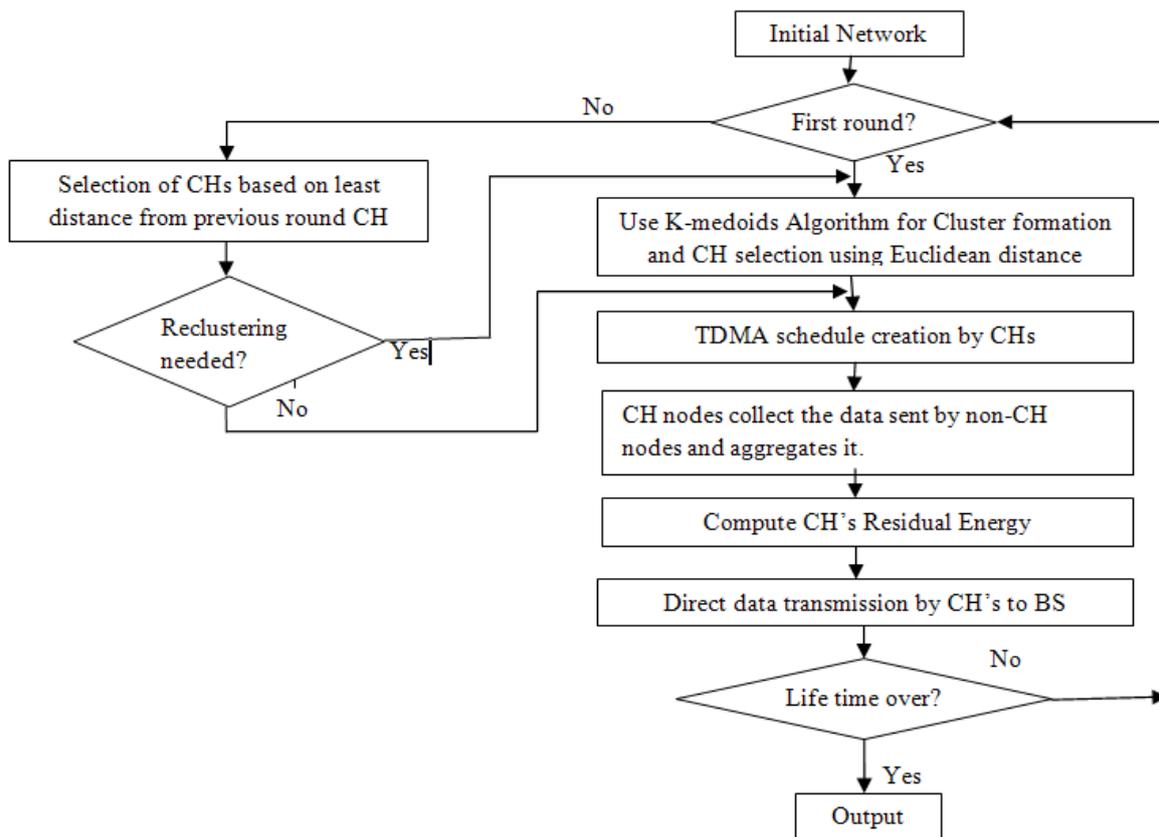


Fig:2: cluster formation

IX. HIERARCHICAL CLUSTER-BASED ROUTING

Our hierarchical cluster-based routing scheme is suitable for habitat and environmental monitoring applications. The proposed routing scheme is based on the fact that the energy consumed to send a message to a distant node is far greater than the energy needed for a short range transmission. by using a head-set instead messages to the distant base station. At one time, only one member of the head-set is active and the remaining head-set members are in sleep mode. The task of transmission to the base station is uniformly distributed among all the head-set members. First, we describe a few terms that are used in defining our protocol. A cluster head is a sensor node that transmits an aggregated sensor data to the distant base station. Non-cluster heads are sensor nodes that transmit the collected data to their cluster head. Each

cluster has a head-set that consists of several virtual cluster heads; however, only one head-set member is active at one time. Iteration consists of two stages: an election phase and a data transfer phase. In an election phase, the head-sets are chosen for the pre-determined number of clusters. In the data transfer phase, the members of head-set transmit aggregated data to the base station. Each data transfer phase consists of several epochs. Each member of a head-set becomes a cluster head once during an epoch. A round consists of several iterations. In one round, each sensor node becomes a member of head-set for one time. The above communication stages are illustrated in Figure 3. Of a cluster head. In other words, during each election, a head-set that consists of several nodes is selected. The members of a head-set are responsible for transmitting.

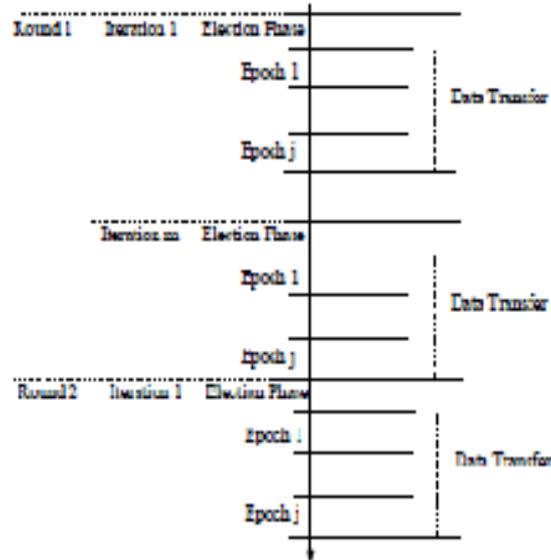


Fig:3: communication stages in a cluster of WSN

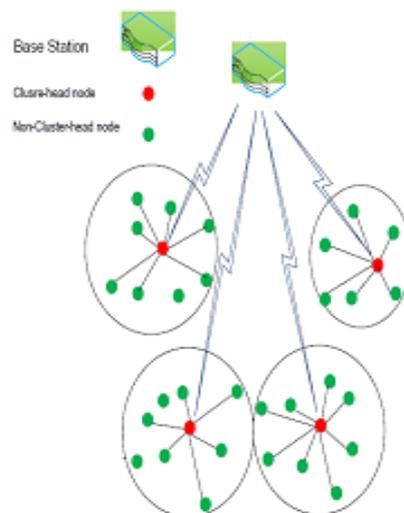


Fig.4. Clustering Model Hierarchical routing

X. STATES OF A SENSOR NODE

Different states of a sensor node in a wireless sensor network are shown in Figure 2. The damaged or malfunctioning sensor states are not considered. Each sensor node joins the network as a *candidate*. At the start of each iteration, a fixed number of sensor nodes are chosen as cluster heads; these chosen cluster heads acquire the *active* state. By the end of election phase, a few nodes are selected as members of the head-sets; these nodes acquire *associate* state. At the end of an election phase, one member of a head-set is in active state and the remaining head-set members are in associate state. In an epoch of a data transfer stage, the active sensor node transmits a frame to the base station and goes into the *passive associate* state. Moreover, the associate, which is the next in the schedule to transmit to the base station, acquires the active state. During an epoch, the head-set members are distributed as follows: one member is in active state, a few members are in associate state, and a few members are in passive associate state. During the transmission of the last frame of an epoch, one member is active and the remaining members are passive associates; there is no member in an associate state. Then, at the start of the next epoch, all the head-set members become associate and one of them is chosen to acquire the active state. At the end of iteration, all the head-set members acquire the *non-candidate* state. The members in non-candidate state are not eligible to become a member of a head-set. At the start of a new round, all non-candidate sensor nodes acquire candidate state; a new round starts when all the nodes acquire non-candidate state.

Election phase: In the proposed model, the number of clusters, k , are pre-determined for the wireless sensor network. At the start, a set of cluster heads are chosen on random basis. These cluster heads send a short range advertisement broadcast message. The sensor nodes receive the advertisements and choose their cluster heads based on the signal strengths of the advertisement messages. Each sensor node sends an acknowledgment message to its cluster head. Moreover, for each iteration, the cluster heads choose a set of associates based on the signal analysis of the acknowledgments. A head-set consists of a cluster head and the associates. The head-set, which is responsible to send messages to the base station, is chosen for one iteration of a round. In an epoch of an iteration, each member of the headset becomes a cluster head. All the head-set members share the same time slot to transmit their frames. Based on uniform rotation, a schedule is created for the head-set members for their frame transmissions; only the active cluster head transmits a frame to the base station. Moreover, a schedule is created for the data acquisition and data transfer time intervals for the sensor nodes that are not members of the head-set.

Data Transfer Phase: Once clusters, head-sets, and TDMA-based schedules are formed, data transmission begins. The non-cluster head nodes collect the sensor data and transmit the data to the cluster head, in their allotted timer slots. The cluster-head node must keep its radio turned on to receive the data from the nodes in the cluster. The associate members of the head-set remain in the sleep mode and do not receive any messages. After, some pre-determined time interval, the next associate becomes a cluster head and the current cluster head becomes a passive head-set member. At the end of an epoch, all the head-set members have become a cluster head for once. There can be several epochs in iteration. At the end of iteration, the head-set members become non-candidate members and a new head-set is chosen 10 for the next iteration. Finally, at the end of a round, all the nodes have become non-candidate members. At this stage, a new round is started and all the nodes become candidate members.

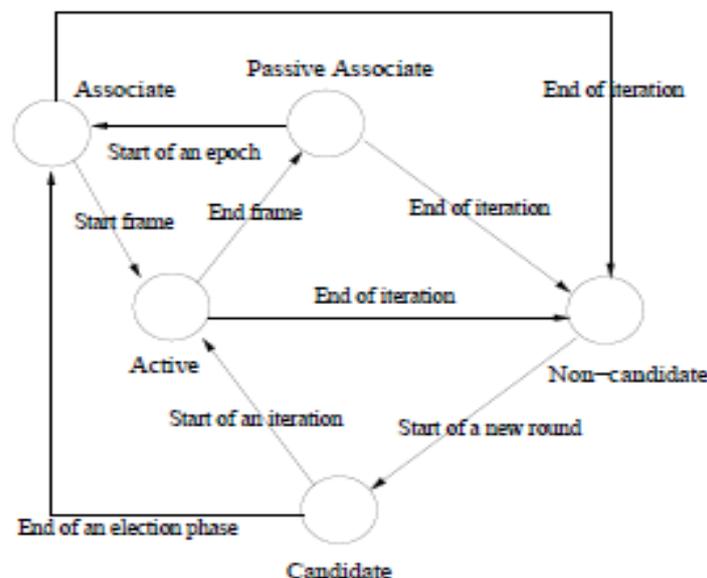


Fig.5. states of a sensor node in wireless sensor networks

XI. CONCLUSION

This work is an overview of routing protocols in wireless sensor networks. Goals, routing challenges and classification of routing protocols in wireless sensor networks are reviewed. Comparison of classification of routing protocols in wireless sensor networks based on network structure and protocol operation. Hierarchical cluster based routing and a different state of a sensor node in wireless sensor network is studied. Energy consumption in wireless sensor network can be formulated using routing techniques.

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