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Threshold Sensitive Stable Election Multi-path Energy Aware Hierarchical Protocol for Clustered Heterogeneous Wireless Sensor Networks

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Abstract- In the current era the major issues in Technologies Generation is wireless sensors life time which is totally depend on management of the energy saving in each sensor Node. The active research in this field is free to improve network lifetime which is vital in (WSN) wireless sensor networks. Several algorithms have been developed out of which cluttering algorithms are increased a lot of significance in increasing the network sensor lifetime of each sensor Nodes. In this research paper a new protocol is developing with using two different protocols advantage property with removing disadvantage of each. Threshold Sensitive Stable Election Multi-Path Energy Aware Hierarchical Protocol (TSMEHP). where work define how this algorithm help to choose cluster head (CH) with help of energy model and how optimal number of clusters can be computed, here use three energy levels of heterogeneity, Regular Nodes, Active Nodes, Smart Nodes. where Smart Nodes having energy greater than all other Nodes, Active Nodes with energy in between Regular and Smart Nodes while remaining Nodes are Regular Nodes. Active Nodes can be chosen by using l, a fraction of Nodes which are Active Nodes and using the relation that energy of Regular Nodes is μ times more than that of Regular Nodes. This paper proposed an algorithm in which work will be comparing with Seven different protocols namely, DEEC, ESEP, LEACH, TEEN, SEP, EAMMH and TSEP with some general scenarios. This work will the analysis of simulation results and observations made with all these protocols are presenting overtakes regarding life time of sensing Nodes. In the protocols work use feather of TSEP protocols and EAMMH. Where TSEP is advance protocols which is combination of TEEN and SEP, which means TSEP is more superior to other protocols.

Keywords- Efficiency and Throughput, IEEE 802.11, unicast and broadcast packet, network.

I. INTRODUCTION

Wireless Technologies based IEEE 802.11 on Wi-Fi system is one of the supreme deployed wireless access technologies around the world. A wireless sensor network is a group of sensor nodes with limited power supply and inhibited computational and broadcasting capability. Because of the limited broadcasting and computational facility, and high density of sensor nodes, promoting of advertisement and data packets are transmitting data with multi-hop. As per as research is concern, routing in wireless sensor networks has been an important area in the past few years.

In sensor nodes non-rechargeable batteries help to run, so along with efficient routing the network should be energy effective with efficient use of the resources and hence this is an important research concern. Improvements in wireless technologies and evolution of low cost sensor nodes have headed to introduction of low power wireless sensor networks. Due to multiple functions and comfort of deployment of the sensor nodes it can be used in various applications such as target tracking, environment monitoring, health care, inventory control, forest fire detection, surveillance, reconnaissance, energy management and so on [1]. The main responsibility of the sensor nodes in a network is to forward the collected information from the source to the sink for further operations, but the resource boundaries and unreliable links between the sensor nodes[2] in combination with the various application demands of different applications make it a difficult task to design an efficient routing algorithm in wireless sensor networks.

Planning appropriate routing algorithms for different applications, achieving the different performance demands has been careful as a significant issue in wireless sensor networks. In this situation, many routing algorithms have been planned to improve the performance demands of various applications through the network layer of the wireless sensor networks protocol stack but most of them are founded on routing.

In the past few years multi-path routing approach is widely used for different network management drives, such as providing a fault tolerant routing, refining broadcasting reliability, Quality of Service (QoS) and Congestion control support in the wired and wireless networks, but the unique features of the wireless sensor networks and the appearances of the short-range radio communications introduce a new trial that should be spoke in designing the multi-path routing protocols.

Some protocols are the hierarchical routing protocols which were projected to rise the scalability of the network and make the network energy efficient through node clustering. In this group of protocols all the sensor nodes are grouped into clusters and each cluster will have a cluster head which will be accountable for the collection of data from its cluster nodes, data processing and then promoting the data towards the sink. Though this construction provides high network scalability, clustering operation but the cluster head replacement levy high signaling overhead to the network. Some routing algorithms such as Low-Energy Adaptive Clustering Hierarchy (LEACH), Threshold-Sensitive Energy-Efficient Sensor Network Protocol (TEEN) fall in this category [2] the next group of routing protocols utilize the careful location of the sensor nodes for the routing purposes. The geographic Location of the nodes can be obtained directly using Global Positioning System (GPS) devices or indirectly through swapping some information regarding to the signal strengths received at each node. Since the localization needs special hardware support and imposes significant computation overhead, this approach cannot be easily used in resource forced wireless sensor networks. Geographic and Energy-Aware Routing (GEAR) and Geographic Adaptive Fidelity (GAF) can be referred as the geographic routing protocols.

Multipath Routing in Wireless Sensor Networks The limited capacity and transmission competence of multi hop path and high dynamics of wireless links single path method is not able to provide efficient data rate in broadcast in WSN. To overcome these issues now a day's multi-path method is used widely. As mentioned before multi-path routing has established its efficiency to improve the performance of wireless sensor and ad-hoc networks.

II. LITERATURE SURVEY

In this research paper [2] author study on the impact of heterogeneity of nodes, in terms of their energy, in wireless sensor networks that are hierarchically clustered. In these networks some of the nodes become CH, aggregate the data of their cluster members and transmit it to the sink. author assume that a % of the population of sensor nodes is equipped with additional energy resources this is a source of heterogeneity which may result from the initial setting or as the operation of the network evolves. author also assume that the sensors are randomly (regularly) distributed and are not mobile, the coordinates of the sink and the dimensions of the sensor field are known. author show that the behavior of such sensor networks becomes very unstable once the first node dies, particularly in the presence of node heterogeneity. Classical clustering protocols undertake that all the nodes are equipped with the same amount of energy and as a result, they cannot take full advantage of the existence of node heterogeneity. in this paper author propose SEP, a heterogeneous aware protocol to prolong the time interval before the death of the first node, which are crucial for many applications where the response from the sensor network must be consistent. SEP is based on weighted election probabilities of each node to become cluster head according to the remaining energy in each node. author show by simulation that SEP always prolongs the stability period associated to the one obtained using current clustering protocols. at last author conclude by learning the sensitivity of our SEP protocol to heterogeneity parameters capturing energy imbalance in the network. author found that SEP yields longer stability region for upper values of extra energy carried by more powerful nodes.

In this article author [3] write wireless sensor network contains a set of sensor devices that are usually operating on battery power with a limited energy resources and due to the dimensionality, it requires replacing the batteries in a such networks is a complicated task. Thus, energy efficiency is one of the most important issues and designing energy efficient protocols is critical for prolonging the lifetime. In this paper introduces a two routing protocols namely, LEACH and EAMMH in Homogenous and Heterogeneous system supported by simulation scripts, and analysis of the results against known metrics with energy and network lifetime being major among them. author show simulation results using MATLAB, that is the proposed EAMMH in Homogenous and Heterogeneous system significantly reduces energy consumption and increases the total lifetime of the wireless sensor network.

In this research paper [4] Advancement in wireless sensor network (WSN) technology has provided the opportunity of small and minor-cost sensor nodes with potential of sensing various provisions of physical and environmental conditions, data processing, and wireless communication. The importance of diversity of sensing effectiveness is in the excess of application areas. However, the originality of wireless sensor networks requires extra effective approach for data forwarding and processing.

In WSN, the sensor nodes have a restricted transmission range, and their refining and storage potential as well as their energy systems are also restricted. Routing protocols for wireless sensor networks are accountable for maintaining the routes in the network and have to create reliable multi-hop communication under certain situations. In this research work, a survey of routing protocols for Wireless Sensor Network and compare their strengths. Author also focuses on one of the prime design points for a sensor network is maintenance of the energy available in each sensor node. Expanding network lifetime is critical in wireless sensor networks. Many routing algorithms have been established in this regard. Out of all these, clustering algorithms have gained a lot of relevance in increasing the network lifetime thereby the efficiency of the nodes in it. Clustering provides an sufficient way for prolonging the lifetime of a wireless sensor network. In This work author put elaborately compares five renowned routing protocols namely, TEEN, SEP, LEACH and EAMMH, PEGASIS for several general scenarios, and brief analysis of the simulation results against known metrics with energy and network lifetime being major among them.

III. PROPOSED TECHNIQUE

In Multi-Path Energy Aware Hierarchical process contains various rounds, having each round begins with a set-up phase, when the clusters are organized, followed by a steady- state phase, when data transfers to the base station occur.

Neighbor Discovery phase:

In this phase every Node broadcasts a control packet contains their Node ID, residual energy, and the location and wait for the neighbor discovery control packets from the Nodes of its range to find the neighbor Nodes. After the neighbor discovery phase each Node finds its neighbor Nodes.

Multi-Path Hierarchical:

After the Neighbor Discovery phase, each Node possesses their neighbor information and then the Multipath Hierarchical Structure phase starts. Here assume that the source Node location is known to the Home and based on the location of the source the Home starts the route request process. In this the main concept is that, there are two type of Nodes Chief and Alter. A Node is a Chief Node if it is in the Chief path from source to Home else if it is the part of any Alter path then it is the Alter Node. As described in the Algorithm, the Chief Nodes find two paths to the source, the Chief path and the Alter path. The Chief path is built with the best possible neighbor (having the minimum Location Factor(LF))and the Alter path is constructed with the next best neighbor (having the next minimum Location Factor(LF) after the Chief path Node). The Alter Nodes find one single path towards the source Node and searches its neighbor table for the Node with minimum Location Factor(LF) and will prefer a Chief Node if possible, this is done to converge the path else the path can diverge from its direction toward the source, Next hop is chosen by the following equations 1 and 2

$$NHop_i = \min(LF_i) \qquad \text{Equation-1}$$

$$LF_i = (Loc_{Scr} - Loc_x)\forall x \in Negb_i) \qquad \text{Equation-2}$$

Where, LF_i is the set of distance of all the neighbors of $Node_i$ from the source. Loc_{scr} is the location of the source Node, Loc_x is the location of the $Node_x$ and $Negb_i$ is the neighbor set of $Node_i$. Here it is an incremental approach from the Home to the source. First the Home Node which is itself a Chief Node, selects two neighbors based on the equation 1. Out of these two neighbor Nodes one with the minimum location factor becomes the next Chief Node and the Node with the second minimum location factor becomes the Alter Node. Algorithm performs this step in the initialization of the multipath construction phase.

In our TSMEHP protocol discuss about energy model and how optimal number of clusters can be computed, here use three energy levels of heterogeneity, Nodes with different energy levels are:

1) *Regular Nodes*
2) *Active Nodes*
3) *Smart Nodes*

Smart Nodes having energy greater than all other Nodes, Active Nodes with energy in between Regular and Smart Nodes while remaining Nodes are Regular Nodes. Active Nodes can be chosen by using l, a fraction of Nodes which are Active Nodes and using the relation that energy of Regular Nodes is µ times more than that of Regular Nodes.

Fraction of Smart Nodes (m) and the additional energy factor between Smart and Regular Nodes (α), Where assumes that each Node knows the total energy of the network in order to adapt its election probability to become a cluster head (CH) according to its remaining energy [5]. Our approach is to assign a weight to the optimal probability P_{opt}. This weight must be equal to the initial energy of each Node divided by the initial energy of the Regular Nodes. Let us define as P_r the weighted election probability for Regular Nodes and P_s the weighted election probability for the Smart Nodes.

Nearly there are n*(1+α*m) Nodes with energy equal to the initial energy of a Regular Nodes. In order to maintain the minimum energy consumption in each round within an epoch, the average number of cluster heads per round per epoch must be constant and equal to n* P_{opt}. In the heterogeneous scenario the average number of cluster heads per round per epoch is equal to n*(1 +

α*m) *P_r (because each virtual Node has the initial energy of a Regular Node). The weighed probabilities for Regular and Smart Nodes are, respectively:

$$P_r = \frac{P_{opt}}{1+\alpha*m+l*\mu} \quad \text{Equation -3}$$

$$P_s = \frac{P_{opt}*(1+\alpha)}{1+\alpha*m+l*\mu} \quad \text{Equation -4}$$

Here replace P_{opt} by the weighted probabilities to obtain the threshold that is used to elect the cluster head in each round. We define as T_r the threshold for Regular Nodes and T_s the threshold for Smart Nodes. Thus, for Regular Nodes,

$$T_r = \begin{cases} \frac{P_r}{1-P_r*(Cr*mode\ \frac{1}{P_r})} & if\ n_r \in G' \ otherwise \\ 0 \end{cases} \quad \text{Equation -5}$$

$$T_s = \begin{cases} \frac{P_s}{1-P_s*(Cr*mode\ \frac{1}{P_s})} & if\ n_s \in G'' \ otherwise \\ 0 \end{cases} \quad \text{Equation -6}$$

G′ and G″ are the set of Regular Nodes and set of Smart Nodes that has not become CHs in the last $\frac{1}{P_s}$ respectively, so ensuring that the equations 3 and 4 are working for rounds of the epoch, and T_s is the threshold applied to a population of n*m Smart Nodes. This guarantees that each Smart Node will become a cluster head (CH) exactly once every $\frac{1}{P_{opt}} * \frac{1+\alpha*m}{1+\alpha}$ rounds. Let us define this period as sub-epoch. It is clear that each epoch (let us refer to this epoch as "heterogeneous epoch" in our heterogeneous setting) has (1+α) sub-epochs and as a result, each Smart Node becomes a cluster head exactly (1+α) times within a heterogeneous epoch. The average number of cluster heads per round per heterogeneous epoch (and sub-epoch) is equal to n*m*Psv. The average number of cluster heads per round per heterogeneous epoch is equal to the average number of cluster heads that are normal Nodes per round per heterogeneous epoch plus the average number of cluster heads that are Smart Nodes per round per sub-epoch. This average number is given by

$$n * P_{opt} = n * (1-m) * Pr + n * m * Ps \quad \text{Equation-7}$$

While, average number of CHs is same as that of LEACH, SEP, ESEP, TSEP and a good aspect of TSMEHP protocol which is energy dissipation is reduced due to energy heterogeneity. At the start of each round, the phenomenon of cluster change takes place. In case of TSMEHP protocol, at cluster change time, the CH broadcasts nodes response parameters are given below-

Report Time (TR): During time period which reports are being sent by each Node successively.
Attributes (A): The physical parameters about which information is being sent.

Active Threshold (AT): An absolute value of identified attribute beyond which Node will transmit data to CH. As if recognized value becomes equal to or greater than this threshold value, Node turns on its transmitter and sends that information to CH.

De-Active Threshold (DAT): The smallest recognized value at which the Nodes switch on their transmitters and transmit.

Here, in this protocol all Nodes keep on detecting environment nonstop. As parameters from attribute set reaches active threshold value, transmitter is turned on and data is transmitted to CH, however this is for the first time when this condition is met.

IV. SIMULATION AND EXPERIMENTATION

Algorithm set-up phase

Multi-Path Hierarchical Algorithm-1
Input: Set of n sensor Nodes randomly distributed
Output: One Chief and Multiple Alter Paths from Source to Home.

```
Repeat
if (Node == Home Node) then
        Find Chief Path();
        Find Alter Path();
else if (Node == Chief) then
        Find Chief Path();
        Find Alter Path();
else if (Node == Alter) then
        Find Chief Path();
end if
        until (Node≠ Source)

Function Find Chief Path()
        if (Node == Chief) then
                Broadcast CHIEF;
                Search for the best Node;
                Node ← Chief;
        end if
        if (Node == Alter) then
                Broadcast ALTER;
        Search for the best Node and prefer Chief;
                if (Node ≠ Chief) then
                        Node ← Alter;
                end if
        end if
end Function

Function Find Alter Path()
        if Node == Chief then
        Search for the next best path Node accept Chief;
                if ((Node ≠ Chief) && (Node ≠ Alter)) then
                        Node ← Alter;
                end if
        end if
if (Node == Alter) then
        Exit();
end if
end Function
```

Algorithm steady- state phase

Threshold Sensitive Base Cluster Head (CH) Selection Algorithm-2
Input: Set of n sensor Nodes, Multi-Path Hierarchical
Output: Node Generated Identified Value and
Cluster Head (CH)

Run Algorithm 1 for Energy Aware and Multi-Path Hierarchical equation 1 and 2
Find Neighbor Discovery
Identify nonstop value
Calculate Optimal Probability of Nodes P_{opt}
Make clusters base on energy of Nodes (by equation 3,4), P_r, and P_s
Calculate Threshold Sensitive Value (by equation 5, 6) T_r, and T_s
Every Node Generate value Ngv
If T_r>= Ngv
Regular Nodes Become CH (G')
Else if T_s>= Ngv Smart Nodes Become CH (G'')
Else
Re-Calculate Ngv Until Node Energy <=0
End if
Calculate Average no. of CH per Round (Cr) by equation 7

Algorithm Periodic Updates
Identify nonstop value (AT and DAT) Value Iv
Iv = store new value
If AT >=T_r Or Iv_x>= Ivy
Transmitter ON
Else if AT >= T_s Or Iv_x>= Ivy
Transmitter ON
Else
Transmission will decreased
End if
Repeat until node died.
Nodes Sleeping until not identify greater than Iv or Active Threshold value

This sensed value is stored in an internal variable in the Node, called Identified Value (Iv). Then for second time and the other, Nodes will transmit data if and only if identified value is greater than active threshold value or if difference between currently identified value and the value stored in Iv variable is equal to or greater than de-active threshold. So, keep these both thresholds in consideration, number of data transmissions can be reduced, as transmission will only take place when identified value reaches active threshold. And further transmissions are decreased by de-active threshold, as it will eliminate transmissions when there is a small change in value, even smaller than interest. Some of important features are described below:

Nodes keep on detecting nonstop but transmission is not done frequently, so energy consumption is much more less than that of proactive networks. At time of cluster change, values of de-active threshold, (TR) and (A) are transmitted afresh and so, user can decide how often to sense and what parameters to be detected according to the criticality of detected attribute and application. The user can change the attributes depending on requirement, as attributes are broadcasted at the cluster change time. One of the main trades off of this scheme is that if threshold is not reached, the simulation will not get any information from network and even if one or all the Nodes die, system will not come to know about that. So, it is not useful for those types of applications where a data is required regularly.

V. CONCLUSION

This research paper proposed "Threshold Sensitive Stable Election Multi-Path Energy Aware Hierarchical Protocol" (TSMEHP) protocol technique in which every sensor node has three energy levels of heterogeneity ordered network which autonomously selects itself as a cluster head CH based on its initial energy relative to that of other nodes. where this work define how algorithm choose cluster head (CH) with help of energy model with optimal number of clusters can be computed, here use three energy levels of heterogeneity, Regular Nodes, Active Nodes, Smart Nodes. where Smart Nodes having energy greater than all other Nodes, Active Nodes with energy in between Regular and Smart Nodes while remaining Nodes are Regular Nodes. This paper analyses simulation results of TSMEHP with different existing protocols of wireless networks and comparing these observations with all these protocols on life time of sensing nodes. This protocol is combination of TSEP protocols and EAMMH where TSEP is advance protocols which is combination of TEEN and SEP, which means TSEP is more superior to other protocols. In this paper TSMEHP, responsive routing protocol is proposed where nodes with three different levels of energies. CHs selection is threshold based, due to three levels of heterogeneity and being responsive routing network protocol, it causes increase in constancy period and network life. This work concluded that our protocol TSMEHP will achieve better results in small as well as large sized networks.

REFERENCE

I. O. Shagdar, K. Nakagawa and B. Zhang, "Achieving Per-Flow Fairness in Wireless Ad Hoc Networks", Elec. Comm. in Japan, Part 1, vol. 89, no. 8, (2006), pp. 37–49.

II. Georgios Smaragdakis Ibrahim Matta Azer Bestavros, "SEP: A Stable Election Protocol for clustered heterogeneous wireless sensor networks", Computer Science Department,Boston University Boston, MA 02215, USA

III. Shaimaa S. Saleh Amr A. Al-Awamry Mahmoud F. M., "Energy- Efficient Communication Protocol for Wireless Sensor Networks", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, IJERTV4IS051108, Vol. 4 Issue 05, May-2015.

IV. Neha Jain, Manasvi Mannan, "Comparative Performance Analysis Of Teen Sep Leach Eammh And Pegasis Routing Protocols", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 - 0056 Volume: 03 Issue: 01 Jan-2016.