International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 10, October-2015

Cross Layer Location Based Routing Protocol in WSN

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***Abstract*—Wireless sensor network (WSNs) have been widely studied in many applications such as monitoring environment, embedded system and so on. Node in WSNs are battery operated, so energy efficient and prolong the network lifetime are the major concerns to researching areas. Many routing protocols are available for power conservation in WSNs. However, most of traditional protocols are suitable for energy conservation only in static WSNs. The goal of proposed routing protocol is to develop energy efficient routing protocol and prolong the network lifetime for dynamic WSNs. Here Cross layer mechanism combined with energy efficient location aided routing (EELAR) Protocol. EELAR makes significant reduction in the energy consumption of the batteries in mobile nodes by restraining the area of discovering a new route to a smaller zone. Thus, network overhead are significantly reduced. In the proposal, by using Cross Layer mechanism the information of node's residual energy and the distance from base station are also considered for routing.**

Keywords— Cross Layer, Energy Efficiency, Routing Protocol, Wireless Sensor Network.

I. INTRODUCTION

This A WSNs consists of sensor nodes deployed over a specific geographical area for monitoring physical or environmental conditions such as sound, pressure, temperature, vibrations and so on[1]. Typically, a sensor node is a small device that includes three basic components: sensing subsystem, processing subsystem, wireless communication subsystem. In addition, a battery power is supplies the energy needed by the device to perform the given task. This power source often consists of a battery with a limited energy. In addition, it could be impossible or inconvenient to recharge the battery, because nodes may be deployed in an unfriendly or in impractical environment [2]. On the other hand, the sensor network should have a lifetime long enough to fulfil the application requirements. Therefore, how to conserve battery energy and prolong the network lifetime in wireless sensor networks is the crucial issue. The main factor responsible for power consumption in WSNs is collision, over emitting, overhearing, control packet overhead, etc. If this factor can be reduced, one can reduce power consumption to some extent.

A variety of routing protocols are available in WSNs. However, most of traditional protocols are not suitable for energy conservation in WSNs. To overcome this cross layer approach is introduce .The cross layer approach for WSNs is more effective than traditional approach [3]. Cross layer approach states that information of two or more layer are used to achieve an optimization objective. Common goal of cross layer approach in WSNs are reduction of energy consumption and effective routing.

The goal of this paper is to show how to cross layer design has been adopted with location based routing protocol in WSNs. Here location aided routing LAR is used for the purpose of reducing overhead which results in minimized energy conservation. The remaining organization of paper is as follows. In section II, overall related work in cross layer and location based routing protocol is discussed. Section III presents description of programmer's design. Section IV contains the result and discussion. Conclusion is shown in section V.

II. REALTED WORK

There are variant of routing protocol for WSNs proposed in literature in an effort to improve performance of WSNs communication. Here two types of routing protocols are considered firstly cross layer routing protocols and secondly location based routing protocol. Cross layer approach helps to improve energy efficiency and location based is used to reduce network overhead.

A. Cross layer routing protocols

First, Interlayer communication is an important factor for WSNs protocol design.

In research paper [4] cross layer Energy efficient routing

XLE2R is proposed for prolonging lifetime of WSNs. Here Concept of cross layer optimization is applied in between PHY, MAC and network layer. The mechanism is based on routing decision which is made with the knowledge of source and the destination node. This protocol works in four phases that are finding the location of destination node, route finding, route maintenance and lastly route re-establishment

In [5] CLAR was proposed which aims to minimize the use of routing control packets and minimizing energy consumption which in turn prolongs network-lifetime. The author used two algorithms first is DSR and second is DRMACSN to proposed CLAR protocol. CLAR allows to exchange of information between physical layer, MAC layer and network layer in WSNs shows in fig. CLAR protocol takes advantage of the information Fig. 1. Cross-layer adaptive routing (CLAR) framework.[5] available in the neighbor table maintained by DR-MACSN protocol and uses channel quality indicator (CQI)Neighbor table contain information about channel load and simultaneous transmissions (STx) per frame interval. Thus author proved that CLAR protocol is to be energy efficient by consuming less energy for same throughput with DSR protocol and also make quick routing decisions by maintaining multiple route to same destination.

In [6] author have proposed a Location based Cross layer routing protocol which is based on LAR protocol. Here concept of Cross layering is applied with physical layer which gathered residual battery information and passed it to Network layer for efficient routing. Proposed CLMHR protocol is to increase network lifetime and to maintain network equilibrium. CLMHR combined three teams, first is equilibrium of candidate relay node's residual energy and second is the distance from the source node to the destination or next hop and lastly the cross-layer design idea.

At[7]author have proposed Efficient Cross Layer Design Adaptive Protocol ECLAP which consider MAC and physical layer together using cross-layer approach in WSN. Mechanism is adopted to save transmission power between the two nodes and maintain the nodes neighbor tables interleaving to utilize the transmission energy efficiently. An optimal routing path is constructed by using the available transmission power and neighbor tables of the physical layer to reduce the total energy dissipation. The nodes sleep time is prolonged by determining the nodes duty cycle by MAC layer which make of use of the routing information from network layer.

B. Location based routing protocols

Young-Bae Ko and Nitin H. Vaidya [2000] have proposed "Location-Aided Routing (LAR) in mobile ad hoc networks" which used location information due to this the search rang of routing of LAR would be restricted, so that the network energy Consumption and routing overhead would reduce. Here, there are two flooding region in LAR protocol, i.e. the expected zone and request zone. When source node wants to send packet to destination node, first source node should get the position of destination node by using location services which is used to get position of node. Two different LAR schemes are presented here: LAR scheme 1 and LAR scheme 2. In scheme 1 request zone is set to be a rectangular, both the source node and destination node should be included in the region. If the request zone will be the small rectangle, then rang of route searching for node will also be small [3].

"Energy Efficient Location Aided Routing (EELAR) Protocol for Wireless MANETs" have been proposed by Mohammad A. Mikki [2009] which is the modification of basic Location-Aided Routing (LAR) protocol. EELAR utilizes location information of mobile nodes with the goal of decreasing routing overhead in MANET. EELAR uses a wireless base station (BS) that covers all mobile nodes (MNs) in the network. BS divides the network into equal six sub-areas. At route discovery phase instead of flooding control packets to the whole network area, in EELAR packets are flooded only in the sub-area where destination mobile node is present. The base station keeps a Position table (PT) that stores locations of all MNs. PT is built by BS through broadcasting small BEACON packets to all MNs in the network. In results author show that EELAR makes significant reduce in energy consumption of network node batteries through limiting the area of discovering a new route to a small zone [4].

III. PROPOSED WORK

This section presents proposed energy efficient cross layer location based routing protocol. This proposed protocol is a modification to the energy efficient LAR protocol and cross layer multi-hop routing protocol in WSNs. An EELAR utilizes location information of mobile nodes with the goal of decreasing routing overhead in network as discussed previously. Given below diagram shows example of a proposed protocol, here marine sensors are shown which are sending sensing data to a ship.

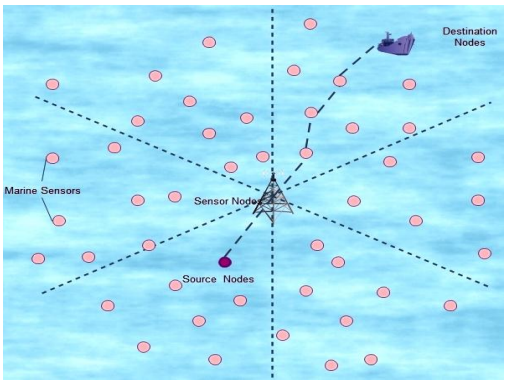

Fig. 1. Example of a System

Here we are importing cross approach in energy efficient location aided routing protocol, due to which significant energy efficiency is achieved. By using Cross Layer mechanism the information of nodes residual energy and the distance from the base station are considered for routing packets in network.

A. Algorithm

```
Algorithm CLLBR ( )
{
Thread (UpdatePositionTable);      // Execution of
//BuildUpdatePositionTable procedure.
while ( 1)
{
if ( a mobile node enters network area of the base
station)
Thread (UpdatePositionTable)
if (source mobile node wants to send data to a
destination mobile node)
Thread (DataTransmission);         // execution of
//DataTransmission procedure using crosslayer
parameters
}    // end while
}    // end CLLBR
```

Here first we algorithm executes UpdatePositionTable module which builds and updates the PT in BS. Then, this protocol executes an infinite loop. In this loop, whenever a new mobile node enters the network area of BS then UpdatePositionTable procedure is called so that the new mobile node will report its position to BS and hence, its position is included in the PT in BS. When a source mobile node S wants to send data packets to a destination mobile node D, then algorithm executes DataTransmission module.

In DataTransmission module when a source mobile node S sends data packets to a destination mobile node D, first, S requests from BS to initiate a route discovery to node D by sending a Dst_Pos_Req (destination position request) packet to BS that requests the position information of D. BS checks if the position of D in PT is out of date, if so BS sends a small BEACON message to node D requesting its new location information to avoid out of date location information and updates its PT. Then, BS searches its position table for the area ID of D. When BS determines the area ID of D, it sends back Dst_IDRp (Destination ID Reply) packet to S containing the network area ID of D. If the BS determines that S and D are not in the same area then BS sends a control packet to S indicating that the data flow will be through BS, so each data packet from S to D will contain a "to_BS" flag in the header forcing all nodes in S's area to drop these packets and not to handle them. Then, BS forwards data packets from node S to the area where D belongs only. When the source node S wants to transmit data to node D and BS determined that S and D are in the same network area, then BS will reply with a packet which indicates that the data flow will be done within the network area of node S and not through BS. This frees BS from being involved in the communication between S and D and BS will not be a performance bottleneck. Then node S floods its own area with data packets that are directed to D. Here we consider Ic factor for cross layer energy efficient routing purpose. Ic factor contains two parameter, that is node's residual energy which is taken from physical layer and the distance between itself and D and compares it with the distance between S and D. If Ic factor is less then B will forward the packet to that node. Otherwise, it will drop it.

B. Parameters used in Proposed System

- $\mathbf{I_E^i}$:- is referred to i the node energy factor used to estimate the residual energy status of the candidate relay node[2].

$$\mathbf{I_E^i = 1 - \frac{E_i - E_{min}}{E_{max} - E_{min}}} \quad (1)$$

Where:

E_i is the residual energy of i the neighbor nodes. E_{max} and E_{min} represent the maximum and the minimum value of the residual energy received by S respectively among all neighbours.

- $\mathbf{I_D^i}$:- is defined to describe the relation of the distance between candidate relay nodes to D[2].

$$\mathbf{I_D^i = 1 - \frac{D_{max} - D_i}{D_{max} - D_{min}}} \quad (2)$$

Where:

D_{max} and D_{min} is the maximum and minimum distance from the neighbor node of the source to the destination node respectively. DI is the distance from the possible next hop node to the destination node.It can be calculated by:

$$\mathbf{D_i = \sqrt{(Y_d + Y_i)^2 + (X_d - X_i)^2 2}} \quad (3)$$

Where:

(X_i, Y_i) and (X_d ,Y_d) is the geography coordinate of neighbor node and D node respectively.

- $\mathbf{I_C^i}$:- This parameter is designed for reflecting the comprehensive influence from both the residual energy and distance when a node is determining whether it is the most appreciate next relay node[2].

$$\mathbf{I^i_C = \alpha I^i_E + \beta I^i_D} \quad (4)$$

Where:

α and β: equilibrium coefficients

IV. EXPERIMENTAL RESULT

In order to evaluate the performance of proposed protocol, we programmed simulations experiment by using network simulator version. The simulation environment settings used in the experiments are shown in Table1.

Table 1 NS2 simulation environment settings

Parameter	Values
Network area	1000 m x 1000 m
Node initial energy	100
Mobile node speed	5 to 30 m/s

We compare performance of proposed protocol with EELAR routing protocol. The measured performance metrics are routing overhead, Average Energy consumption, packets delivery ratio and throughput.

In the first experiment we measure the Average Energy Consumption in the network of the protocols as a function of the No of Nodes. As the Fig. 2. Shows, Average Energy Consumption of CLLBR protocol is comparatively lower than EELAR. Fig 3 shows Throughput of both CLLBR and EELAR protocol. Here throughput of CLLBR is larger than EELAR protocol. In general, both the throughput of CLLBR and EELAR decreased when no of nodes increase.

Fig 4 shows Routing overhead of CLLBR and EELAR protocol. The routing overhead of CLLBR is lower than that of EELAR. In general, both the routing overhead of CLLBR and EELAR increased when interval increase. Now finally, Fig 5 shows the packet delivery ratio of CLLBR and EELAR with Interval. Packet delivery ratio of CLLBR was larger than ELLAR.

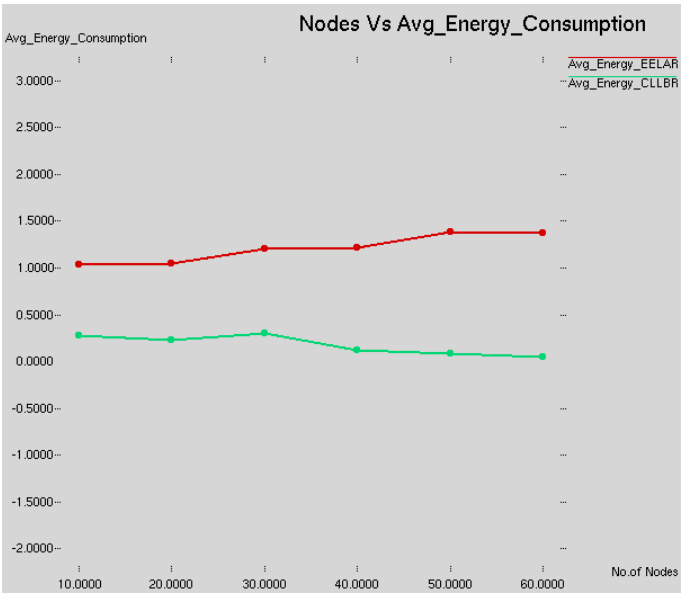

Fig. 2. No Nodes versus Average Energy Consumption

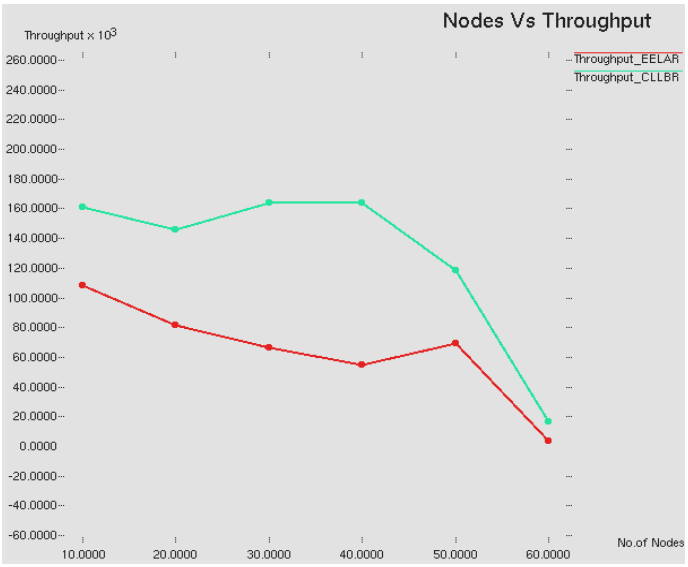

Fig. 3. No of Nodes versus Throughput

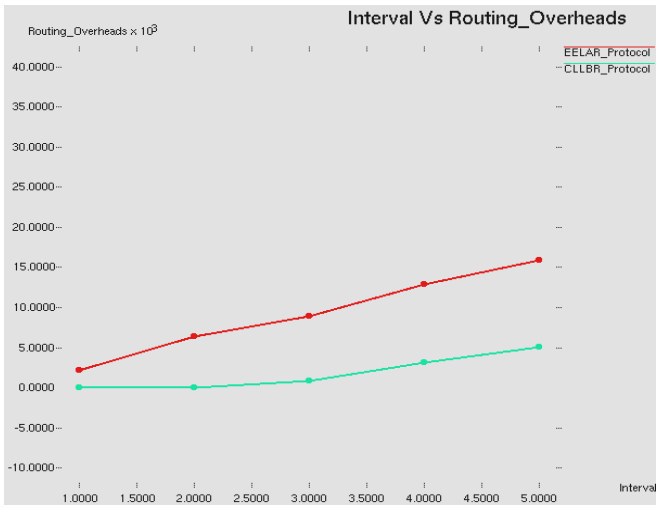

Fig. 4. Interval versus Routing Overheads

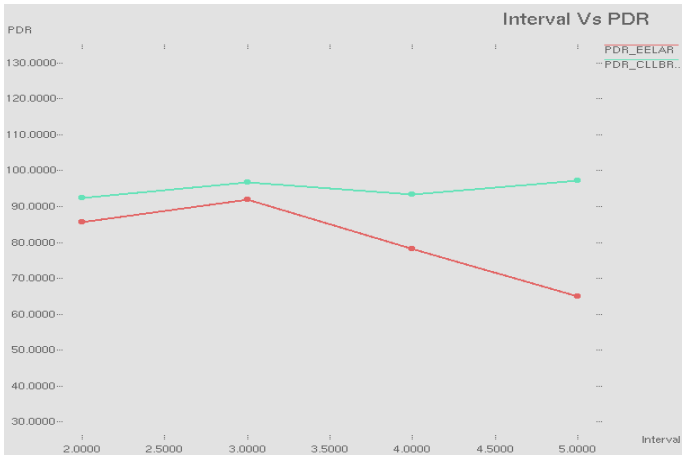

Fig. 5. Interval versus Packet Delivery Ratio

V. CONCULATION

In this paper, Cross Layer Location Based Routing Protocol (CLLBR) in WSN is proposed which improves efficiency of a network. Here we used the principle of cross-layer design based on Energy Efficient Location aided routing (EELAR) protocol for WSN. Firstly, by Using Energy Efficient Location aided routing protocol, the search range of route would be restricted so that energy consumption and overhead would reduce. After that by using Cross Layer approach, the residual energy information of an intermediate node is taken for next hop selection for efficient routing, which results in minimizing energy conservation and prolong the network lifetime.

We compare the performance of CLLBR and EELAR. In our simulation, we conduct the average energy consumption, routing overhead, throughput and the packet delivery ratio with no of nodes and interval. Simulation shows that CLLBR can reduce the routing overhead and increase energy efficacy in network.

In WSN security is also one of the major concern which is not considered in this system. The future scope for this proposed system is to add security parameters to improve security in sensor network

REFERENCES

[1] C. Cirstea, “Energy efficient routing protocols for wireless sensor networks: A survey,” in Design and Technology in Electronic Packaging (SIITME), 2011 IEEE 17th International Symposium for, pp. 277–282.

[2] F. Gao1, Hongli Wen, Lifen Zhao, Yuebin Chen, “Design and Optimization of a Cross-Layer Routing Protocol for Multi-Hop Wireless Sensor Networks”, IEEE International Conference on Sensor Network Security Technology and Privacy Communication System, 2013.

[3] K.S. Babulal, Rajiv Ranjan Tewari, “Cross layer Energy Efficient Routing (XLE2R) for Prolonging Lifetime of Wireless Sensor Networks”, Conf. on Computer and Communication Technology IEEE, 2010.

[4] L. Mendes, J.P.C. Rodrigues,``A survey on cross-layer solutions for wireless sensor networks", Journal of Network and Comput Application,2010.

[5] L. Gavrilovska, “Cross-layering Approaches in Wireless Ad Hoc Networks,” Wireless Personal Communications, 37(3-4), Springer, 2006.

[6] M. A. Mikki, “ Energy Efficient Location Aided Routing Protocol for Wireless MANETs,” (IJCSIS) International Journal of Computer Science and Information Security, Vol. 4, No. 1 and 2, 2009

[7] S.C.Chabalala,T.N.Muddenahalli,F.Takawira, “Cross-Layer Adaptive Routing Protocol for Wireless Sensor Networks”, IEEE Africon 2011 - The Falls Resort and Conference Centre, Livingstone, Zambia, 13 – 15

[8] S Rani, C Puttamadappa. "Efficient Cross Layer Design Adaptive for Wireless Sensor Networks", International Journal of Computer Networks and Wireless Communications (IJCNWC), ISSN: 2250-3501 Vol.3, No3, June 2013
[9] T. Melodia, M. C. Vuran, D. Pompili, The State of the Art in Cross-layer Design for Wireless Sensor Networks, Springer Lecture Notes in Computer Science (LNCS), 2006.
[10] Young-Bae Ko, Nitin H.Vaidya."Location-Aided Routing (LAR) in mobile ad hoc networks" Wireless Networks, vol. 6, no. 4, 2000, pp.307-321.