An Adaptive Energy Efficient Reliable Routing Protocol for Wireless Sensor Networks

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***Abstract*—** Wireless sensor networks are networks of tiny sensing devices for communicating in using wireless technology. Wireless sensor networks are deployed in scenarios where any plant information should be available for industrial control applications. Cross-layer interaction is most important factor to gain maximum efficiency and also able to provide difficult interaction among the layers of the protocol stack. Hence to achieve this is challenging issue because latency, energy and reliability are at odds, and also resource constrained does not support complex algorithm. Wireless sensor networks have many protocols. In this paper Breath protocol is proposed for industrial control application .To minimizing energy consumption in network breath is designed for WSNs by which nodes attached to plants must carry information via through multi hop routing to sink. To optimize energy efficiency the protocol is based on randomized routing, medium access control, and duty-cycling. Alternate model of breath protocol ensures a long lifetime of the network by making effective distribution of workload in sensor nodes. Hence it shows as a good terminology for efficient, timely data gathering for industrial control applications.

Keywords- *energy consumption,Wireless sensor network,cross layer design*

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I. INTRODUCTION

A wireless sensor network (WSN) has a large number of tiny self powered devices that can sense and communicate with each other devices to collect local information for making decisions about a physical environment. Wireless sensor network don't have fixed infrastructure in the form of base stations to perform operations. Wireless sensor network having sensors which are used to keep track of environmental and physical conditions for example temperature, noise and humidity in climate. Wireless sensor network are used in various applications like Biodiversity mapping, disaster relief operation, smart agriculture. In such networks, wireless devices are small and are battery Powered, energy efficiency is critical factor in WSN to prolong the lifetime of the connections. It is too difficult work to design a reliable communication protocols because in most of the applications environment condition cannot be predicted. Anyway some applications have most similar features which tends to design effective protocol .Taking into consideration of some important classes of applications are featured with clustered topologies. Sensors are deployed in specific rooms for building an automation system, and hence, to monitor the chemical leakage report to remote central station in multi-hop fashion. Wireless sensor network plays important role in human life, where there are many protocols are developed but routing protocols for wireless sensor network is important task because it should provide energy efficiency, reliability and adaptability with huge number of sensor nodes.

In manufacturing place the sensors are grouped around specific terms of interest that can be in robots or in end of the railways. According to network terminology, these are all clustered topologies even though the position and size of these clusters can vary for various applications, this type of similarity leads to create protocols that effective over all applications. Industrial control system are with high cost sensitive, so for effective implementation system-level approach is employed .To design system architecture WSN uses control algorithm which is having some requirements on reliability ,packet delay and energy consumption must be satisfied by infrastructure of network. Thus proposed system includes implementing alternate model of the breath protocol .Alternate model of breath protocol uses its basic protocol as DSDV protocol which ensures a self- adaptation and efficient solution for timely and reliable data transmission, as the protocol adapts to the changing network by enlarging and shrinking next-hop distance.

II. RELATED WORK

Designing a sensor network comes with various factors which is caused by nature of WSN, those are scalability, production cost, sensor network topology, power consumption and hardware. In earlier hierarchical protocols have met the energy efficiency and scalability requirements but the main problem is generating sub network clusters, developing multi hop transmission.[3] LEACH low energy Adaptive clustering Hierarchy [8], this algorithm based on clustering .This protocol is first sub cluster format routing protocol in WSN. Energy efficiency can be gained by LEACH by using data compression techniques and also with sub-cluster routing technology .Leach algorithm made up of two states one is setup state at this stage cluster head selected for that round, another state is steady state at this step nodes sends data to cluster head. Thus cluster head node is taken randomly and maintains network load. Clusters are made up for noticing received signal rate of nodes. In this algorithm local cluster heads act as gateways to the sink. There is a limitation in choosing number of clusters heads. In order to balance the network cluster heads are selected randomly.

GAF (Geographic Adaptive Fidelity)[7] it is designed for mobile networks .This algorithm based on rotating of these nodes without affecting routing .Hence there is increase in network lifetime observed especially for larger densities. There is change of state in nodes from sleep state to active state to balance the node. However, GAF has certain limitations as it uses geographic location information to divide world into square grids, Routing features is guaranteed that having low efficiency in terms of latency and energy consumption which can be overcome by SPAN. SPAN[2]includes energy efficiency as a performance indicator that can be performed by algorithms comes below routing layer and above MAC layer known as bridge layer. Bridge means that protocols are designed by bridging Routing and MAC layer. In both protocols are some of the features are in common so that it operates only few nodes in certain area for a time given. In SPAN energy consumption increases as nodes are increases.

Different levels of power consumption in Sensor network are Idle listening, Retransmission which results in collisions, packet overhead control. The main terminology for designing duty cycle protocol is routing and scheduling. Therefore guaranteed transmission of packets by scheduling the sleep schedules of nodes between source and destination so that connected network topology is maintained.MAC are carefully designed for this purpose.[5] XMAC, low power MAC protocol has a lookup table for nodes based on the traffic load can adapt to changing duty cycle. Anyway when there are many number of transmitter and reciever in network its only temporary solution since X-MAC only brings most desirable state of energy consumption by only one reciever. The Reciever-Initiated (RI)-MAC [7] designed where in this the reciever sends out beacon messages at regular intervals and a sender must wait for sometimes until to gets one and reply's back by sending the message in the action just like meeting by fixing appointment to minimize channel or to reduce long preambles. Hence the main disadvantage in this protocol is that beacon message interferes with normal traffic and also with each other. Thus protocols described above gives only maximization of energy efficiency or reliability or only minimization of delay but do not supports parallely application requirements in terms of reliability and delay in packet delivery. Although these mentioned above protocols are not used in control requirements but supports only in monitoring applications.

III. PROPOSED PROTOCOL

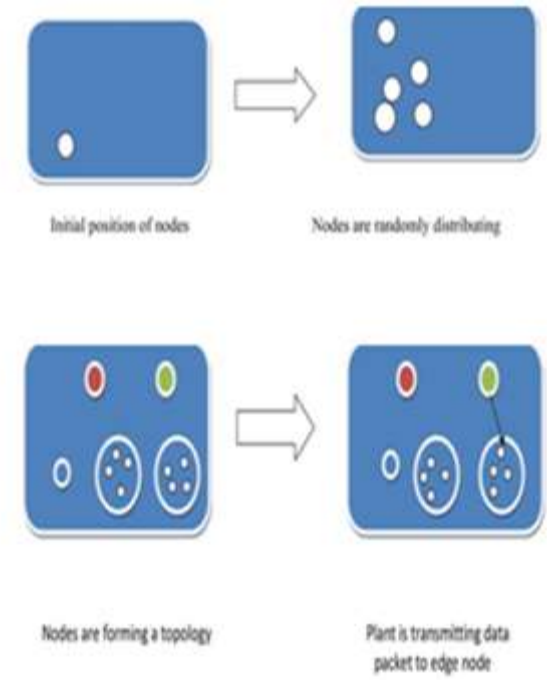
Energy efficiency is important factor in wireless sensor network to utilize power in wireless sensor network effectively alternate model of breath an self adaptation protocol is being proposed .Thus proposed system includes implementing alternate model of the breath protocol .Alternate model of breath protocol uses its basic protocol as DSDV protocol which ensures a self-adaptation and efficient solution for timely and reliable data transmission, as the protocol adapts to the changing network by enlarging and shrinking next-hop distance.

A. DSDV protocol

Destination-sequenced distance vector routing[4] (DSDV) is based on bellman ford algorithm it is table driven or proactive protocol routing protocol for ad hoc network .This algorithm schedules fresh list of destination and also routes at each node. The main focus of algorithm is to solve routing loop problem. When the network is at idle DSDV uses battery power for energy and small amount of bandwidth for routing hence continuous update to routing table is emerged. Thus the improvement to bellman-ford algorithm done through by using sequence number to free from loops in routing table .sequence number is even when link is present otherwise it is odd. Destination generates number and emitter has to send the next update with this number. Routing takes place with different measurement when sequence number is already mentioned in routing table. Whenever the topology of the network changes, a new sequence number is required just before the network comes to the same point again; thus, DSDV is not suitable for highly dynamic or large scale networks but it is suitable for only dynamic network.

B. System Design

Comparing with more traditional communication network an efficient System-level design designed which deals with the extra challenges to perform activities in industrial control applications, those are namely: Reliability, Delay, Energy efficiency, Adaptation and scalability .This paper approves complete design approach which fulfill all factors mentioned above. The system Architecture represented in Figure 1, where node with green circle represented as a plant .Plant actions are controlled by controller over a WSN denoted by red circle. Total packet generation rate is the outcome of plant measured at periodic intervals by sensors. Packets are sent to sink which are associated with state of plant and also controller is connected to plant and also over a multi hop network which is having randomly and uniformly distributed relayed nodes within network. Plant cannot send any packets directly to the sink hence relay nodes are act as a mediator to



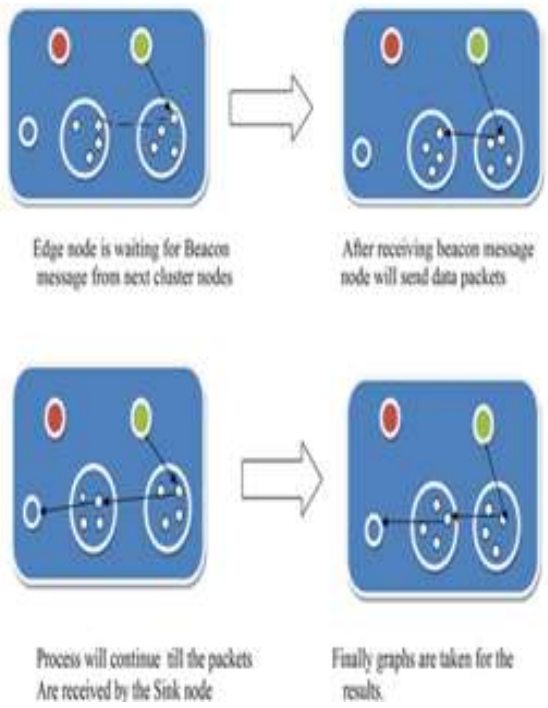


Figure:1 System Architecture

send packets. Initially all nodes are in 0^{th} position. Network has formed with some cluster. Wireless control loop has been formed with the Controller, Plant and Network. As Shown in the figure 1 Cluster-Heads are selected according to their energy levels. Edge node will wake up as soon as they sense a packets generated by the plant. Then the edge node before sending a packet stays for a beacon message from the cluster of nodes closer to the edge. Process continuous until packets received by sink nodes, finally graphs are taken for the result.

C. Alternate Model of Breath Protocol

Alternate model of protocol breath groups all N nodes between the cluster of nodes attached to the plant and the sink with h - 1 relay clusters [1]. Data packets can be transmitted only from a cluster to the next cluster nearer to the sink. A network topology is grouped and supported in networks that needs efficient use of given energy, hence transmission of packets through relays use up less energy than routing directly to the sink. Dynamic clustering method adapts the network parameters. Selection of cluster head is based on the residual energy levels for clustered environments. Thus periodic selection of clustering may not be energy efficient, and does not ensure the flexibility of the network to a time-varying wireless channel environment. A simpler geographic clustering is instead used in protocol breath , where nodes are in the forwarding region .

Proposed protocol is alternate model of the protocol breath which ensures clustered network topology so that to solve the most important critical situation in wireless sensor network that is energy efficiency. As described in system Architecture, protocol groups all N nodes in between clustered nodes which are linked with plant and sink by h-l relay clusters. Transmission of data packets occurs from one cluster to another which is closer to sink. It is assumed that forwarding packets with the help of relays consumes less energy than directly transmitting to sink. Clustering method which is not static acquires network parameters. Each relays has multiple nodes is being situated so it is most confusing thing from which node data has to be transmitted to sink with the help of other relays attached to it. So better solution is found that cluster head in cluster is selected to forward packets. Selection of cluster head is based on the levels of clustered nature. Hence it is observed that continuous selection of clustering is not efficient when protocol switched on to geographic clustering in proposed protocol. Geographic clustering includes where to move the packets in region where short beacon message are sent to nodes when they are ready to receive packets from some other nodes. Information having correspondence with Control parameters are taken to provide beacon message. Based on some knowledge the node is modified to suit to its cluster when a it gets a beacon message with updated number of cluster h-1.

Wireless network varies when compared to others in high range because of some moving hindrance, also with some disturbances in network. For example in natural conditions in surrounding environmental stages like earthquake, volcano eruption and forest fire monitoring. At that type of situations the scheme of routing that use fixed routing are not capable to provide flexibility over reforming industrial control applications, designing limitations. The cost of maintaining and forming is high in WSN hence fixed routing is not so efficient. To solve this problem of limitation forwarding packet through a random sequence of nodes has been introduced. Hence Alternate model of breath protocol is built on random routing in which next node to transmit the packet is selected in efficient way in random fashion. Random routing is adapted to reduce overhead to maintain not allow node coordination and state of routing to be managed by network. Failure of nodes is easily overcome by random routing .Hence by these routing to next nodes takes place effectively by assuming each node knows its location.

System Architecture describes how network is formed in this way as shown in figure 1.Network formed with h-1 blocks or clusters. Blocks or clusters are in forwarding regions. According to channel conditions of network there is variation in number of blocks and wake- up rate of nodes. There is repeatedly enlarging and shrinking of cluster size makes protocol to behave like breathing organism hence solution to this is Alternate model of breath protocol. Packets transmitted by nodes are two types those are: data packets and beacon packets are transmitted with intent frequencies for minimizing packet collision.

IV SIMULATION

All simulation Experiments are developed and Performed by using Ubuntu10.04 using 3GB RAM in Ns2 simulator of version 2.33.

V CONCLUSION

This project deals with design and implementing the alternate model of Breath protocol based on a system- level design to get reliability and delay in wireless sensor networks .The protocol considers routing, MAC, and physical layers, duty cycle

together to increase the network lifetime by considering the trade-off between energy consumption and what are necessary things for control operations in industries. With the help of simulation using ns2.33 thus the proposed protocol solves critical factor in wireless sensor network that is energy efficiency by reducing energy consumption in overall network using estimation of the remaining energy. Hence if the remaining energy after network completes its process is high than it means that energy consumed will be reduced. Therefore there will be increase in the lifetime of network with the help of decreasing delay in nodes while transmission. Alternate model of breath also shows good load balancing performance. With the help of simulation using ns2.33 thus the proposed protocol solves critical factor in wireless sensor network that is energy efficiency by reducing energy consumption in overall network using estimation of the remaining energy. Hence if the remaining energy after network completes its process is high than it means that energy consumed will be reduced. Therefore there will be increase in the lifetime of network with the help of decreasing delay in nodes while transmission. Alternate model of breath also shows good load balancing performance.

REFERENCES

[1] Pangun Park,Carlo Fischione,"Breath: An Adaptive Protocol for Industrial Control Applications using Wireless Sensor networks", IEEE transactions on mobile computing, vol. 10, no. 6, JUNE 2011.

[2] Benjie Chen, Kyle Jamieson, Hari Balakrishnan , and Robert Morris.Jiangtao Wang; Geng Yang; "Span: An Energy Efficient Coordination Algorithm for Topology Maintenance in Ad Hoc Wireless Networks".

[3] Shengshou Chen;Yanfei Sun, "Secure LEACH routing protocol based on low-power cluster-head selection algorithm for wireless sensor networks ",Intelligent Signal Processing and Communication Systems, 2007. ISPACS 2007.

[4] Narendra Singh Yaday, R.P. Yadav," Performance Comparison and Analysis of Table-Driven and On-Demand Routing Protocols for Mobile Ad-hoc Networks," Interational Journal of Information and Communication Engineering, 2008.

[5] Michael Buettner, Gary V. Yee, Eric Anderson, Richard Han"X-MAC: A Short Preamble MAC Protocol for Duty-Cycled Wireless Sensor Networks".

[6] Joseph Polastre,"RI-MAC: A Receiver-Initiated Asynchronous Duty Cycle MAC Protocol for Dynamic Traffic Loads in Wireless Sensor Networks".

[7] Y. Xu, J. Heidemann , and D. Estrin, "Geography-informed energy conservation for ad hoc routing," in the Proceedings of the 7th Annual ACM/IEEE International Conference on Mobile Computing and Networking July 2001.

[8] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan,"Energy-efficient communication protocol for wireless sensor networks," in the Proceeding of theHawaii International Conference System Sciences, Hawaii, January 2000.