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A Hybrid Multipath and Energy Harvesting Routing for Wireless Sensor Networks

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Abstract - A wireless sensor network (WSN) consists of a large number of sensor nodes which are deployed over an area to perform local computations based on information gathered from the surroundings. In this paper we are approaching a problem in which the link reliability along with concepts of multiple paths and energy harvesting are used. In this paper we are making a new hybrid protocol which intends to make use and remove the drawback of both RL and WL algorithms. The simulation is done in MATLAB to get the results.

Keywords— wireless sensor network, WLA, RLA, HYBRID.

I. INTRODUCTION

WIRELESS sensor networks (WSNs) bring significant advantages over traditional communications in applications such as homeland security, healthcare, structure and environment monitoring. Many important factors can affect the design of WSNs, including power management, fault tolerance, scalability, implementation cost, topology, and operating environment of sensors. In addition, energy depletion, weak wireless links and node failures reduce WSN performance and reliability. Recent advances in micro-electro-mechanical systems which are highly integrated digital electronics have led to the development of micro-sensors that sensor nodes can sense, measure, and gather information from the environment. These systems can be based on some local decision process and transmit the sensed data to the user that are displayed. Units of sensory nodes can be listed as a power unit, processing unit, sensing unit, and communication unit. On the other hand, some potential applications of sensor networks that have been currently pointed out include: military sensing, physical security, traffic surveillance, industrial automation and environment monitoring .Since, data transmission from the target area towards the sink node is the main task of wireless sensor networks, the utilized method to forward data packets between each pair of source-sink nodes is an important issue that should be addressed in developing these networks. Routing in sensor networks is very challenging issue which is due to several characteristics that distinguish them from other contemporary communication and wireless ad hoc networks. First of all, it is not possible to build a global addressing scheme for the deployment of sheer number of sensor nodes.

Therefore, classical IP-based protocols cannot be applied to sensor networks. Second, in contrary to typical communication networks, almost all applications of sensor networks require the flow of sensed data from multiple regions (sources) to a particular sink. Third, since multiple sensors may generate the same data within the vicinity of a phenomenon generated data traffic has significant redundancy in it. Fourth, sensor nodes are tightly constrained in terms of transmission power, on-board energy, processing capacity and storage, and thus require careful resource management . Substantial research effort is undertaken which mainly falls into two categories: packet loss avoidance and packet-loss recovery. Packet-loss avoidance approaches try to reduce the occurrence of packet loss by selecting more productive next-hop nodes or introducing multiple data paths during transmissions. To the opposite, packet-loss recovery approaches try to recover the packet loss when it happens. It can be done in an either end-to-end or per-hop manner .

II. LITERATURE SURVEY

ZANG Zhiyuan , LUO Guiming , YIN Chongyuan et.al [1] authors here present the framework for checking spps with verification of an interdomain routing system using formal methods and the nusmv software. Sufficient conditions and necessary conditions for determining SPP occurrence are presented with proof of the method’s effectiveness. Linear temporal logic is used to model an interdomain routing system and its properties were analyzed. An example is included to demonstrate the method’s reliability.

Hongwei Zhang et.al.[2] this paper explains how important is wireless sensor network in a cyber physical system. But it have one problem and that is wirelesscommunication itself assumes complex spatial and temporal dynamics. For dependable and predictable performance, therefore, link estimation has become a basic element of wireless network routing. Using a testbed of 98 XSM motes (an enhanced version of MICA2 motes), authors had characterize the negative impact that link layer retransmission and traffic-induced interference have on the accuracy of beacon-based link estimation, and they showed that data-driven link estimation and routing achieve higher event reliability and transmission efficiency than beacon-based approaches. These findings provide solid evidence for the necessity of data-driven link estimation and demonstrate the importance of addressing the drawbacks of beacon-based link estimation when designing protocols for low-power wireless networks of cyber-physical systems.

Ted H. Szymanski et.al. [3] Authors here present a constrained multicommodity maximum-flow-minimum-cost routing algorithm. The algorithm computes maximum-flow routings for all smooth unicast traffic demands within the Capacity Region of a network subject to routing cost constraints. It is shows that every network has a finite Bandwidth-Cost capacity. The Bandwidth- Distance and the Bandwidth-Energy capacities are explored. The routing algorithm requires the formulation of two Linear Programs (lps). The edge cost can be a distance, reliability, congestion or energy metric. It is shown that every network has a finite Bandwidth-Cost capacity. The application of these algorithms to route aggregated video streams from cloud data centers in a Future-Internet network, with improved throughput, energy-efficiency and qos guarantees is presented.

Chen Wu, Chenchen Deng, Leibo Liu, Jie Han, Jiqiang Chen, Shouyi Yin, Shaojun Wei et.al.[4] in this paper an efficient application mapping approach is proposed for the co-optimization of reliability, communication energy and performance in network-on-chip (noc) based reconfigurable architectures. A cost model for the co-optimization of reliability, communication energy and performance is developed to evaluate the overall cost of a mapping. In this model, communication energy and latency are first considered in energy latency product (ELP), and then ELP is co-optimized with reliability by a weight parameter that defines the optimization priority. Two techniques, branch node priority recognition and partial cost ratio utilization, are adopted to improve the search efficiency. Experimental results show that the proposed approach achieves significant improvements in reliability, energy and performance. The proposed approach has following distinctive advantages: 1) corep is highly flexible to address various noc topologies and routing algorithms while others are limited to some specific topologies and/or routing algorithms; 2) General quantitative evaluation for reliability, energy and performance are made respectively before integrated into unified cost model in general context while other similar models only touch upon two of them; 3) corep based PRBB attains a competitive processing speed, which is faster than other mapping approaches.

Jun long, mianxiong dong, kaoru ota, anfeng liu, and songyuan hai et.al [5] here the authors presented an efficient data gathering scheme that guarantees the Quality of Service and optimizes the following network performance metrics as well as the end-to-end reliability in wsns: 1) minimum total energy consumption; 2) minimum unit data transmitting energy consumption; and 3) maximum utilization efficiency defined as network lifetime per unit deployment. They first transformed the performance optimization problem into a problem to optimize the following parameters: 1) deployed nodal number N*; 2) nodal placement d*; and 3) nodal transmission structure p*. The key point of this optimization is adopting lower reliability requirements and shorter transmission distance for nodes near the sink. Consequently, this reduces the energy consumption of the nodes in the hotspot area. Meanwhile, it adopts higher reliability requirements and farther transmission distance for nodes far from the sink to make full use of the node residual energy, so as to optimize the network performance without harming network reliability.

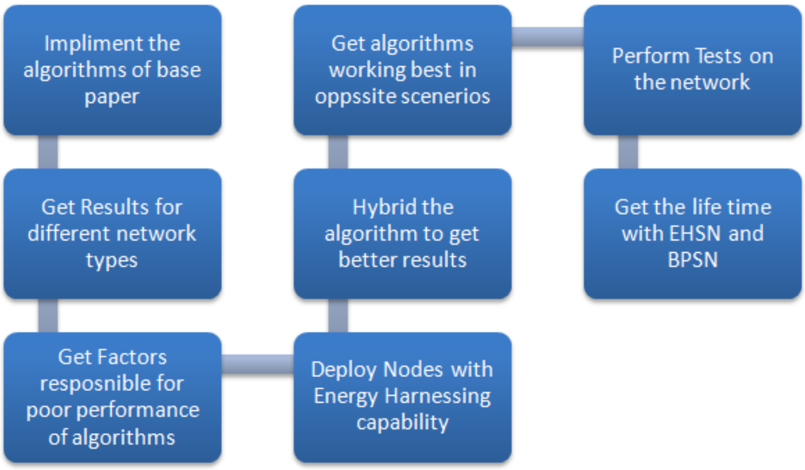
III. PROBLEM FORMULATION

Wireless sensor networks are becoming today technologies as the field of implementation of WSN is increasing per day. WSN have become one of the most researched topics in last decade. We decided to use this topic as our field of research because of its increasing scope and usability. In the WSN energy has become factor of utmost importance and in our research we will try to improve the energy performance of the network by studding and optimizing routing protocols in the network.

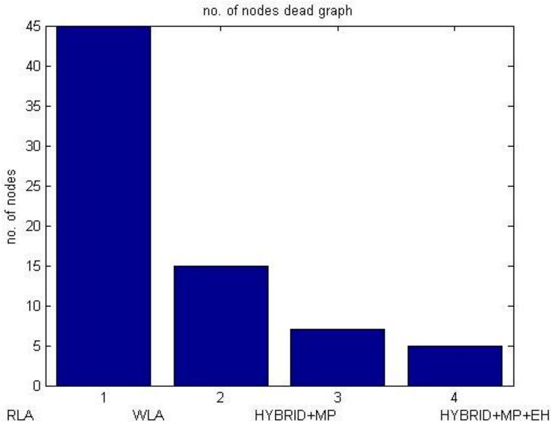
In the papers we studied, we analyzed that many algorithms have worked on single path routing protocol and work efficiently we also studies hybrid algorithms to give robust features. So we decided to take that work a level ahead. In the papers we studies the main problem

- We encountered that algorithms were available for single path only.
- And we have different algorithms of different types and we can hybrid them for better results.
- The third problem we faced was that there is requirement of analysis on networks contain both EHSN and BPSN nodes. So keeping the problems we deduced in mind we decided following objectives.

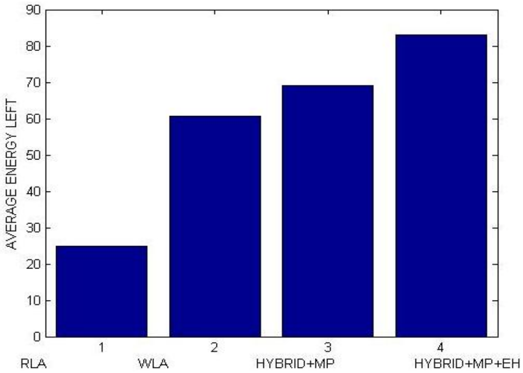
FLOW CHART



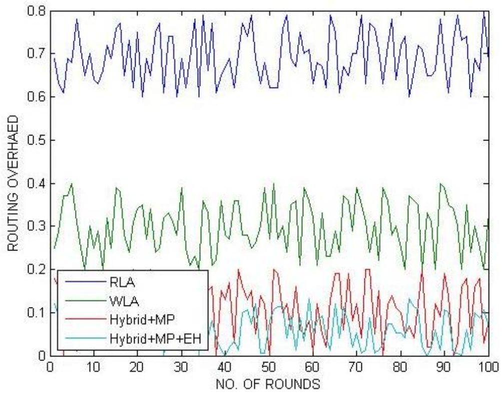
IV. RESULT AND ANNALYSIS



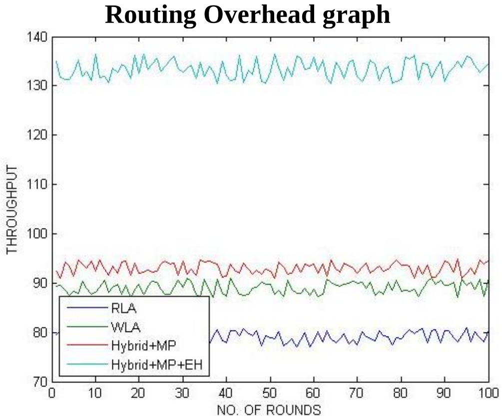
Number of nodes dead graph



Average energy left graph



Routing Overhead graph



Throughput graph

CALCULATIONS

1. Energy Calculation

   E(n) = E(n-1)-(Ec*d(n))

2. Throughput Calculation
   T(n) = Tr(n)*E(n)

3. Delay Calculation
   D(n) = $\frac{tm}{(T(n))}$
4. Number of nodes dead is calculated using the energy. The nodes with energy less than 0 are incorporated.

Where E, Ec, d, T, n, D and tm are Energy, Energy constant, distance of transmission, Throughput, Delay or Overhead and timeslot respectively.

ROUTE SELECTION ALGORITHM PSEUDO CODES

RLA

- Step 1 : GET(f);// Getting values for fading.
- Step 2 : GET(s);// Getting values for shadowing.
- Step 3 : GET(u);// Getting values for uncertainties.
- Step 4 : For r=1:z // considering all routes
- Step 5 : If (f<Tf) // if fading is less that the threshold fading
- Step 6 : If (s<Ts) // if shadowing is less that the threshold shadowing
- Step 7 : If (u<Ts) // if uncertainties is less that the threshold uncertainties
- Step 8 : Route selected;
- Step 9 : End
- Step 10 : End
- Step 11 : End
- Step 12 : End

WLA

- Step 1 : GET(h);// Getting values for hop counts.
- Step 2 : GET(d);// Getting values for distance.
- Step 3 : d+h/2; // Calculating over all weights of routes.
- Step 4 : For r=1:z // considering all routes
- Step 5 : W(all)/no. of routes; // if Normalization of weights
- Step 6 : min(w) // selecting minimum weight value
- Step 7 : selecting R(w) // Selecting minimum weight value route
- Step 8 : Route selected;
- Step 9 : End

HYBRID

- Step 1 : GET(h);// Getting values for hop counts.
- Step 2 : GET(d);// Getting values for distance.
- Step 3 : GET(f);// Getting values for fading.
- Step 4 : GET(s);// Getting values for shadowing.
- Step 5 : GET(u);// Getting values for uncertainties.
- Step 6 : d+h+f+s+u/5; // Calculating over all weights of routes.
- Step 7 : For r=1:z // considering all routes
- Step 8 : W(all)/no. of routes; // if Normalization of weights
- Step 9 : min(w) // selecting minimum weight value
- Step 10 : selecting R(w) // Selecting minimum weight value route
- Step 11 : Route selected;
- Step 12 : End

V. CONCLUSION

The work in this paper includes the simulation for the comparison of RLA, WLA, HYBRID+MP, HYBRID+MP+EH i.e. Hybrid and multipath routing with energy harvesting scenario. This is the scenario in which we are assuming and doing simulation for multipath routing we assume more them two nodes which undergo transmission. It might be Sending or Reception. The energy per round is reduced according to the distance of transmission and the involvement of node. As the simulation goes on the energy of the reduced and eventually those nodes which reach a stage of reduced energy below zero are assumed to be dead. Dead nodes are represented as black in this simulation. Green are alive nodes and Red are the sinks. In the end after the whole simulation is we get the conclusion that the Hybrid multipath energy harvesting routing algorithm performs better than the Hybrid multipath, RLA and WLA. The simulation parameters which are taken and better results are received are throughput, Energy left, Number of dead nodes and routing Overhead**.**

The future scope of this work will to produce a more efficient protocol which can perform a power with the proposed work in different harvesting scenarios.

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