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Optimal Energy Allocation Through Utility Maximization In Wireless Sensor Networks

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Abstract

Wireless Sensor Networks (WSNs) have emerged as research areas with an overwhelming effect on practical application developments. The aim of the paper is to improve the link stability in distributed wireless network. We propose a model for the energy consumption of a node as a function of its throughput in a wireless CSMA network. We first model a single-hop network, and then a multi-hop network. We show that operating the CSMA network at a high throughput is energy inefficient since unsuccessful carrier sensing attempts increase the energy consumption per transmitted bit. Operating the network at a low throughput also causes energy inefficiency because of increased sleeping duration. Achieving a balance between these two opposite operating regimes, we derive the energy-optimum carrier-sensing rate and the energy-optimum throughput which maximize the number of transmitted bits for a given energy budget. For the single-hop case, we show that the energy-optimum total throughput increases as the number of nodes sharing the channel increases. For the multi-hop case, energy-optimum throughput decreases as the degree of the conflict graph corresponding to the network increases. We proposed the system for high performance of the wireless network through the link stability (OLSR) concept use of the routing algorithm. The issues in this system are scalability to large number of nodes, design of data handling techniques, localization techniques, real time communication, data availability, fault tolerance etc. By using the proposed model, the system overcomes the current issues and system complexities.

Keywords: Wireless Sensor Networks, OLSR, CSMA, Energy-optimum throughput, localization

I.INTRODUCTION

A. Duality Model of TCP and Queue Management Algorithms

A duality model of end-to-end congestion control and apply it to understand the equilibrium properties of TCP and active queue management schemes. The basic idea is to regard source rates as primal variables and congestion measures as dual variables, and congestion control as a distributed primal-dual algorithm over the Internet to maximize aggregate utility subject to capacity constraints. The primal iteration is carried out by TCP algorithms such as Reno or Vegas, and the dual iteration is carried out by queue management algorithms such as Drop Tail, RED or REM. We present these algorithms and their generalizations, de- rive their utility functions, and study their interaction.

B. The Impact of Stochastic Noisy Feedback on Distributed Network Utility Maximization

The implementation of distributed network utility maximization (NUM) algorithms hinges heavily on information feedback through message passing among network elements. In practical systems the feedback is often obtained using error-prone measurement mechanisms and suffers from random errors. In this paper, we investigate the impact of noisy feedback on distributed NUM. We first study the distributed NUM algorithms based on the Lagrangian dual method, and focus on the primal-dual (P-D) algorithm, which is a single time-scale algorithm in the sense that the primal and dual parameters are updated simultaneously. Assuming strong duality, we study both cases when the stochastic gradients are unbiased or biased, and develop a general theory on the stochastic stability of the P-D algorithms in the presence of noisy feedback. When the gradient estimators are unbiased, we establish, via a combination of tools in Martingale theory and convex analysis, that the iterates generated by distributed P-D algorithms converge with probability one to the optimal point, under standard technical conditions. In contrast, when the gradient estimators are biased, we show that the iterates converge to a contraction region around the optimal point, provided that the biased terms are asymptotically bounded by a scaled version of the true gradients. We also investigate the rate of convergence for the unbiased case, and find that, in general, the limit process of the interpolated process corresponding to the normalized iterates sequence is a stationary reflected linear diffusion process, not necessarily a Gaussian diffusion process. We apply the above general theory to investigate stability of cross-layer rate control for joint congestion control and random access. Next, we study the impact of noisy feedback on distributed two time-scale NUM algorithms based on primal decomposition. We establish, via the mean ODE method, the convergence of the stochastic two time-scale algorithm under mild conditions, for the cases where the gradient estimators in both time scales are unbiased. Numerical examples are used to illustrate the finding that compared to the single time-scale counterpart, the two time-scale algorithm, although having lower complexity is less robust to noisy feedback.

C. Transmission with Energy Harvesting Nodes in Fading Wireless Channels: Optimal Policies

Wireless systems comprised of rechargeable nodes have a significantly prolonged lifetime and are sustainable. A distinct characteristic of these systems is the fact that the nodes can harvest energy throughout the duration in which communication takes place. As such, transmission policies of the nodes need to adapt to these harvested energy arrivals. In this paper, we consider optimization of point-to-point data transmission with an energy harvesting transmitter which has a limited battery capacity, communicating in a wireless fading channel. We consider two objectives: maximizing the throughput by a deadline, and minimizing the transmission completion time of the communication session. We optimize these objectives by controlling the time sequence of transmit powers subject to energy storage capacity and causality constraints. We first, study optimal offline policies. We introduce a directional water-filling algorithm which provides a simple and concise interpretation of the necessary optimality conditions. We show the optimality of an adaptive directional water-filling algorithm for the throughput maximization problem. We solve the transmission completion time minimization problem by utilizing its equivalence to its throughput maximization counterpart. Next, we consider online policies. We use stochastic dynamic programming to solve for the optimal online policy that maximizes the average number of bits delivered by a deadline under stochastic fading and energy arrival processes with causal channel state feedback. We also propose near-optimal policies with reduced complexity, and numerically study their performances along with the performances of the offline and online optimal policies under various different configurations.

D. Power Scheduling of Universal Decentralized Estimation in Sensor Networks

The proposed power scheduling scheme proposed in this paper suggests that the sensors with bad channels or poor observation qualities should decrease their quantization resolutions or become inactive in order to save power. At last, by using numerical example it is found that in inhomogeneous sensing environment, significant energy savings is possible when compared to the uniform quantization strategy.

E. Adaptive Power Management for Environmentally Powered Systems

Here we are concerned with optimizing the performance of an application in a system where it receives their energy from regenerative sources such as solar cells while respecting the limited and time-varying amount of available power. Designing of such a system is of substantial interest in this era. A new method for approximate multi parametric linear programming is suggested which substantially lowers the computational demand and memory requirement of the embedded software. These approaches are evaluated using long-term measurements of solar energy in an outdoor environment.

F. Distributed Tracking with Energy Management in Wireless Sensor Networks

A wireless sensor network (WSN) is considered here that performs the task of tracking a process using a set of distributed nodes, these multiple remote sensor nodes estimate the physical process (viz., a moving Object) and transmit quantized estimates to a fusion centre for processing. A BLUE (best linear unbiased Estimation) approach is used to combine the sensor estimates and to create a final estimate of the state at the fusion centre node. Thus the uncertainty of the overall estimate is derived that depends on the individual sensor transmit energy and quantization levels, as well as the Kalman tracker uncertainty at the node. Since power and bandwidth are critically constrained resources in battery operated sensor nodes, quantification of the trade-off between the lifetime of the network and the estimation quality over time is attempted in this paper. Three different convex formulations of the underlying non convex mixed integer nonlinear optimization problem are presented. This effort incorporates the operating state of the nodes into the decisions of the optimum bits and the transmission power levels based on a heuristic. The simulation result for all formulations shows the improved quality of the state estimate as well as the extended lifetime of the WSN.

G. Estimation Of Sensor Networks

According to this paper, I absorbed decentralized estimation of noise corrupted deterministic estimation signal in homogeneous sensor network. And that sensor observation of quantized into a discreet messages. This discreet message was sending to the sensor networks, and then these discreet messages were transmitted to the fusion centre, where the final estimate is generated. Suppose the sensor used the universal decentralized quantization or estimation scheme an uncoded quadrature amplitude modulated transmission strategy, we determine optimal quantization power at local sensor so as to reduce the total transmit power.

For the remaining active sensor, the optimal quantization resolutions are simply become inactive in order to save the power. Transmit power levels are determined jointly by individual channel path losses by local observation, noise variation and targeted MSE performance.

II.SYSTEM MODEL

Location Based Energy level Routing is our new proposed routing protocol which is similar to GRID, which helps in maintaining the nodes or sensors location in the entire network. So while a packet is needed to be sent from one node to another node, energy can be effectively conserved by checking the energy level of the required nodes. Many routing protocols have been proposed for EH-WSNs. However, they are all based on a graph model in the sense that a mobile host only knows the connectivity relation with its neighbours, but not its relative location with its neighbours. Since data packets are actually routed in a physical area, protocols based on a geographic model have been proposed recently in this field. It is assumed that a mobile host knows its current physical location, and thus such location information can be exploited to facilitate routing. We call protocols with such capability location-aware protocols.

Modules Description

A. Module I: NETWORK FORMATION

Network formation is an aspect of network science that seeks to model how a network evolves by identifying which factors affect its structure and how these mechanisms operate. Network formation hypotheses are tested by using either a dynamic model with an increasing network size or by making an agent-based model to determine which network structure is the equilibrium in a fixed-size network.

Networks are formed with the given range of the sensors. Nodes are grouped automatically depends upon their radio waves Agents are formed for group registration.The simulation work has been done with The Network Simulator ns-2. In the simulation nodes are randomly distributed within the network field of size 300m*300m.Using manna-sim for data genration.

B. Module II: CLUSTER HEAD SELECTION

Cluster head selection

A distance based Cluster head selection algorithm is used for improving the sensor network life time. This protocol achieves a good performance in terms of lifetime by balancing the energy load among all the nodes. This clustering technique help to prolong the life of wireless sensor network, especially in hostile environment where battery replacement of individual sensor nodes is not possible after their deployment in the given target area. Therefore, this technique is used to distribute the role of the cluster head (CH) among the wireless sensor nodes in the same cluster is vital to increase the lifetime of the network. This algorithm uses a distance based method for providing the cluster head selection. Clustering techniques also provide good load balancing, and in-network data aggregation.

Heuristic is a technique designed for solving a problem more quickly when classic methods are too slow, or for finding an approximate solution when classic methods fail to find any exact solution. This is achieved by trading optimality, completeness, accuracy, or precision for speed.

Hybrid of residual energy (primary) and communication cost (secondary) such as node proximity.

- Number of rounds of iterations
- Tentative CHs formed
- Final CH until CH_{prob}=1
- Same or different power levels used for intra cluster communication.

Assigned Cluster heads collect the recorded information from the sensor nodes and perform filtering upon raw data and forward the filtered information to the appropriate “Ingress Node”.

C. Module III: DATA COLLECTION

Assigned Cluster heads collect the recorded information from the sensor nodes and perform filtering upon raw data and forward the filtered information to the appropriate "Ingress Node". The latency in data collection due to low speed of Mobile element can be addressed by using subset of nodes as ingress nodes that buffer and aggregate data from other nodes and transfer to the ME when it arrives, achieving a balance between energy saving and data collection delay.

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. The data traces are collected from a real deployed WSN. The distributed spatial data correlation detection and spatial redundancy destruction is achieved by dividing a WSN into several clusters. The algorithm achieves low communication cost by fair certain stable state and strong sensual used to sensors.

D. Module IV: MEASUREMENT THROUGH RELAY POINTS

Proposed to achieve trade-off of energy consumption and time delay. Sensors send their measurement to a subset of sensors called relay points (RPs) by multi-hop communication.a sink moves around in the network and retrieves data from encountered RPs. RPs are static, data dissemination to RPs is equivalent to data dissemination to static sinks.Multihop, a wireless network adopting multihop wireless technology without deployment of wired backhaul links.Tree based topology, one end of the path is the base station Broadband Multimedia Wireless Research Lab, Dedicated carrier owned infrastructure.Benefit of multi-hop technology are Rapid deployment with lower-cost backhaul, Easy to provide coverage in hard-to-wire areas, Under the right circumstances, it may, Extend coverage due to multi-hop forwarding Broadband Multimedia Wireless Research Lab. Extend coverage due to multi-hop forwarding, Enhance throughput due to shorter hops, Extend battery life due to lower power transmission

E. Module V: SIMULATION ANALYSIS

The objective of this approach is to produce a solution in a reasonable time frame that is good enough for solving the problem at hand. This solution may not be the best of all the actual solutions to this problem, or it may simply approximate the exact solution. But it is still valuable because finding it does not require a prohibitively long time. Let us focus on the performance of the hybrid model with the Link state stability model. We have evaluated the performance using ns2.We have analyzed transmission overhead, packet delivery ratio and forwarding delay, Path length.In analysis the work identifies data resemblances among the sensor nodes by matching their local guesstimate models rather than their original data. The simulation outputs show that our approach can greatly reduce the volume of messages in wireless communications

III.SYSTEM ARCHITECTURE

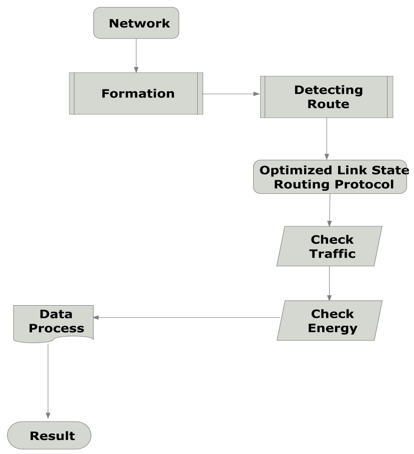

Figure 1: System Architecture

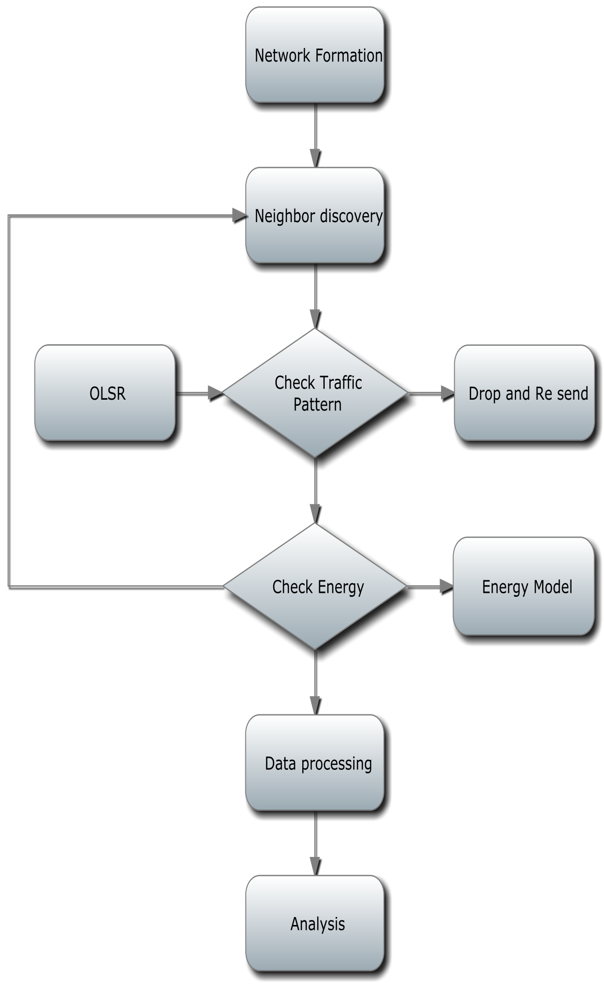

Figure 2: Flow Diagram

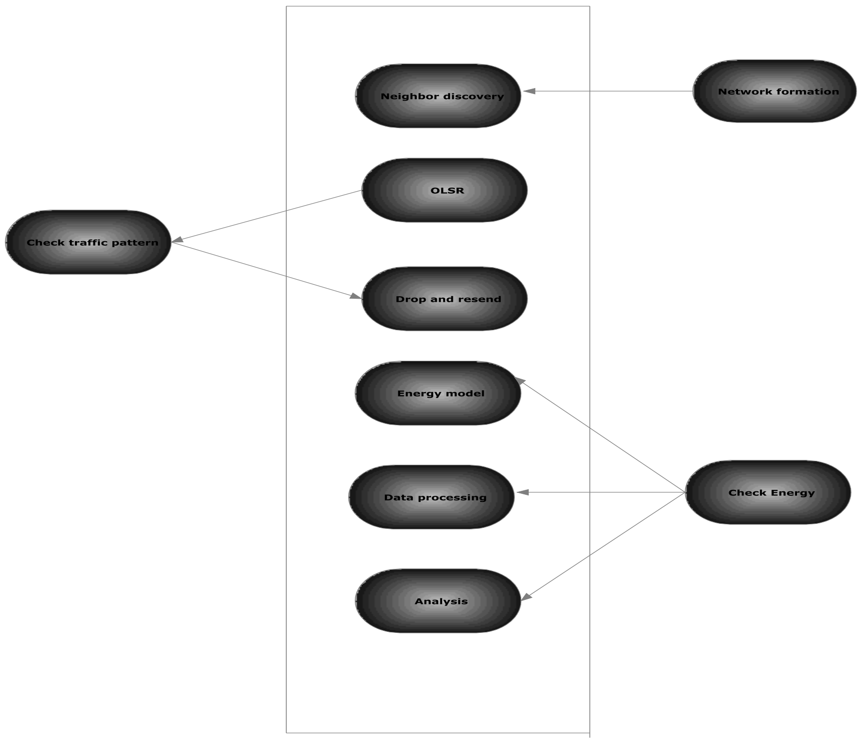

Figure 3: UML DIAGRAM

Figure 4: CLASS DIAGRAM

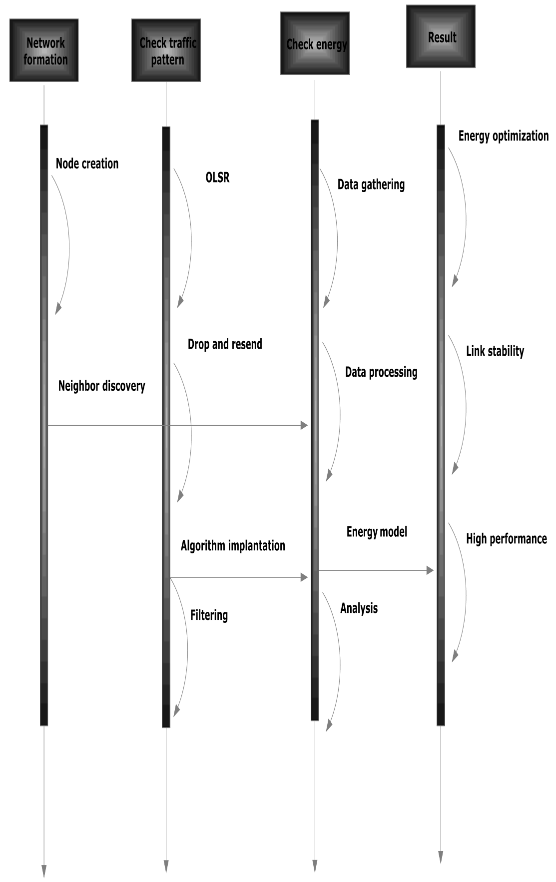

Figure 5: SEQUENCE DIAGRAM

IV.LOCATION BASED ENERGY LEVEL ROUTING ALGORITHM

Cluster head selection

Hybrid of residual energy (primary) and communication cost (secondary) such as node proximity

Number of rounds of iterations

Tentative CHs formed

Final CH until $CH_{prob}=1$

Same or different power levels used for intra cluster communication

Assigned Cluster heads collect the recorded information from the sensor nodes and perform filtering upon raw data and forward the filtered information to the appropriate “Ingress Node”.

Cluster Head Selection Algorithm:

$$E\left[\sum_{i=1}^{N} C_i(t)\right] = N - k * \left(r \bmod \frac{N}{k}\right)$$

$\sum_{i=1}^{N} C_i(t)$ = total no. of nodes eligible to be a **cluster-head** at time *t*.

This ensures energy at each node to be approx. equal after every N/k rounds.
, expected no of Cluster Heads per round is,

$$\begin{aligned} E[\#CH] &= \sum_{i=1}^{N} P_i(t) * 1 \\ &= \left(N - k * \left(r \bmod \frac{N}{k}\right)\right) * \frac{k}{N - k * \left(r \bmod \frac{N}{k}\right)} \\ &= k. \end{aligned} \tag{5}$$

OLSR inherits Stability of Link-state protocol.Only Selective Flooding are done. Only MPR retransmit control messages and it has Minimize flooding Suitable for large and dense networks. In multipoint relay, MPRs is indicated as set of selected neighbour nodes. Minimize the flooding of broadcast packets. Each node selects its MPRs among its on hop neighbours. The set covers all the nodes that are two hops away.MPR Selector can be the node which has selected node as MPR. The information required to calculate the multipoint relays.The set of one-hop neighbours and the two-hop neighbours. Set of MPRs is able to transmit to all two-hop neighbours. Link between node and its MPR is bidirectional.

This system is proposed to achieve trade-off of energy consumption and time delay. Sensors send their measurement to a subset of sensors called relay points (RPs) by multi-hop communication. A sink moves around in the network and retrieves data from encountered RPs. RPs are static, data dissemination to RPs is equivalent to data dissemination to static sinks

The system for to high performance of the wireless network through the link stability (OLSR) concept use of the routing algorithm has been proposed. Hence it reduces the chances of collision because the stations wait a random amount of time. It is unlikely that two or more stations will wait for same amount of time and will retransmit at the same time.

V.RESULT AND ANALYSIS

Experimental Image

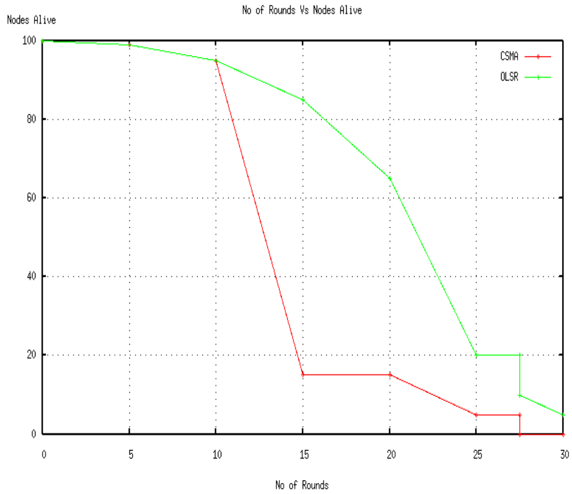

Figure 6a: Number of rounds Vs Number Node Alive

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of number of rounds and the number of alive node in the system. The cost of carrier-sensing increases with respect to sleeping, the nodes need to sense the channel less frequently to minimize energy consumption per bit, so the energy-optimum rate and throughput Reduces. When compare with existing CSMA method, the proposed routing algorithm perform well.

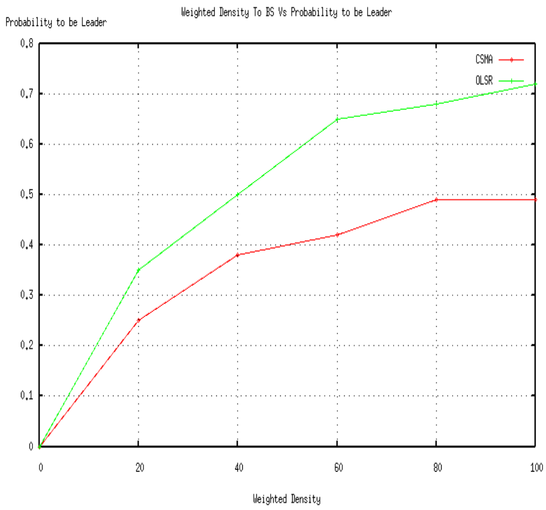

Figure 6b: Weighted Density to BS Vs Probability to be leader

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of weighted density and probability. The probability of proposed system in this comparison is high when compare with CSMA.

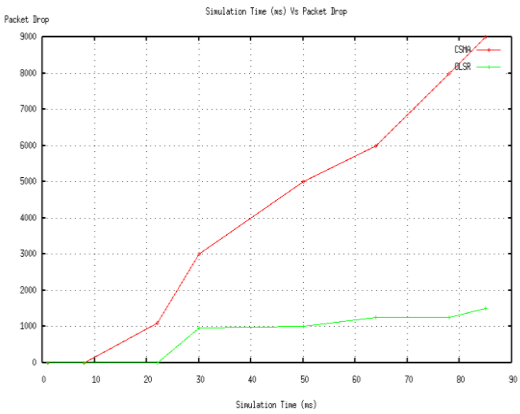

Figure 6c: Simulation Time Vs Packet Drop

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of simulation time and packet drop during the process. The system work well when compared with the current models.

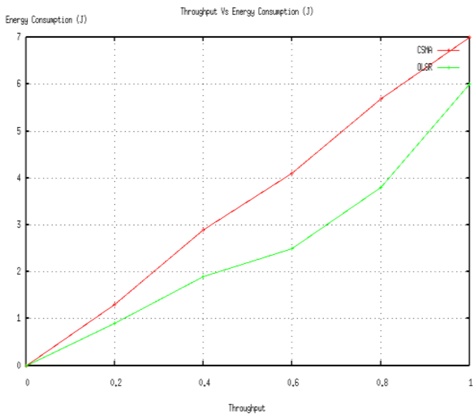

Figure 6d: Throughput Vs Energy Consumption

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of throughput and energy consumption. It presents the total energy consumption as the total throughput in the network increases.

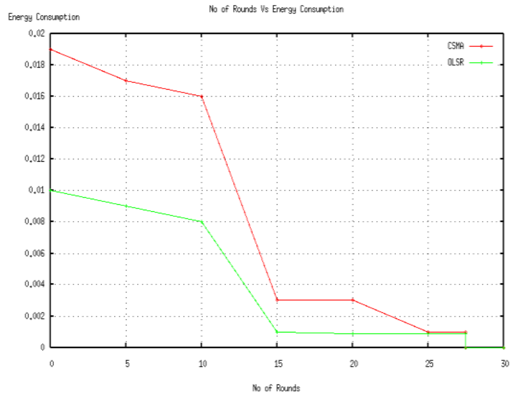

Figure 6e: Number of Rounds Vs Energy Consumption

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of number of rounds and energy consumption. Energy consumption rate is high when compared with the CSMA method.

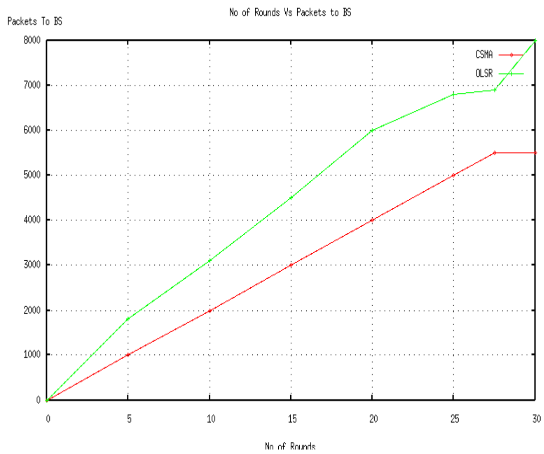

Figure 6f: Number of Rounds Vs Packet to the Bs

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of packets to Bs with the number of round and its function.

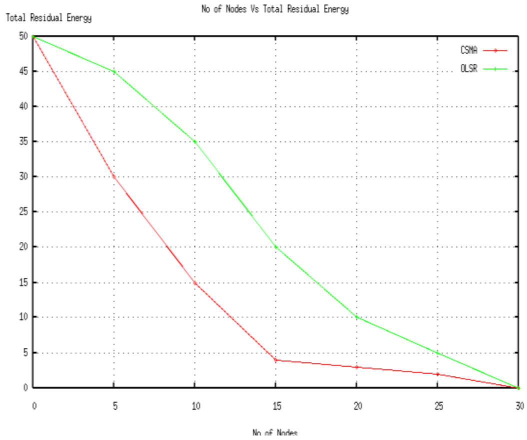

Figure 6g: Number of nodes Vs Total Residual energy

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of nodes with the residual energy.

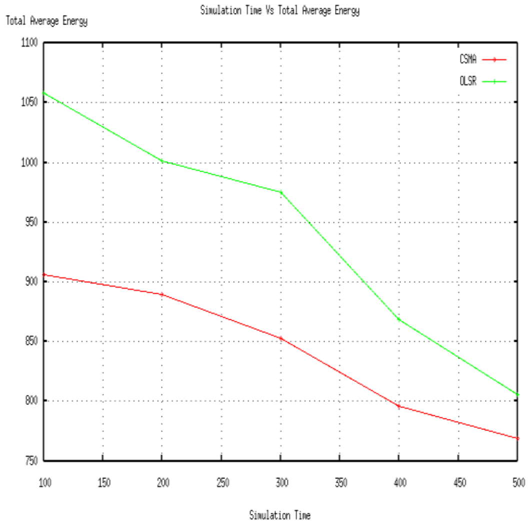

Figure 6h: Simulation Time Vs Total Average Energy

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of simulation time with average energy. We performed simulations to compare the energy consumption of both protocols. As the simulation time increases total average energy also increases, this makes the proposed system to work better than all other current system available.

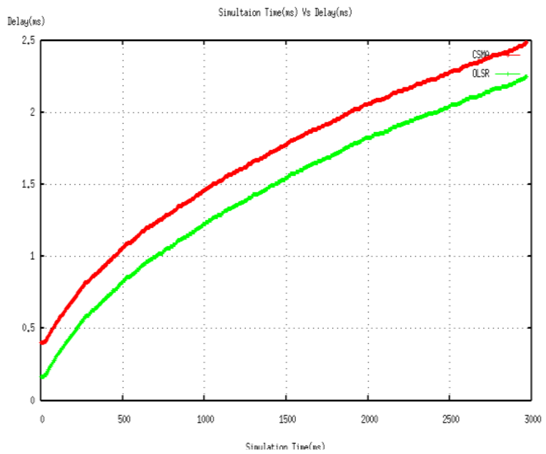

Figure 6i: Simulation Time Vs Delay

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of simulation time with the delay.

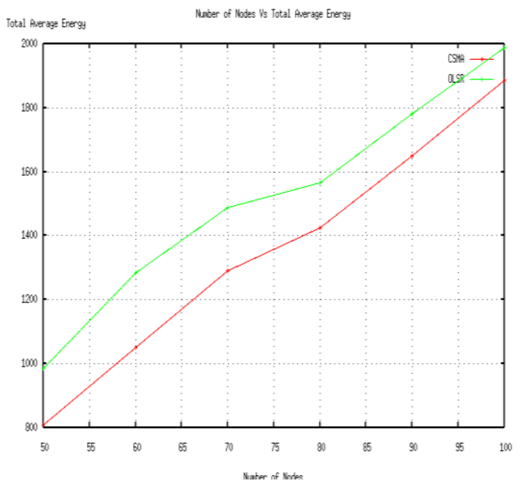

Figure 6j: Number of nodes Vs Total Average Energy

This section presents the experimental result with graphs indicating the comparison of proposed system with CSMA; it describes the evaluation of number of nodes with its average energy level. The proposed system works better saving total average energy.

VI.CONCLUSION

We propose the system for to high performance of the wireless network through the link stability (OLSR) concept use of the routing algorithm. The issues are scalability to large number of nodes, design of data handling techniques, localization techniques, real time communication, data availability, fault tolerance etc. The proposed System is simple, secured and adaptive energy efficient link based algorithm in wsn. For that we use Dynamic routing algorithm for selection reliable path for energy efficiency and performance. Dynamic routing is a networking technique that provides optimal data routing.

This system is proposed to achieve trade-off of energy consumption and time delay. Sensors send their measurement to a subset of sensors called relay points (RPs) by multi-hop communication. A sink moves around in the network and retrieves data from encountered RPs. RPs are static, data dissemination to RPs is equivalent to data dissemination to static sinks

Simulation results have proven that proposed approach outperforms when compared with the previous schemes. Ultimate objective behind the routing protocol is to keep the sensor operating for as far as possible, thus extending the network lifetime.

FUTURE SCOPE

OLSR is a proactive routing protocol for mobile adhoc networks (MANETs). OLSR uses a concept of MPR [Multi-Point Relay] selection mechanism to reduce broadcast packets during a flooding process. OLSR does not consider available node energy and mobility of nodes for path selection and communication purposes. Future investigation is to avoid selecting MPR nodes which has small residual energy and concentrating energy consumption in specific nodes by using weighted MPR approach. Weighted MPR is calculated using Residual Energy, Transmission Delay, and Signal Strength.

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