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Performance Evaluation of QoS Based Improved Rumour Routing Scheme for WSN

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ABSTRACT

The emerging field of wireless sensor networks (WSNs) combines sensing, computation and communication into a single tiny device. The power of wireless sensor networks lies in the ability to deploy large numbers of tiny nodes that assemble and configure themselves. Usage scenarios for these devices range from real-time tracking, monitoring of environmental conditions, ubiquitous computing environments, in situ monitoring of the health of structures or equipment. The up-coming networks are expected to support a wide range of communication-intensive, real-time multimedia applications. The requirement for timely delivery of data raises new challenges for the next generation networks. One of the key issues is the Quality-of-Service (QoS) routing. It selects network routes with sufficient resources for the requested QoS parameters. Node routing protocols have been specifically designed for WSNs in which energy conservation is an essential design issue. Rumour Routing (RR) is a hybrid protocol which combines both proactive and reactive routing methods, which balances event, query flooding and adapted to the case of few data and many queries. It is proposed to develop a QoS based Relative Coordinate Rumour Routing protocol based on a straight line random walk approach. The main objective is to evaluate the performances of the proposed protocol under different situations and considering different factors such as network size or the impact of the positions of the Beacon nodes. The performances are evaluated through network simulator2 (NS2).The simulation results indicate the superiority of proposed scheme compared with Rumour Routing, in terms of performance indices, provide better path quality and higher data delivery ratio.

Keywords
Energy Consumption, Quality-of-Service Routing, Routing Protocols, Shortest Path, WSN.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) fall into the class of an ad hoc network in which sensors are scattered over the entire network area [1]. A single wireless sensor can carry out self-configuration, transmission, sensing the environment or even self-localization with the aid of localization devices such as a global positioning system (GPS) . A sensor node typically consists of several parts i.e. Radio transceiver

with an internal antenna , a microcontroller used to interface with the sensors and an energy source usually a battery [2].

The size of a sensor node can be either small or large. These sensors work with each other to sense some physical phenomenon and then the information gathered is processed to get relevant results .WSN consists of a base station also called sink that communicates with sensor nodes [3]. These large number of nodes wirelessly communicate with each other and have capabilities to sense the data from their surroundings, store the data , pass their sensed data to their neighbor sensor nodes or to the base station and perform some computations on the sensed data.

Usually there are hundreds or even thousands of nodes in a large geographical region available to be used to collect information and transfer it to the data computation centre for analysis purposes. Each single sensor is unattached to the others, generally, each with its own sensing device, memory and central processing unit (CPU) which brings about many constraining limitations on the design and application of WSNs. In WSNs, nodes are energy constrained as they use only a battery unit. Thus, they need to minimize the CPU and memory usage to reduce the cost and energy consumption [4]. In order to minimize the energy needed for communication purposes, several contributions have been proposed for several communication layers, that is, the physical layer and the access layer. .Sensors are always deployed randomly in the surveying area. They collaborate with each other in order to monitor the environment. Because the application requirements are not the same, different routing protocols are used for different data gathering conditions. Thus, a given routing protocol cannot be replaced by another one in all the simulations. WSNs have a profound effect on the efficiency of many application domains, such as disaster (forest fire, volcanic eruption. .etc.), military applicants, intrusion detection, weather monitoring, security and tactical surveillance, and the observation of ambient conditions [5].

An energy aware quality of services (QOS) based routing protocol has been proposed for WSN [6]. The proposed algorithm has been designed based on minimum path energy and path hop-count. The simulation results shows that the algorithm has the advantage like differential dimension services for real time, best effort traffic, achieve lower delay, sustainably longer network lifetime, more scalable and robust existing QOS algorithm. A new routing algorithm based on ID free epidemic flooding protocol has been suggested for WSN [7]. It has been found that, the simulation results shows maximize the throughput and minimize delay to enhance the performance of network. A new routing protocol has been suggested based on architectural and operational challenges of the QOS traffic for WSN [8]. It has been found that the algorithm shows the efficient usage of the sensor resources and effective access to gather measurements in order to increase the energy efficiency of the sensor .A new concept of QOS services routing pattern has been designed for WSN [9]. It has been found that the algorithm ensure reliability like load capacity, bandwidth, flow control and end-to-end transmission in WSN.A QOS based shortest route with energy efficient routing algorithm has been proposed for WSN [10]. It has been shown that the algorithm has an advantage of minimizing routing control message with energy efficient perspective and avoids amount of conjunction in the network .The QOS aware routing protocol (QARP) has been proposed for wireless actor and sensor network (WASN) [11]. The simulation result shows the ability of the WASN for managing power backup, mobility and route failure .A multi traffic, multipath an energy aware routing mechanism has been proposed for improving QOS in WSN [12]. The simulation results has been found that the algorithm efficiently improves quality of reception ratio and satisfying the QOS service matrices. A system for guarantying QOS has been proposed for WSN [13]. The simulation results shows that the effectiveness of proposed systems in terms of throughput, latency, loss of packet and sense of power consumption.

II. PROBLEM STATEMENT

It is proposed to develop a new improved QOS based rumor routing (RR) with relative co-ordinate approach (RCRR) for Wireless Sensor Networks with a view to increase the lifetime of the network and to reduce the energy consumption. The performance metrics for proposed scheme evaluated through Network Simulator 2(NS2) platform**.**

III. PROPOSED METHODOLOGY

A hybrid routing protocol derived from RR based on a random-walk approach designed based on relative co-ordinate rumour routing and some of the indices like are specially considered. The improvement of the performance of RR is mainly based on the usage of the topology of the WSN. The proposed RCRR) consisting of straight line routing (SLR) procedure and has improved the performances of the RR protocol. To keep the routing path straight, SLR uses a very interesting concept to find the next hop Figure 1 illustrates the function of SLR

Suppose node B broadcasts to node A. Subsequently, the next stop node A broadcasts the same packet, and the third node in the red can receive the broadcast again. By calculating the signal strength of both received signals, from nodes B and A, the third node can work out that this broadcasting is from B to A and will broadcast forward without telling who will carry out the next broadcast, since the node who receives this broadcast twice will broadcast this packet automatically. Here they define a concept of the intersected region of the Inside Band of node A and the Outside Band of node B. The node in this kind of intersected region can hear different signal strengths broadcasting to determine the direction of the broadcast and make a forward transmission. SLR is without doubt a smart protocol since nodes can detect the direction of transmission. Some simulations are given in this study in order to show the effectiveness of the improvement provided by SLR to RR Protocol; however, to implement this protocol we need a sensor that can detect signal strength. In the coverage of one single sensor, we need to set at least two sensors to process the protocol function. A larger number of sensors need to be set than that needed in RR.A new routing algorithm has been proposed for WSN based on random walk approach

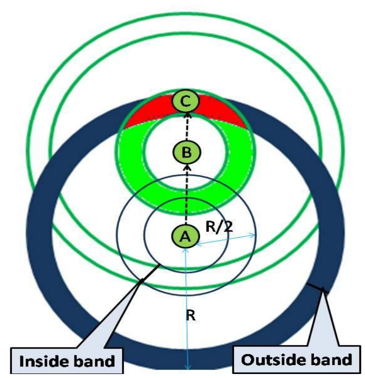

Figure 1: Straight Line Routing

The performance of RCRR is mainly based on the usage of the topology of the WSN. As a derivative of RR, the event detection process of RCRR is similar to RR. To complete the relative coordinate function, there is an extra process called initialization in addition to RR that will be carried out when the nodes are deployed to establish the network

Energy Consumption Analysis of RCRR

In RCRR, there are three kinds of procedures to establish a route as described in section 4.3, namely, the initialization, notification and query procedures. To analyze the different energy consumptions of each part of this protocol, we can make use of the energy consumption equation

$$E_{tq} = E_{path} * n * TTL_n + (q - Q_f) * TTL_q * \Theta_q + Q_f * N$$

θq: The average hops ratio of TTL query of the Intersection with the notified nodes.
The average hops number is the product of TTL query and θq.
TTLn: The time-to-live parameter for the event notification agent.
TTLq: The time-to-live parameter for the query agent.
Epath: The average energy needed by an agent-generated route,
N: Number of nodes.
Qf: The number of queries that need flooding.

To compare with RR, there are some assumptions that need to be stated prior to the analysis. These assumptions can guarantee that the comparison of RR and RCRR is based on the same environmental conditions, nodes deployment and unit node functions. The only difference lays in the protocols being implemented by the beacon nodes so that the different performances can be analyzed in order to reveal the benefits of the new proposed routing protocol. The transmission ranges in RR and RCRR should be the same. Figure 2 illustrate the proposed flow diagram.

Flow Diagram of Proposed System

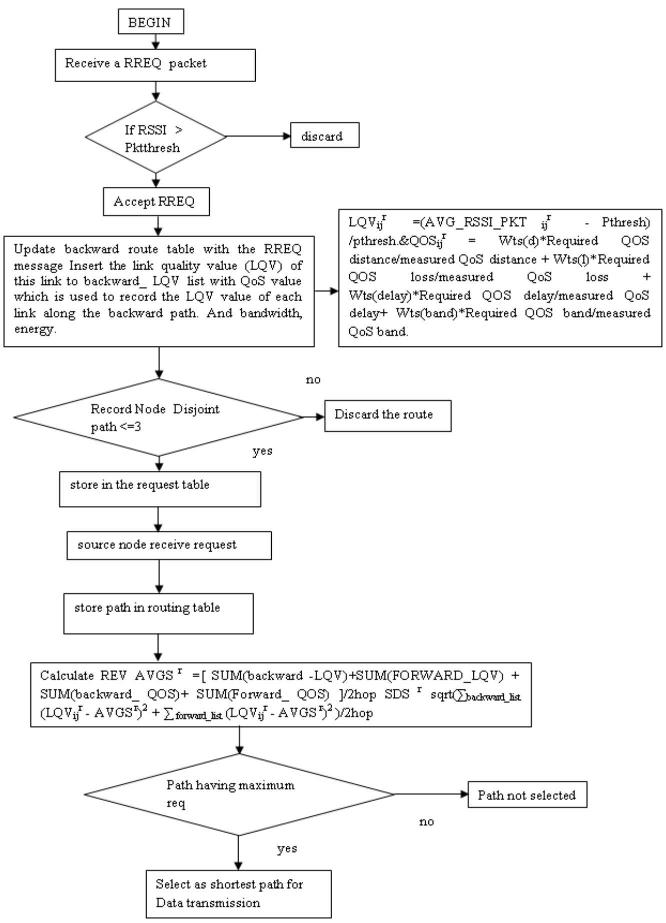

Figure 2: Flow Diagram of Proposed Approach

IV. SIMULATION RESULTS

The exercise endeavors to examine the performance of the network designed to transfer data between three sources and destination as seen in Figure 3. The scheme configures a network with two fifty mobile nodes distributed in a space of 1000m × 1000m and the NS2 simulation study calculates the indices over a time frame of two hundred seconds using improved QoS Rumour and Rumour Routing. The Figure 4~9 display the NS2 graphs for the different metrics that include the number of packets received, packet loss, throughput, energy expended and routing delay for a packet size of 1000 KB.

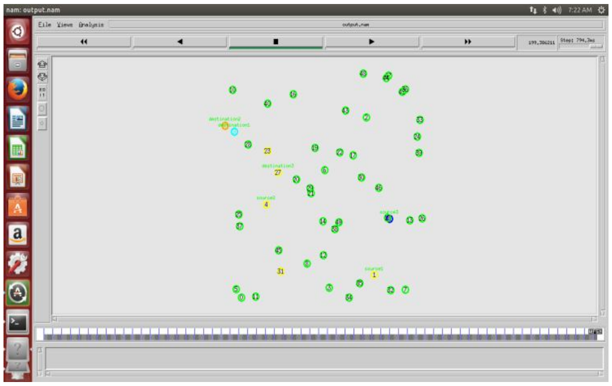

Figure 3: Network Model

The number of packets appears to increase with time showcasing the highest increase for QoS rumour in Figure 4

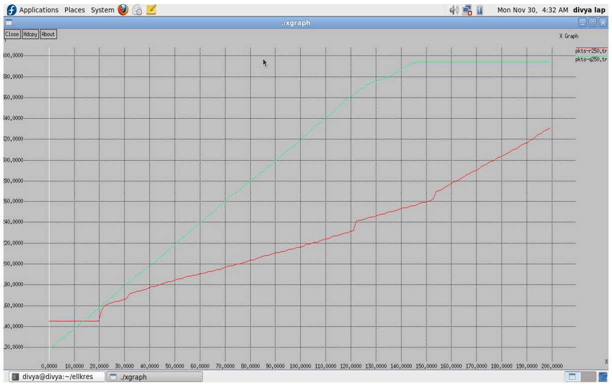

Figure 4: Packet Received vs Time

The energy pattern expressed in Figure 5 exhilarates the improved QoS Rumour to etch out an energy efficient path for the packets in contrast with other routing technique to claim an increase in the network lifetime.

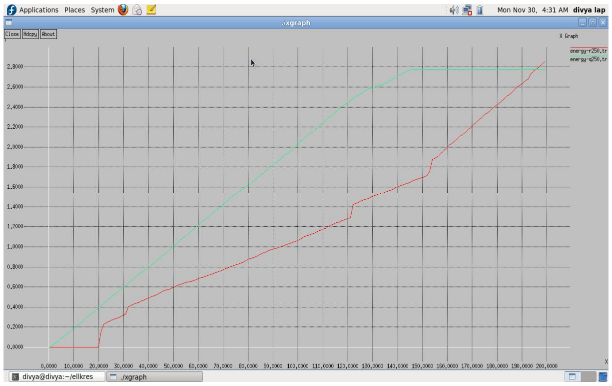

Figure 5: Energy vs Number Of Nodes

The graph in Figure 6 dwells with the minimum delay encountered with the flow of data for improved QoS Rumour in comparison with its counterpart.

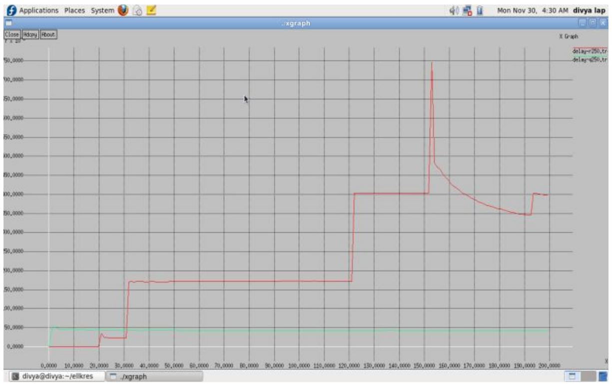

Figure 6: Routing Delay vs Time

While the plot in Figure 7 depicts the minimum loss of packets for improved QoS Rumour over other routing scheme.

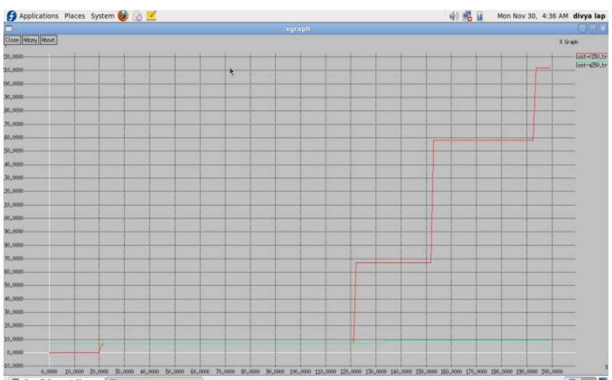

Figure 7: Loss vs Time

Figure 8 exhibits the highest average throughput for QoS Rumour to extradite its benefits on a similar platform

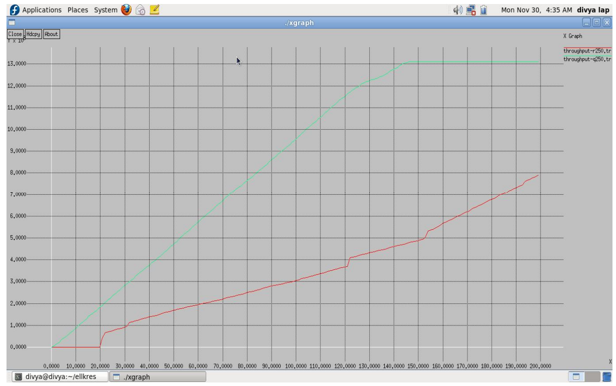

Figure 8: Throughput vs Time

Though the bar chart depicts the network Packet Delivery Ratio (PDR) in Figure 9 improved QoS Rumour derives the largest PDR over other routing method. The results endeavor to validate the fact that improved QoS Rumour outperforms Rumour and elucidates the benefits of proposed concept in the process of routing.

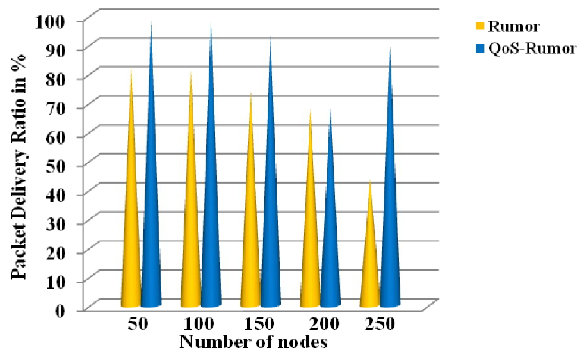

Figure 9: Packet Delivery Ratio vs Number of Nodes

The entries in Table.1 bring out the ability of the QoS Rumour routing to arrive at the admirable indices for the network. Comparative study of the performance with nodes variation and with packet size variation reflects the benefits of routing the data through an enhancement in the performance.

Table 1: Performance Comparison with Node Variation

Nodes	Protocol	Energy in Joules	Delay in Secs	No. of Paks Loss	No. of Packs Received	Throughput in Bytes	PDR in %
50	RUMOR	5.25	0.143	81	483	14393	82.59
	QOS- RUMOR	**4.05**	**0.049**	**7**	**520**	**19124**	**98.34**
100	RUMOR	5.28	1.48	74	479	14195	81.19
	QOS- RUMOR	**4.06**	**0.054**	**8**	**520**	**19156**	**98.1**
150	RUMOR	6	0.086	14	141	16150	73.68
	QOS- RUMOR	**2.45**	**0.073**	**10**	**362**	**11602**	**93.04**
200	RUMOR	4.3	0.199	81	426	11942	67.85
	QOS- RUMOR	**2.86**	**0.047**	**53**	**403**	**13546**	**68.16**
250	RUMOR	2.85	0.75	212	331	7904	43.54
	QOS- RUMOR	**2.77**	**0.052**	**9**	**394**	**13100**	**89.41**

V. CONCLUSION

The role of a new QoS based rumor routing scheme has been introduced and performance metrics displayed to support an increase in the performance of the network. An exhaustive comparative study has been carried out to reveal the relative merits of the proposed routing pattern. The NS2 graphs have been drawn to establish the higher number of packets received, minimum packet loss, larger throughput, lesser delay and minimum use of energy for transferring the data using improved QoS method.

Besides its ability to outperform RR has been centered to validate the use of a QoS based RCRR concept with the philosophy of straight line approach and extricate still superior indices. The cognizance of the higher network PDR for Straight Line rumor routing over other scheme has been the highlight of the use of this methodology. The large scale data carrying capability of proposed method has been decorated to reveal new edge for wireless data communication network

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