Appraise the QoS Metrics Comparison of REAR and SPEED Routing Protocols in the Wireless Sensor Network

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Abstract— In the modern network development era wireless sensor networks (WSNs) is taking an essential role to do the research. Wireless Network containing more sensor nodes, this sensors can quickly be installed in random manner and are normally battery operated, having some energy limits. Which is used for to inspect the temperatures, pressure, sound etc. This sensor node can communicate from one into another and collect the information through the nodes and send the report to the corresponding Base Station (BS). The important key challenges in the wireless network is the saving the energy constraints in the wireless network. This research is mentioned, how to effectively reduce the energy and improve the consistency and evaluate the error rate between the REAR and SPEED routing protocols, in the wireless networks. As there exist many different routing technique are avail, but they can't produce the energy efficiency properly. This proposed work is totally based on sequential routing techniques exploited in the wireless network pattern to get better error tolerance and reduce the energy consumption.
Key words: Wireless sensor networks (WSN), QoS Routing protocol, QoS Metrics, REAR, SPEED, Energy consumption

I. INTRODUCTION

Wireless sensor networks (WSN) can be applied into many reasons in different circumstances because they are consists of small sensor nodes, which are using battery supplies. The improvement of WSN was encouraged by many applications (ex: battleground surveillance, industrial and consumer applications, health monitoring). Wireless sensor networks consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. Routing protocols in WSNs might differ depending on the application and network architecture. The flexibility, fault tolerance, high sensing fidelity, low cost, and rapid deployment characteristics of sensor networks create many new and exciting application areas for remote sensing. In the future, this wide range of application areas will make sensor networks an integral part of our lives. However, realization of sensor networks needs to satisfy the constraints introduced by factors such as fault tolerance, scalability, cost, hardware, topology change, environment, and power consumption [2].

A. What Is Wireless Sensors

Main functions of sensor is used for Motion of any type using monitor, vibration, and presence, communications, as in Sensor nodes are small and often spread over huge areas which is having power supplies, so generally they are using small batteries which are very difficult or impossible to restore. Where every node is connected with one or more sensors. Each such sensor network node has typically several parts [3]: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting [4]. Here, monitoring the Area through the many sensors is installed over the area, where some intrusions are to be examining. This paper is going to presents the art for energy consumption, delay, error tolerance and consistency of routing process in the sensor networks.

B. Understanding WSN Architecture

A wireless sensor network (WSN) consists of three main components: nodes, gateways, and software [5]. The spatially distributed measurement nodes interface with sensors to monitor assets or their environment. The acquired data wirelessly transmits to the gateway, which can operate independently or connect to a host system where you can collect, process, analyze, and present your measurement data using software. Routers are a special type of measurement node that you can use to extend WSN distance and reliability.

The main characteristics of a Wireless Sensor Network [4]:

- Power expenditure limitation for nodes using batteries
- Capability to cope with node failures.
- large level of use
- tolerate cruel environmental conditions
- no difficulty of use

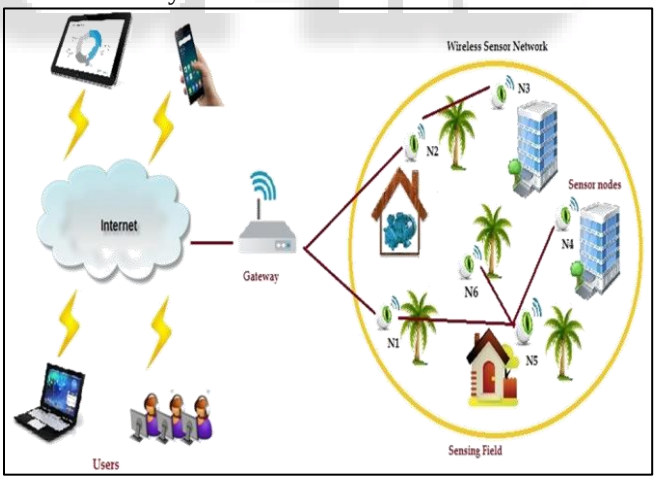

Fig. 1: Simple Wireless Sensor Network- WSN Architecture in a Small Campus

C. Why Choose Wireless Sensor Network

Wireless sensor network (WSN) provide the same quality and accuracy as traditional wired measurement systems, but with increased flexibility, lower costs, and the ability to create smart WSN systems with the WSN Module. . The WSN platform provides multiple types of high-quality measurements, from single-point to waveform, all within a single system.

Some Advantages:-

- Measurement Quality

- Rugged, Reliable Embedded Hardware
- Node Programmability
- Web-Based Visualization and Analytics
- Flexibility
- Cost Savings

QoS routing can enhance the network performance by increasing the network utilization, compared to routing that is not sensitive to QoS requirements of traffic. so the primary focus here is on evaluating and comparing the network performance in the WSN having QoS routing [6].

The main QoS-based routing protocols that are under consideration in this paper are REAR and SPEED as discussed in the following section.

1) Rear (Reliable Energy Aware Routing):

REAR is designed and implemented on the Nano-Qplus platform to overcome the energy constraint issues in the WSN. To establish routing paths in the network, REAR considers the residual energy capacity of each sensor node and it also supports the multi-path routing for reliable data transmission in WSN. Moreover, the REAR also supports the DATA-ACK oriented packet transmission, to confirm success of data transmission from one sensor node to other [7].

2) SPEED (Stateless Protocol for End-to-End Delay):

SPEED (Stateless Protocol for End-to-End Delay) is a protocol of real-time communication for sensor networks. It is specifically designed to be a stateless, localized algorithm with minimum control overhead. In SPEED, real-time communication is achieved by sustaining a desired delivery speed across the sensor network through a novel combination of feedback control and non-deterministic geographic forwarding. SPEED retains a desired delivery speed across sensor networks by both diverting traffic at the networking layer and locally regulating packets sent to the MAC layer [8].

II. RELATED RESEARCH WORKS

SAR is the first protocol providing QoS supports for wireless sensor network. This protocol is a table driven multipath routing protocol and it tries to get both fault tolerance and energy efficiency [9]. The SAR creates a tree of nodes rooted at one hop of neighbors of the sink node. By taking QoS metrics, energy resources in each path and priority of each packet into consideration with the use of created tree multiple path are selected on the basis of energy resources and QoS on each path failure recovery is done by enforcing routing table consistency on each path between downstream and upstream node. SAR provides fault recovery and tolerance. The aim of the SAR algorithm is to decrease the average weighted QoS metrics throughout the lifetime of the network due to node failure topology changes a path re-computation is needed.

R.Sumathi et al, An Energy constraint [10], each sensor node has low processing capability, low memory power, and limited transmission energy. As a result, these constraints impose an essential requirement on any QoS support mechanisms in WSNs: simplicity. In most WSN applications, traffic mainly flows from a large number of sensor nodes to a small subset of sink nodes. QoS mechanisms should be designed for unbalanced QoS-constrained traffic.

Jalel Ben-Othman et al, They evaluate [11] and compare the performance of our routing protocol with the MCMP (Multi-Constraint Multi-Path) routing protocol. Simulation results have shown that our protocol achieves lower average delay, more energy savings, and higher packet delivery ratio than the MCMP protocol. we propose an Energy Efficient and QoS aware multipath routing protocol (abbreviated shortly as EQSR) that maximizes the network lifetime through balancing energy consumption across multiple nodes, uses the concept of service differentiation to allow delay sensitive traffic to reach the sink node within an acceptable delay, reduces the end to end delay through spreading out the traffic across multiple paths, and increases the throughput through introducing data redundancy.

Hua Chen et al, They propose [12] an Energy-efficient based Maximal Lifetime Routing Algorithm to prolong lifetime (EMLRA), which is able to dramatically prolong network lifetime while effectively reducing energy consumption. Through an analytical study, we provide guidance on how to choose parameters in our scheme and demonstrate that the scheme is efficient in both network lifetime and energy consumption. Simulation results show that, with the proposed Energy-efficient based Maximal Lifetime Routing Algorithm in WSN energy consumption, network lifetime, energy consumption balance can be improved in most of cases. It is an available approach to routing decision.

Kemal Akkaya et al, aim is to find [13] an optimal path to the gateway in terms of energy consumption and error rate while meeting the end-to-end delay requirements. End-to-end delay requirements are associated only with the real-time data. Note that, in this case we have both real-time and non-real-time traffic coexisting in the network, which makes the problem more complex. We not only should find paths that meet the requirements for real-time traffic, but need to maximize the throughput for non-real time traffic as well. This is because most of the critical applications such as battlefield surveillance have to receive for instance acoustic data regularly in order not to miss targets. Therefore it is important to prevent the real-time traffic from consuming the bulk of network bandwidth and leave non-real-time data starving and thus incurring large amount of delay.

S. M. Mazinani et al. [14] proposed a new QoS based routing protocol called tree-based routing protocol (TBRR) that provides a high reliability in routing packets towards the destination node. The author has also compared the performance of the TBRR with three other QoS based protocols called PISA-III, SBRR and REAR using MATLAB and C++ simulation frameworks. The simulation results show that the TBRR minimizes the energy consumption, shows the minimum amount of reduction in packet delivery ratio and yields less average packet latency as the percentage of nodes with high channel error rate increases as compared to all the other three protocols.

A. Naderi et al. [15] focused on building a routing protocol called MBRR which classifies the data into differentiated classes using a decision-making function called Win and then routes the data-packets towards the sink node in a highly reliable way. Moreover, MBRR engages a new adaptive approach called majority based re-routing

approach in order to route the data-packets with instantaneously change in number intimating occurrence of special events via some more reliable paths. The paper demonstrated that MBRR protocol exhibits a better performance in regards of total energy consumption, Packe Delivery Ratio and Packet Delivery Ratio as percentage of nodes with high channel error-rate increases and when operating in a noisy wireless environment along with node failure, as compared to PISA-III, REAR, LEQR and SBRR protocols.

M.A. Koulali et al.[16], suggested a hybrid QoS based routing protocol for wireless sensor networks based on a customized Distributed Genetic Algorithm (DGA) that accounts for delay and energy constraints. The suggested protocol QDGRP (i.e. QoS Distributed Genetic Routing Protocol) supports QoS constraints on end-to-end delay and sensor's residual energy. The realized simulations show that QDGRP shows better results than AODV in terms of delay,.throughput, and packet delivery ratio.

III. QOS PERFORMANCE METRICS

MATLAB supports different parameters for the measurement performance evaluation of the WSN under different routing protocols [6]. The metrics used are Bit Error Rate (BER) vs. Signal-to-Noise Ratio (SNR), Average end-to-end delay vs. BER, Packet Delivery Ratio vs. BER, Energy Consumed vs. BER, Network Lifetime vs. Energy Consumption, Throughput vs. BER and Throughput vs. SNR. The table of the metrics with their details, used to evaluate the performance of the routing protocols is given below in Table.

S.No	QoS Metrics	Description
1.	Bit Error Rate (BER) (measured in % age)	BER is number of bit errors divided by total number of in transferred bits in a specified time interval [15].
2.	Average End-to- End Delay (expressed in seconds)	It is the time taken by a data packet to be transmitted across a network from source to destination [13].
3.	Packet Delivery Ratio (expressed in number of packets)	It is the ratio of total number of delivered packets successfully received by the sink node to the number of packets sent by all sensor nodes in the network [13].
4.	Energy Consumed (measured in KJ)	It is a measure of rate at which energy is dissipated by sensor nodes in a WSN within a specific time period [13].
5.	Network Lifetime (measured in minutes)	The lifetime of a WSN can be defined as the time elapsed until the first node dies, the last node dies, or a fraction of nodes dies[14].
6.	Average Network Throughput (measured in bps i.e. bits per seconds)	It is the average number of data packets successfully received by the sink node per unit time [13].
7.	Signal-to-Noise Ratio (SNR) (expressed in db i.e. decibels)	It is described as the ratio of signal strength to the noise strength. A ratio higher than 1:1 (greater than 0 dB) denotes more signal than noise [16].

Table 1: Description of the QoS Metrics

IV. RESULTS AND DISCUSSIONS

Every node is implicit to be within communication series of the base station and that they are all attentive who the base station is. In the occurrence that the nodes doesn't know who the base station is, the base station could transmission a message proclaiming itself as the base station, later which all nodes in range will send to the particular base station.

The REAR and SPEED Protocols are examined through the ten nodes, they are connected and sending the data packets, here we can calculate the Error rate and energy consumptions and display the graphical outputs. Here the SPEED Protocol is containing the low level energy consumption, compared to the REAR Protocol.

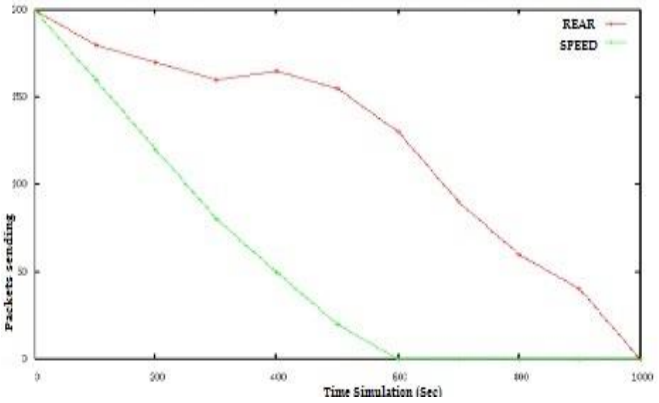

Fig. 2: Calculating the Error Rate to sending packets

Here the above graphical diagram illustrates the data sending over the ten nodes in the wireless network. Thus the Error rates are displayed in the above diagram.

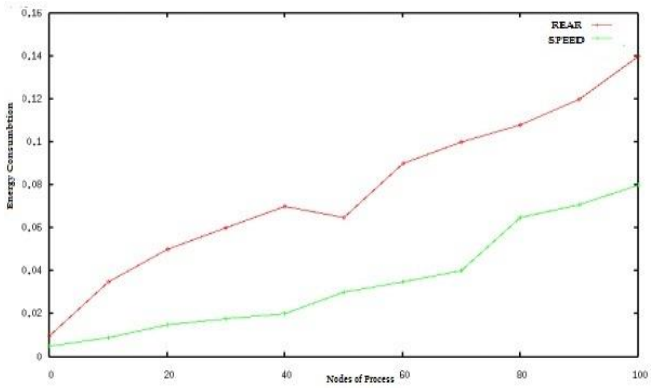

Fig. 3: Percentage of Energy Consumption (Joules)

Thus the above diagram explains the percentage of energy consumption in the ten nodes are connected in the sensor network.

V. CONCLUSION

In this paper, a summary of the necessities for QoS based routing protocols and factors that are a challenge in implementing these protocols in a WSN Each routing protocol is discussed along with their solution to meet QoS requirements. Through simulation, the per- formance of the REAR and SPEED protocols are evaluated and analyzed with respect to different combinations of network and traffic control parameters. Their QoS Performance Metrics are discussed and compared. I have also highlighted the reliability, delay, and energy efficiency performances of these protocols.

VI. FUTURE ENHANCEMENT

In this research paper contains the comparison of the two QoS routing Protocols and evaluate the Protocols, but in future Medium Access Protocols Metrics (i.e Energy consumption) oriented research is going on, so the result is publish as soon as possible.

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