Improving Quality of Service through enhanced node selection technique in Wireless Sensor Networks

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Abstract- Wireless sensor networks (WSNs) consist of frivolous devices with low cost, low power and short-ranged wireless communication. The sensors in the network can communicate with each other to form a network. In this paper, we propose the Enhanced Node Selection Technique (ENST) approach for vigorous multipath QoS routing for WSNs. This approach is based on determining the optimized node that helps route discovery for improving the QoS parameters in the communication network. The selection of enhanced nodes makes the chain for route selection using received signal strength indicator (RSSI) and residual energy. Simulation analysis shows that ENST improves throughput, end-to-end delay, packet delivery rate and extend the energy efficiency of the communication network.

Keywords: wireless sensor network, throughput, end-to-end delay, energy, enhanced node selection technique.

1. Introduction

Wireless Sensor Networks (WSNs) finds important difference with other wireless networks in terms of resource constraints, especially energy which arise usually from small size of sensor nodes. WSNs involve a large number of small and low-cost sensors, which are equipped with computation capabilities and wireless communication. The applications of WSNs include military battlefields, health care monitoring, civilian, commercial and environmental applications. For all the applications, energy plays an important role in the current world. The energy expenditure of wireless sensor networks

depends on the data processing, environmental sensing and wireless communication. Accomplishment of energy conservation is considered to be most important aim of the most QoS routing protocols.

Routing protocols in WSNs should be designed with minimum routing overhead and low processing convolution. The routing protocols in WSNs must be performance efficient and scalable. The multipath QoS routing protocols establish multiple paths to balance the network traffic between the source to destination path. This paper focuses on multi-path QoS routing protocol for improving the energy efficiency, packet delivery rate, throughput, reducing the end-to-end delay.

The rest of this paper is organized as follows: In section 2, various existing algorithms related to this work are studied. Section 3 describes the enhanced node selection technique in WSN. In section 4, the performance of the ENST is evaluated and compared. Finally, section 5 concludes the paper with the advantages of ENST technique.

2. Related Works

Energy Efficient and QoS aware Routing (EEQR) protocol for Clustered WSN ensures QoS for different types of traffic. The prioritization of data is done based on message type and content of the message [1]. To address the problem of energy efficiency and high end-to-end delay, a mobile and static sink combination is used for data gathering. Delay sensitive messages are sent through the static sink and delay tolerant messages are sent through the mobile sink. EEQR incurs less end-to-end delay and is able to ensure QoS.

Equalized Cluster Head Election Routing Protocol (ECHERP) follows conservation of energy through balanced clustering [2]. ECHERP uses the Gaussian elimination algorithm for calculating the node combinations that can be chosen as cluster

heads in order to extend the energy efficiency which in turn increase the lifetime of the communication network.

An ideal model for developing routing protocols for WSNs is the Swarm Intelligence (SI) because they consist of modest, independent individuals that through local interactions self-organize which produce system level behaviors that show lifelong adaptivity to change [3]. The bee-inspired BeeSensor protocol is energy-aware, scalable and efficient.

Quality of Service (QoS) is becoming an important feature of data routing in WSNs [4]. QoS is required for real-time data transmission when the result of a sensing task is dependent not only on the correct sensing of the environment but also on the timely delivery of the event notification to the monitoring center, the sink. Vehicular Ad Hoc Networks (VANETs) are envisioned to improve inter vehicle coordination and become a part of intelligent transport systems with an ultimate goal of increasing safety on the roads and improving travel comfort. Routing protocols for VANETs also aim at satisfying end-to-end QoS requirements. Energy-efficient clustering routing protocols for WSNs are first discussed followed by approaches aimed at satisfying QoS in WSNs and VANETS.

A disjointed multipath routing scheme was designed for real time data transmission in WSNs [5]. This routing scheme uses a hybrid routing protocol based on Bluetooth and Zigbee to overcome the limitation of low bandwidth in conventional sensor networks. This scheme performs disjointed multipath routing based on competition to alleviate the delay of routing path.

The real-time QoS routing protocols are categorized into probabilistic and deterministic protocols [6]. In addition, both categories are classified into soft and hard real time protocols by highlighting the QoS issues including the restrictions and features of each protocol in the communication network. The performance of mobility-aware query based real-time QoS routing protocols are compared from each category.

To improve the efficiency of QoS aware routing, an angle based QoS and energy aware dynamic routing scheme was designed for WSNs [7]. This approach uses the inclination angle and the transmission distance between nodes optimizes the selection of the forwarding candidate set and extends the network lifetime. The drawbacks of Sequential Assignment Routing (SAR) include low delay and increased energy consumption.

3. Proposed System

In this paper, Enhanced Node Technique: ENST is an energy efficient and QoS based multi-path routing protocol for WSNs that selects optimized disjoint and braided paths to achieve load balancing though splitting the network traffic on the primary path and braided paths. ONST improves the data delivery using a Received Signal Strength Indicator (RSSI) and residual energy models. In order to transmit the data over optimized and braided paths, the load balancing algorithm is used to guarantee for balancing the load over the network traffic and improves the throughput while reducing latency.
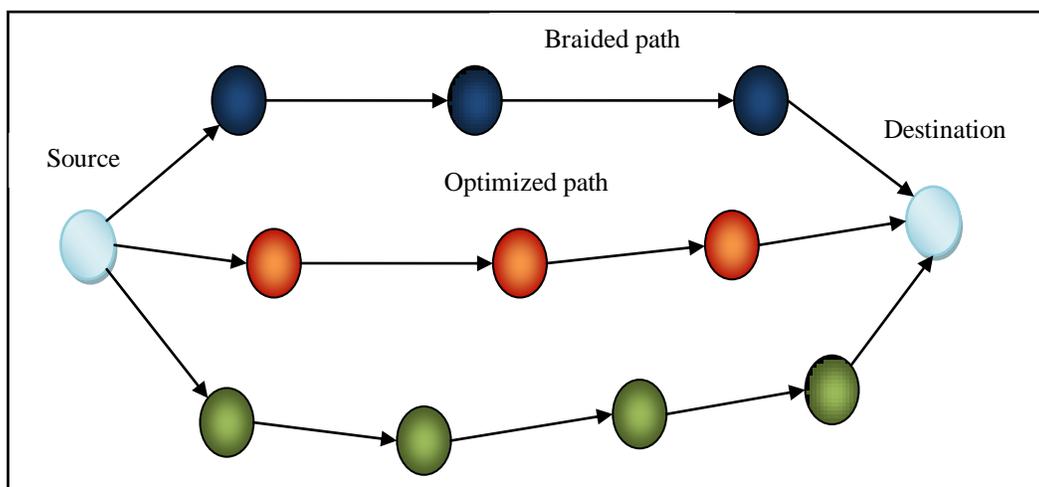

Figure 1: Design of the ENST Scheme

The enhanced node selection technique determines the node which has sufficient resources to forward the data to next node based on the remaining energy and RSSI. To determine the node discovery, each path between source and destination is defined as P = $(P_1, P_2……P_n)$, where P is the set of paths, P_1 the source and P_n the base station. The residual energy (R_E) is calculated using equation 1.

$$R_E = P + \sum_{i=1}^{n-1} E(P_i, P_{i+1}) \qquad (1)$$

The amount of energy required for routing the message between two intermediate nodes is given by $E(P_i,P_{i+1})$. Therefore the enhanced path between two nodes can be calculated as in equation 2.

$$a_m = \max\{(R_E) : a_m \in A \qquad (2)$$

To balance the load over the network, the traffic is routed through multiple routes. The dynamic load balancing approach is used for all paths from source to destination in the communication network. The bandwidth is distributed over these paths according to the traffic load. The paths consist of both enhanced and braided paths. The enhanced path is the primary path that is allotted more Bandwidth and braided paths are alternate paths to balance the traffic depicted in Figure 1.

4. Simulation Analysis

Network simulator version 2 (NS2) is used to perform simulation analysis between the existing TMA and the proposed ENST protocols. NS-2 uses two languages: programming in Object Oriented Tool Command Language (OTCL) and C++ for simulation of various wired and wireless network scenarios.

Both the protocols discussed in this paper are simulated with the parameters packet delivery rate, average delay, throughput and residual energy.

Table1: Simulation Parameters of ENST Scheme

Parameter	Value
# nodes	50
Antenna Model	Omni Antenna
MAC Type	IEEE 802.11
Radio Propagation model	TwoRayGround
Simulation Area	1000x600m
Simulation Time	50ms
Type of Channel	Wireless Channel
Type of Interface Queue	PriQueue
Type of Link Layer	LL
Type of Network interface	WirelessPhy

Packet Delivery Rate

Packet Delivery Rate (PDR) is defined as the rate of number of packets delivered to the destination node to the number of data packets sent by the source node and is estimated by (3).

$$PDR = \frac{Total\ Packets\ Received}{Total\ Packets\ Send}$$

(3)

The figure 3 shows that the delivery rate of the ENST method is higher than the delivery rate of the existing SAR. This improved value of delivery rate means the improved performance of the protocol.
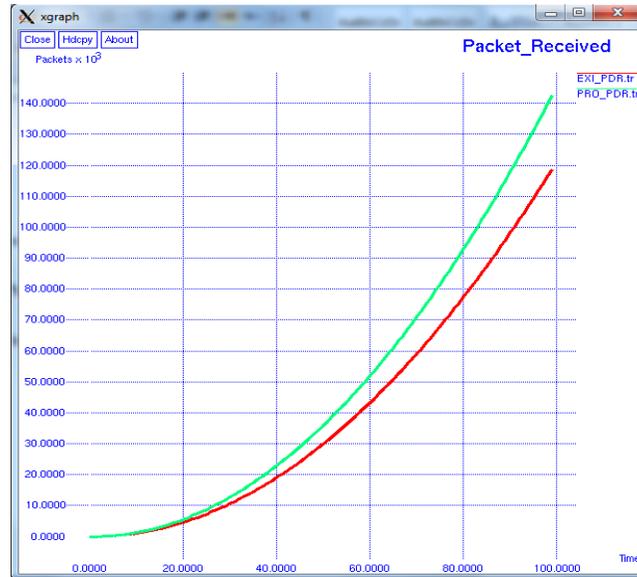
Figure 2: Packet Delivery Rate of SAR and ENST

Average Delay

The average delay is defined as the difference in time between the current packets sent and received and is shown by (4).

$$Delay = \frac{\sum_{0}^{n} Pkt\,Send\,Time - Pkt\,\mathrm{Re}\,cvd\,Time}{Time} \qquad (4)$$

Figure 3: Average Delay of SAR and ENST

Figure 3 shows that the average delay value is comparatively low for ENST than the existing SAR.

Throughput

Throughput is the average of successful messages delivered to the destination from the source node and is estimated using (5).

$$Throughput = \frac{\sum_0^n Pkts\, Received\,(n) * Pkt\, Size}{1000}$$
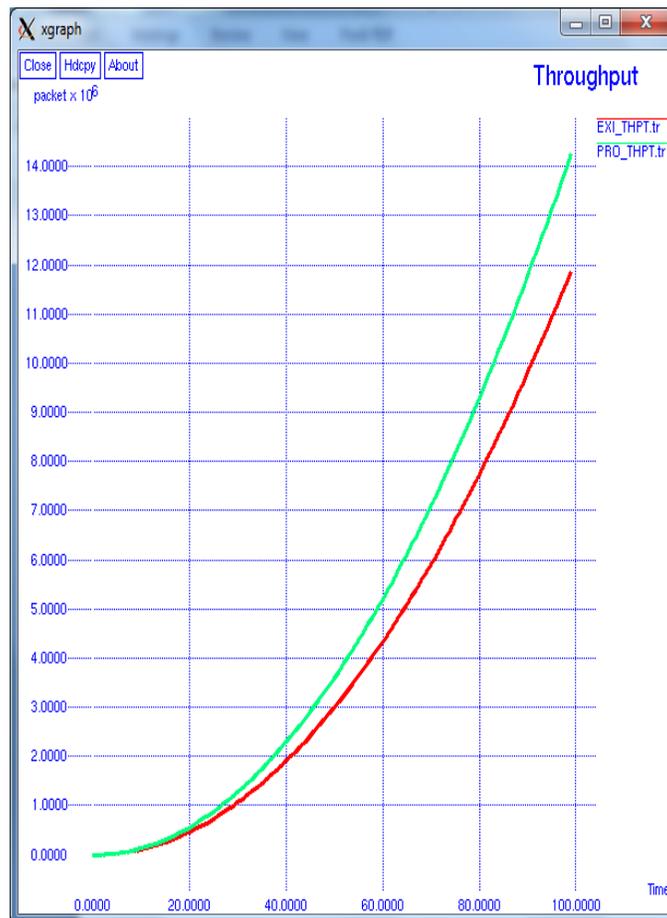
(5)

Figure 4: Throughput of SAR and ENST

Throughput is measured in bps. Figure 4 show the ENST has improved throughput when compared to the existing SAR.

Residual Energy

The amount of energy remaining in a sensor node after completion of current work is called as residual energy.

Figure 5 shows that the residual energy of the network is better for the ENST compared to SAR. As long as there is higher amount of residual or remaining energy, the network will be efficient and will have a longer lifetime.
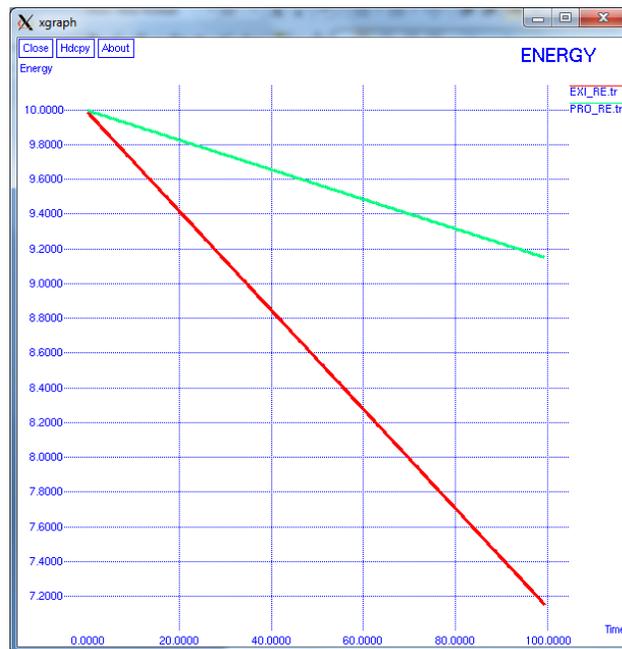

Figure 5: Residual Energy of SAR and ENST

5. Conclusion

The Enhanced Node Selection Technique (ENST) approach for vigorous multipath QoS routing for WSNs is proposed in this paper. This approach is based on determining the enhanced node that helps route discovery for improving the QoS parameters in the communication network. The selection of enhanced nodes makes the chain for route

selection using residual energy and RSSI. Simulation analysis shows that ENST improves throughput, end-to-end delay, packet delivery rate and extend the energy efficiency of the communication network.

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