M-ASSR TO IMPROVE ENERGY CONSUMPTION AND RELIABILITY OF WIRELESS SENSOR NETWORKS

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Abstract: Wireless sensor networks (WSNs) are composed of nodes running on smaller batteries. These nodes use the broadcasting procedure to find a path and route the data between two nodes. The energy efficiency and reliability are two major concerns for these networks. This work proposes a solution to these issues and is modification to the adaptive sectoring scheme for reliability (ASSR). The proposed scheme considers the common neighbors of the nodes when the unreliable node has to be replaced with another node. The performance of the network has been compared based on packet delivery ratio, remaining energy, throughput and number of packets dropped in the network. The results have been simulated in network simulator and have outperformed the existing scheme in terms of these parameters.

Keywords: Wireless sensor network, energy efficiency, ASSR, reliability.

I. INTRODUCTION

WSNs has gained wonderful attention together in academia and industry because of its massive application potential. One of the critical areas of research is to develop energy-saving techniques, which can extend the lifetime of a WSN as much as possible [1]. Many applications such as emergency alarm, fire alarm detection, and intrusion detection require immediate, and guaranteed deliverability of the information [2]. Therefore, sensor networks provide secure and reliable data transportation in an IoT environment [3].

In a resource constraint environment such as WSNs, it is importance to propagate the information as efficiently as possible among the neighboring nodes. Consequently, minimizing the energy-consumption [4] and improving the deliverability of the information to the sink node is very critical [5]. The energy-consumption plays a crucial role, and therefore, it effects other factors such as end-to-end delay and data reliability in the proper functioning of the WSNs [6-8].

This paper thus, presents existing techniques that focus on energy efficiency of the network and reliability of the data transfer in section II. Modified scheme has been proposed in section III and the results have been presented and discussed in section IV of this paper. Finally the paper is concluded in section V.

II. LITERATURE REVIEW

In the paper [9] Markov model for reliability analyses of sensor node in wireless sensor networks is proposed. It is shown that reliability of the sensor node depends on the strategy of it monitoring and is unimodal function of test period. For passive part of sensor node, the optimal time for test of functionality is defined.

In this paper [10] the authors model the problem as a multi-constrained optimal path problem and propose a distributed learning automaton (DLA) based algorithm to preserve it. The proposed approach leverages the advantage of DLA to find the smallest number of nodes to preserve the desired QoS requirements. It takes several QoS routing constraints like end-to-end reliability and delay into account in path selection. They simulate the proposed algorithm, and the obtained results verify the effectiveness of our solution. The results demonstrate that their algorithm has a better performance than current state-of-the-art competitive algorithms in terms of end-to-end delay and energy-efficiency.

In this paper [11], a methodology to design, configure, and deploy a reliable ultra-low power WSNs is proposed. A comprehensive energy model and a realistic path-loss (PL) model of the sensor node are also established. Through estimations and field measurements it is proven that, following the proposed methodology, the designer can thoroughly explore the design space and the make most favorable decisions when choosing commercial off-the-shelf (COTS) components, configuring the node, and deploying a reliable and energy-efficient WSN.

In this paper [12], the authors propose a TTCP targeted for reliable WSN deployments. The proposed protocol is based on the assumption that the WSN deployment is composed of a number of disjoint connected-covers. They implement the proposed protocol using a network simulator and apply the proposed protocol on different deployment scenarios. They present and discuss the experimental results in terms of two protocol performance metrics: the incurred overhead and the time required to detect and repair the functionality of the WSN due to potential SN failures. The factors which affect these performance metrics are also highlighted.

In this paper [13] the authors propose an energy efficient reliable data transfer scheme named as "Adaptive Sectoring Scheme for Reliability (ASSR)" for WSNs. In this approach, the given sensor field is divided into sectors activated one at a time by the occurrence of an event. To minimize the congestion as well as to increase the throughput with maximum packet delivery ratio, the sectoring process is adjusted dynamically to ensure reliable data transmission. Simulation experiments show that the proposed scheme leads to an improvement of the reliability and energy consumption.

III. MODIFIED ASSR

The proposed modified ASSR considers the same network scenario as the existing scheme [13] in which the Sink node is in the Corner, and the network is divided into N number of sectors. The nodes that are close to the sink are declared as Sector Heads (SHs). If an event occurs in a particular sector, then the nodes present in this sector are activated. The remaining sector nodes are kept in idle condition.

AODV Mechanism in the activated sector

Sensors in the activated sector will execute the AODV routing protocol to find a suitable path to the sector head for which RREQ packet is broadcasted in the network. During route reply phase, all the nodes will also forward their list of neighbors back to their downlink nodes. Thus, each node will maintain a list of neighbors of the uplink node. Similarly all the downlink nodes will also share their list of neighbors with their uplink nodes. This step ensures that all the nodes in the path have complete knowledge of the neighbors of the other nodes in the same path. Source node will send the data packets to sink through SH via shortest path.

Achieving Reliability

Once the data transmission starts, the observed reliability is compared with desired reliability (ratio of number of packets received and number of packets sent which is set at 1). If observed reliability is less than desired reliability, then instead of formulating the new sector, the promiscuous behavior of the nodes can be utilized to see which nodes are dropping the packets.

If the node in the path observes that succeeding node is dropping the packets, then the observing node can broadcast the help packet to their common neighbors. All the common neighbors will reply back to the node. The node can then forward the packet using nearest common neighbor. Thus, instead of broadcasting the RREQ again in the entire new sector again, the packet dropping node can be replaced by one of its neighbors.

IV. RESULTS AND DISCUSSION

The aim of the study is to achieve reliability in wireless ad hoc networks. To achieve this, the adaptive sectoring scheme was modified. The proposed modification as well as to check the effectiveness of the proposed scheme against the existing scheme, both the schemes were implemented in network simulator 2.35.

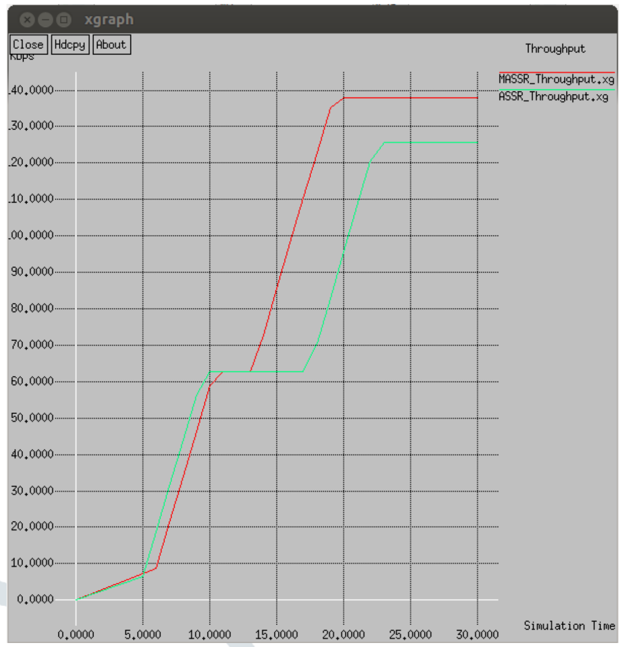

Figure 4.1: Throughput Comparison

This figure shows the comparison of the throughput achieved after simulating both the schemes. The value of throughput was found to be 138 Kbps for the proposed scheme and for the existing scheme, the throughput was 125.6 Kbps. This indicates that the sink node receives more packets in the network with the proposed scheme.

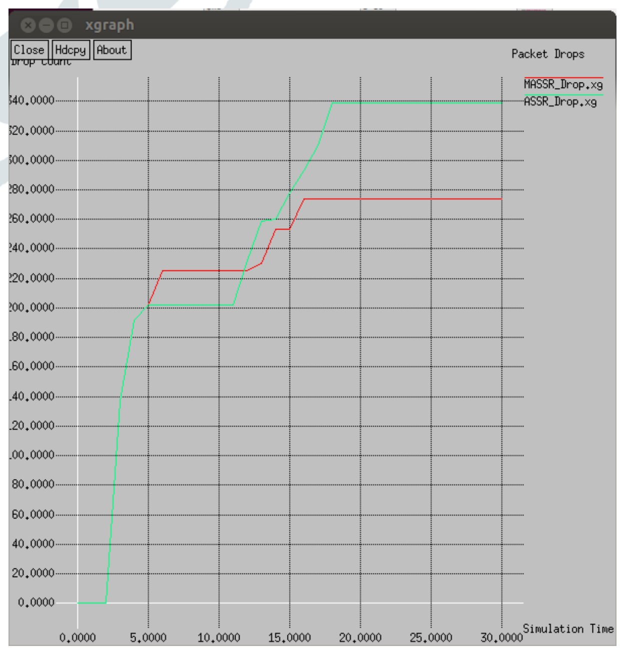

Figure 4.2: Packet Drops Comparison

This figure shows the comparison of the number of packets dropped after simulating both the schemes. The value of packet drops was found to be 274 for the proposed scheme and for the existing scheme, the packet dropped were 339.

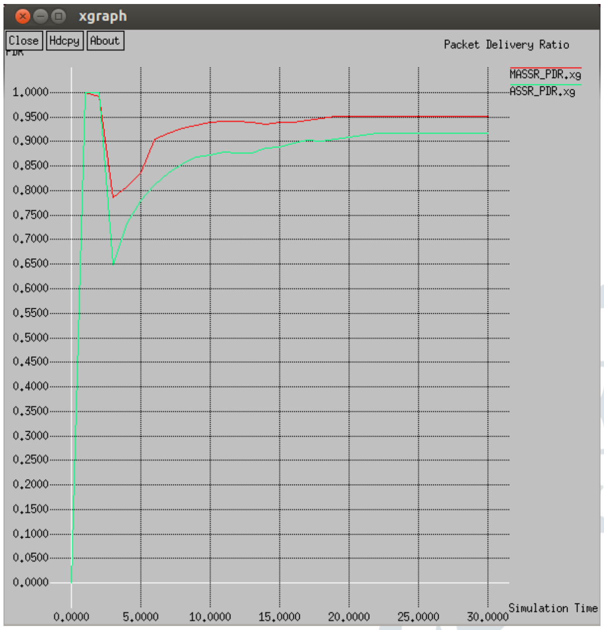

Figure 4.3: PDR Comparison

This figure shows the comparison of the packet delivery ratio obtained after simulating both the schemes. The value of PDR was found to be 95.1 for the proposed scheme and for the existing scheme, the value of packet delivery ratio was 91.6.

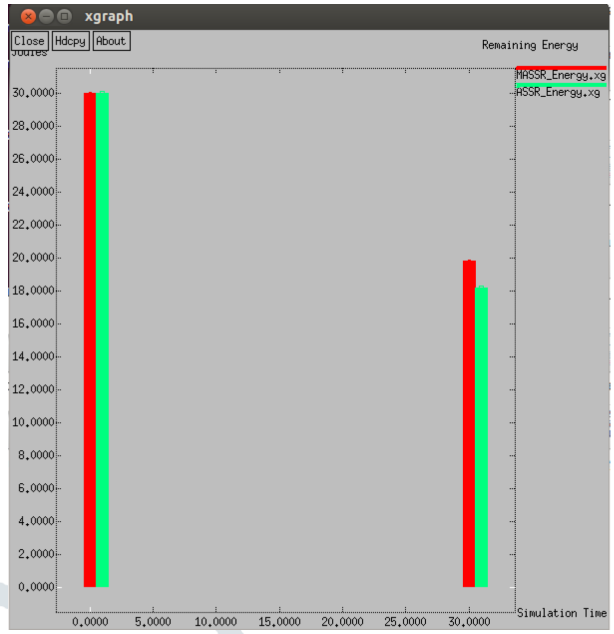

Figure 4.4: Remaining Energy Comparison

This figure shows the comparison of the remaining energy after simulating both the schemes. The value of remaining energy was found to be 19.8 Joules for the proposed scheme and for the existing scheme, the value of remaining energy was 18.2 Joules.

Parameter\Scheme	**ASSR**	**Modified ASSR**
PDR	91.6	95.1
Remaining Energy	18.2 Joules	19.8 Joules
Throughput	125.6 Kbps	138 Kbps
Packets Dropped	339	274

Table 4.1: Results Comparison

V. CONCLUSION

This work considers the reliability of the wireless ad hoc networks. The existing ASSR broadcasts the packets in the adjacent sector to re-form the new path in case observed reliability is less than desired reliability. This leads to more congestion in the network and reduces network's performance. The proposed modified ASSR considers the neighbors of the nodes in the path to re-form the route if any node in found unreliable in the network. This reduces the congestion leading to increased PDR as well as throughput of the network. Also, the reduced broadcasting leads to decreased energy consumption. This indicates that the proposed scheme outperforms that existing scheme.

Furthermore, the path chosen by AODV is the shortest path from source to destination node. This shortest path can be optimized using various path selection scheme available in the literature.

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