An Efficient Self-Reconfiguration and Route Selection for Wireless Sensor Networks

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Abstract:

The wireless network is one of the most significant purposes behind the accomplishment of long range wireless communication. Frequent link failures are occurred in the sensor organised network due to obstruction, snags, message drop because of node energy depletion; Time to Live (TTL) lapsed and so forth. The total communication gets collapsed if there any lessening in the nature of correspondence or quality between the sensor nodes or from the sensor nodes to the sink nodes and this prompts to connection failures. To overcome the frequent link failures and to provide reliable data communication an Efficient Self-Reconfiguration and Route Selection for Wireless Sensor Networks to mitigate link failures is proposed. E-SRRS scheme automatically senses the energy efficient nodes with reliable routes to improve and conserve the network performance. The simulation analysis for E-SRRS and the parameters such as throughput, transmission delay and energy consumption in the network is shown.

Keywords: Self-Reconfigurable, Fault tolerance, Routing, WSN.

I. Introduction

Wireless sensor networks are used for several applications by employing a set of mobile sensor nodes to collaboratively monitor an area of interest and track certain events or phenomena. With the most elevated development in the field of embedded computer and sensor innovation, WSN, which is made out of a several thousands of sensor nodes equipped for detecting, actuating, and handing-off aaggregated statistics, have made remarkable impact all over the place. These sensor nodes ought to be reliable, energy efficient, implanted with reconfigurable device.

The assets of the nodes are in like manner compelled as far as computational vitality of the microcontroller unit (MCU), control source and memory space. Due to the limited energy supply of sensors, energy is a very scarce resource and directly influencing the network lifetime. Therefore, the energy efficiency is the most important issue in WSN.

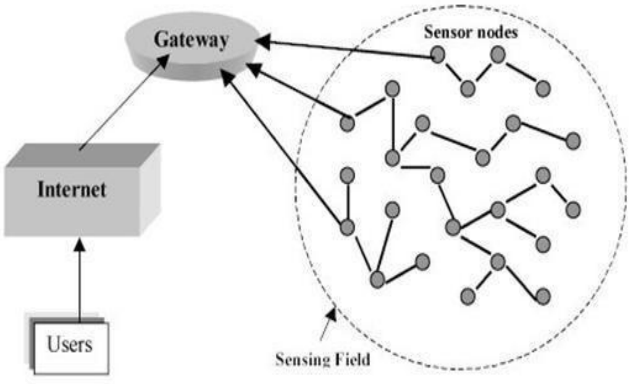

Figure.1. MANET Architecture

Since a sensor node is typically obliged in its energy, computation and correspondence resources, an expansive set of sensors are included to guarantee range scope and increment the fidelity of the gathered information. Upon their sending, nodes are relied upon to remain reachable to each other furthermore, forms a network. Network connectivity empowers nodes to organize their activity while performing a task, and to forward their readings to in situ clients or a base-station (BS) that fills in as a passage (gateway) to remote war rooms.

II. Related Works:

In WSNs [1] a connection or a gathering of connections in the comparative range or area could fail because of various causes such as radio blurring, signal attenuation, radio obstruction, background commotion, or failure of one of the sensor nodes that are connected to the link. The most conventionally used radio model for association failures in wireless systems is based on the path loss model as the transmitter and the recipient move more distant separated. Time-Dependent Link Failure Model incorporates the consideration of battery release display, sensor control utilization in various modes and remote channel conditions. This tradition inspects the WSN application relentless quality and vitality usage of transmitting detected information.

Hello-based failure detection [2] is the prevalent disappointment location system that gives a lower bound on the packet delivery ratio. It captures the competing requirements of connection disappointments, false location, and missed recognizable data on the beaconing parameters. Drawbacks of this model are route repair, queuing losses when route misfortunes when course revelation is delayed and covering. Autonomous reconfiguration system (ARS) [9] independently lightens the nearby connection inability to safeguard the system execution.

Dynamically Reconfigurable Routing Protocol [5] was intended for submerged Sensor Network. The nodes must have the capacity to re-route their packets if the design of the system changes. It is a multi-hop datagram routing plan which will offer solid submerged wireless transmission by progressively re-directing when network setting changes. This tradition gives the perfect courses for effective correspondence of information with no interference and grants dependable correspondence inside restricted. Node-link failures may leave some areas uncovered and corrupt the loyalty of the gathered data. Losing network connectivity has an extremely negative impact on the applications. Topology administration techniques for persevering node failures in WSN [4] focus on network topology management for tolerating/handling node failures in WSNs. Faulty sensor node is recognized by computing the Round Trip Delay (RTD) time of discrete round trip paths and contrasting them with limit esteem (or) threshold value [6].

Failure detection using counter approach [7], examines the failure circumstance of communication. This approach is utilised to recoup from the message failure at the circumference node and the radius node. Self-link Breakage Announcement [8] introduced rapidly distinguishes the connection breakages in order to limiting the deferral and power utilization. In this scheme, a node perceives forthcoming connection link breakages in such interfaced connection breakage cases by implementing inner detectors inside of the node to detect that cause before the link breakage actually occurs therefore the neighbour nodes can promptly start the course of route recovery process. This scheme also eliminates the routing overhead.

HW Reconfigurable Node with Novel Scheduling [9] enables the utilization of environmental imperativeness with gathering cares. The task allocation can be arranged by imperativeness availability. In this approach, energy imperative can be saved because only the most frequently used tasks are executed time to time only using the hardware. The novel scheduling strategy is used to identify the most valuable application for the reconfigurable hardware. The reconfigurable HW-based heterogeneous system is a suitable procedure for extending the get ready limit of structures however at lower imperativeness costs. However, this scheme provides versatile complexity.

Each mobile device in the network is controlled by a multi-role agent by using the local interactions can be done using the protocol Distributed Self-Organization Algorithm (DSOA). The role management allows the strength of characterised reconfiguration when the nodes leave or arrive in to the network of the global emergent behaviour. Energy reduction is achieved by adapting the time interval and transmission power only after the network formation.

III. Lightweight Fault Tolerance Routing (LFTR) protocol:

At first every sensor nodes screens the nature of its connection by considering the RREP message. This is ensuring the connectivity between all nodes in the network. These nodes are sending the link association information to the source node. Then the source transmits the data to receiver node. Secondly, the link failures links are detected caused by packet loss or links are not used yet.

Thirdly, this failed node constructs the self re-configuration plan and sends to the forwarding node and its neighbourhood node. Finally, these nodes execute the self re-configuration plan and re-establishment of route.

Based on the technique Fault tolerance and backbone reconfiguration an Efficient Self-Reconfiguration and Route Selection for Wireless Sensor Network to mitigate link failure are proposed. Fault tolerance routing protocol that divides the whole network to backbone network and non-backbone network to perform the static routing and dynamic routing, respectively. Since the behaviours of nodes have big affect on the routing, in order to obtain good network performance, this paper designs a node distinguishing algorithm to rapidly distinguish the behaviours of nodes in non-backbone network. Therefore, according to the different behaviours of nodes, the network can choose the corresponding routing policy adaptively.

The occurrence of node faults can be identified using lightweight fault tolerant mechanism which includes node's energy drain rate, nodes failure rate based on threshold value. The nodes initially broadcast RREQ for neighbouring nodes and this process continues until it reaches the destination. The sink node reverts back with the RREP in the reverse path. During the RREP the lightweight nodes are identified based on the threshold level of node energy drain rate.

Based on the threshold value, the lightweight nodes are determined and the primary routing is done with energy efficient nodes. The threshold level is fixed and the higher threshold nodes obtained is taken for primary route. The other nodes with lower threshold node energy value are considered for secondary routing.

IV. Results:

Lightweight fault tolerance routing protocol performance is examined by using Network Simulator 2 (NS2). Tool command language is a scripting language used in the front end. NS2 is a discrete event time driven simulator. The simulation parameters used for LFTR are shown in Table 1.

The nodes are distributed in the simulation environment. The simulation scenario consists of 50 nodes and the traffic model used is Constant Bit rate (CBR).

Packet Delivery Rate

The Packet Delivery Rate (PDR) is the ratio of number of packets delivered to all receivers to the number of data packets sent by the source node. The PDR is calculated by the equation 2.

$$PDR = \frac{\sum_{0}^{n} Packets\ Received}{\sum_{0}^{n} Packets\ Sent} \quad (1)$$

Table.1.Simulation Parameter

Parameter	Value
Channel Type	Wireless Channel
Simulation Time	50 s
Number of nodes	50
Network interface Type	WirelessPhy
Transmission range	250m
Traffic model	CBR
MAC type	802.11

The figure 2 shows the performance of PDR for the proposed scheme LFTR. The PDR of the LFTR method is greater than the existing method DSOA. The greater value of PDR means the better performance of the protocol.

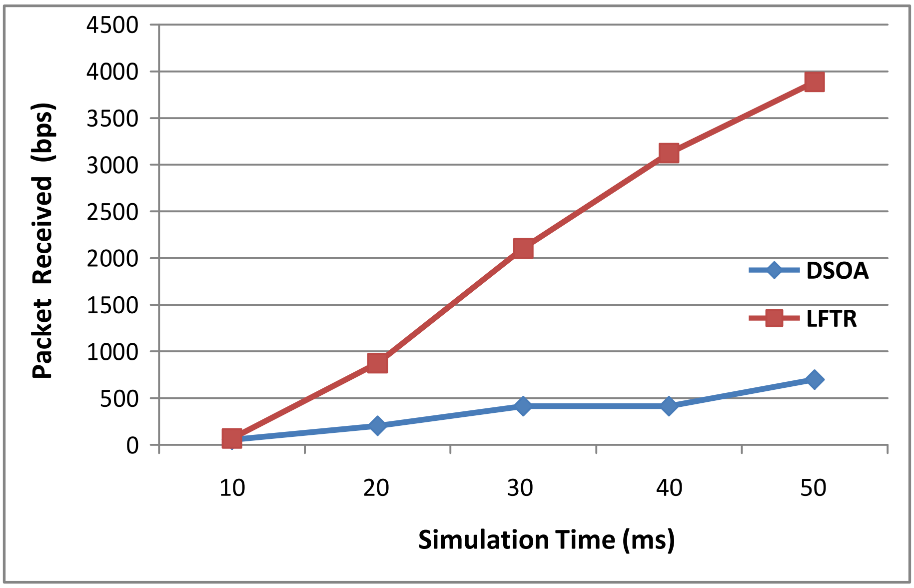

Figure 2: Packet Delivery Rate

Packet Loss Rate

The Packet Loss Rate (PLR) is the proportion of the number of packets dropped to the number of data packets sent. The formula used to calculate the PLR is given in equation 2.

$$PLR = \frac{\sum_0^n Packets\ Dropped}{\sum_0^n Packets\ Sent} \tag{2}$$

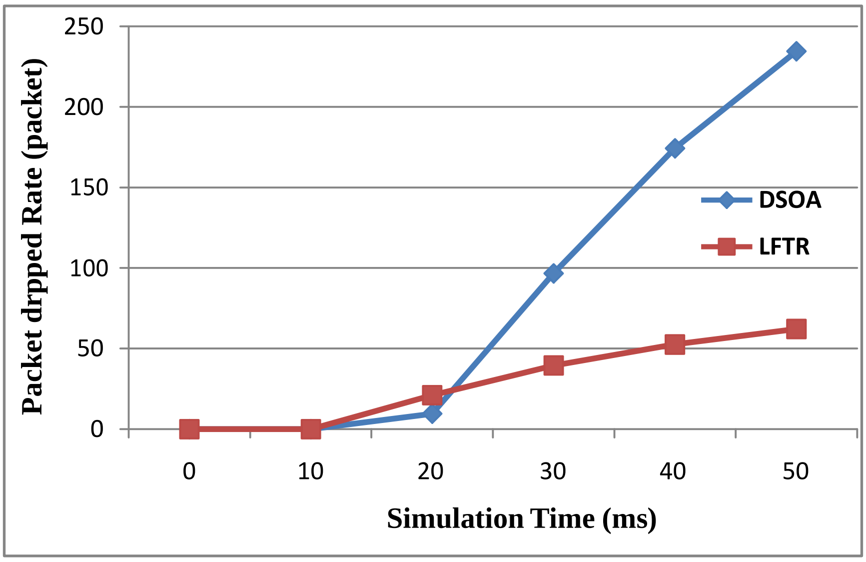

Figure 3: Packet Loss Rate

The loss ratio of LFTR is lower than the existing scheme DSOA which is shown in Figure 3. Lower the PLR indicates the higher performance of the network.

Average Delay

The average delay is defined as the time difference between the current packets received and the previous packet received. It is measured by the equation 3.

$$Average\ Delay = \frac{\sum_0^n Pkt\ Recvd\ Time - Pkt\ Sent\ Time}{n} \tag{3}$$

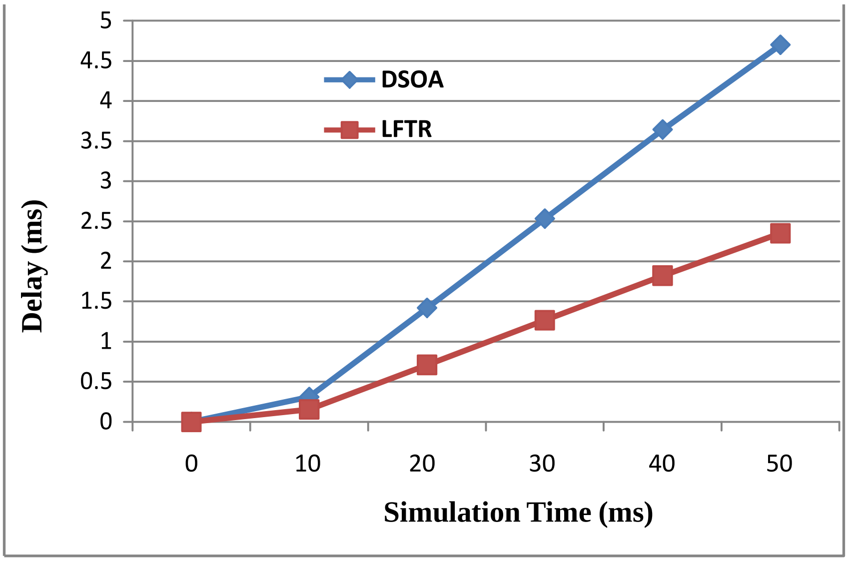

Figure 4: Delay Rate

Figure 4 shows that the average delay performance of the proposed scheme, the achieved delay value is low for the proposed scheme LFTR than the existing scheme DSOA.

Throughput

Throughput is the average of successful messages delivered to the destination. The average throughput is estimated using equation 4.

$$Throughput = \frac{\sum_{0}^{n} Pkts\ Received\ (n) * Pkt\ Size}{1000} \quad (4)$$

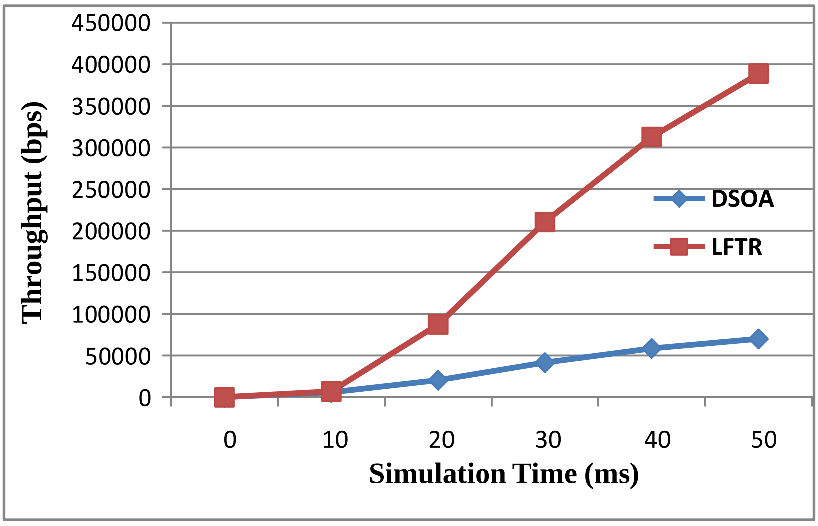

Figure 5: Throughput

Figure 6 shows that proposed scheme LFTR has greater average throughput when compared to the existing scheme DSOA.

V. Conclusion:

Efficient Self-Reconfiguration and Route Selection for Wireless Sensor Networks to mitigate link failures is proposed to overcome the frequent link failures and to provide the reliable data communication among the nodes in the network. Frequent link failures are occurred in the sensor network due to interference, obstacles, message drop due to node energy drained; Time to Live (TTL) expired etc., In WSN, the total communication get collapsed if there is the reduction in the quality of communication between the sensor nodes or from the sensor nodes to the sink nodes and this leads to failure of links these can be overcome by using the proposed technique. The simulation results are analysed and the proposed LFTR mechanism achieves the greater throughput.

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