INVESTIGATION OF ENERGY CONSUMPTION IN WIRELESS SENSOR NETWORKS USING LINK-DELAY AWARE ROUTING

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Abstract:In a harsh environment, wireless sensor points are spread where conditions vary greatly from abrupt changes in connection quality and node status. Due to the difference in connection quality and node status, the end-to-end delay for each sensitive node varies. The sensor contract, on the other hand, has limited capacity, and it is a major concern to extend the lifetime of the network.To address these issues, this paper offers a simple, measurement guide, predicted remaining deliveries (PRD), combination of parameters including residual energy, link quality, end-to-end delay, and distance together to improve network performance.In addition to the end-to-end delay, PRD sets the weights for individual connectors to reflect the node state over the long run of the network. The simulation results show that PRD performance is better than the widely used ETX and two other power and end-to-end delays that have been recently designed to ensure packet delivery.

***Index Terms*-Energy consumption, Link-delay aware, routingmetric.**

1. INTRODUCTION

The Wireless Sensor Network (WSN) consists of independent spatially distributed sensors for monitoring physical or environmental conditions, such as temperature, sound, pressure, etc., and passing their data collaboratively across the network to a central location. Modern networks are bidirectional, so you can also control the activity of the sensor.Military applications such as battlefield observation have driven the development of wireless sensor networks; these networks are now used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

WSN is designed from "nodes" - from a few to several hundred or even thousands, where each node is (or sometimes) connected to one of the sensors.Typically, each sensor network node has several parts: a radio transmitter and receiver with an internal antenna or an external antenna connection, a precise monitor, an electronic circuit to interact with the sensors and a source of energy, usually the battery or a form included in the power assembly.The shoebox size sensor node may vary depending on the size of the dust bead, although no real "movements" have been created with real microscopic dimensions. Depending on the complexity of the individual sensor nodes, the costs of sensor nodes are similar, ranging from a few hundred to hundred dollars.Restrictions on volume and cost cause the sensor to hold corresponding resource restrictions such as power, memory, computing speed, and bandwidth of communication. WSN topology can be different to advanced multiple wireless network hops from a simple star network. Routing or flooding may be the propagation technique between network leaps.

2. RELATED WORK

Extending their lifetime is important because of a battery constraint in wireless sensor networks (WSNs). In doing so, energy - efficient routing techniques for WSNs play a major role. Finally, some open problems are indicated in the design of energy - efficient routing protocols for WSNs[1].Wireless sensor networks ' dynamic nature and topology introduces very special requirements in the routing protocols to be met.Energy - efficient routing protocols are divided into four main systems: network structure, communication model, topology - based routing and reliable routing[2].The expected transmission count metric(ETX), which finds high - throughput paths on wireless multi - hop networks. ETX minimizes the expected total number of packet transmissions needed to deliver a packet to the ultimate destination successfully[3].Localization of wireless sensor networks is an important area that attracted considerable interest in research. It provides an overview of the measurement techniques based on these measurements in the location of the sensor network and the one - hop location algorithms [4].A routing protocol design must be based on its target network characteristics. Our work provides important guidelines for the design of routing metrics and identifies the specific properties that a routing metric needs to combine with certain routing protocol types[5].The link - aware clustering mechanism (LCM) considers primarily node status and link condition, and uses a novel clustering metric called the predicted transmission count (PTX) to evaluate cluster head and gateway qualification[6].In a sensor network, topology control loads on sensor nodes and increases the scalability of the network and the lifetime. HEED (Hybrid Energy Efficient Distributed Clustering), which periodically selects cluster heads based on a residual energy hybrid and a secondary parameter, such as neighborhood node proximity or node degree.HEED can almost certainly guarantee clustered network connectivity asymptotically[7].PEACH concerns clustering protocols to minimize each node's energy consumption and maximize wireless sensor networks ' network life. Peach forms clusters without additional overhead by using overhearing characteristics of wireless communication and supports adaptive multi-level clustering [8].In order to balance the traffic load and energy consumption in the network, the role of CH should be rotated between all nodes and the cluster sizes should be carefully determined in different parts of the network [9].In this novel forwarding technique based on the geographical location of the involved nodes and random selection of the relaying node via recipient contention [10].

3. PROBLEM OVERVIEW AND MOTIVATION

In the intertidal region of Zhoushan (29056'43"N, 1220 5'10"E, an island town in the province of Zhejiang, China), a 26 nodes WSN framework is sent for intermittent monitoring of temperature changes. Sensor node's status varies from above water to submerged.In addition, due to tides, ocean waves, sensor nodes often experience the ill effects of connection quality changes in the intertidal condition. Even with close separation, two neighboring nodes experience poor connection quality when tides rise, and the quality of the connection turns good when tides ebb.The connection characteristics of the sensor hubs fluctuate over and over with time along these lines. Then again, the quantity of parcel retransmissions and the queuing length of the buffer can increase both due to the difference in earth and hub status, resulting in an increase in end-to-end delay.

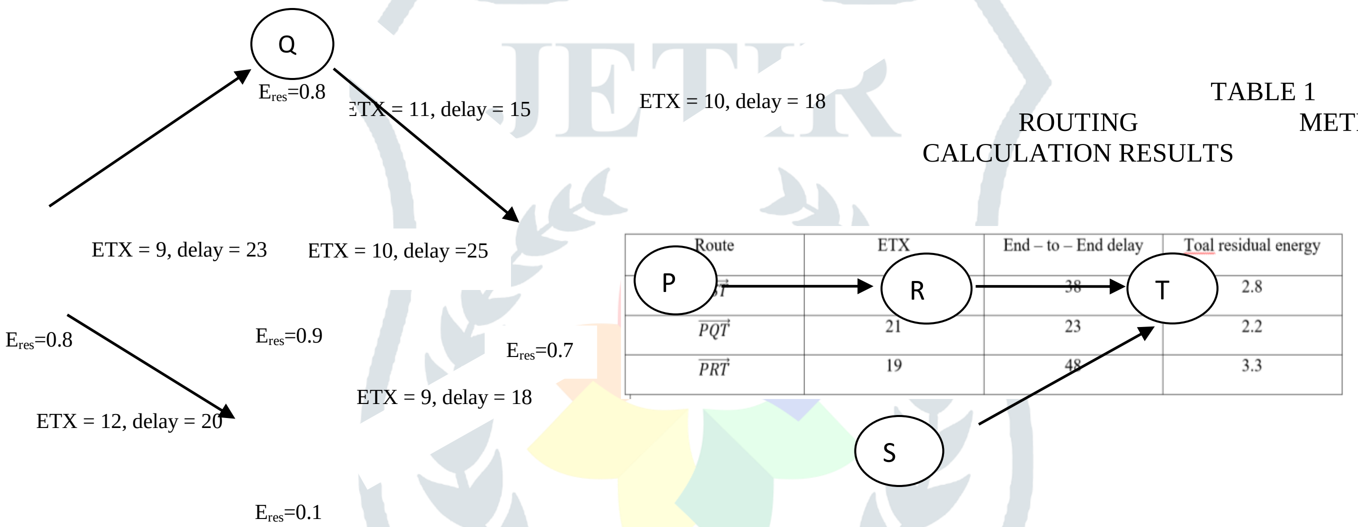

TABLE 1 ROUTING METRIC CALCULATION RESULTS

Route	ETX	End – to – End delay	Toal residual energy
[illegible]	[illegible]	38	2.8
$\overrightarrow{PQT}$	21	23	2.2
$\overrightarrow{PRT}$	19	48	3.3

Fig 1: A small region of the Zhoushan WSN system with 5 sensor nodes.

The delay provided by the link is a small area of Zhoushan experience with 5 nodes in Figure 1, where Eres is the residual energy delay. Node P is attempting to transfer data to destination T. Three sensor contracts Q, R and S are data nodes that are redirected, contribute to three possible routes, and ($\overrightarrow{PST}$) possibly.The calculation results for the three paths are shown in Table I using ETX. If ETX is implemented as the routing standard, node R is selected as the mother because the ($\overrightarrow{PRT}$) alpine track has the road's minimum ETX value. The ($\overrightarrow{PRT}$) route, however, with the longest delays from beginning to end. In addition,the Node R's remaining energy is the least.Thus selecting the route ($\overrightarrow{PRT}$) will lead to rapid node R death and poor performance of the network. Road ($\overrightarrow{PQT}$) may be the best route because it is a shorter end - to - end delay and a higher total residual energy, although it is a slightly higher ETX route than ($\overrightarrow{PRT}$).

4. RESEARCH METHODOLOGY

This section first describes the network model and Power consumption model. Then predicted remaining delivery scale is described in detail.

A. ***Preliminaries****:* The expected number of transmissions, known by many researchers as ETX to evaluate the quality of the connection. ETX includes the effects of losing the link between each link's direction and the overlap between indirect success links to a path.

B. ***Network Model:*** A WSN model is described in this subsection. The studied network is a periodic graph (DAG) G= (V, E), where V represents a set of sensors E representing the set of connections between each neighboring contract pair. Let e_{ij} be the connection between two nodes, n_i and n_j. Let Fi refer to the neighboring node n_i node group.

C. ***Energy Consumption Model****:* For connecting power consumption, a simplified energy assumption model is applied. The transmitter consumes radio electronics and power amplifier power while the receiver discharges wireless electronics power to operate.

D. ***Metric Design****:* To reflect the influence of other factors on routing performance, use only one operator as a measure. Factors such as residual energy, distance and delay have a dramatic impact on network performance. The node status is subsequently as well as the quality of the link and the steering scale is proposed to evaluate the data transfer capability contract of the sensor.

E. ***Routing Mechanism****:* The CTP - like routing mechanism is based on the algorithm of Dijkstra. The process can be divided into four stages, such as detection of proximity, metric calculation, result account and parent selection. Detailed routing mechanism process.

• **Neighbor discovery:** Each sensor node declares in the adjacent discovery phase that there is a HELLO message containing the node ID entered several times into another node. Based on receiving "Hello" messages from neighboring nodes, each of them is created by the node sensor that stores information from its neighbors.The size of a "Hello" message can be used to calculate the ETX between a pair of sensors.

• **Metric calculation:** The meter account requires neighboring node information matte. Each node sends a message sensor to the neighbor in the scale calculation at the stage. The node contains the message on the node ID, residual power level, delay and ETX value. Store it in a neighboring table with each of the received message and information scanned.

• **Score calculation:** The result has two parts, i.e. the degree of correlation which is the degree of individual correlation between the two adjacent points, the degree to which the path of the sum of the link points is in the path of routing. PRD value In this study, the reverse value of PRD can be used both the degree of correlation.

• **Parent selection:** each node will discover the best score by updating the paths score for each neighbor. Distance several times, the grades are fully updated and then the neighbors are chosen to redirect the sensed data with the best road score as the parent node. When all sensor points are updated in their course, orientation tracks are selected.

ANALYSIS OF THE PROPOSED METRIC:

A. **Metric Properties:** When the planned metric is applied with Dijkstra's rule supported by a hop - by - hop routing theme, we tend to observe that the PRD metric is loop - free and consistent as it satisfies the property of isotonicity and monotonicity.

B. **Energy consumption:** It was also observed in Zhoushan experiments that the pelvic position has an impact on energy consumption throughout the network. Although it is possible to identify the optimum position from the sink node, there is poor distribution of power consumption between nodes.

5. PERFORMANCE EVALUTION

In a circular sensor area, 200 random sensor units are deployed. The basin is in the center of the sensor area and 300 meters away is the sensor area radius. The sensor nodes are identified as the main nodes within the contact range of a single jump to the pelvis. Each node senses the sensor of the neighboring region and generates a single 125-byte data packet.

Network Life: The main concern about WSNs is power consumption. One of the main aims of this paper is to achieve energy conservation by balancing energy consumption between sensor nodes in order to extend the network's lifetime.Several definitions have been proposed in literature about WSN age, including time so first die sensor node, even half-time die sensor contract and time until the sensor dies out.

Energy Balance Factor (EBF): The energy balance factor is defined by the hold sensor as the standard deviation of the remaining energy. EBF is used to measure the residual energy variation of the sensor nodes.

Package delivery ratio (PDR): the packet delivery rate is the percentage of packets that the aquarium has successfully received to the total number of packets sent by the sensor nodes. In designing the WSN network, it is important to ensure the delivery rate of packages.

End-to-end delay: End - to - end delays are total delays from the source node to the sink data packet, including delay processing, queue delay, delay in transmission, and delayed release.

A. ***Energy consumption:*** With a lower d, the average energy consumption of sensor nodes with average distance to d to the tub increases dramatically. The Power consumption in simulations using all ETX PRD, EFW and PTX shows a drastic increase trend with a decrease in the tub distance.

B. ***The behavior of the key nodes:***Initially, all sensor nodes are alive. The number of nodes alive decreases when the contract sensor depletes their energy. In PRD, the first death occurs at round 269 in the sensor; while death sensor death occurs first at about 95 rounds in the ETX. The main sensor nodes that are responsible for a large amount of data being directed. If it was the main sensor nodes, all their power is exhausted, and no network the longest connection loses the ability to collect environmental information.

C. ***Factor of energy balance:*** reflects the difference in the factor of energy balance. When WSN starts working, each node of the sensor starts consuming different amounts of energy, EBF changes. The EBF reaches the highest peak in about half of the network's life from the main nodes and then goes down to zero at the end of network life.

D. ***Package delivery ratio:*** Since all four measurements select the sensor nodes with the best quality linker to act as father points, at the beginning of life in simulation, the package delivery rate is nearly 100 percent. Then the rate of packet delivery in all four metrics decreases significantly. However, both ETX and EFW package delivery rates show a significant earlier decline in PRD and PTX delivery rates.

E. ***Impact of the Contact Radius:*** We are also investigating the relationship between the lifetime networks and the sensor node communication radius.

6. CONCLUSION

In this paper, a new metric for channeling link - related energy to support the routing of WSNs that are deployed in harsh environments where networks are subject to extremely long delays and unbalanced power consumption in a sensor.PRD captures the remaining deliveries expected in one delay unit, restoring each sensor's ability to deliver packets. The PRD also takes into account an end-to-end delay.The main PRD goals are to balance the power consumption of the sensor nodes and extend the network life as well as control the delay from the beginning to the end of extensive PRD performance simulation.The results indicate that in terms of end - to - end delay, power consumption, and network life performance, PRD outperforms conventional metrics such as ETX, EFW, and PTX while ensuring high packet delivery.We can therefore conclude that the proposed PRD standard can be an effective and efficient solution for selecting suitable routing paths for deployed WSNs in harsh environments.

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