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UNDER WATER SENSOR NODE COMMUNICATION USING OR ROUTER

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ABSTRACT: The major constraint when Wireless Sensor Networks is considered is the energy consumption. Since the sensor nodes are deployed in a rough terrain with unpredictable environment conditions the nodes fail mainly due to battery drain, and in most cases it is impossible to replace the batteries. So it will be wise to use an appropriate routing algorithm for finding the best available path that consumes lesser energy and reduces the delay. One such type of routing protocol is Opportunistic Routing. In this type of routing each packet, each hop and the next relay node is found dynamically by selecting the node that captures the packet transmission .Here each node maintains a group of next hop nodes called as the forwarder list and next relay node is selected from that list according to the type of opportunistic routing used. The Energy Efficient Selective Opportunistic Routing, reduces the size of the forwarder list by including only the nodes that are nearer to the destination. In the next step the list is arranged according to their distance from the destination, the node that has the highest priority will act as the next relay node that is the selected relay node will be the one that is nearer to the destination. It also routes the acknowledgement using the opportunistic routing this is done to balance the energy spend by the nodes for transmission and reception. It provides better results than many existing opportunistic routing protocols in terms of end-to-end delay, and network life time.

Key Words: AsOR, EESOR, End-to-End Delay, P2P

1.INTRODUCTION

A WSN (Wireless Sensor Network) consists of a large number of sensors, each of which are physically small devices, and are equipped with the capability of sensing the physical environment, data processing, and communicating wirelessly with other sensors. Generally, we assume that each sensor in a WSN has certain constraints with respect to its energy source, power, memory, and computational capabilities. The communication paradigm of WSN has its root in wireless ad hoc networks, where network nodes self-organize in an ad hoc fashion, usually on a temporary basis. In a wireless ad hoc network, a group of wireless nodes spontaneously form a network without any fixed and centralized infrastructure. When two nodes wish to communicate, intermediate nodes are called upon to forward packets and to form a multi-hop wireless route. Due to possibilities of node mobility, the topology is dynamic and routing protocols are proposed to search for end-to-end paths. The network nodes rely on peers for all or most of the services needed and for basic needs of communications. Due to the lack of centralized control and management, nodes rely on fully distributed and self-organizing protocols to coordinate their activities. With respect to the characteristics previously discussed, wireless sensor networks (or sensor networks for simplicity) are very similar to wireless ad hoc networks, as sensors act as network nodes. Each sensor can only reach its neighboring sensors directly. Intermediate sensors may relay the messages when source sensors and destination sensors are far away from one another.

2. UNIQUE CHARACTERISTICS OF SENSOR NETWORKS

The number of the nodes in a sensor network is significantly larger than that in a typical wireless ad hoc network. The difference can be of several orders of magnitude. Sensors are usually low-cost devices with severe constraints with respect to energy source, power, computation capabilities and memory. Sensors are usually densely deployed. The probability of sensor failure is much higher. The sensors are usually stationary rather than constantly moving. However, the topology of sensor networks can still change frequently due to node failure. It is important to understand the similarities and differences between wireless ad hoc networks and sensor networks. On the other hand, understanding the differences between the two types of networks leads to insights on new research problems in sensor networks. Figure 1.1 shows an example of WSN.

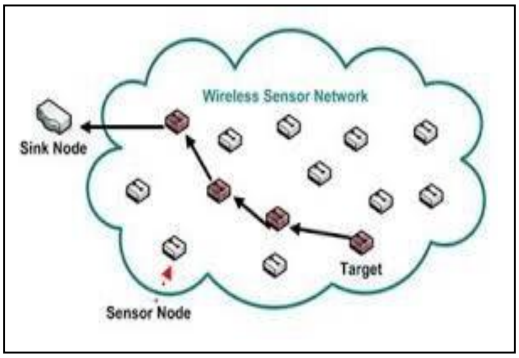


Figure 1.1 Example Wireless Sensor Network

3. APPLICATIONS OF WIRELESS SENSOR NETWORKS

Development of WSNs was primarily motivated by their need for military surveillance. With the availability of low cost sensors, these networks are no longer limited to military applications but are used in a wide array of applications including habitat monitoring, industrial process monitoring, traffic control, etc.

1.3.1. Military Applications

Military missions often involve high risk to human personnel. Thus, unmanned surveillance missions using WSN have wide applications for military purposes such as surveillance, enquiry of opposing forces, targeting, damage assessment, etc.

1.3.2. Habitat Monitoring

Monitoring plant and animal habitats on a long-term basis is widely employed by researchers in Life Sciences. However, human presence in such monitoring often causes disturbances in plant and animal conditions, increases stress, reduces breeding successes, etc.

1.3.3. Environment Monitoring

WSN can be used in a wide range of environmental monitoring applications such as forest fire monitoring, air pollution monitoring, greenhouse gas monitoring etc. WSNs to monitor dangerous gases such as CO, NO2, and CH4 have already been deployed in some cities.

4. CHALLENGES IN WIRELESS SENSOR NETWORKS

4.1. Energy Constraint

Wireless sensor nodes are battery-powered and often deployed in remote and inhospitable locations. As such, battery replacement or any other human intervention is either not possible or extremely difficult. Therefore, these nodes are required to function for months or years at a time on the same power source to maintain the application Quality of Service (QoS).

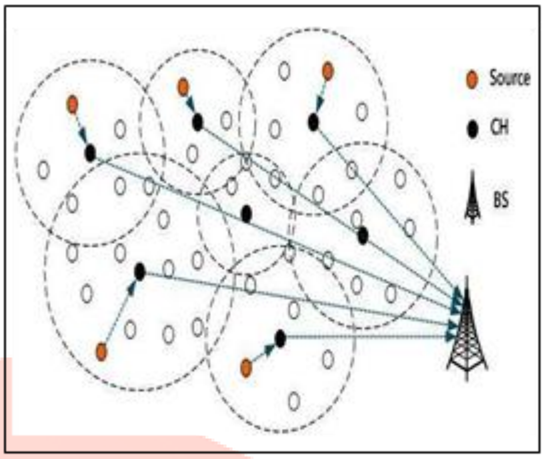
4.2. Fault Tolerance

Often a sensor node may be destroyed or stop functioning, such as when a sensor node is destroyed in a forest fire or by the enemy in a battlefield. The remaining nodes must adapt dynamically in real time and convey the data to the base stationsor sinks.

5. WORKING OF WIRELESS SENSOR NETWORK

WSN mechanism is quite easy, simple and applicable to a variety of fields. It is based on smaller nodes, controller, radio transceiver, and battery. The system is totally dependent on the nodes and the harmony established between them through proper frequency. These nodes are of different sizes according to the function they perform. To activate the monitoring or tracking function of these nodes a radio transmitter is attached to forward the information signals in the form of waves. They are controlled by the microcontroller according to the function and device in which they are used. The information transmits through proper channel taking the information collecting it in the form of data and send to the base.

Figure 1.2 shows the working of WSN



6. OPPORTUNISTIC ROUTING

Opportunistic routing protocols are a rather recently devised class of routing protocols for wire- less multi-hop networks. What separates opportunistic routing protocols from fixed-route routing protocols is the fact that a packet's route is not pre- determined by its source before the packet transmission.

7. ENERGY EFFICIENT OPPORTUNISTIC ROUTING

EEOR is a multi-hop routing protocol for wireless sensor networks. It makes use of the forwarders list of the node to choose the forwarding node to transfer the data towards the target. Priorities are assigned for the neighbors of a node to choose the forwarding node. Energy consumption, packet loss ratio, and delivery delay parameters in a wireless sensor network are measured. Efficient protocols are required to reduce delay in transmission and to prolong the network lifetime.

8. WORKING PRINCIPLE

Calculating the Expected Cost

The main idea of calculating the expected cost for each node and selecting the forwarder list. Consider a node u and its neighbors. We will compute the expected cost and the forwarder list of node u based on the expected cost of its neighbors whose expected cost of sending data to the given target node has already been computed. The third part is the communication cost to reach an agreement on choosing the actual relay node.

9.NETWORK MODEL

For this EEOR algorithm the network settings are as follows: 50 Wireless Sensor Nodes are deployed randomly in a square area of 500m by 500 m, with uniform distribution. The packet generation rate is one packet per second. Packets of 1000bytes each, are transferred between source and destination pairs for a simulation time of 150 seconds. The acknowledgment packet size is 40 bytes. All the sensor nodes in the network are deposited with an initial energy of 100 Joules. The energy spent by a sensor node in transmission and reception of packet is maximum of 0.50 Joules, in idle state consumes 0.005 Joules.

9.1. ENERGY EFFICIENT SELECTIVE OPPORTUNISTIC ROUTING

EESOR protocol is similar to EEOR protocol but it makes itself efficient by reducing the size of the forwarder list by applying the condition that forwarder node is a one that is nearer to the destination. It also increases the reliability by using the acknowledgement packets and balances the energy for transmission and reception by routing the acknowledgement packets also opportunistically.

9.2. WORKING PRINCIPLE

The working of EESOR protocol can be divided in to two steps, formation of routing table and updating the routing table whenever there is a change in the network.

The distance d between two nodes A(x1,y1) and B(x1,y2) is calculated by the Euclidean distance equation ,here the distance refers to the geographical distance in meters.

Table 4.1 Network Parameter Notations

Variable	Description
N	Number of nodes in the network
P	Number of packets transmitted between a pair of source and destination
(x, y)	x and y co-ordinates of a node
D	Distance between the nodes
T	Simulation time
EI	Initial energy of the node
Ec	Critical energy of the node
Er	Residual energy of the node

In the network considered, the source node forms the set of neighboring nodes to forward the packet, when the destination is more than one hop away from the source. The set of neighbors is sorted according to its distance from the destination, and normally the first of these nodes in the forwarder list relays the packet towards the destination.

9.3. MODULE DESCRIPTION

The routing table of a node consists of the following fields: Destination, Next Hop, Packet Sequence Number and Distance from the node to destination. Each node has a routing table of all its neighbors, consisting of all the required fields.

Distance between node and target node is used in updating the routing table entry of the node during multi-hop transmission.

9.4. Creation of Routing Table

Initially, the routing table of every node is constructed based on the neighboring node information. This phase starts with the construction of a HELLO packet from the node to all its neighbors. Once it is done, a timer is used to broadcast the HELLO packets to all of its neighbors. The HELLO packet is not sent to any particular node.

9.5. Updating the Routing Table

The distance between the forwarding node and the target node is updated in the routing table entry, so that the next hop node is the one with smallest distance between itself and the target node. According to the concept of EESOR, the next hop to a particular destination is decided on the fly and new protocol implemented is completely opportunistic. This process is repeated till the destination node is reached

9.6. EXAMPLE SCENARIO

Let us consider an example scenario as shown in Figure 4.4 with 10 nodes distributed randomly and we can calculate the distance between the nodes using the

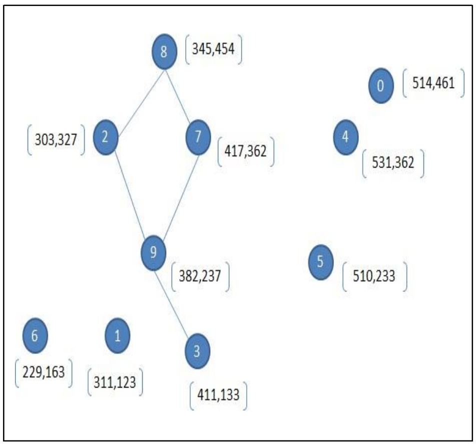


Figure 4.4 Example Scenario with 10 Nodes

9.7. PERFORMANCE EVALUATION

This section analyzes the performance of the wireless sensor network for Energy Efficient Selective Opportunistic Routing for the parameters Maximum End-to-End delay, average End-to-End delay and network lifetime .The network scenario is defined as wireless sensor network with 50 nodes randomly deployed in the area of 500 m X 500 m. 250 m is the transmission range of each of the sensor nodes in the network.

9.71. Average End-to-End Delay

End-to-End Delay is defined as the time elapsed between the source node sending the packet and the destination node receiving the packet. The average of the End-to-End delay of all the packets transmitted between each of the pairs of source- destinations gives the average End-to-End delay.

9.7.2. Maximum End-to-End Delay

Figure 4.6 shows the plot of maximum of End-to-End delay values, for the same 9 pairs of nodes considered for analyzing average End-to-End delay. Once again, single hop communication takes same amount of time in Energy Efficient Selective Opportunistic

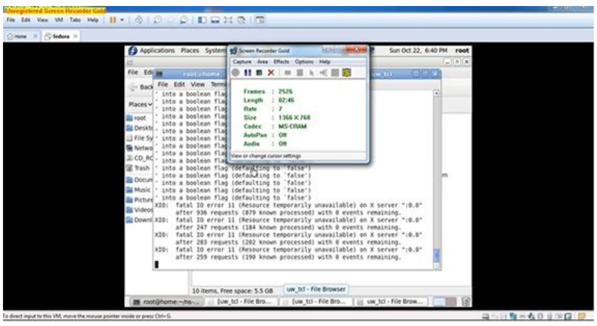
Routing. Two-hop communication between the nodes 30 and 32 shows the maximum improvement of around 300 ms, or 3 % of total delay for each source destination pair. And more than two-hop communication yields a maximum reduction of delay by approximately 1000 ms, or 50 %, for the source destination pair 11-22.

The small size of forwarder list reduces the time taken for prioritizing and sorting the nodes. The time for finding the shortest distance between each node inthe forwarder list and the destination is reduced. The analysis of maximum End-to-End delay shows that, as the number of hops increases, the transmission delay increases. The End-to-End delay is lesser in Energy Efficient Selective Opportunistic Routing as compared to Energy Efficient Opportunistic Routing.

9.7.3. Network Lifetime

The lifetime of a sensor node is considered as the time from its deployment to the time till which the node is having more than 10% of its initial energy. The node is said to be alive in this period. Beyond this period the node is said to be dead. The network performance is analyzed for the network sizes 25, 50, 75 and 100 nodes for network lifetime.

10.CONCLUSION AND FUTURE WORK



The presented EESOR algorithm is found to reduce the average end-to-end delay and maximum End-to-End delay lifetime since it includes only the nodes that are nearer to the destination in to the forwarder list so the decision for selecting the next relay node can be done quickly. It also increases the network since the acknowledgement is also being routed opportunistically, as well as the reliability of packet delivery increases.

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