A Novel Approach for Reducing Energy Consumption and Increasing Throughput in Wireless Sensor Network using Network Simulator 2

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ABSTRACT
A wireless sensor network contains collection of sensor nodes which are situated at desired locations to control various real time applications like moisture, climate, stress etc. So, Wireless sensor networks (WSNs) involve greater efficiency to control the environment related applications which are greatly used for military purposes and other life related applications in the field of medical. The wireless sensor nodes mainly make use of the battery systems and thus the wireless network's life is the main issue of the battery's power system. Hence, to assist better results for consumption of battery and security mechanism for the wireless sensor network to be energy efficient, anycast forwarding scheme is proposed and used in this paper. In the wireless network each node has multiple next-hop relaying nodes in a candidate set (forwarding set), results in reducing the delay and reducing the consumption of battery power. An active node forwards the packet to the first wakeup node in the forwarding set.

Keywords
Sensor, Energy, Delay, Node, MAC, DSR, Throughput

1. INTRODUCTION
There are four major activities which consume energy: energy consumed by radios when they are on; the energy consumed during the process of transmission and receiving of control packets; the energy required to remain wireless sensors in on state; and energy consumed during data transfer from source to destination . The active process of data sending and receiving is a rarely occurring event and thus only a small amount of the total energy is consumed. But, the network sense events occur repeatedly with continued and independent energy consumption. Thus we propose spreading the network's lifetime by controlling the energy expended to keep the radio communication systems on (for listening to the medium and for control packets) [1]. So, wireless communication systems while waiting for a packet arrival consumes most of the energy. Hence, sleep wake scheduling is an effective mechanism to prolong the lifetime of this energy constrained wireless sensor networks. In sleep wake scheduling a transmitting node needs to wait for its next-hop relay node to wake up which may cause a substantial delay. This delay can be reduced by using some DSR techniques and packet forwarding schemes [2].

1.1 Wireless Sensor Network
Wireless ad-hoc network consists of mobile nodes which are communicating over wireless links with processing capability containing multiple types of memory (programs, data and flash memories), RF transceivers, and power source and various sensors and actuators. There are two types of wireless sensor networks.

1) Structured network

2) Unstructured network

In the structured network, wireless sensor networks plan the deployment of wireless sensor nodes while the deployment of nodes is in an ad-hoc network manner in the unstructured wireless sensor networks. These wireless sensor nodes consume most of the energy during listening process. We generally solve this problem by using the concept of duty cycling in the wireless sensor network. The process of time synchronization is critical for diverse purposes, including coordinated actuation, sensor data fusion and power-saving duty cycling [3]. The wireless sensor nodes periodically switch between sleeping and active states, called as Duty cycling. These wireless sensor nodes transmit and receive the data in active state and going completely inactive in sleeping state in order to save energy. Here, synchronization process between the operating cycles of different wireless nodes is motivated as the radios of both machines must be on to transmit a packet from one machine to another machine. Example of protocols using synchronized approach: T-MAC, S-MAC and RMAC routing protocols [4].

The current duty cycling MAC layer protocols for wireless sensor networks is synchronized using explicit schedule exchanges or leave unsynchronized as both possess weaknesses and deficiencies. The process of duty cycling and packet transmissions are scheduled by periodic synchronization of messages (SMAC, TMAC and DMAC), which consume significant energy even at zero traffic. The BMAC process wakes up the receiver using the unsynchronized duty cycling process and long preambles mechanism. The long prelude mechanism has some problems. First, the latency accumulated along multihop routes could be uncontrolled due to the use of long preludes on each hop. Second, after the awakening of the receiver node, the energy consumed on prelude transmission and reception at the node is wasted. This all can be avoided if sender's side is aware of the receiver's wake up schedule and thus choosing the prelude length conservatively. Third, unneeded prelude overhearing by neighbor nodes other than the intended receiver node by

remaining awake till the last data packet transmission to the node results in energy wastage.[5]-[6].

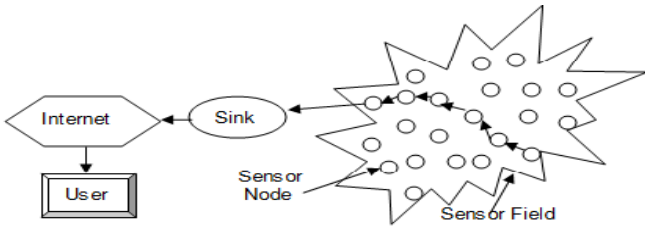

Fig 1: Basic architecture of wireless sensor network

To increase higher power efficiency, to reduce the latency , higher packet delivery ratios for traffic, integration of the selected scheduling algorithm and access control to maintain one–to-one mapping function between a data active period and the subsequent sleep period, DW-MAC uses a new energy efficient duty cycle MAC protocol.[4]. The major elements characterizing the performance of a wireless sensor network are like the consumption of power in different operating environments, the impact of weather conditions during the use of wireless networks, interference between neighboring nodes, etc. are also aiming to be studied and analyzed. Analysis is the part of the technology, which provides specific general information about the transmission range of mote wireless sensor nodes decreases significantly in the presence of rain, fog and other climate conditions [7].

1.2 The protocol used in Wireless Ad-hoc Network

There are various sleep wake protocols, we have synchronized sleep-wake scheduling protocols proposed in [3], [8]-[11]. These protocols are used when wireless sensor nodes periodically or a periodically exchange their synchronization information with their neighboring nodes. However, such synchronization schemes can cause additional communication overhead, communication delay and consuming a considerable amount of energy. The On-demand sleep-wake scheduling protocols as proposed in [12], where nodes turn off the most of their circuitry and always turn on a secondary low-powered receiver to response to "wake-up" calls from neighboring nodes when there is a need for relaying packets. However, this on-demand sleep-wake scheduling have an additional receiver which significantly increases the cost of the sensor motes. Hence, to save energy, each node wakes up independently of their neighboring nodes in the above protocols. But there is an occurring additional delay at each node along the path to the sink node as each node needs to wait for its next-hop relaying node to wake up before it can transmit the packet to the node, adds restraints to it. In a situation like fire detection and Tsunami alarm the delay between nodes is unacceptable and thus, to minimize the event reporting delay for such delay sensitive applications, the On Demand (Reactive) protocol is used. The Dynamic Source Routing protocol (DSR) is an on demand and efficient routing protocol designed for multi-hop wireless sensor ad hoc networks. It organizes and configures the protocols by itself without any help of any existing network infrastructure or administration. In DSR the two routing schemes are used, i.e. (a) Route Discovery and (b) Route Maintenance. These schemes work together to allow sensor nodes to discover and maintain source routes to arbitrary destinations in the wireless ad hoc network. It is called as a loop free technique because it won't require up-to-date routing information in the intermediate nodes through which packets are forwarded. It aids nodes forwarding packets to cache the routing information in them for their own future use. It allows the packet skyward to those nodes that are reacting to changes in the current routes which they are using. Here, nodes forward the packets for each other to allow communication between them over multiple "hops" between nodes that are not directly within the wireless transmission range area of one another. All routing information about sources of intermediate nodes changes and also joining or leaving of nodes in the network area are determined and maintained by DSR. The resulting network topology may be quite rich and rapidly changing, because there may be a change in the number or sequence of intermediate hops to reach any destination,. The DSR protocol also finds the multiple routes (hops) to any destination node in the ad hoc network of wireless. There is an order list of nodes through which the packets with the header information must pass. DSR can successfully discover and forward packets over uni-directional links as if other protocols operate only over bidirectional links of the wireless sensor network.

2. PROPOSED ALGORITHM

There is a cogent increase in the cost of sensor motes due to the additional receivers in the DSR routing protocol when an on-demand synchronized sleep-wake schedule is used. As it is impractical for every sensor node to be know about wake-sleep schedule of other sensor nodes, leading to the additional delays along the path to the sink node because each node needs to wait for its next-hop node to wake up before it can transmit the packet. But the delay is minimized for the delay sensitive applications, such as fire detection or tsunami alarm, where delay is unacceptable. In traditional packet-forwarding schemes, each sensor node has one designated next-hop relaying node in the neighborhood, and it has to wait for the next-hop node to wake up when it needs to forward a packet. There are multiple next-hop relaying nodes in a candidate set (forwarding set) for each node. A packet can forward by a sending node to the first node that wakes up in the forwarding set. Thus the proposed Anycast forwarding scheme reduces the event-reporting delay and minimizes the power consumption and maximizing the lifetime of nodes.

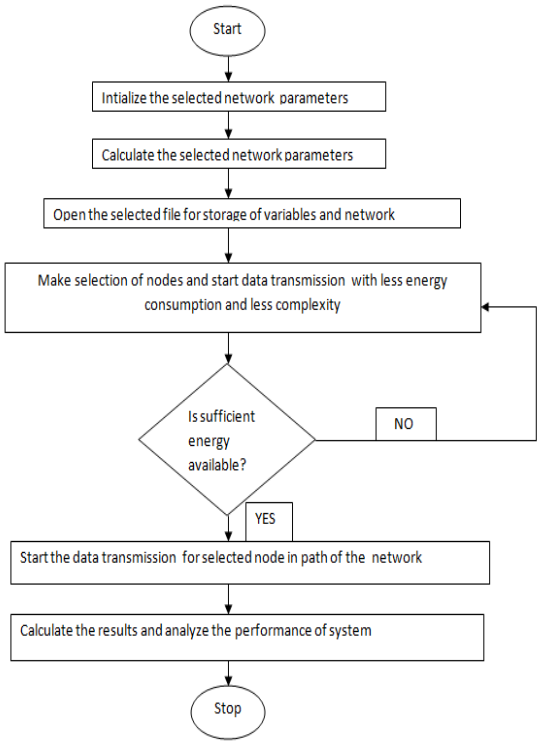

Fig 2: Flowchart of anycast forwarding scheme

3. SIMULATION RESULTS

We have used the various parameters and simulate them by Network Simulator 2 (NS2) and compared with existing techniques of on demand (reactive) routing protocol, DSR. We achieved our major objective that anycast forwarding technique has significant improvement as compared to the existing individual Reactive Protocol for a wireless sensor network using these simulations.

Table 1. Table captions should be placed above the table

Name	Type
Simulator	Network Simulator 2.34
Network Size	1500m x 1500m
No. of nodes	20
Simulation Time	30Sec
MAC Type	802.11
Bandwidth	2Mz
Traffic Sources	CBR
Traffic Agents	UDP
Interface Queue Length	250
Packet Size	512 Byte data
Routing Protocol	DSR
Antenna Type	Omni-directional
Initial Energy	850Joules

The Performance analysis of proposed anycast forwarding technique is done by comparing with existing on demand technique on the basis of the following parameters:

a) End to End delay b) Throughput c) Energy

3.1 End to End delay performance Comparison

It is the delay which is calculated from the time when an event occurs for a node to the time when the packet due to this event is received at the sink node [8]. It is the average time taken by the data packet to arrive at the destination node when an event occurs in the network. It also counts the delay caused by the queue in data packet transmission and route discovery process.

$$Delay = Tr - Ts$$

Whereas Tr is arrive time & Ts is send time. The lower value of end to end delay means the better performance of the protocol which is used. The proposed work shows the comparable end to end delay with existing DSR is shown in figure.

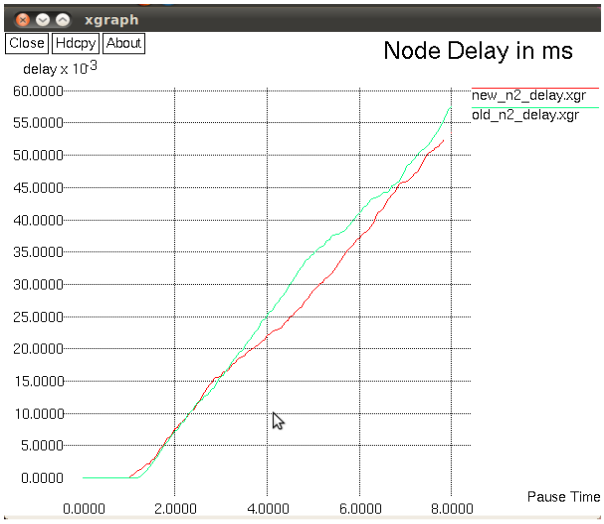

Fig 3: Delay v/s pause time comparison

3.2 Throughput performance Comparison

Throughput refers to the ratio of the amount of packets received at the Destination node to the amount of packets transmitted at the Source node. It must be higher for the better performance of the wireless sensor network.

Throughput= Total Data Bits Received/Simulation Runtime

Here the proposed work shows the higher throughput of anycast forwarding technique as compared to existing DSR technique is shown in figure.

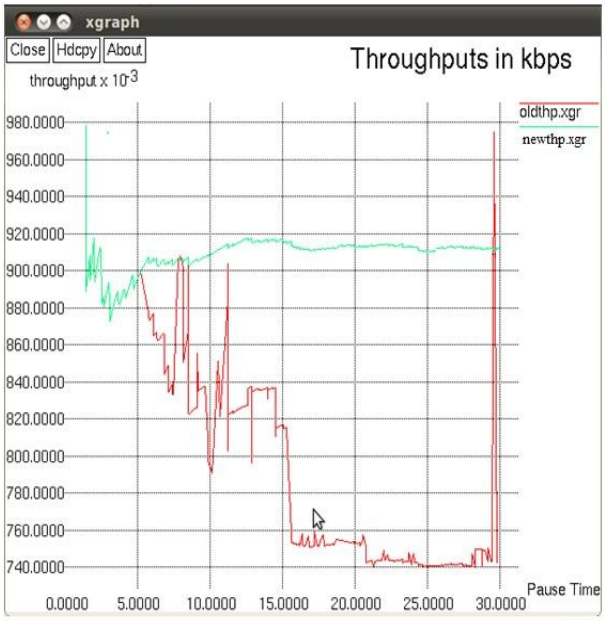

Fig 4: Throughput v/s pause time comparison

3.3 Energy Performance Comparison

Energy is consumed while sending a file or data, with the consideration of the size of the packets. Since it is just impractical possible to replace the batteries of a large number of deployed sensors in the hostile environment of wireless network. So, to develop an energy efficient network keeping consumption of energy as low as possible .Our proposed network consumes less energy as compared to the existing DSR technique.

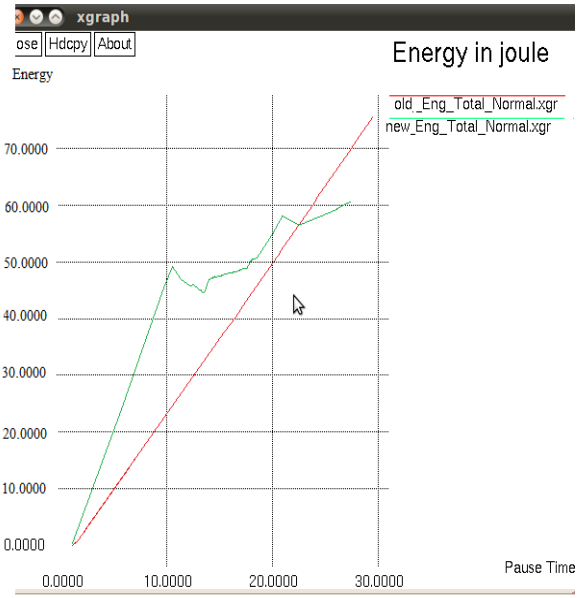

Fig 5: Energy versus Pause time Comparison

4. CONCLUSION

Hence, it can be concluded that anycast forwarding technique giving better results than the existing DSR technique. Network parameters act as the performance markers. Thus, in the proposed work, the results in terms of end to end delay is lower along with higher throughput and less required energy as in comparison to the existing DSR technique. Hence, it can be concluded that results of proposed protocol are better or comparable with existing DSR protocol.

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