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Maximizing the Lifetime & Collision Avoidance for Wireless Sensor Network

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Abstract: ***WSN i.e. Wireless sensor networks are composed of a large number of small sensing self-powered nodes which gather information about their environment and cooperate to communicate the collected data in a wireless fashion to a base station. Wireless sensor network (WSN) consist of a large number of sensor nodes which are distributed randomly over an area in order to collect information and proceed it. In Wireless sensor networks have a unique capacity to remotely sense the environment. These systems are often deployed in remote or hard to reach areas. Hence it is critical that such networks operate for long time durations as battery is the sole source of energy. Therefore for extending network lifetime through the efficient use of energy has been important issue in the development of wireless sensor networks. Therefore the energy consumption creates major problems in WSN.***

Keywords: Wireless Sensor Network (WSN), energy consumption.

1. Introduction

Wireless sensor network is the network where there are a number of sensor nodes which are distributed randomly over an area or a place or a location (e.g. buildings, farmer fields) in order to collect information and proceed it. A wireless sensor node normally consists of four basic components:

- Sensing unit
- Processing unit
- Communication unit
- Power unit

Wireless sensor networks are composed of a large number of small sensing self-powered nodes which gather information about their environment and cooperate to communicate the collected data in a wireless fashion to a base station called the sink. Devices are capable of detecting change like temperature, pressure, humidity, light, sound and many more. These wireless sensors are connected and communicate with each other in a random and multi-hop fashion. They collect the information and pass it to the next hop i.e. sensor. In this way the information is reached to the server and appropriate action took place. There are lots of applications where the wireless sensor network can be used like environmental monitoring applications (which includes Habitat Monitoring, Air Quality Monitoring and Water Quality Monitoring, Hazard Monitoring, Disaster Monitoring), military applications (which includes Battlefield Monitoring, Object Protection, Intelligent Guiding), health care application (which includes Behavior Monitoring Medical Monitoring), home intelligence applications (which includes Smart Home, Remote Metering) in home and building automation to industrial control. But the major and usual problem with sensor network is that when we are using them in the outfields like valleys or hills area is related to the battery. Because whenever the battery discharges it is not possible to replace it or recharge the battery to avoid this problem. In a sensor node there are three main functions which consume the energy most – (1) sensing, (2) computation, (3) radio operation. Radio operation means transmitting the collected information. The major part of energy loss comes from transmitting. This energy consumption can be reduced at some level. Radio communication is one of the main sources of energy dissipation.

2. Literature Review

In the paper, it minimize the delay and maximize the lifetime of event-driven wireless sensor networks, for which events occur infrequently. In such systems, most of the energy is consumed when the radios are on, waiting for an arrival to occur. Sleep-wake scheduling is an effective mechanism to extend the lifetime of these energy-constrained wireless sensor networks. However, sleep-wake scheduling could result in substantial delays because a transmitting node needs to wait for its next-hop relay node to wake up. An interesting line of work attempts to reduce these delays by developing anycast based packet forwarding schemes, where each node opportunistically forwards a packet to the first neighboring node that wakes up among multiple candidate nodes. In this paper, it tells how to optimize the anycast forwarding schemes for minimizing the expected packet-delivery delays from the sensor nodes to the sink. Based on this result and then provide a solution to the joint control problem of how to optimally control the system parameters of the sleep-wake scheduling protocol and the anycast packet-forwarding protocol to maximize the network lifetime. **[1]**

In the paper, to overcome energy waste caused by collisions and contention based algorithm, the channel assignment mechanisms, like TDMA 1, seem to be an effective way for scheduling node transmissions. To solve channel assignment problems, graph coloring theory has been exploited, primarily in order to assure collision-free communications. This paper present a novel distributed coloring algorithm for WSNs taking into account the constraints of a real WSN environment. The collision aware coloring algorithm assures a 2 hop nodes coloring, in a deterministic time execution, without requiring a neighborhood discovering phase. The algorithm takes into account the constraints of the wireless environment, especially collision and interference issues. **[2]**

In this paper, they have avoid duplicate transmission and node reconfiguration and power consumption in Wireless Sensor Networks (WSN). Wireless sensor network requires robust and energy efficient communication protocols to minimize the energy consumption as much as possible. However, the lifetime of sensor network reduces due to the adverse impacts caused by radio irregularity and fading in multi-hop WSN. The scheme extends High Energy First (HEF) clustering algorithm and enables multi-hop transmissions among the clusters by incorporating the selection of cooperative sending and receiving nodes. It focuses to develop any node to act as cluster head (CH) instead of affected CH because it need to get a data from CH continuously. To reduce energy consumption, the scheme extends with the help of S-MAC layer to get the efficient energy saving. The performance of the proposed system is evaluated in terms of energy efficiency and reliability. Simulation results show that tremendous energy savings can be achieved by adopting hard network lifetime scheme among the clusters. This paper shows that the HEF algorithm achieves significant performance improvement over LEACH, and HEF's lifetime can be bounded. **[3]**

In this paper, they endeavor to address the lack of a joint routing-and-sleep-scheduling scheme by incorporating the design of the two components into one optimization framework. The joint routing-and sleep-scheduling by itself is a non-convex optimization problem, which is difficult to solve. They tackle the problem by transforming it into an equivalent Signomial Program (SP) through relaxing the flow conservation constraints. The SP problem is then solved by an iterative Geometric Programming (IGP) method, yielding an near optimal routing-and-sleep-scheduling scheme that maximizes network lifetime. They attempt to obtain the optimal joint routing-and sleep- scheduling strategy for wireless sensor networks. The proposed algorithm serves as a useful level to evaluate practical heuristics that endeavor to maximize the network lifetime. **[4]**

3. Design Module

Formation of network: - It consist of creation of a network consist of different wireless sensor nodes. Maximizing the lifetime of event in wireless sensor networks for which events occur infrequently is very essential. In such systems, most of the energy is consumed when the radios are on, waiting for an arrival to occur. Sleep-wake scheduling is an effective mechanism to prolong the lifetime of these energy-constrained of wireless sensor networks. Sleep Wake Scheduling:- Sleep Wake Scheduling keep nodes in sleep mode when they are not in use.
Two types of Sleep Wake Scheduling
- Synchronous
- Asynchronous

Sleep Wake Scheduling helps to reduce Energy consumption

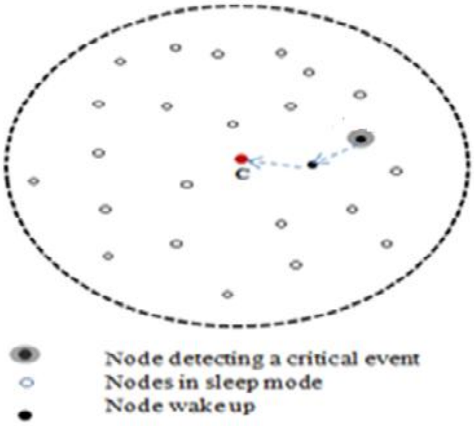

Figure 1: Wireless sensor nodes with Sleep Wake Scheduling

As the lifetime maximization is essential thing in wireless sensor network thus to implement the algorithm for lifetime maximization of WSN is necessary. Thus firstly, network consist of different nodes is created. As sleep-wake scheduling is very much helpful to reduce power consumption, thus the sleep-wake scheduling is implemented in network consist of different nodes.

Anycast:- Under usual packet-forwarding schemes, every 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. But under anycast packet-forwarding schemes, each node has multiple next-hop relaying nodes in a forwarding set. The sending node can forward the packet to the first node that wakes up in the forwarding set. The advantage of anycast in sensor networks with asynchronous sleep-wake scheduling is that the anycast helps us to reduce the delay. When there is long distance between two nodes the Anycast packet-forwarding scheme will be used.

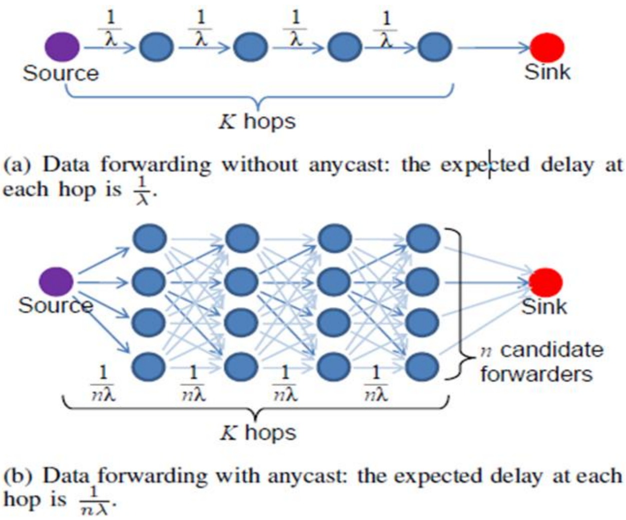

Figure 2: Example of Anycast data-forwarding : Anycast can reduce the expected one-hop delay and the expected end-to-end delay by n times

By using Anycast algorithm, the delay $1/\lambda$ can be reduced to $1/n\lambda$.

Coloring Algorithm: The Coloring Algorithm works on the principle like TDMA scheme. Number of colors used in an algorithm is called Chrome numbers. Lots of coloring algorithms are there but their aim is same to reduce the Chrome number. Here the Coloring algorithm works on principle of three different colors.

4. Results

The output window of formation of network is as shown in figure (3). It shows the network consist of different nodes located at different places.

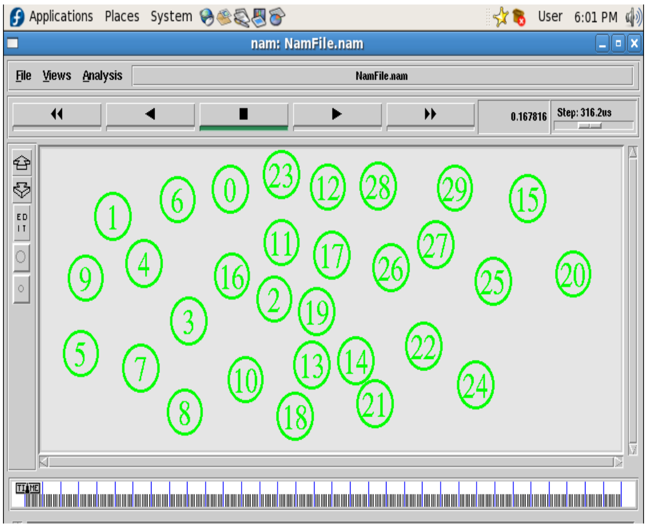

Figure 3: Output Window of Network Formation

The output window of formation of network where Sleep Scheduling, Anycast Algorithm & Coloring Algorithm is applied is as shown in figure (4) It shows the network consist of different nodes located at different places with three different colors.

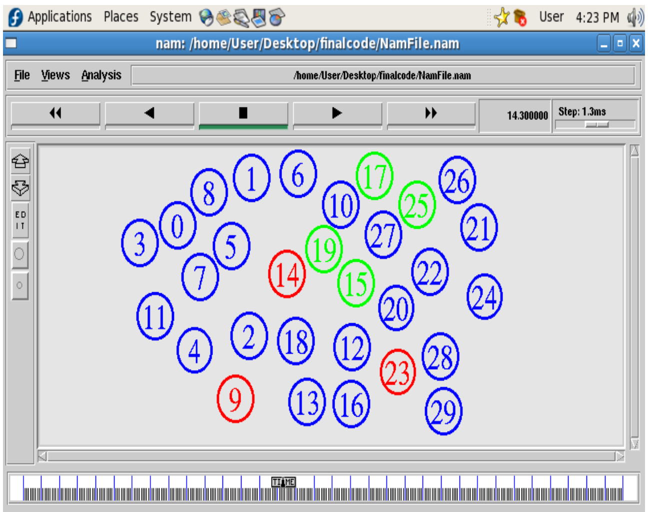

Figure 4: Output Window of Network Formation where Sleep Scheduling, Anycast Algorithm & Coloring Algorithm is applied

Figure (5) shows the broadcasting of signal during Data Communication.

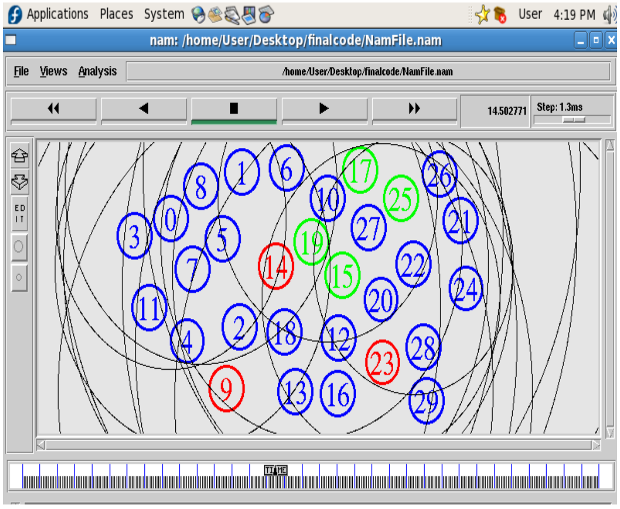

Figure 5: Output Window broadcasting of signal during Data Communication

Figure (6) shows output window of data flow in network with Sleep Scheduling with Anycast packet-forwarding scheme and Coloring algorithm.

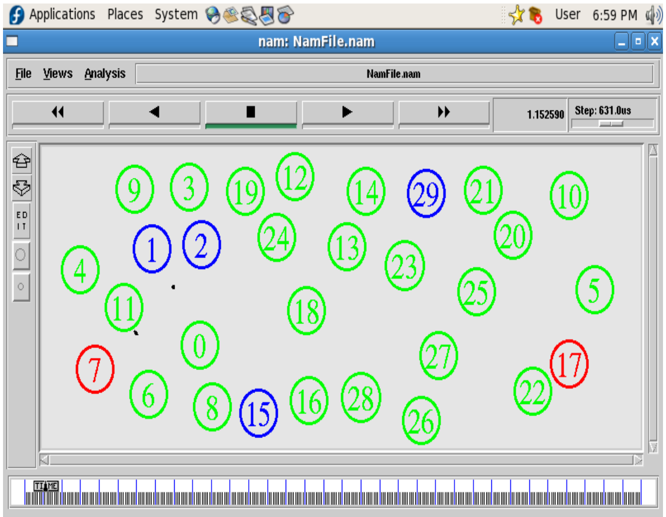

Figure 6: Output Window of data flow in network with Sleep Scheduling with Anycast packet-forwarding scheme and Coloring algorithm

After applying the Sleep scheduling and Anycast packet-forwarding schemes and the Coloring algorithm, the results of energy consumption , delay and packet drop rate graph shown in given below.

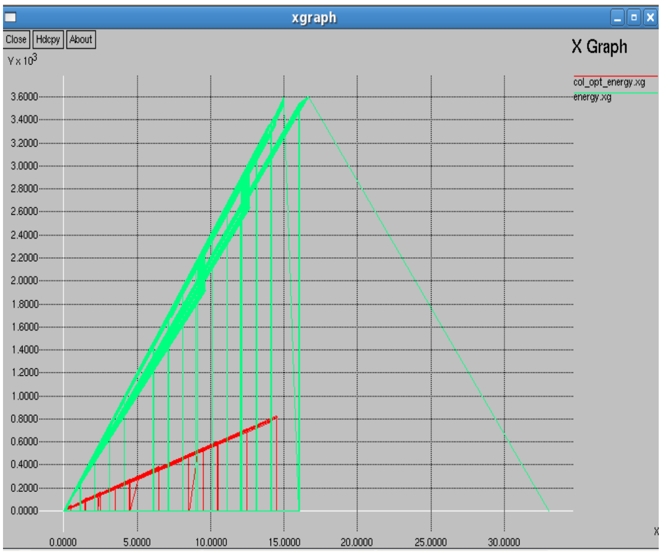

Figure 7: Window of Energy graph

Figure 8: Window of Delay graph

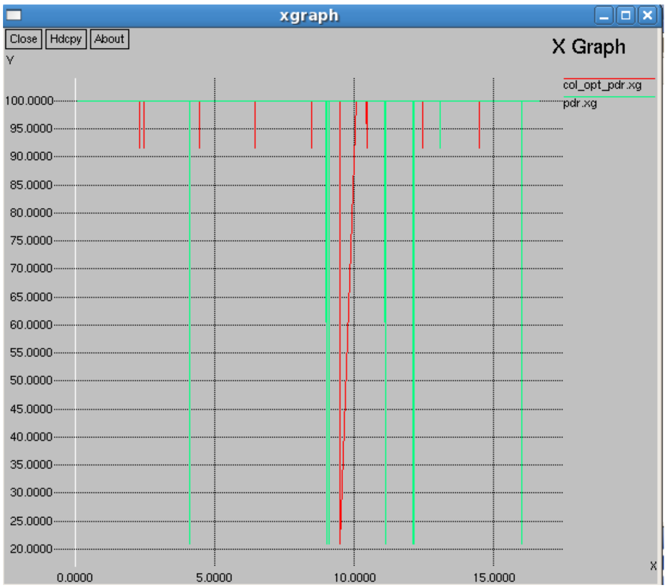

Figure 9: Window showing packet drop rate graph

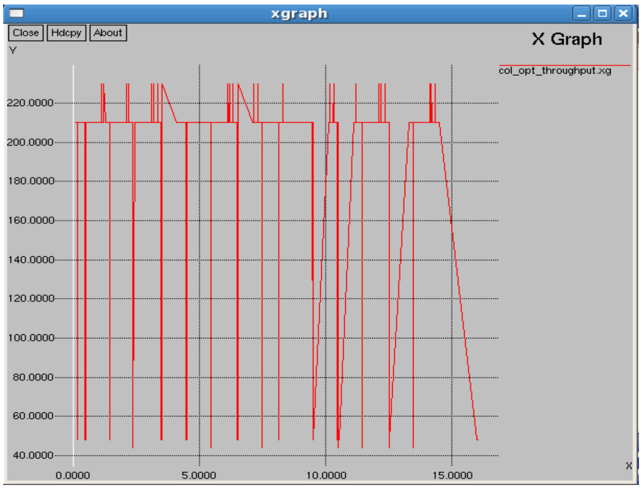

Figure 10: Window of Throughput graph

Table 1: Performance of Network

Parameters	N/W with Sleep Scheduling with Anycast Algorithm	N/W with Sleep Scheduling with Anycast Algorithm & Coloring Algo (For Few Communic-ations)	N/W with Sleep Scheduling with Anycast Algorithm & Coloring Algo (When Communications increased)
Energy consumption	Reduced by 77.08%	Reduced by 77.03%	Reduced by 77.77%
Delay	Decreases	Decreases	Decreases
PDR	Less	Very Less	Very Less
Throughput	Increased	Increased	Highly Increased

5. Conclusion

The implemented work i.e. Sleep scheduling results in reduction in power consumption from battery of wireless sensor network. Therefore it is helpful in maximizing lifetime of wireless sensor network. With the help of Anycast, we can reduce the delay. The advantage of Anycast is that the anycast can reduce the expect one hop delay and the expected end-to-end delay by n times. Here we can reduce collision of data packets during transmission of data packets due to Coloring Algorithm.

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