Volume : 2 | Issue : 12 | December 2013 • ISSN No 2277 - 8179

Research Paper

Performance Improvement of Multicast Protocol in Wireless Sensor Networks

Computer Science

KEYWORDS : Wireless Sensor Networks, Shortest Path Tree, Multicast, Multihop, Collision

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ABSTRACT

Now a day's increase in use of sensor networks and to measure the environment for data transfer and sensing is widely applied. Sensors are applied in different fields like military, industries, traffic control etc. Earlier work show the improvement of energy efficiency and data gathering is done easily and lose of data is controlled in wireless sensor networks. It also focus on data collection scheme called Maximum amount Shortest Path but attention is shown only to the data gathering and movement of mobile sink but lacks in increasing network throughput or about energy consumption. This work focus on designing and implementing the SIMP (Sink-initiated Multicast protocol) scheme, which constructs its own data delivery path to source and a multicast trees is automatically constructed by merging the members. Apart from it the impact of different overlapping time partition methods is studied and the data gathering speed is increased and the data loss is also controlled here. This work mainly concentrates on throughput maximization and also in minimizing the energy consumption of nodes. The proposed protocol is validated through simulation experiments using GLOMOSIM.

1. INTRODUCTION

A Wireless Sensor networks (WSN) consists of spatially distributed autonomous sensors to monitor physical or environment conditions, such as temperature, sound, pressure, etc and to cooperatively pass their data through the network to a main location. Size and cost constraints on sensor nodes result in corresponding constraints on resource such as energy, memory, computational speed and communication bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop mesh network.

Similarly Wireless Sensor Networks can use a range of sensors to detect the presence of vehicles ranging from motor cycles to train cars. Other applications like Air pollution monitoring, Environment / Earth monitoring, Landscape detection and they are also used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control. Data Logging in Wireless Sensor Networks are also used for the collection of data for monitoring of environmental information [6]. Sink mobility has become an important research topic in wireless sensor networks (WSNs). One of its fundamental tasks is to gather sensor readings from the sensory field at data sinks. Research has shown that sensors near a sink deplete their battery power faster than those far apart due to the heavy overhead of relaying messages. Non-uniform energy consumption causes degraded network performance and shortened network lifetime. The problem of energy-efficient data collection by mobile sink in delay-tolerant WSN is also addressed here.

The main characteristics of WSN include power consumption constrains for nodes using batteries or energy harvesting, the power source usually in the form of a battery. To conserve power, the node should be shut off the radio power supply when not use. If a centralized architecture is used in a sensor network and when the central node fails, then the entire network will collapse. The data gathered from Wireless Sensor Networks is usually saved in the form of numerical data in a central base station [1][5].

2. EFFICIENT DATA COLLECTION IN SENSOR NETWORKS

Efficient data collection in WSNs plays a key role in power conservation. In recent years a new category of important sensor networks applications emerges where motion is a fundamental characteristic of the examined system. Data exchange between individual sensors and infrastructure nodes will drive applications such as traffic and wild life monitoring, smart homes, hospitals and pollution control. In WSN, sensor readings are transmitted to one or more pre-defined data sinks for analysis and processing. Research has shown that the closer to a sink a sensor is, the faster its battery exhausts. It is because, when compared with sensors far apart from a sink, nearby sensors is shared by more data communication paths to the sink and have heavier message relay load. By the time when the one-hop neighboring sensors of a sink deplete their battery power, those farther away may still have more than 90% of their initial energy. The proposed system aiming at the data delivery problem in large-scale wireless sensor networks with mobile sinks which move along fixed paths with constant speed, and also produce an efficient data collection scheme that simultaneously improves the total amount of data and reduces the energy consumption [2][7].

Traditionally, two approaches can be adopted to accomplish the data collection task: through direct communication, and through multi-hop forwarding. In the first case, sensor nodes upload data directly to the sink through one-hop wireless communication, which may result in long communication distances and degrade the energy efficiency of sensor nodes. On the other hand, with multi-hop forwarding, data are reported to the sink through multiple relays, and the communication distance is reduced. The nodes near the sink always have much heavier forwarding load and their energy is lost at the time these problems are solved in this paper.

3. PROBLEM FORMULATION

The Shortest Path Tree (SPT) method is proposed to choose subsinks and relay data from members. Each member chooses the closest subsink in terms of hop distance as its destination and then sends its own data or forwards data from downstream nodes to upstream nodes along with the shortest path trees. However, the number of members associated with each subsink is independent of its communication time, which may cause imbalance in the assignment of members among the subsinks. It is possible that some subsinks with longer communication time own fewer members, implying that the mobile sink may collect less data than expected. Consequently, the excess data traffic may result in oversaturated subsinks which are not able to transmit all data to the mobile sink in the limited communication duration. In other words, the SPT method has low energy efficiency for data collection [2]. A wireless sensor network consists of nodes and mobile sinks with wireless communication capabilities for specific sensing tasks. The mobility and driver partition which applicable to node placement under zone process thus creates the framework for the proposed protocol. Mobility describes the node movement and the driver initializes position of each and every nodes.

A communication protocol and a speed control algorithm of the mobile sink are suggested to improve the energy performance and the amount of data collected by the sink. In this protocol, a SPT is used to choose the cluster heads and route data, which may cause imbalance in traffic and energy dissipation. To address the imbalance problem, the SIMP scheme proposed in this paper to design and enhance data collection from the viewpoint of choosing cluster heads more efficiently. Based on the existing work, the proposed system focuses on large-scale dense WSNs with path-constrained mobile sinks that may exist in real world applications, such as ecological environment monitoring and health monitoring of large buildings.

The Maximum Amount Shortest Path (MASP) problem from the existing system (MSWSN) as a 0-1 Integer Linear Programming (ILP) problem which does not aims in optimized mapping between members and sub sinks to minimize the energy consumption under the condition that the total amount of data collected by the mobile sinks is maximized. To validate the proposed schemes on different scenarios with various movement trajectories of mobile sinks the proposed system is introduced. In the proposed system the mobility model for the sink is suitable for making multicast data collection through sink. Consider that the analysis lead to the maximization of network lifetime and a study about subsink selection problem is done [8].

Here Sink-initiated Multicast protocol (SIMP) is proposed for mobile sinks in wireless sensor networks. To reduce location updates from sinks to a source and to achieve fast multicast tree construction and data delivery, SIMP allows sinks to construct their own data delivery paths from a source to them and a multicast tree to be automatically constructed by merging the data delivery paths. Then, the source forwards data to the sinks down the multicast tree and also it proposes a round-based virtual infrastructure with a radial shape for growing the merging probability of data delivery paths and reducing the reconstruction frequency of the multicast tree due to mobility of the sinks. Based on the existing work, the proposed system focuses on large-scale dense WSNs with path-constrained mobile sinks that may exist in real world applications, such as ecological environment monitoring and health monitoring of large buildings.

The mobile sink collects data from sensor nodes while moving close to them. According to the communication range of mobile sink, the monitored region can be divided into two parts, the direct communication area (DCA) near the Mobile Sinks communication range, and the multihop communication area (MCA) for far-off sensors. Sensor nodes within the DCA, called subsinks, can directly transmit data to the mobile sink due to their closer proximity of the trajectory. On the other hand, sensors within the MCA, called members, must first relay data to the subsinks which complete the final data transmission to the mobile sink.

The communication time between each subsink and the mobile sink is assumed to be fixed due to the fixed movement path and constant speed of mobile sink. So each subsink has an upper bound on the amount of data that can be transmitted to the mobile sink in one round. The throughput of the WSN is dependent on the relationship between the upper bound on the data collected and the number of members belonging to each subsink. The main challenge here is to find an efficient assignment of members to the subsinks that improves the data delivery performance as well as reduces energy consumption [4][9].

In this paper, aiming at the data delivery problem in large-scale wireless sensor networks with mobile sinks which move along fixed paths with constant speed, it proposes an efficient data collection scheme that simultaneously improves the total amount of data and reduces the energy consumption. In this scheme, the members within the MCA are assigned to the corresponding sub sinks within the DCA according to the length of the communication time between the mobile sink and the sub sinks, thus improving the network throughput.

4. RESULTS AND DISCUSSION

Collection of data at sensor nodes consumes a lot of energy and sensor nodes have limited energy. Proposed a Sink-initiated Multicast protocol (SIMP) model which uses a mobile sink to collect the data from the static nodes of the network, and proposes a mobility model for sink to move with the relative distance, direction and speed. SIMP increases the delivery ratio, residual energy and lifetime of the network by one hop communication.

The system is tested with different data intervals. The data values are selected according to the number of nodes. The results are compared with labeled data values. The performance metrics applied are Collision, Throughput and Energy consumption. The comparison between MASP (Maximum Amount Shortest Path) protocol and SIMP (Sink Initiated Multicast protocol) is done.

4.1. Collision Analysis Graph

A collision is a situation that occurs when two distinct pieces of data have the same hash value. The collision rate is so high in MASP protocol but the SIMP protocol minimizes the collision rate. The collision rate is increased above 350 from nodes 6 to 10 in MASP but in SIMP the collision rate is only 40. For nodes 0 to 30 the collision rate is discussed in this graph.

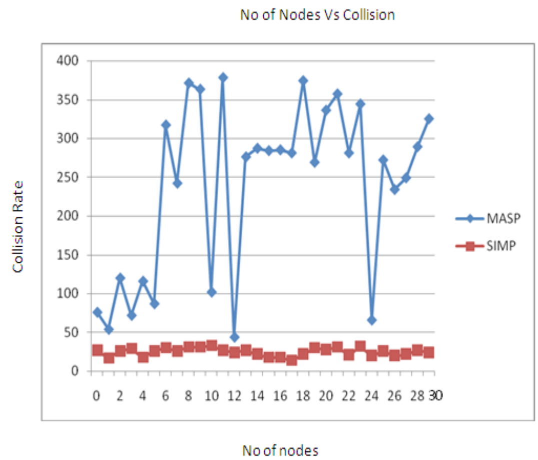
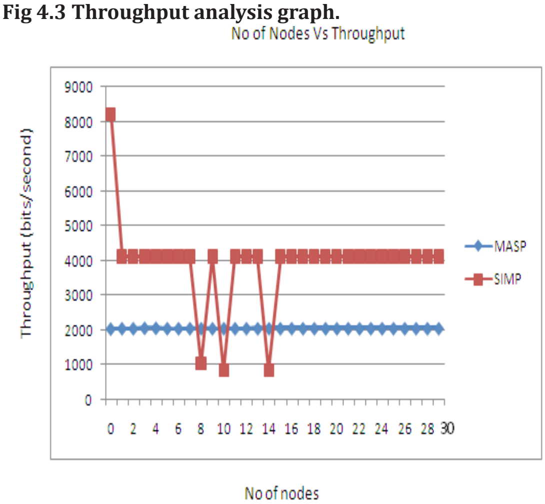


Fig 4.1 Collision Graph

4.2. Throughput Analysis Graph

Throghput is the average rate of successful message delivery over a communication channel. In SIMP the nodes 2 to 6 takes only 8000 bits per seconds to send or to collect the data but MASP takes more than 2000 bits per seconds The main aim of the research is to increase the throughput by using SIMP the result has been shown here.

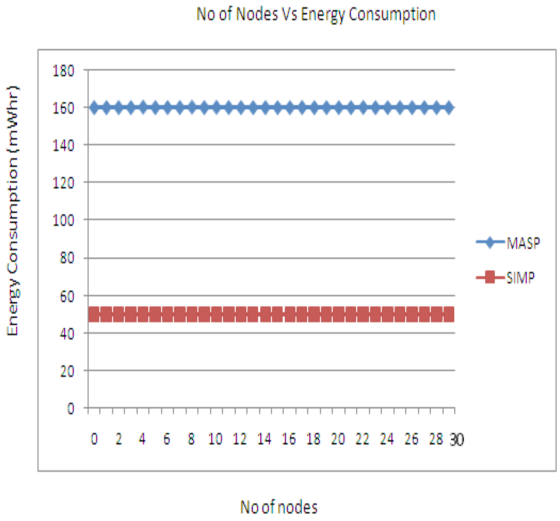
Fig 4.3 Throughput analysis graph.



4.3. Energy Consumption Graph

MASP protocol consumes more energy than SIMP protocol. When the energy consumption is less it increases the nodes lifetime those things are discussed in this graph. The enregy consumption is measured in megawatt per hour. MASP use more than 160 mWhr that decreases the sensor networks lifetime but SIMP uses only 50 mWhr that helps the sensor device to work for a long time. The energy consumption always increases the lifetime of sensor devices.

Fig 4.3 Energy Consumption graph.



5. CONCLUSION AND FUTUREWORK

The proposed system explains an efficient data collection scheme called SIMP for wireless sensor networks. In SIMP, the mapping between sensor nodes and sub-sinks in multicast environment is optimized to maximize the amount of data collected by mobile sinks and also to balance the energy consumption. SIMP has good scalability to support sensor networks with low density and multiple mobile sinks. A heuristic based on sub-sink selection and tree formation is presented to solve the SIMP optimization problem. Added to it, a communication protocol has been designed which supports SIMP and adapts to dynamic topology changes. A simulation experiment shows that SIMP outperforms SPT and MASP in terms of utilization of energy. SIMP initiates dynamic method where the amount of data collection is high when compared to the static method. The results shows that usage of SIMP increases the network throughput, the consumption of energy, and collision are minimized when compared to MASP.

In future, the research can be focused on different scenarios with different movement trajectories.

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