Energy Efficient Transmission for Mobile Data in Wireless Sensor Networks

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***Abstract*— This paper represents Energy preservation in Wireless Sensor Networks (WSNs) will be a important issue. Energy preservation has received increased attention in the recent years. The new transmission scheme for energy-constrained WSNs was using stateless multicast protocol. The scheme, called MIHOP (Made It Happen On Purpose), combines cluster-based virtual MIMO and multihop technologies. The multihop mode is employed in data transmission. Here the related sensors are located within a specific number of hops from the sink, and the virtual MIMO mode is used for transmitting data from the remaining sensor nodes. The comparison of the energy consumption of different transmission schemes was performed and propose an algorithm for determining the optimal hop count in MIHOP. The controllable mobile sink reduces the energy consumed in sensor transmission is also adopted for data collection. This project combine both MIMO with multi point relay set. MIMO technology takes the advantage of a radio wave phenomenon called multipath where transmitting the information to other objects. Getting the receiving antenna multiple times via different angles and at slightly different times. In multihop wireless networks are used in communication between two end nodes is carried out through a number of intermediate nodes whose function is to relay information from one point to another. Multipoint relays (MPR) are nodes in wireless Ad-Hoc networks that do the job of relaying the messages between nodes. Multipoint relays are also have the main role in selecting the proper route from any source to any desired destination node.**

Keywords*— *Mesh Topology, Multipoint Relay, Stateless Multicast Protocol, Virtual MIMO, Wireless Sensor Networks.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have received great attention in communication investigate. Hundreds or even thousands of sensors are spread over a field, from which necessary data may not be obtained in a timely manner. Sensors enable the acquisition of sensed data and uploading to data sinks through wireless channels without manual involvement. One of the most critical problems in WSNs is the limited energy income of battery-operated sensor nodes. Sometimes replacing or recharging the batteries of sensor nodes is difficult given environmental boundaries. An entire set of connections would be disconnected as a result of energy reduction in the sensors. Enhancing the energy preservation of transmission is advantageous because transceivers consume substantial energy. Numerous techniques, such as multi-hop and virtual MIMO, as well as mobile data gathering schemes, have been developed for this purpose.

Multi-hop routing and direct transmission are conservative transmission schemes for WSNs. In multi-hop networks, determined data are generated and transmitted by one sensor to an intermediate node, and then relayed to a sink hop by hop. It shows that multi-hop transmission is more energy accomplished than single-hop transmission in general WSNs. However, when a sink is distant from the sensor area or the area is so large that most sensor nodes need several hops to reach the sink, huge retransmitting energy is consumed during transmission, thereby considerably accelerating node depletion.

MIMO systems use less energy than SISO systems in Rayleigh loss channels. Deploying several antennas on one sensor node is infeasible as a result of the limited physical size of a node. To resolve this problem, researchers proposed a cooperative MIMO transmission method. Antennas deployed on different sensor nodes form a virtual MIMO system, thereby enabling substantial energy preservation in long haul transmission. STBC-based Cluster Heads Co-operative Transmission (SCHCT) scheme for energy conservation, the nodes in one cluster require extra energy as they work in combination. When transmission distance is comparatively short and below a assured threshold, the energy used by collaborating nodes accounts for a enormous proportion of consumption. Under this circumstance, virtual MIMO systems also consume much more energy.

A number of studies have alert on multi-hop MIMO networks where MIMO tools is implemented hop by hop. To minimize total energy preservation, researchers determined the optimal number of collaborating nodes in one hop. The organization and transmission protocols in the afore-mentioned systems were described in this chapter. It has proposed a double-string network transmission method which combines the virtual MIMO and multi-hop networks. In this method, two sensor nodes form into one cluster, and source node transmits its data to the sink cluster by cluster.

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A new energy-efficient transmission method is called MIHOP (MIMO and Multi-hop), combines the improvement of multi-hop and STBC based virtual MIMO method. In MIHOP (Made It Happen On Purpose), a mobile sink is managed so that it moves along a prepared path and pauses at certain locations to broadcast routing information. The sensor nodes near the sink are located within a specific predefined number of hops, and comprise a multi-hop network. Every node transmits data to the sink hop by hop. The sensor additional added from the sink may use STBC-based virtual MIMO (Multi Input Multi Output) technology to transmit data. The theoretical investigation and simulation results show that the MIHOP scheme significantly outperforms individual virtual MIMO (Multi Input Multi Output), multi-hop schemes and double-string network in terms of energy efficiency when energy consumption in transmission and circuitry are considered.

A. System Model

This section describes the proposed MIHOP (Made It Happen On Purpose) method in detail, and illustrates the mobile data gathering mechanism of MIHOP. Figure 1 denotes the system model of MIHOP. The sink works parallel to a base station that broadcasts and gathers some information. In the multi-hop network formation stage, a sink broadcasts routing in sequence packets, and the sensors that collect the packets function as first-hop nodes. The nodes rebroadcast the routing information packets in wireless channels, and the entire multi-hop network is formed during the hop-by-hop routing of an algorithm. The range of a multi-hop network is restricted by maximum number of hops MH, which can be optimized in accordance with the model proposed in Section. This optimization minimizes energy preservation. Each two nodes with hops greater than MH form a cluster on the basis of minimum cooperation range.

The STBC-based virtual MIMO (Multi Input Multi Output) method proposed in Ref. [1] is adopted for data transmission to a sink. The nodes in one cluster are understood located on the same tier of the virtual MIMO network, and the distance between two neighboring tiers is denoted as r (Figure 1).Two nodes in one cluster should be located on the kth tier and the collaboration distance between these nodes is denoted as d. The transmission distance from node to sink is called as kr. Remaining single nodes will transmit data to a sink by SISO (Single Input Single Output) technology alone. Once each sensor selects a transmission mode, the TDMA program is used by the sink to establish the sequence at which the sensors transmit data.

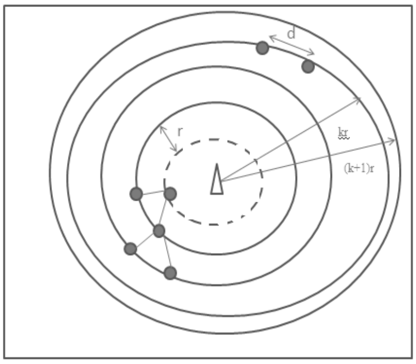

Figure.1.System Model of MIHOP

B. Mobile Sink

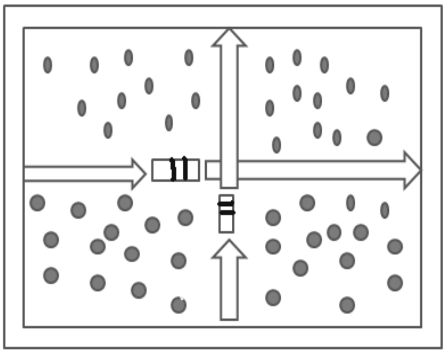

Figure.2.Movement of the Mobile Sink

N sensor nodes are spread in the sensing area in Figure 2, to which a mobile sink is created. The sink is employed to facilitate movement along a fixed path, it is a cross path. It pauses at assured data assembly points to broadcast BEACON packets and periodically collect data from sensor nodes. The sink is equipped by two antennas, and every sensor has a single antenna for uploading data. Each packet has a fixed length of L bits. The network layer algorithms planned in Ref. [5] are used to select a route from the sink to each sensor in the multi-hop network. Each sensor node maintains a factor N_{hop}, which represents the shortest hop count to the mobile sink. The assessment of hop N_{hop} is initialized as infinite, but the hop N_{hop} on the mobile sink is set as 0.

In the instruction phase, the mobile sink stops at a data assembly point and broadcasts BEACON packets with MH and K. K is initialized to 0. Each sensor node receiving the BEACON packet and requests adds 1 to K, next updates its N_{hop} into $N_{hop}= \min\{N_{hop},K\}$ and rebroadcasts the BEACON with the new K. This process continues in anticipation of all the nodes in the network receive a BEACON hop by hop. The mobile sink then moves on the next point and another time broadcasts routing information. After the instruction phase sensor nodes with N_{hop} higher than MH form into clusters and the virtual MIMO mechanism is used to transmit data to the mobile sink. Additional nodes with N_{hop} lower or equal to MH adopt multi-hop transmission technology.

II. STATELESS MULTICAST PROTOCOL

In this research project, based on the Multi Point Relay and CDS approaches, three new efficient broadcast algorithms for Mobile Ad-hoc Networks are proposed. These algorithms used to minimize the redundant transmissions in the network by limiting the number of nodes that forward the broadcast packets. In this project combine both Multi Input Multi Output with multi point relay set. MIMO algorithm takes advantage of a radio-wave phenomenon called multipath where transmitted information bounces off ceilings, walls, and other objects. Reaching the receiving antenna multiple times via different angles and at slightly different times. In multi-hop wireless networks, are used for communication linking two end nodes is carried out through a number of intermediate nodes which function is to relay information from one point to another. To achieve this, the algorithms generate a CDS of the network, where only the nodes in the CDS retransmit broadcast packets. This chapter discusses the proposed algorithms. Multipoint relays (MPR) are used for relaying messages between nodes. They also have the main role of selecting the proper route from any source to any desired destination node.

In Wireless Mesh Networks (WMN), the medium is usually shared thus: once a packet is flooded, the same packet is sent several times to the same receiver. Not only is this a waste of bandwidth however, while the load of broadcast packets is increased in the network, it may increase the collision rate and the actual packet delivery may then be decreased. The multipoint relay (MPR) technique is used to reduce the overhead induced by transmitting of broadcast packets. The concept of multipoint relay was first introduced in [6] for HiPERLAN type 1 and the multipoint relay optimization is the core optimization of Optimal Link State Routing (OLSR) [4]. The main idea of the multipoint relay(MPR) optimization is that only a subset of neighbours has to relay a flooded packet that has been flooded. It can be easily implicit that if a suitably chosen subset of one's neighbour nodes can relay a flooded packet to all one's 2-hop neighbours; then the relay of these nodes will be sufficient to ensure the proper delivery of the packet to the node m's 2-hop neighbours, see Figure 3. This subset of nodes is called the multipoint relay set of node m; of course the smaller the number of nodes in the multipoint relay set, the greater the optimization.

A. Multipoint Relay

Multipoint relay optimization must be repeated recursively when the packet is flooded. At each hop a flooded packet is relayed by the next hop multipoint relay set. Of course an already transmitted packet is not retransmitted twice; this is controlled by a duplicate table. The interesting point is that the notion of multipoint relay is deeply embedded in the OLSR protocol. To preserve the information of the network topology OLSR (Optimal Link State Routing) uses two kinds of control. The first kind of packet called "hello" is used to build the neighbourhood. The second kind of packet called "TC" is used by each node to disseminate the neighbourhood within the network. The two main OLSR functionalities are: Neighbour Discovery and Topology Dissemination.

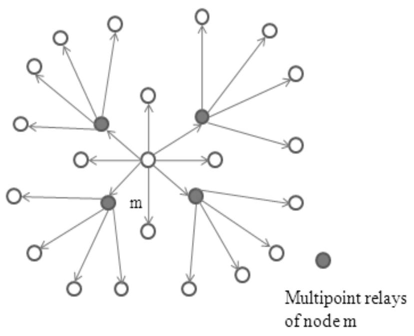

Figure 3: Multipoint Relays of node m

B. Mesh Topology

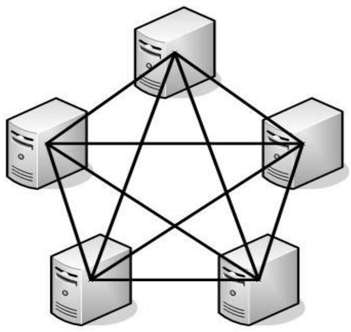

Figure 4: Mesh Network

Mesh topology is one type of network topology where each node is not only used for collecting data, although can also be used as a relay for the data transfer to another nodes. The mesh topology can be designed by using flooding or routing technique, it is using routing technique each data travelling to the destination through the path or hooping via other node.

C. Advantages

- Retransmission only done by current node only.
- It is not required to detect path

D. Application

- Military application.
- National security application.
- Environment monitoring.
- Medical application.
- Forest fire accident monitoring.
- Intelligent building monitoring.
- Animal surveillance.

E. Stateless Multicast Protocol

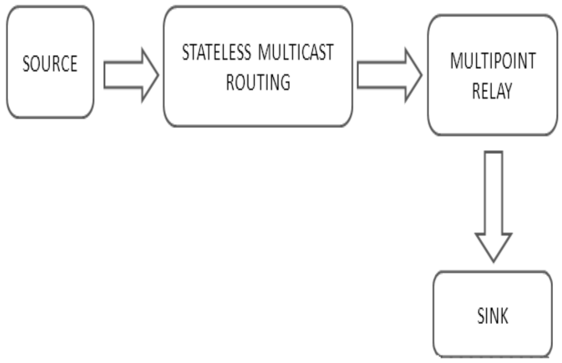

Figure 5: Flow Chart of Stateless Multicast Protocol

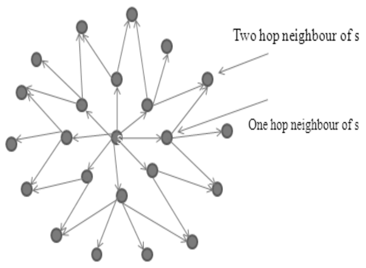

Figure 6: Basic Flooding Problem

Multicast routing algorithm typically rely on the a priori creation of a multicast tree (or mesh), which requires the individual nodes to maintain state information. In active networks with bursty traffic, where long periods of quiet are expected linking the bursts of information, this multicast state performance adds a huge amount of communication, processing, and memory overhead for no advantage to the application. Thus, the project have developed a stateless receiver-based multicast (RBMulticast) protocol that simply uses a list of the multicast members' ('sinks') addresses, embedding in packet headers, to enable receivers to choose the best way to forward the multicast traffic. This protocol is always called Receiver-Based Multicast, exploits the facts of the geographic locations of the nodes to remove the need for costly state maintenance (e.g., tree/mesh/neighbor table maintenance), making it preferably suited for multicasting in active networks. RBMulticast was implemented by using the OPNET simulator and tested by using a sensor network performance. Mutually simulation and experimental results confirm that RBMulticast provides high success rates and low delay without the burden of state protection.

III. MIMO

In radio, Multiple Input and Multiple Output (MIMO) is the use of multiple antennas at both the transmitter and receiver to improve communication presentation. MIMO is one forms of smart antenna technology. Multiple Input Multiple Output technology has attracted consideration in wireless communication, since it offers momentous increases in data throughput and link range without additional bandwidth or increased transmit power. It achieves this goal through distributing the same total transmit power over the antennas to achieve an array gain and improves the spectral efficiency (more bits per second per hertz of bandwidth) and/or to achieve adversity gain that improves the link reliability (reduced desertion). Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPP Long Term Evolution, WiMAX and High Speed Packet Access Plus (HSPA+).

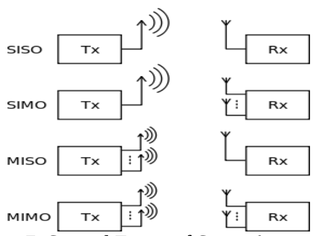

Figure7: Several Forms of Smart Antenna

IV. RESULTS

Wireless sensor networks are self organized, low cost and low power utilizing network. It can sense, calculate and communicate the data. Collection of data at sensor nodes consumes a lot of energy and sensor nodes have limited energy. Proposed a Stateless Multicast protocol (SMP) model which uses a mobile sink to collect the data from the static nodes of the network.

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 is measured using four metrics. They are Collision, Delay, Throughput and Energy consumption. The throughput of radio transmitter & radio receiver in gateway (packets/sec), mobile node 3(bits/sec), mobile node 6(bits/sec) is shown in result. How many packets or bits are transmitted and received effectively is shown in result.

A. Throughput Analysis Graph

Throughput is the average rate of successful message delivery over a communication channel. The throughput is measured in bits per second and sometimes in data packets per second. In SMP the nodes 2 to 6 takes only 8000 bits per seconds to send or to collect the data. The main aim of the research is to increase the throughput by using SMP the result has been shown here.

TABLE I. THROUGHPUT ANALYSIS

Throughput	**Table Column Head**		
	Gateway (Packets/sec)	***Mobile node 3 (bits/sec)***	***Mobile node 6 (bits/sec)***
Radio transmitter	6	525	530
Radio receiver	8.4	650	710

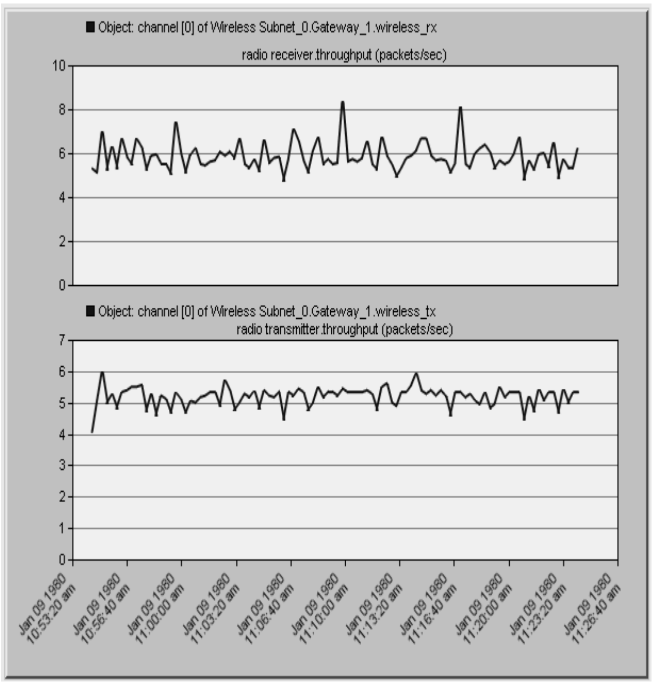

Figure.8.Throughput in Gateway (packets/sec)

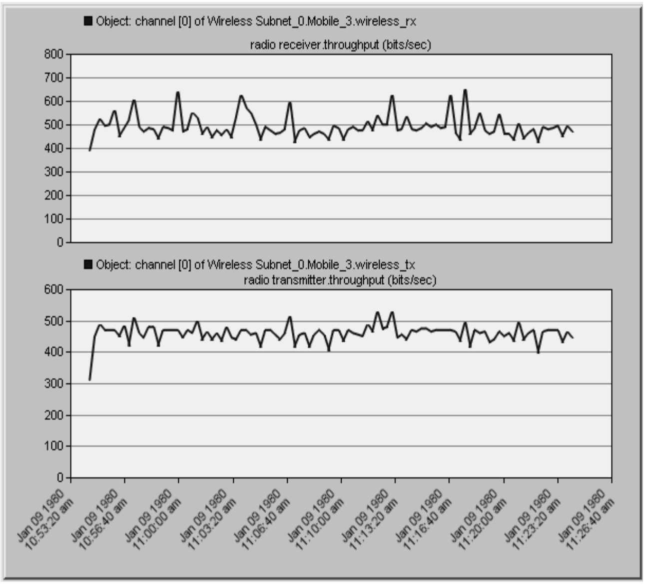

Figure.9.Throughput in Mobile Node-3(bits/sec)

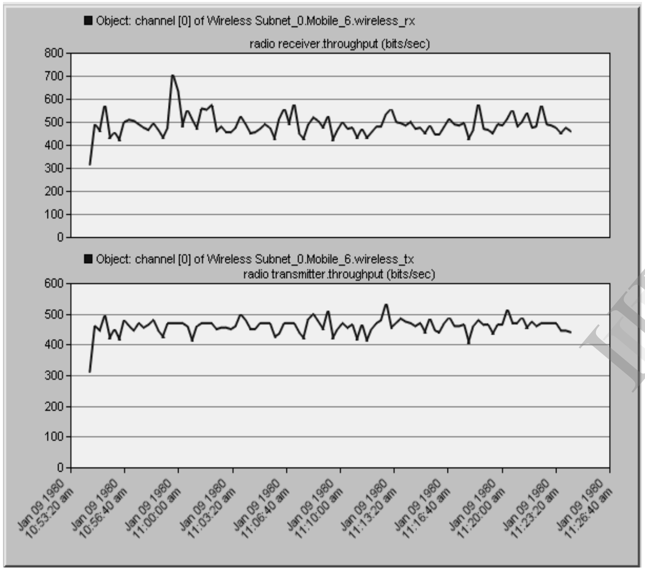

Figure.10.Throughput in Mobile Node-6(bits/sec)

V. CONCLUSION

A new energy-efficient transmission scheme for mobile data gathering in WSNs was proposed, it combine both MIMO with multi point relay set. Multipoint relay also have the main role in routing and selecting the proper route from any source to any desired destination node. Three nodes are used in this system. Stateless multicast protocol is used in this system. Finally measure transmitted and received packet, end to end delay, throughput in this result.

The proposed system explains an efficient data collection scheme called Stateless Multicast protocol for wireless sensor networks. Stateless multicast Protocol has good scalability to support sensor networks with low density and multiple mobile sinks. The conclusion shows that by using Stateless multicast Protocol the network throughput is increased and the energy consumption, delay and collision are minimized.

In future number of node is increased and transmits the packet efficiently. Ten nodes are used in this system. In future using multipoint relay to improve the energy level and measure the throughput, end to end delay.

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REFERENCES

[1] LIU Danpu, DING Jie,ZHANG Kailin,"Energy-Efficient Transmission Scheme for Mobile Data Gathering in Wireless Sensor Networks,"China communications, March 2013,pp. 114-123.

[2] LUO Hong, SUN Yan, CHEN Qiang, "Smart Home Based on the Wireless Sensor-Actuator Networks," [J]. China Communication, 2011, 8(1):102-109.

[3] DUAN Junqi, ZHENG Tao,ZHANG Sidong,"Improved Implementation and Evaluation of Wireless Sensor Networks in Intelligent Building," China Communications, 2011, 8(8): 64-71.

[4] Ahmed Chalak Shakir, GuXuemai and Jia Min, "Securing Message in Wireless Sensor Network by using New Method of Code Conversions," 2011, pp.1182-1188.

[5] WU Huari, DING Jie, , LIU Danpu, "A Cooperative MIMO Transmission Scheme for Cluster-based Wireless Sensor Network," [J]. China Communication, 2010, 7(5): 14-22.

[6] ZHOU Zhong, CUI Shuguang, ZHOU Shengli, "Energy-Efficient Cooperative Communication in a Cluster Wireless Sensor Networks," [J]. IEEE Transactions on the Vehicular Technologies, 2008, 57(6): 3618-3628.

[7] CUI Shuguang, BAHAI A, GOLDSMITH A J," "Energy-Efficiency of MIMO and Cooperative MIMO Techniques in Sensor Network," [J]. IEEE Journal on the Selected Areas in a Communications, 2004, 22(6): 1o89-1o98.

[8] JAYAWEERA S K, "Energy Analysis of MIMO Techniques in Wireless Sensor Networks",[C]// Proceedings of the 38th Annual Conference on Information Sciences and Systems: Princeton, NJ, USA ,March 17-19, 2004.

[9] CUI Shuguang, GOLDSMITH A J, "Energy Efficient Routing Based on Cooperative MIMO Techniques",[C]//Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing: Philadelphia, USA, 2005: 805-808, March 18-23, 2005.

[10] SOMASUNDARA A A, KANSAL A, JEA D D, et al, "Controllably Mobile Infrastructure for Low Energy Embedded Networks",[J]. IEEE Transactions on Mobile Computing, 5(8): 958- 973, 2006.

[11] BOUKERCHE A, XIN Fei, "Energy-Efficient Multi Hop Virtual MIMO Wireless Sensor Network",[C]// Proceedings of the IEEE International Conference on Wireless Communications and Networking: March 11-15, 2007. Hong Kong, China, 2007: 4301-4306.

[12] MA Ming, YANG Yuanyuan, "Data Gathering in Wireless Sensor Networks with Mobile Collectors", [C]// Proceedings of the IEEE International Symposium on Parallel and Distributed:April 14-18, 2008. Miami, Florida, USA, 2008:1-9.

[13] TANG Qiuling, SUN Changyin, WEN Huan, et al, "Cross-Layer Energy Efficiency Analysis and Optimization in WSN", [C]// Proceedings of the International Conference on Networking,Sensing and Control: April 10-12, 2010. Chicago, USA, 2010: 138-142.

[14] YAN Bin, WU Xia, ZHOU Xiaojia,"An Improved Base Station Cooperative Mobile Strategy for WSN with Finite Powered Cluster Heads", [C]// Proceedings of the 6th International Conference on Wireless Communications Networking and Mobile Computing: September 23-25,2010. Chengdu, China, 2010: 1-4.

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