ENHANCED FAIR ROUTING FOR WIRELESS SENSOR NETWORKS USING CPMP PROTOCOL MODEL

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***Abstract*--- The wireless sensor network present all sensor nodes to generate an equal amount of data packets in a WSN. The nodes around a sink have to relay more packets and tend to die earlier than other nodes because the energy consumption of sensor nodes Hence, the whole network lifetime can be prolonged by balancing the communication load around a sink. This problem is called the energy hole problem and is one of the most important issues for WSNs. The study proposes to address the energy efficiency problem by synchronizing the transmission times of all the nodes in the system. The main contribution consists then of a suite of synchronization protocols, built on top of CPMP(Content Present Multicast Protocol). Specifically, in the project presents a Weight Based Synchronization (WBS) protocol that uses the size of synchronized node clusters as a catalyst for synchronization. While efficient, it shows that WBS's reliance on information contained in CPMP updates makes it vulnerable to simple attacks.**

***Keyword* : Fair routing, WSN, Flexible channel allocation, AODV,Heavy load node, CPMP, WBS.**

I. INTRODUCTION

It is spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to other locations. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

II . RELATED WORKS

Pedro O.S. Vaz de Melo , Felipe D. Cunha , Antonio A.F. Loureiro [1]stated that, when two or more WSNs are deployed in the same place and their sensors cooperate with the other networks, they may improve their operability, by extending its lifetime by trading routing favors or increasing the data entropy by a common data aggregation. Despite being obvious and simple, this idea brings with it many implications that hinder cooperation between the networks. Whereas a WSN has a rational and selfish character, it will only cooperate with another WSN if this provides services that justify the cooperation. The goal of this work is to present the Virtual Cooperation Bond (VCB) protocol, which is a distributed protocol that makes different WSNs to cooperate, enabling cooperation if and only if, and all the different WSNs benefit with the cooperation.

M.J. Shamani, Hossein Gharaee, Sahba Sadri, Fereidoon Rezaei [2] explained in some applications of sensor networks, multi-domain exists and cooperation among domains could lead to longer lifetime. They considered heterogeneous multi-domain sensor networks. It means that different networks belong to different domains and sensors are deployed at the same physical location and their topology is heterogonous. Apparently, domains life time can be increased by means of cooperation in packet forwarding; however selfishness is inevitable from rational perspective. They found out the cooperation of authorities while their sensors are energy aware. When sensors are energy aware, spontaneous cooperation cannot take place. Therefore they presented the Adaptive Energy Aware strategy, a novel algorithm that is based on TIT-FOR-TAT, starts with generosity and ends up with conservative behavior. Their simulation results showed that this algorithm could prolong its network lifetime in competition with other networks.

E. Ilker Oyman and Cem Ersoy [3] stated that the battery resource of the sensor nodes should be managed efficiently, in order to prolong network lifetime in wireless sensor networks. Moreover, in large-scale networks with a large number of sensor nodes, multiple sink nodes should be deployed, not only to increase the manageability of the network, but also to reduce the energy dissipation at each node. They focused on the multiple sink location problems in large-scale wireless sensor networks. Different problems depending on the design criteria are presented. They consider locating sink nodes to the sensor environment, where they are given a time constraint that states the minimum required operational time for the sensor network. Wireless sensor nodes are combining the wireless communication infrastructure with the sensing technology. Instead of transmitting the perceived data to the control center through wired links, ad hoc communication methods are utilized and the data packets are transmitted using multi-hop connections. The efficiency of the sensor network investment is directly related with the length of the reliable monitoring duration of the field.

Gaurav Gupta and Mohamed Younis[4] investigated the performance of an algorithm to network these sensors in to well define clusters with less energy-constrained gateway nodes acting as cluster heads and balance load among these gateways. Load balanced clustering increases the system stability and improves the communication between different nodes in the system. To evaluate the efficiency of their approach and performance of sensor networks applying various different routing protocols. Sensors are generally equipped with data processing and communication capabilities. The sensing circuit measures parameters from the environment surrounding the sensor and transforms them into an electric signal. Processing such a signal reveals some properties about objects located and/or events happening in the vicinity of the sensors.

Junko Nagata, Kazuhiko Kinoshita, Koso Murakami[5] proposed a routing method for cooperative forwarding in such multiple WSNs that will extend their lifetime. For multiple WSNs, each sink location will differ from the others, and some nodes around a sink in one WSN may be far from a sink in another WSN. It focused on the issue in the proposed method, with a node that is far from a sink in its own network and near to a sink in another network being able to forward packets from a node in another WSN to the corresponding sink. In this case, the energy of such nodes will exhaust earlier than that of other nodes, causing an "energy hole" to appear around the sink. No more data can be delivered to the sink after the hole appears. The proposed method decides how much other WSNs with different sink locations can help such "heavy-load" situations.

III. FAIR ROUTING MODEL

In this paper, implemented fair routing from select WSN node structure. WSNs operate different applications independently, hence, heterogeneous characteristics, such as battery capacity, operation start time, the number of nodes, nodes locations, energy consumption, packet size and/or data transmission timing. However, most existing cooperation methods do not consider this heterogeneity. For instance, when batteries capacities on sensor nodes are quite different by a WSN, a cooperative routing method based on residual energy is not appropriate since a WSN which has the maximum battery capacity always forwards packets from other WSNs. The existing system results certain WSNs prolong their lifetime, the other WSNs may shorten their lifetime. In such a situation, fairness of cooperation is a highly important problem for energy allocation in WSN. In addition, for proper scheduling between PUs and SUs, techniques for synchronizing WSN nodes are presented that periodically identifies the suitable SUs for the given PUs and so the sub channel assignment is better than existing system. Best SU Detection algorithm is proposed to avoid the inflation attack which is made by sending false maximum weight among the SUs.

The new system eliminates the problem by calculating the transmission schedule using the weight information based on the proposed algorithm steps. In addition, synchronizing all the neighbor nodes which belong to various clusters is must to attain the stable state of the network. The proposed approach presents the techniques for synchronizing nodes that periodically content and presence updates to collocated nodes over an WSN network. Instead of aligning duty cycles, the new algorithms synchronize the periodic transmissions of nodes. This allows nodes to save battery power by switching off their network cards without missing updates from their neighbors.

IV. TECHNIQUES

In a sensing field, m different WSNs are constructed, and different applications are operating on each WSN independently. It shows an example where two WSNs are constructed. If heavy loaded nodes are in different places among the WSNs as indicated in the example, it is possible that data packets via heavy loaded nodes are forwarded by other nodes in another WSN. However, each network adopts different channel, hence sensor nodes are unable to communicate with a node belonging to another WSN. To overcome this limitation, q shared nodes, which are high-end nodes with multi-channel communication unit, are deployed in the area. Shared nodes and sinks are able to communicate with any nodes belonging to all WSNs.

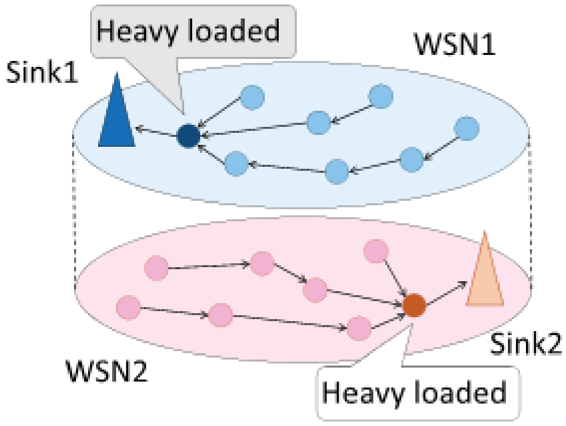

Fig: 1 Two WSNs deployed at the same area

System Model

In this section, formulate the overlapped WSNs model for fair cooperation routing. In a sensing field, m different WSNs $N_1,\ldots,N_m$ are constructed, and each network N_i , $1 \leq i \leq m$, has a set of unique sensor nodes $N_i = \{n_{i1}, n_{i2},\ldots, n_{i|N_i|}\}$ and the sink BS_i. q shared nodes $s_1,\ldots, s_q$ also exists in the area. All WSNs are able to use these shared nodes as relay node for packet forwarding. For guaranteeing the lifetime improvement by the cooperation, we define network lifetime L_i, the estimated lifetime of Ni.

$$Li = \min_{n_{ij} \in N_i} L_{ij} \ (1 \leq j \leq |N_i|).$$

Route Discovery

Each sensor node creates its routing table based on a routing protocol. In this project, used ad hoc on-demand distance vector (AODV) as a routing protocol, because AODV was developed for wireless ad hoc networks and was adopted for some WSN protocols such as Zigbee and ANT. In route discovery, each sensor node discovers its routes not only to the sink in its WSN but also to all the other sinks in the different WSNs for opportunities to forward data packets from nodes in different WSNs to their sink. Therefore, the routing table of each sensor node has m routes corresponding to each sink in all WSN.

A shared node discovers its route with a slightly different mechanism. A shared node creates m routes via m different WSNs to a sink. There are m sinks, in total, corresponding to m WSNs. Therefore, a shared node has m × m routes. In AODV route discovery, each node chooses a route that has the minimum number of hops to the sink. However, the proposed method uses not the number of hops but a cost calculated by simple accumulation, so that more routes are established via shared nodes. This is because different WSNs can be used only via shared nodes as alternative routes. Specifically, we set 1 as the cost of going through a sensor node and we set $x(0 < x < 1)$ as the cost of going through a shared node. When each node discovers a route, it chooses a route that has the minimum cost calculated as the sum of traversing nodes. Another advantage of the proposed route discovery is that using shared nodes, which have sufficiently large batteries or power supply, is expected to reduce power consumption of other sensor nodes.

Obtaining Lifetime Information

For cooperation considering the fairness among multiple WSNs, shared node s_k maintains estimated lifetime information, network lifetime L_i, minimum lifetime L^0_i and route lifetime $L_{R^i_{kl}}$. We explain how to obtain this information as follows. At the time of transmitting a data packet, sensor node n_{ij} adds the values of its network lifetime L_i and route lifetime $L_{R^i_{kl}}$ to the MAC frame header of the packet. If the node does not have any information on network lifetime or route lifetime yet, for instance at the time immediately after creating or updating the route, its own node lifetime L_{ij} is added alternatively. Each node updates this information by overhearing data packets from other nodes. Specifically, when node n_{ij} overhears a data packet, it compares the value of the network lifetime in the data packet and Li in its own information, and updates its own L_i to the smaller value between them. In addition, if the packet is from a node which is contained in R^i_{ji}, the route from n_{ij} to BS_i, it checks the value of route lifetime in the packet header, and updates its route lifetime by the smaller value as in the case of updating L_i After that, the overhearing node discards the packet immediately if the destination of the packet is not itself.

V. EXPERIMENTAL RESULTS

The performance of the proposed fair cooperative routing method with shared nodes is evaluated using the sample datasets. It is observed that the receiving rate, which is the rate of sensor nodes that send data packets to their sinks successfully. Therefore, in the performance analysis process, it counted a node that cannot communicate with its sink as a dead node, in spite of its remaining battery.

The Table 7.1 shows the results and performance of the existing cooperative routing and proposed flexible channel allocation approaches. The efficiency of the proposed method is compared with the existing cooperative routing method with the number of nodes communicated for sending and receiving the packets. The table data describes the number of sensor nodes and number of nodes involved in the routing process of existing and proposed methods.

WSN Nodes List (N)	Existing Approach (Cooperative Routing)	Proposed Approach (Flexible Channel Allocation)
100	30	25
150	45	58
200	80	71
250	96	84
300	112	102
350	146	129
400	250	212
450	299	273
500	415	401

Table 5.1 Comparison of Cooperative Routing & Flexible Channel Allocation

The Figure 5.1 shows the results and performance of the existing cooperative routing and proposed flexible channel allocation approaches. The figure describes the number of sensor nodes and the nodes involved in the routing and data transmission process of existing and proposed methods.

The sensor network nodes sent 256 bytes data packets asynchronously at intervals of 10 minutes. It is assumed that sinks and shared nodes had a adequate energy of battery. Table 5.2 show the receiving rate as a function of elapsed time for each WSN. The analysis is made based on the energy capacity of the nodes.

The sensor nodes have different battery capacities, the lifetime of them without cooperation are also different. Even if the total amount of extended lifetime is equal, the life improving ratio may take larger value with smaller battery capacity. Figures 5.2 show the receiving rate as a function of elapsed time for each WSN.

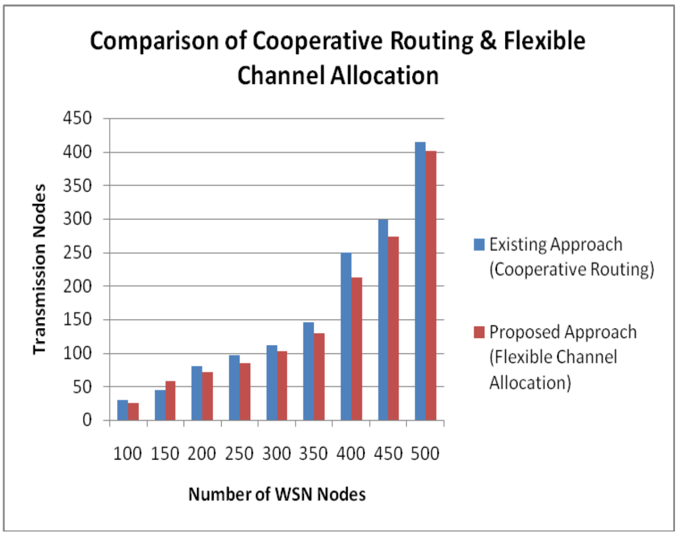

Fig 5.1 Comparison of Cooperative Routing & Flexible Channel Allocation

WSN Nodes List (N)	Time (Minutes)	Packet Receiving Rate in Bytes	
		Cooperative Routing	Flexible Channel Allocation
100	10	100	150
150	20	150	220
200	30	200	305
250	40	250	356
300	50	320	380
350	60	350	415
400	70	365	478
450	80	410	512
500	90	545	629

Table 5.2 Packet Receiving Rate of Cooperative Routing & Flexible Channel Allocation

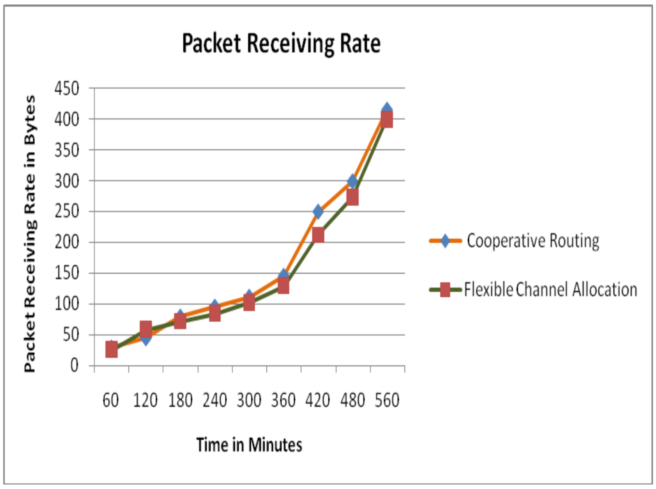

Fig 5.2 Packet Receiving Rate - Cooperative Routing & Flexible Channel Allocation

VI. CONCLUSION

To avoid unfair improvement only on certain networks, in this project heterogeneity of networks and a fair cooperative routing method is proposed and analyzed. In this project, one or a few shared nodes that can use multiple channels to relay data packets. The sinks and shared nodes can communicate with any WSNs node, different WSNs can use cooperative routing with each other since shared nodes allow sensor nodes to forward data from another WSN as the function of interchange points among respective WSN planes. When receiving a packet, a shared node selects the route to send the packet, according to proposed route selection methods. This cooperation prolongs the lifetime of each network equally as possible. In particular, Pool-based cooperation achieved quite small variance of lifetime improvement, that is, it provided quite fair cooperation. As a future work, implement the proposed method on an experimental system and evaluate its feasibility. And also to address the energy efficiency problem by synchronizing the transmission times of all the nodes in the system is explored in the future works.

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