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A Fair Routing Method for Cooperative Forwarding in Heterogeneous Wireless Sensor Networks

[1]Mrs.C.NavamaniMCA.,M.Phil.,M.E.,AssistantProfessor,
[2]Mr.C.Bharath Final MCA,
Department of MCA, Nandha Engineering College(Autonomous),Erode-52.
E-Mail ID: navamanimca@gmail.com, 3bharath04c@gmail.com

***Abstract*—Wireless sensor network is a network composed of a large number of sensor nodes with limited radio capabilities and one or a few sinks that collect data from sensor nodes. Sensor nodes are powered by small batteries, hence, the energy consumption in operating a WSN should be as low as possible. Hence, the whole network lifetime can be prolonged by balancing the communication load at heavily loaded nodes around a sink. This problem is called the energy hole problem and is one of the most important issues for WSNs.It proposes to address the energy efficiency problem by synchronizing the transmission times of all the nodes in the system. Transmission synchronization presents energy saving opportunities through dynamic power management of the WSN network interface. That is, nodes can switch off their wireless interfaces between transmissions.**

***Index Terms*-synchronization algorithm, transmission, wireless sensor network**

I. INTRODUCTION

In System Methodology the thesis propose a Content and Presence Multicast Protocol (CPMP) which nodes use to send updates to their neighbors. The updates contain the relative time of their sender's next transmission. It proposes to address the energy efficiency problem by synchronizing the transmission times of all the nodes in the system. Transmission synchronization presents energy saving opportunities through dynamic power management of the network interface. That is, nodes can switch off their wireless interfaces between transmissions.

In uncontrolled ad hoc environments, a single malicious user can easily disrupt network stability and synchronization, affecting either the nodes' power savings or their ability to receive updates from their neighbors. Designing synchronization algorithms that are resilient to synchronization behavior of nodes is instrumental to the correct functionality of a network. The main contribution consists then of a suite of synchronization protocols, built on top of CPMP. To address this problem, the thesis proposes the Hope Max out Detection Algorithm (HMODA) algorithm. Nodes runningHMODA use CPMP updates to synchronization with their largest set of already synced neighbors, counting the number of packets received within a given interval and setting the node's next transmission to be in synchronization with the slot where most packets have been received. While lightweight and efficient, HMODA greedy strategy clusters the network: nodes reach a stable state without being synchronized with all their neighbors.

The Content and Presence Multicast Protocol (CPMP) is use to send packet in to source to designation. The protocol is mainly used synchronized node details sent or denote to both neighbors node and current communication node. It is finding and reduces to power consumption in switching between the active and sleep mode of the nodes. The CPMP protocol process transmission data into node to neighbored are easily communicate and finding number synchronization.

The synchronization transmission calculates the next transmission schedule for synchronization with neighbor node and to schedule the transmission time to the available neighbor nodes. The proposed systems find and detect the malicious weight information provided by the nodes during the packet transmission. Easily track the suspicious node in inflation attack scenario.

II. RELATED WORKS

Pedro O.S et aldiscussed about an important issue in the design of a wireless sensor network (WSN) is to devise techniques to make efficient use of its energy, and thus, extend its lifetime. When two or moreWSNs 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 increasingthe 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 WSNhas 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. In the simulation results, they consider WSNs with different configurations and they showed that the proposed protocol enables cooperation solely when the cooperation is beneficial to both networks, and in this case, it saves their energies and extends their lifetimes.

Recently, Wireless Sensor Networks (WSNs) have received much attention as a means for collecting and utilizing data from real world. The number of WSN applications has been increasing widely and the application range is expected to spread. A WSN is a network composed of a large number of sensor nodes with limited radio capabilities and one or a few sinks that collect data from sensor nodes. Generally, sensor nodes are powered by small batteries; hence, the energy consumption in operating a WSN should be as low as possible. Some methods for prolonging network lifetime are required in WSNs.

E. IlkerOyman and CemErsoydescribes 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 Youngishinvestigate 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 etal*stated that multiple WSNs can be constructed within the same geographic area. It 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.

Wireless Sensor Networks (WSNs) are composed of tiny battery-powered sensor nodes that have limited storage and radio capabilities. Therefore, for WSNs to remain operational for a long time, much attention has to be paid to energy consumption in the nodes. In a typical WSN, sensor nodes acquire and send data to a processing center called the sink. Because all data are forwarded to a sink, nodes around the sink tend to transmit many more packets than the others.

FereidoonRezaeietalexplainedsome 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.

The most important advantage of authorities with these situations is to give each other free riding and ask others for free riding in order to prolong their network lifetime. This behavior is due to the fact that transmitting a packet is the most energy depleting task in WSNs. If the sensors are able to send their data through multi-hops that are close to them, they will survive more. This is a critical question and the response to this question is available through game theory because it is the tool to analyze strategies between rational decision makers.

III. SYSTEM METHODOLOGY

A.Proposed methodology

In the proposed system, all the existing system approach is implemented. 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 system present 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.

B. 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 , $1 \le i \le m$, has a set of unique sensor nodes $N_i = \{n_{i1}, n_{i2}, . . ., n_i| N_i |\}$ and the sink BS_i. q shared nodes $s_1,. . ., s_q$ 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.

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

C. 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.

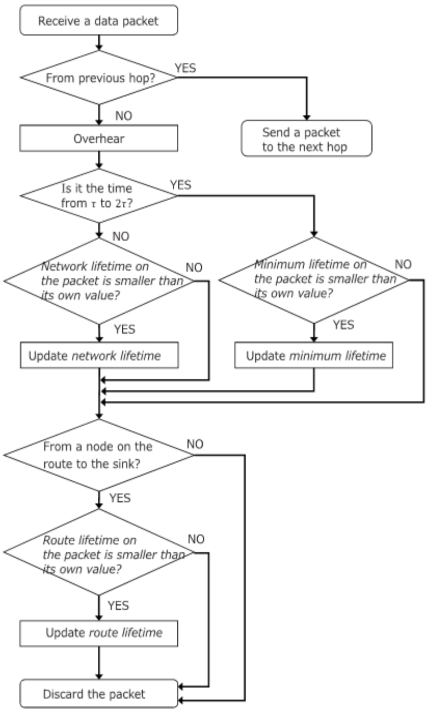
A shared node discovers its route with a slightly different mechanism. A shared node creates m routes via m different WSNs to a sink. There are m sinks, in total, corresponding to m WSNs. Therefore, a shared node has m × m routes. In AODV route discovery, each node chooses a route that has the minimum 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.

D.*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}toBS_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.

E. *Process Flow of Obtaining Lifetime Information*



F.Resource Allocation

In this module, the flexible channel cooperation that opens up all dimensions of resource allocation for the primary and secondary users. The module further divided into following modules such as,

G.Distributed Bargaining

In this module, the primary users and secondary users are added in to list box controls. The primary users after initializing the power and band width requirement, they select the secondary users which are capable to provide the requirements. The secondary users maintain the list of primary users for which the channels are allotted.

Distributed Bargaining

1. The primary BS runs a multiuser scheduling algorithm to determine $R_i^{\min}$ for PUs without cooperation.
2. Each user initializes its power price $\lambda_n^{(0)}$. Each PU initializes the dual variable $\mu_i^{(0)}$.
3. Given $\boldsymbol{\lambda}^{(l)}$, each PU i solves the per-subchannel resource allocation problem (29) using *Subroutine* 2.
4. Each user n bargains by performing a subgradient update for the price λ_n as in (19). Each PU i also updates μ_i as in (20).
5. Return to step 3 until convergence.
6. Every user updates $\bar{R}_n$ from its total throughput R_n in this epoch. Every PU i updates $\bar{R}_i^{\min}$ from $R_i^{\min}$ in Step 1. They will be used for resource allocation in next epoch.

Using this information, the sub channels can be assigned such that each Secondary user assigns the primary users in the order of least bandwidth. The time is equally divided into two slots among cooperating users1. PUs transmit in the first slot to SUs, and SUs transmit in the second to the primary base station (BS) and to their own access point (AP). A SU strategically optimizes its use of the leased resources.

H.Rounding Based Sub Channel Assignment

For each set of users belongs to a different type (time slot and primary/secondary). The profit of allocating an item (subchannel) depends not only on the knapsacks but also the type of them.The one-type of multiple user problem is known to be NP-hard and even hard to approximate and this could be resolved in this module using rounding based sub channel assignment. It ensures that each subchannel is assigned to at most one user for both slots.

I.Synchronization

In this module, an effort to address the energy efficiency problem by synchronizing the transmission times of all the nodes in the system is proposed. Transmission synchronization presents energy saving opportunities through dynamic power management of the network interface. That is, nodes can switch off their wireless interfaces between transmissions.

J.Weight Based Synchronization

In this module, each node to locally maintain a variable monitoring the size of the cluster of synchronization which contains the node. The variable is called the weight of the node/cluster. Initially, the weight of each node is 1. Each node includes its weight in all its CPMP updates. Certainly, nodes cannot maintain globally accurate weights. Instead, each node needs to use only local knowledge extracted from packets received from neighbors to update the value of this variable.At the end of each active interval, a node uses the slotArray structure to decide its next transmission time. The slotArray structure has s entries, one for each slot of the next (sleep) interval. The node has to choose one of these slots, called winner slot, and synchronize with it. That is, the node has to advertise the time of its next transmission (T_X value) such that the update packet will be placed into that winner slot by its neighbors.

K..Future Peak Detection

FPD works by counting the number of packets that are stored in each slot of the current active interval. Note that each packet received during the current active interval is stored in the slot corresponding to the packet sender's next transmission time. FPD then makes a greedy choice for the winner slot, by choosing the slot x whose slotArray [x] = $\max^{*}_{i=1}$ | slotArray[i]|. SlotArray[x] denotes the number of packets stored in the x^{th} entry of slotArray. This choice ensures that the node's next transmission is in sync with most of its neighbors. In case of ties, N chooses the earliest slot to sync.In this module the algorithm executed at the end of each active interval, the setT_X method first determines the maximum number of packets stored in any slot of the interval and marks that slot as the winner slot. If the winner slot is different from the node's current transmission slot, the node synchronizes with the winner slot, by setting the node's TX value to the winnerSlot value and correspondingly updating the time of the node's next transmission. FPD makes a greedy choice for the winner slot, ensuring that a node's next transmission is in sync with most of its neighbors.

L.Randomized Future Peak Detection

FPD is unable to completely synchronize, the situation changes when imperfect channel conditions are considered. Specifically, for a network of 100 nodes with 15 percent packet loss rates, FPD synchronizes the entire network in 21,000 s. While in a network with perfect channel conditions clusters created by FPD are stable, packet loss can make nodes move from one cluster of synchronization to another, thus breaking the stability. If enough nodes switch, clusters may engulf other clusters in their vicinity, eventually creating a single cluster of synchronization.

However, relying only on packet loss is insufficient. One of our requirements is that a network synchronizes in a timely manner. To achieve this, we extend FPD with randomization: nodes choose to synchronize with their neighbors in a weighted probabilistic fashion.Let total =$\sum_{i=0}$slotArray[i] be the total number of packets received by a node during an active interval. Then, the node synchronizes with any slot x 2 1::s with probability P_x = slotArray[x] / total. For example, node N will choose the seventh slot (chosen by five of its neighbors) for its transmission with probability 5/12 and the fourth slot (chosen by three of its neighbors) with probability 3/12.

IV. 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.

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