STAR Research Journal

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ELECTRICAL ENGINEERING

UGC Journal No: 63023

MAXIMIZING THE LIFETIME OF NETWORK SECURITY BY DSDV PROTOCOL USING GAME THEORY TECHNIQUES IN WIRELESS SENSOR NETWORK

[1.] M. MALINI, [2.] Dr. U.DURAI.

[1.] Research Scholar, Dept. Of Computer Science, Marudupandiyar College of Arts and Science, Thanjavur.

[2.] Research Advisor, Dept. Of Computer Science, Marudupandiyar College of Arts and Science, Thanjavur.
(Affiliated to Bharathidasan University, Tiruchirappalli)

ABSTRACT

Wireless sensor networks (WSNs) have gained popularity as a study topic in recent years. A WSN is made up of several sensor nodes, each having a set amount of energy, bandwidth, storage, and computation. When creating a large and dense sensor network, one of the fundamental concepts that offers a realistic solution to provide scalability is clustering. One strategy to improve the WSN's resilience is to limit communication between the base station and only a select few sensor nodes, known as the cluster heads, in a cluster of sensor nodes. In this work, a game-theoretic method for choosing a cluster head for each cluster in a WSN is provided. In this study, we use game theoretical modeling of cluster-head selection for wireless sensor networks in order to ensure longitivity of network lifetime and network security. An interactive decision-making process occurs when a group of self-interested nodes schedule nodes to assume the role of cluster leader. In this study, we look into data transfer cooperation between cluster heads. It is preferable for a mobile node to join a group when it moves to a new site. Thus, by combining the game theory method with the DSDV protocol and the suggested algorithm, we were able to increase network lifetime, reduce energy consumption, and shorten end-to-end delays. Additionally, we provide a coalitional game theory-based approach for nodes to select the ideal group within their signal range.

Key words: clustering, Cooperative Game Theory, DSDV protocol, Wireless sensor network.

I. INTRODUCTION

A brand-new technology called wireless sensor networks is employed in the vast majority of applications. This network is made up of a huge number of sense nodes and is represented as a graph. These nodes have the capacity to gather the data, process it, and transmit it to the proper locations. The sensors offer various distinctive qualities, including tiny size and low power usage. These qualities make them suitable for usage in a variety of industries and disciplines, including biomedical, agricultural, industrial, and military ones. They might also be employed in a variety of settings, including remote or dangerous areas. We may utilise these sensors at a lesser cost than we could with traditional networks since they don't require a lot of wiring or sophisticated design or installation. A method for examining how decision-makers with divergent goals interact is game theory. It has long been a method used by economists to analyse the activities of economic agents, such as businesses in a market. It has been used by computer scientists in recent years to address issues like flow control and routing, but we think it can be successfully applied to a far larger class of communications system issues. In some ways, game theory is more effective at addressing communication issues. Typically, sensor nodes with sensing, computation, and communication equipment make up a wireless sensor network (WSN). The primary objective of the WSN is to collect environmental data and transfer it to a sink node. The design and maintenance of WSNs are made more difficult by the relatively tiny physical size of sensor nodes. Since data transmission is costly, controlling communication between nodes is crucial. Cooperation between sensor nodes may be able to lower the overall amount of power used for data transmission throughout the whole WSN. In a WSN, grouping is a technique for organising node cooperation. A leader of a group of nodes collects information from the group's members and interacts with the outside world. In theory, nodes that are near to one another might communicate with less energy. Members of a group can reduce their transmission power to a minimum while still connecting with the leader by working together. The network architecture can alter if nodes do not have fixed placements, though. Nodes should determine the network's most effective communication method. As a result, the network's group structure could need to change. A new node may seek to join a group in a self-organizing network, and the group must determine whether to accept the node. This study suggests a technique for selecting nodes for groups. We assume that a node may transmit directly to the group leader utilising maximum transmission power, and that a group leader establishes and governs its group in a way that is advantageous to the group's members. In our technique, group extensions are chosen using coalitional game theory. This research suggests a DSDV protocol that contributes to the longevity of network life and throughput growth. The structure of the essay is as follows. The associated work is reviewed in Section 2. In section 3, the proposed framework and coalitional game theory were covered. The suggested algorithm and protocol are covered in Section 4. The paper's simulation results are detailed in section 5. The final portion contains the work's conclusion and its future directions.

RELATED WORKS

The majority of studies on energy balancing models for wireless sensor networks in the literature focus on planned networks. Since these networks either do not necessarily require energy balancing or do not offer many opportunities for energy balancing, researchers have not concentrated on energy balancing in these networks. However, due to unpredictable topology in randomly distributed networks, energy balancing is one of the most important needs. A spreading strategy has been put out by Powell et al. to balance the energy among the sensors in the same slice. The entire sensing region was broken up into multiple pieces by the authors. Applying the probabilistic data propagation algorithm with the best parameters allowed for the task of monitoring and propagating data allowed for the simulation-based validation of the method. Azad and Kamruzzaman in presented the Energy-Balanced Transmission Policy (EBTP) based on managed transmission power. According to authors, an imbalance in energy consumption leads to the early death of some sensors, which in turn causes issues with network coverage and connection. Concentric circles have been drawn around the sink to complete the analysis, and the load is balanced by cutting down on the transmission range of various sensors close to the sink. An method for energy balancing in the sensor network using routing has been proposed by Efthymiou et al. In, Sardouk et al.

suggested a method to enhance the network's lifespan based on collaboration between several sensors. For energy-efficient data processing, this plan takes into account communication based on information relevance. In order to balance the energy in the network, Bouabdallah et al. proposed a protocol that identifies different pathways for traffic produced by sensors. Analytical evidence shows that selecting several channels for sensors to transfer data saves energy and extends the lifespan of a network. Chang and Tassiulas describe a scalable and distributed method for data routing. This method of routing is based on the next hop selection process in linear programming. A plan put out by Chiasserini and Garetto schedules redundant sensors to enter sleep mode in order to conserve battery life and extend network lifespan. A method for estimating energy has been proposed in, where the authors said that their method enables mobile agents to forecast how much power all of the sensors in their clusters would have left over. They have also provided a routing strategy that makes use of mobile agents to balance the energy across sensors. The authors have created a clustering method in which a sensor is chosen as the cluster head based on the amount of energy left, the degree of the nodes, the density, etc. This technique gives each sensor the chance to take on the role of cluster head in order to balance the energy usage among all the sensors. It has been recommended in to use a heuristic-based routing strategy to manage the transmission power of all sensors. The load-balanced clustering algorithm has been suggested by the authors. In order to build clusters, this method takes into account variables like the radius of the cluster based on distance and distribution, node degree, and remaining energy of the sensors. Gradient routing is used in the Energy Balancing and Unequal Clustering Algorithm (EBCAG), which has been described. EBCAG assesses each network sensor by awarding them a grade. The bare minimum of hop counts needed to get to the sink is an A grade. Uneven clusters were made after grades were given in order to produce reasonably even energy depletion across all of the sensors. Each member of the cluster has utilised a descending gradient-based forwarding method to send data to the sink. There are also offered effective cluster head selection and cluster formation algorithms. Our motivation for writing this work stems from scholars' laziness in failing to effectively address the issue of energy imbalance. After assuming the dispersion of sensors, a few researchers focused on this issue. Due to the unequal load, this assumption comes with a number of restrictions. Others approached the issue by considering routing as one of several potential options for energy balance. Therefore, in this study, we have tried to use adaptive sensing and transmission to address the issue of energy imbalance without sacrificing coverage and connection. This strategy increases network longevity and appropriately balances energy usage among various sensors.

PROPOSED FRAME WORK

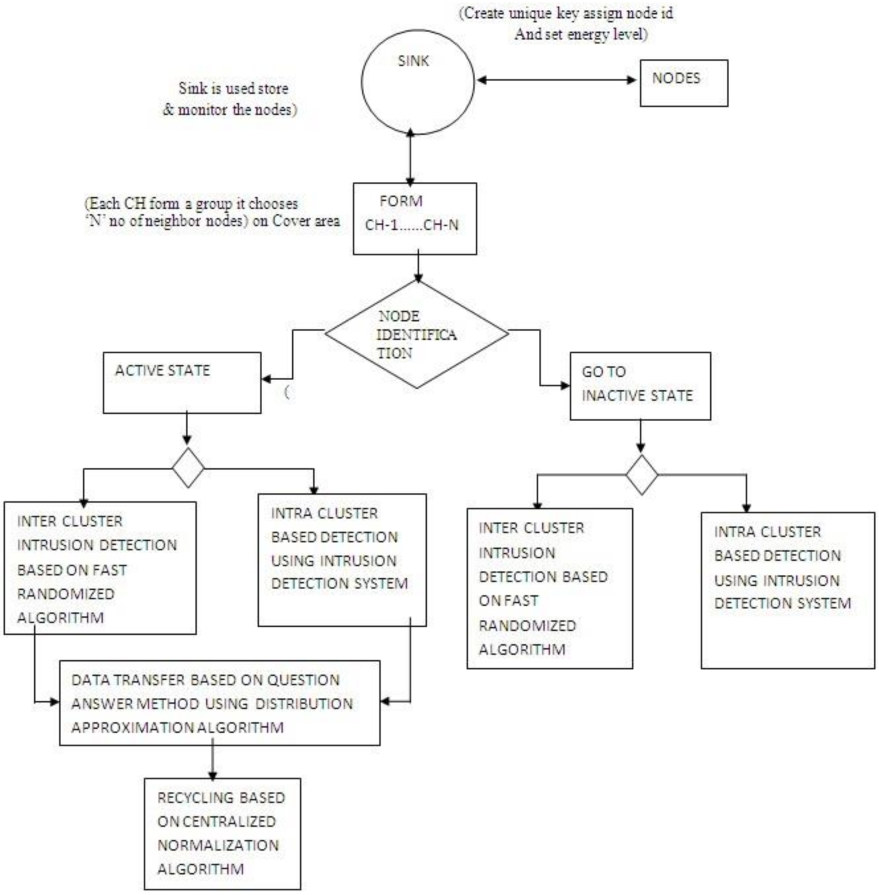
We suggested a coalitional (cooperative) game theory between cluster chiefs in this study. The sensor network will initially have nodes. where one of the nodes serves as the base station or sink node. The base station or sink node will keep track of the whole sensor network. All of the sub nodes are given a Node ID and a starting energy level by the sink node. Node chosen by the sink node to serve as cluster head. The cluster head will then establish connections with the subnodes based on coverage area. The second cluster head is picked once the first has been selected and the sub nodes have been created. This procedure was repeated until five cluster heads were developed. Packets from sub nodes are sent to the appropriate heads. The following algorithms are used in the framework that is being suggested.

Coalitional game theory: The behaviour of decentralised and self-organizing networks may be examined using game theory. In order to simulate how players interact in a setting like a communication network, game theory often models the nodes as players and the self-interested players' strategy choices. A game includes

- a set of players N = {1, 2, ...,n};
- an indexed set of possible actions A = A_1x …..x A_n where A_i is the set of actions of player I (for $0 < i \leq n$)
- a set of utility functions, one for each player. The utility function u assigns a numerical value to the elements of the action set A; for actions x; y □A if $u(x) \geq u(y)$ then x must be at least as preferred as y.

Non-cooperative and cooperative game theory are two categories of game theory. Non-cooperative game when each player picks their own strategy and each player's objective is to increase their utility or decrease their cost, the ory investigates the interaction between competing players.

Coalitions—collectives of players—are created in cooperative games. Players want to form a coalition to improve their standing in the game and agree to behave simply. Designing equitable, reliable, and effective collaboration tactics in communication networks has proven to be helpful when using coalitional games. A characteristic function v: 2N R that is applicable to player coalitions determines the coalition in a coalitional game (N, v) with N players. No player will have an incentive to abandon N and establish another coalition because of the coalitional game's core (N, v).



PROPOSED PROTOCOL: DSDV PROTOCOL

A gateway will regularly broadcast a gateway advertisement message using the proactive gateway discovery algorithm (DSDV), which is then relayed once the gateway's timeout has run out.

This protocol was created for MANETS and is based on the traditional Bellman-Ford routing algorithm. Every node keeps track of every destination and the amount of hops needed to get there. The sequence number is written next to each entry. To lessen the network bandwidth caused by rout updates, it employs a complete dump or an incremental update. The settling time affects how soon route updates are disseminated. The elimination of routing loops in a mobile network of routers is the sole enhancement accomplished here. This enhancement makes it possible for routing information to always be available, whether or not the source node needs it. By linking each route entry with a sequence number indicating its freshness, DSDV overcome the issue of routing loops and count to infinity. A sequence number in DSDV is associated with a destination node and is often generated by that node (the owner).

Proposed Algorithm

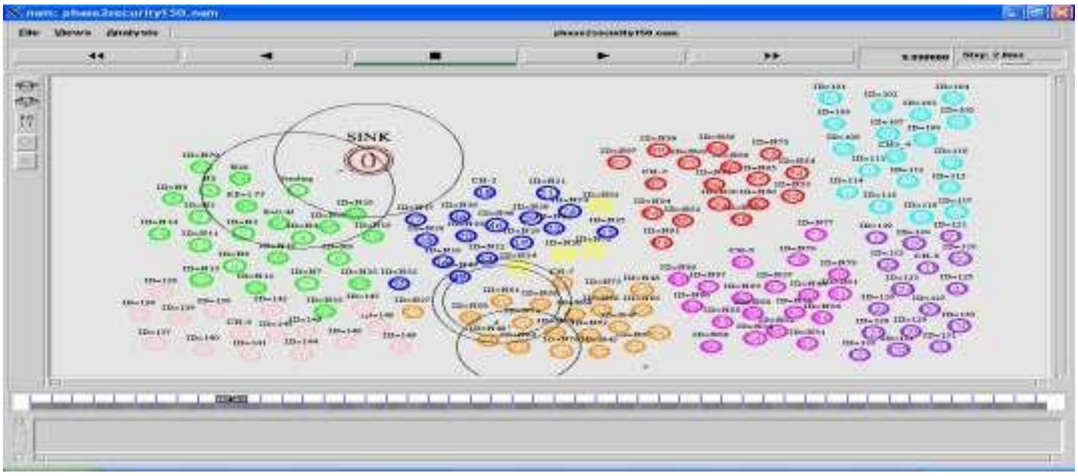
Centralized normalized algorithm Use a centrally located, normalised method to check the energy flow from the cluster head to the sink. Choose a new cluster head depending on energy level after sink recycling.

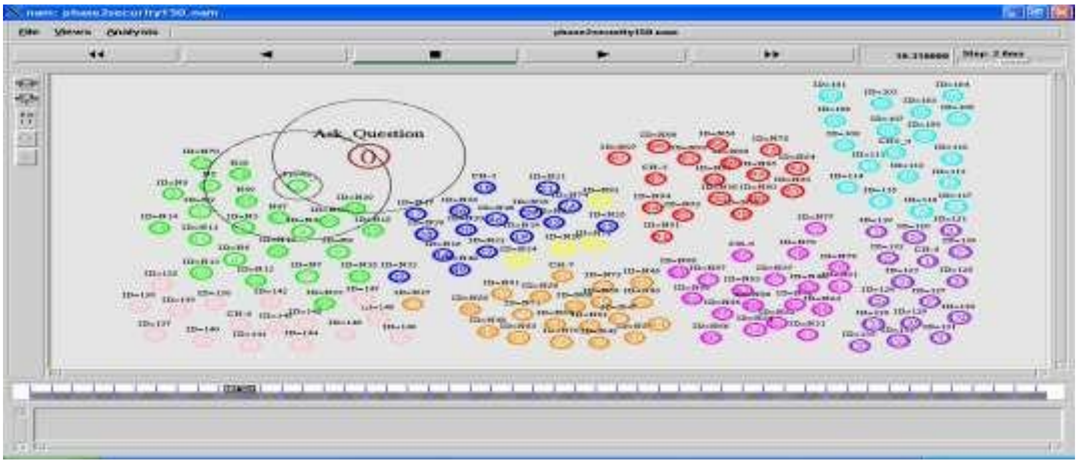
Distribution normalized algorithm: While sending packets, a distributed normalisation algorithm will find IDS nodes on different networks. Additionally, when base stations provide requests and answers to all cluster heads following each iteration of the cycle process, the primary security of the network lifespan is maximised. This may be base station monitoring-based cluster head security maintenance. Additionally, any mobile sensor nodes that are migrating into another cluster will swap over, allowing this cluster to provide authority to other cluster heads. As a result, we can quickly determine if a mobile sensor node has been registered or not.

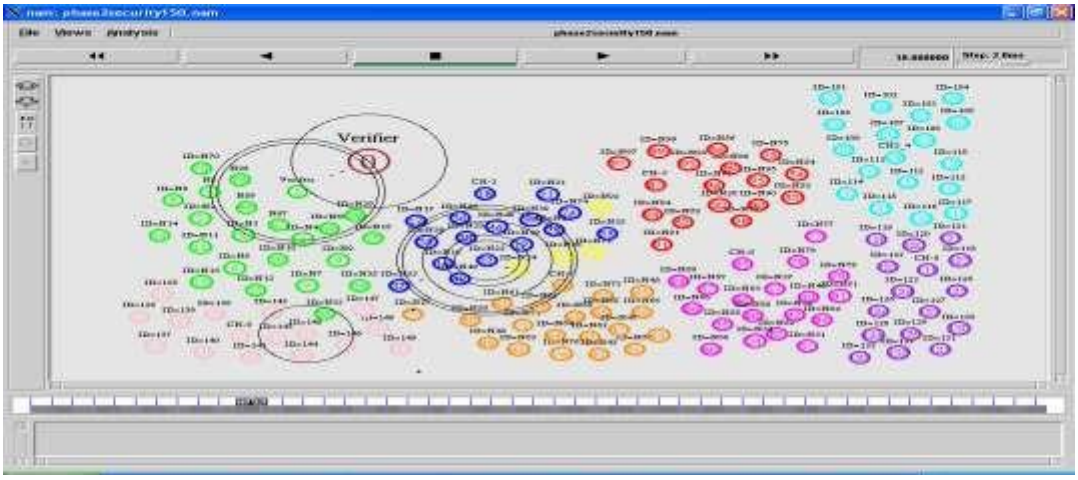
False Randomized Algorithm: During the recycling process, this method is utilised to create a secret key for each and every sensor node. Every cluster head will get a query and a response from the base station in order to extend network lifespan and increase security. Each inquiry and response will vary for each cluster head during the recycling process. Data will be sent from sub nodes to cluster heads using a centralised normalised method, and from cluster heads to sub nodes using a distribution normalised algorithm. To identify misbehaving nodes, all cluster heads will double-check their inquiries and responses. Following this, cluster heads will send the data to the sink, extending the network's lifetime.

Using the TTL (Time to Leave) option on a timer, we may I reduce end-to-end delays while also improving energy usage. (ii) The throughput rises. Increased packet delivery ratio; (iii) network life is prolonged; (iv) packet delivery ratio.

SIMULATION MODEL





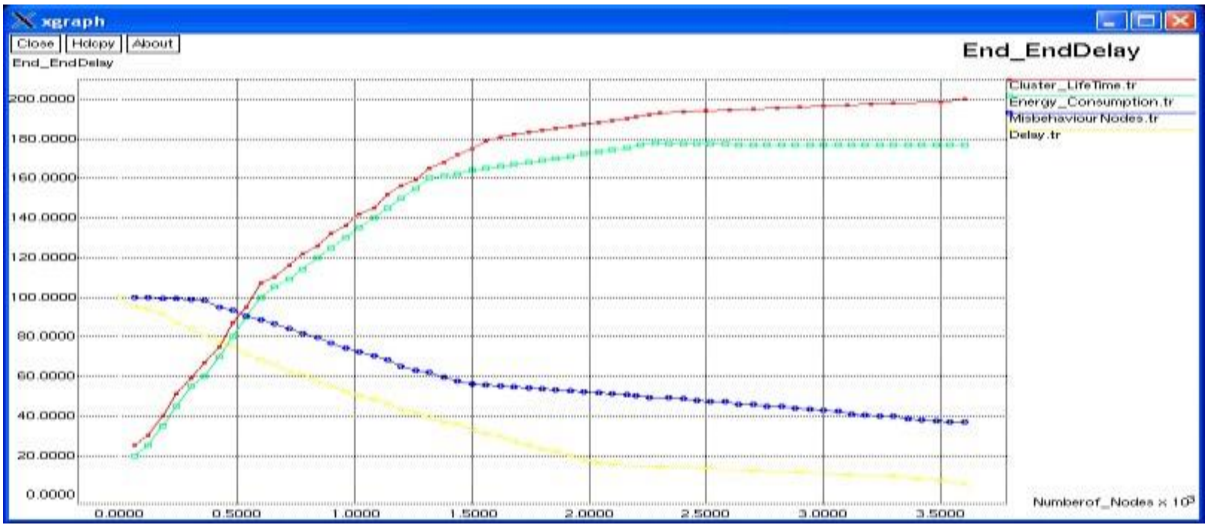


Simulation setup

Network Size	1900x1100
Number of Nodes	150
Number of Clusters	8
Throughput	25 Mbps
Bandwidth	5 Mbps
Frequency	10 Hz
Average Speed of nodes	4.2 m/s
Data Transmission	1200 Bytes
Packet Rate	100 Packets per second (pps)
Request message interval	5 –1 5 Seconds
Mobility Factor	500 seconds
Request message jitter	200 ms
Mobility Detection Interval	100 seconds
Initial Energy Assigned	100 Joules
Energy Consumption	10 Joules
Protocol	DSDV Protocol
Simulation Time	8000 seconds

(1) End – End delay

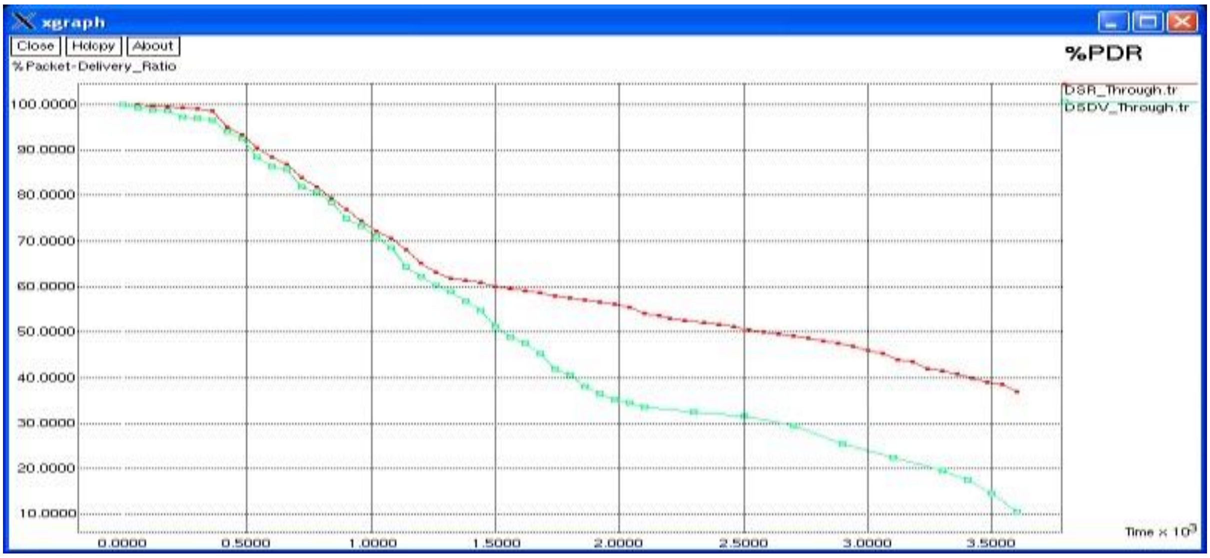
In x- axis number of nodes and in y- axis delay



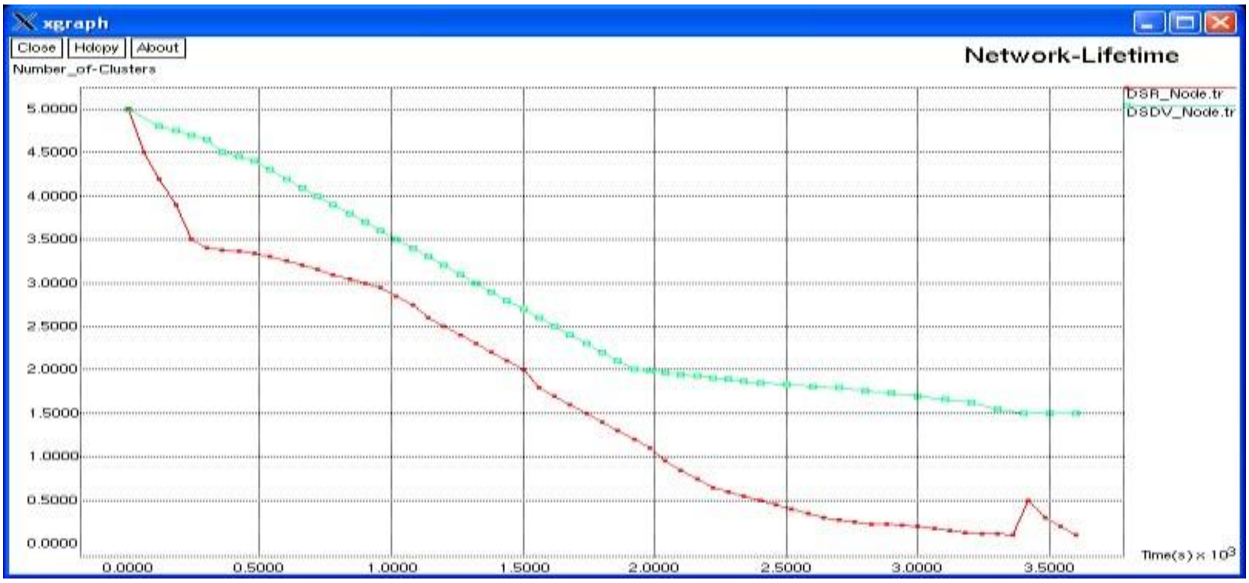
When misbehaving nodes are detected, transmission delays and cluster lifetimes in the graph decrease, but energy consumption depending on network security increases.

2) Packet delivery ratio:

In x-axis is Time and Y-axis is Packet Delivery Ratio. When Using DSR protocol is less packet delivered than the DSDV protocol.



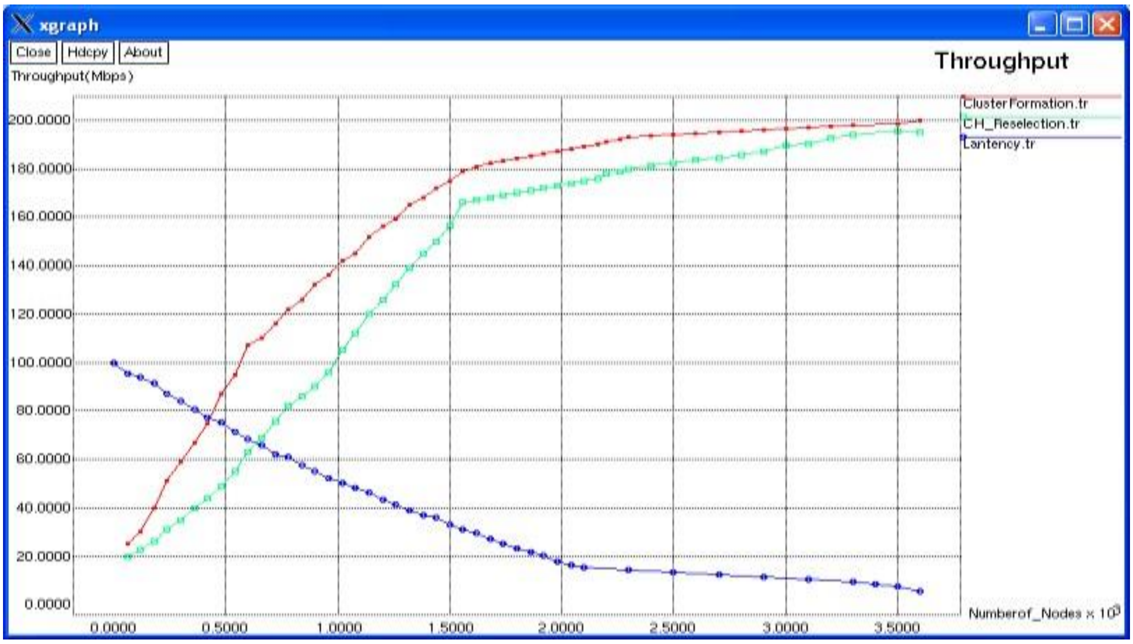
(3) Network life time



Using this graph, DSR protocol formation of cluster is less compare to the DSDV protocol based on time (s). So network lifetime easily judge to the best protocol.

(4) Through put

In x- axis number of nodes and in y- axis Throughput



The end-to-end delay decreases when throughput of the cluster formation and cluster head reselection increasing in the network.

CONCLUSION

In this research, we put forth a DSDV protocol that calls for data transmission between cluster heads working together. Additionally, we increased network longevity, lowered energy usage, and decreased end-to-end latency. We plan to expand on our existing condition as follows in future work: All sub nodes will proceed to register the specified cluster heads within the requested time frame here following the establishment of cluster heads. All nodes that are registered are referred to as primary nodes, while all nodes that are not registered are referred to as secondary nodes or unlicensed nodes. Secondary nodes will transmit data to the same cluster head at the same time that the cluster head gets data from main nodes to transfer to the sink node, but that cluster head will move over the data to another cluster head to prevent the secondary nodes' waiting or holding time. The secondary nodes will receive the packets from the idle Cluster head and be sent to the sink node. As a result, we have decreased the load balancing energy level without completely time-setting in wsn.

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