# Grid Based Clustering with Intrusion Detection System to Extend Network Lifetime in Mobile ADHOC Network

**D.Nethra Pingala Suthishni, Anna Saro Vijendran**

***Abstract:** The key determination of researches on cluster-based Mobile Ad-hoc Networks (MANETs) and the election of consistent energy holding Cluster Head (CH) is to improve the lifetime of the network. Both in real-time as well as non-real-time basis data are collected and spread accordingly. Energy efficiency is said to be the major concern in MANET. Every node in the network supplied with preferred node energy and it will get exhausted whenever node transmits the data. When node runs out of energy transmission may be failed. In order to avoid transmission failure, energy-efficient methods are incorporated in data transmission. In this paper, a clustering method is proposed which is grounded by the Grid-based model. Static sinks in the MANET transmit the data to the transmission area which is distant to the destination that may lead to the energy-hole problem. Hence, an efficient approach is proposed wherein a centralized cluster configuration by the mobile sink is used for Grid-Based Clustering (GBC) and Verification algorithm to achieve improved energy balance to thereby extending network lifetime in the network. The simulation results depict that the GBC and Verification method can effectively increase the network lifetime and energy dissipation.*

***Keywords:** Mobile Ad-hoc Network, Centralized Cluster Configuration, Grid-Based Clustering, Verification Algorithm, Wireless Network, Network Lifetime.*

## I. INTRODUCTION

MANET is a developmental stage of wireless ad hoc network technology. In MANETs the nodes exhibit mobility and play roles of client and server. MANETs can be deployed without any predefined schema and do not require central authority which makes it a decentralized system. The topology of the MANETs was discovered by automatic connection and conveys the message. MANET's mobile nodes are permitted to take arbitrary movement and it will end in a repeated change of the topology. Power preservation shows a significant part in MANET as the nodes in the network mostly use exhaustible battery/energy sources. MANETS is the naturally energy-reserved environment. The core challenges in the MANET environment are the boundaries of Wireless Network and the restrictions imposed by the mobility of the mobile computer. In recent time many of the approaches have been considered to elongate the life of active transmission.

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Here, GBC with a dual CHs scheme along with mobile sink for data collection is projected to avoid the occurrence of the energy-hole that can efficiently extend network lifetime.
GBC with a dual CH system is designed to attain energy balance during data transmission [3]. The definition of uniform and non-uniform node distribution is explained in [10]. In [4], the authors designed logical modeling for the issues of energy-hole, which would help to recognize the significance of unlike factors on the energy consumption rate. Information about location and the space between two nodes used to estimate the usage of energy [8].
In the recent past algorithms utilizing various optimizations, goals have been proposed. A clustering algorithm termed as Lowest ID (LID) is proposed which utilizes the concept of unique identification (ID) assigned to every node in the network. The unique identity is broadcast to all the neighboring nodes. These IDs if decoded without error are compared and one among them with the lowest ID is selected as the cluster-head and all 1 hop neighbors are selected as the cluster's members. If a node is a cluster member for more than one cluster, it is designated as a gateway node for those clusters. The chief drawback of this algorithm is that there may be an unenviable increase in the number of cluster heads. In Highest-Degree algorithm5 every node keeps information of all its neighbors with the exchange of beacons. A CH is elected based on the connectivity. Connectivity is high with an increase in the number of neighboring nodes. If several nodes exhibit the same connectivity then the node with the lowest ID is selected as a cluster head. This algorithm results in a relatively fewer number of clusters which automatically reduces the path length (hops) between the source and destination nodes [2].
In this paper, a GBC elects CH selection which subtly offers fault-tolerant data sharing and network lifetime for MANETs is projected. The CH selection is introduced to progress the network lifetime. This proposed method applies the verification algorithm to minimize the energy consumption problem. Finally, the simulation result analysis shows that the developed model elongates the network's lifetime.
The remainder of the paper is organized as follows: Section II explains the Grid-Based Clustering Process details. Section III explains the Enhanced Grid-Based Clustering Process details. Section IV derives the result and discuss details. Section V explains the conclusion of the paper.

## II. GRID-BASED CLUSTERING PROCESS

Data transmission area in the network is segregated into equal portion of grids.

Grids in the network region are square in shape and static in nature. During the collection of data at the sink, it may be a mobile or static. Midpoint of the grid cell which is elected as a Cluster Head (CH). Every node in the network is assigned with node-id and grid is assigned with grid-id. Configuration for the cluster is initiated through the sink. With the configuration of sink node-id and configuration-id are recognized which in turn decides CH scheduling. Data transmission as well as receiving with the grid cells is achieved by proper scheduling. Phase renewal, identifying CH's neighbor, data collection phase and Centralized cluster configuration are the tasks of system design.

- **Identification of Nodes in Each Grid Cell by Node_Id and Grid_Id**

The existence of a node in a particular grid cell is found by checking the following condition given below:

(node_l (i) ≥l1) && (node_l (i) ≤l2) && (node_m (i) ≥m1) && (node_m (i) ≤m2)

Where node_l (i) is the l coordinates of node i and node_m (i) is the m coordinate of node i. By the above condition, the nodes in a grid cell are identified and grouped into clusters.

- **Cluster Head Selection**

GBC algorithm is a network area that is segregated into equal sections of grids. Grids in the network region are square in shape and static in nature. During the compilation of data at the sink, it may be a mobile or static. Midpoint of the grid cell which is nominated as a CH. Among all other nodes in the grid cell, the node which has a minimum distance to the midpoint is chosen to the CH.

- **Broadcast of Grid Cell Information by Sink**

In the scenario of GBC-SS, the static sink offer the coordinates, whereas, in the GBC-MS, the mobile sink offers the location coordinates where it gathers the data in the whole network region. It is to be noted that the mobile sink would collect data only when it pauses and does not collect data on the move. Frequent updation of information is used for inter as well as intra communication.

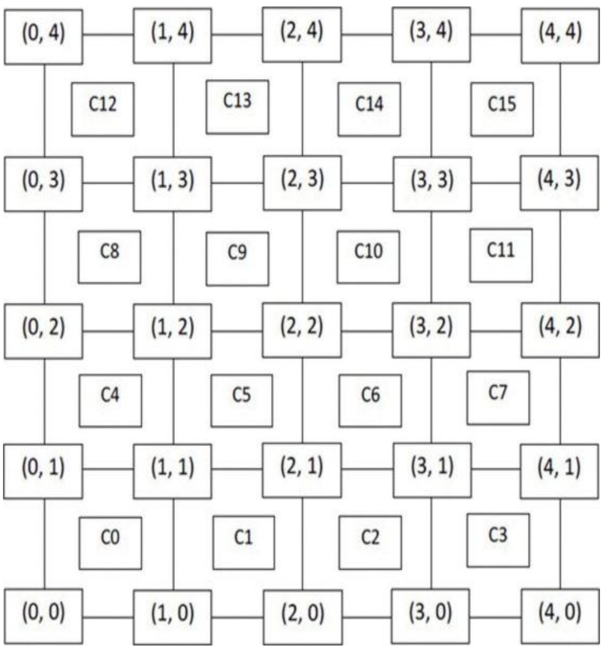


**Figure. 1. Grid Indexing [3]**

## A. Abbreviations and Acronyms

- MANET – Mobile Ad hoc Network
- GBC – Grid-Based Clustering
- LID – Lowest ID
- CH – Cluster Head
- GBC-MS - Grid-Based Clustering-Mobile Sink
- GBC-SS - Grid-Based Clustering-Static Sink
- HEED - Hybrid Energy-Efficient Distributed clustering

## B. *Units*

- Unit of the energy is (Joule/S)
- Unit of the packet dropping is (drop/S)
- Unit of Overall detection error probability (Random packet/S)
- Unit of Miss Detection Probability (Random Packets/s)
- Unit of False Alarm Probability (Random Packets/s)
- Unit of Impact of Control Packet Dropping Rate (Control Packets/s)
- Unit of Impact of L-data (Control Packets/s)
- Unit of Impact of PGB (Control Packets/s)
- Unit of Random Packet Drops (Drop/s)
- Unit of Impact of Sample Packets (Drop/s)
- Unit of Selective Packet Drops (Drop/s)

**GBC ALGORITHM**

In the grid cell, location of every node is established based on the global arrangement system. Selection of master node is based ID value that is ID with top most value and the cluster with single node is assigned as master node. Through the grids, propagation of information is initiated. Status of every node in the network is broadcasted and the reply is received by the corresponding nodes. Transmission is accomplished with the ID which makes the connectivity among the nodes possible. The size of the grid must satisfy the condition

$$S = 2 *(2G) ^\wedge 1/2$$

Where, size of the grid is denoted by G and S is the radio range of the sensor.

In this section, the analysis of the grid-based cluster scheme for the static sink is dealt with separately. Midpoint of the transmission area is assigned to static sink. In the diagram 3, shaded region of concentric square where, n = 1 and r*r is the area of each grid.

**Area of concentric square with 4 grid cells = 4 * r*r**

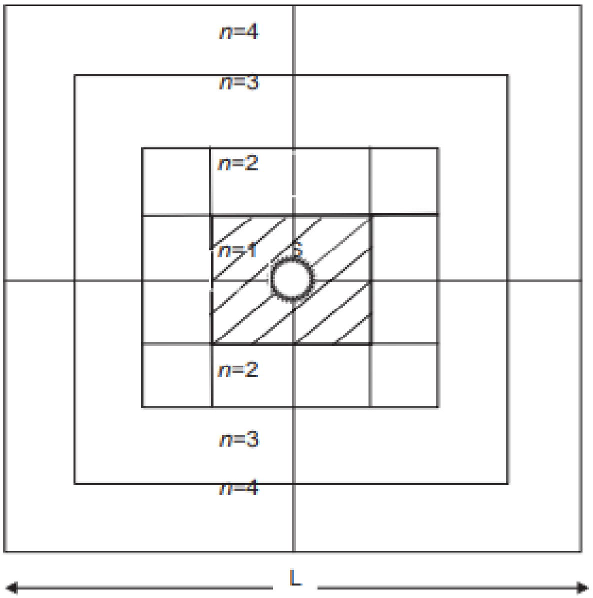


**Figure 2. Segregation of network area into a concentric squares**

Further concentric region in the square is denoted by,

**N=2, A2 = 12*r*r = 3A1**

A1 - The area of the first concentric square region.

**Total Area of Network** = $\left(\sum_{i=1}^{n}(2i-1)\right)A_1$ - (1)

g1- static sink

Load in the CH node in the concentric square is denoted by,

Whole CH communication cost to sink / Total cost of CH node in the inner most concentric square – (2)

Let ρ is the density of the nodes and b is the rate of the data per node, and then load per grid cell or intra-cluster communication cost is given by:

Intra cluster communication cost per grid cell =

$r^2 \ \rho b$ - (3)

Overall cluster head communication costs to the sink =

$\left(\sum_{i=1}^{n}(2i-1)\right).g$ - (4)

The above expression is reduced by replacing the values for g and g1, it is given below.

$LPCH_{GBC-SS} = \left(\sum_{i=1}^{n}(2i-1)\right).r^2 \ \rho b$ - (5)

Total inter cluster communication costs =

$\left(\sum_{i=1}^{n}(2i-1)i\right).g$ - (6)

Total hop count will be the sum of intra- and inter-cluster communication, given by

$r^2 \ \rho b.\left(\sum_{i=1}^{n}(2i-1)g1\right)+\left(\sum_{i=1}^{n}(2i-1)i\right).4\,r^2\,\rho b$ - (7)

From (7), the first term is dependent on the density or distribution of the nodes.

**Algorithm Steps:**

**Step 1:** Centralized Cluster configuration by the sink

A. Construction of Grid

i. Area X and Y is assigned as a network

ii. Assign the grid cell length as d

iii. Find grid co-ordinates for each grid cell

iv. Find each grid cells mid point

B. Identification of nodes in each grid cell by node Id and grid Id

C. Cluster Head selection

D. Identify the mean value of every grid cell

**Step 2:** Separate every cell by node id and grid id after finding the nodes distance and energy value.

**Step 3:** After finding the value to check low distance value and highest energy value find that node elects the CH.

**Step 4:** Status of the CH is broadcasted to every CH

**Step 5:** Along with the position, location and energy is transmitted to the nodes.

**Step 6:** Secondary cluster head selection

**Step 7:** Status of the CH is broadcasted to every secondary CH

**Step 8:** Determine the neighboring cluster heads

A. Predefined mid-square path

B. Pause at each of 4 corners of the square path

C. Broadcast beacon message at the pause point

**Step 9:** Renewal phase

A. Electing node with next higher energy level close to the center as secondary CH

B. Broadcast the selection of the new primary CH and secondary CH

C. The new CH is broadcasting status as CH

**Step 10:** Go to step 8

**VERIFICATION ALGORITHM**

Verification Algorithm is a supervised learning method. The verification algorithm is used to verify the cluster group head after sending the data. In this algorithm source input, the value to source node includes the CH after CH send to destination node includes the CH. Finally, CH sends to the Destination Node.

**Algorithm Steps:**

**Step 1:** Initially include the source and destination

**Step 2:** Input source node S, destination node D

**Step 3**: Initializing for loop and then include all nodes after all nodes are the check source node

For (j=0; j < n; j++)

**Step 4:** After matching the source node compare to the grid id and node-id based on cluster group

**Step 5:** Find the source node present the group of the cluster then,

IF (S ! =D && S = = CH) THEN

Find the CH present the head stored in an array of the source node

If (n [j , 2] = = S)

Ac [S] = CH [n [j , 1]]

Cluster message send from source s to CH

**Step 6:** IF (d = = CH1 && CH ! = CH1) THEN

If (n [j , 2]==D)

Ac [D] =CH [n [j , 1]]

Cluster message send from CH to CH1then CH1 send cluster message to destination d

END IF

END IF

## III. ENHANCED GRID-BASED CLUSTERING PROCESS

GBC algorithm is a network area that is segregated into equal portion of grids. Grids in the network region are square in shape and static in nature. During the collection of data at the sink, it may be a mobile or static. Midpoint of the grid cell which is elected as a Cluster Head (CH). Among all other nodes in the grid cell, the node which has a minimum distance to the midpoint is chosen to the CH. Every node in the network is assigned with node-id and grid is assigned with grid-id [8].

The verification algorithm is incorporated to verifying the cluster group head after sending the data. In this algorithm source input, the value to source node includes the CH after CH send to destination node includes the CH. Finally, CH sends to the Destination Node.

**Pseudocode for Improved based Clustering process**

1. Deploy nodes
2. If(node distance)
    a. Send packets to neighbour node
3. End if
4. Apply GBC algorithm
5. If(Find low distance and high energy value of node)
    a. Elect the Cluster Head(CH)
6. Else
    a. Re-Cluster Process
7. End if
8. Cluster member send data to CH
9. Apply Verification Algorithm
10. Source node sends to CH and CH send the Destination node

End

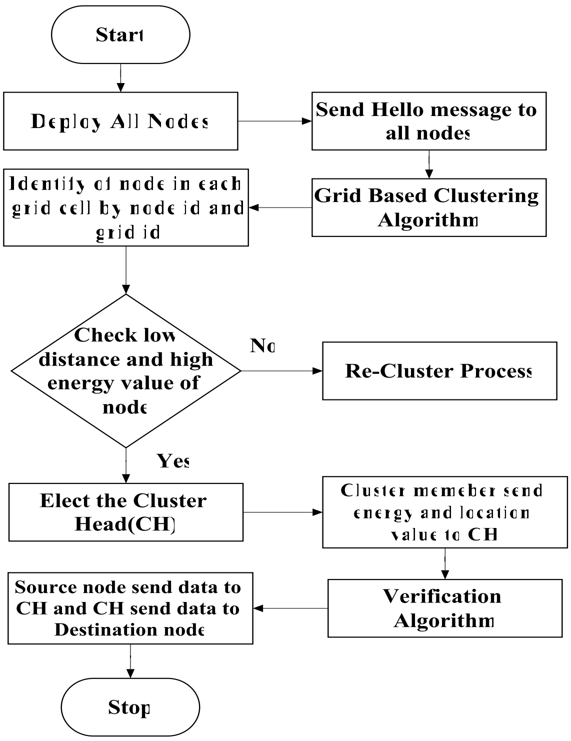


**Figure 3. Flowchart**

## IV. RESULT AND DISCUSSION

**Error Probability**

In the context of and transmission, During the transmission of the data packets, average packet loss rate due to the link errors at that time is calculated as overall detection error probability. Packet drops are in the background [12].

**Overall detection = Pgb / Pgb + Pbg**

Pgb - Link error rate

Pbg - a Packet loss rate

**Miss Detection Probability**

The probability that secondary transmission in the network may misses at the time of any primary transmission due to the noise and channel fading [14].

**Miss-Detection probability (Pmd) = Imd / 1000**

Imd - Attacker is not present time calculate the drop

**False - alarm Probability**

False Alarm Probability is the falsely detected data transmission when the source node is actually silent in the current transmission medium [15].

**False-Alarm probability (Pfa) = Ifa / 1000**

Ifa – packet loss

**Impact of Control Packet Dropping Rate**

Dropping packets is undesirable that is either lost during the transmission or must be retransmitted to the wrong route and impact throughput; however, increasing the buffer size can lead to buffer bloat which has its collision on latency and jitter during congestion [16].

**Control Packet Dropping rate = CDL – Mdp**

CDL - Control and data packet drop,

Mdp - Malicious packet Drops

**Impact of L-data**

The detection accuracy is the function of an average of total data transferred between two uninterrupted control data (L-data) is called as L-data.

**L-data = 1 / (1 - PBG)**

PBG - Packet loss rate

**Impact of PGB**

Detection-error probability is a transition parameter PGB and it can be identified that the detection accuracy will deteriorate with the increase of PGB value.

**PGB = Tpkt – Spkt**

Tpkt - Total no of Packet loss

Spkt - Source of Packet loss

**Random Packet Drops**

Random packet drop is losing arises when one or more packets. The data is transmitting the network fail to the extent of the destination. Random drop, most specifics of packet losses are hidden inside a larger block size, which leads difficulty in calculation.

**Random Packet Drops = Mpkt * Gpkt**
Mpkt - Most recent packets sent
Gpkt - Generates a packet-reception

**Impact of Sample Packets**

Packet sampling is initiated to reduce the traffic flow along the network. Size of the sample varies with the block size.

**Sample Packet = Bs * Ra**
Bs - Decreases with the block size
Ra - Does not reduce the amount of computation

**Selective Packet Drops**

Selective Packet Drop attack is a portion of a denial of service attacks and it is triggering by the malicious nodes in the network. Selective attacks from the network. It sends 10packets [11].

**Selective Packet Drops = Hdp + Ldp**
Hdp - High packet dropping rate
Ldp - Low packet dropping rate

## A. *Figures and Tables*

In order to estimate the performance of the newly designed work, simulation set up is established with the help of NS2. Table 1 gives the parameter that are used in the simulation. A network area of 1300 m×1300 m is used. The network area is divided in to grid cells of equal size. Each grid cell has an area of 350 m×350 m square region. Finally, the implementation of Cluster with IDS methods is defined,

- **Simulation Parameters**

| S.NO | Metrics | With IDS |
|---|---|---|
| 1 | No of nodes | 100 |
| 2 | Routing Protocol | DSDV |
| 3 | Protocol Queue Type | Queue/Drop Tail/PriQueue |
| 4 | Initial Energy | 100(J) |
| 5 | Packet Size | 500 bytes |
| 6 | MAC Type | Mac/802_11 |
| 7 | No of Cluster Head | 9 |
| 8 | CH Propagation | 11.11% |
| 9 | IDS Propagation | 2.55% |
| 10 | No of Sink | 1 |
| 11 | Simulation Area | 1300 * 1300 m |
| 12 | Simulation Ending Time | 60ms |

**Table 1. Simulation Parameters**

**Implementation of Overall Detection probability in Random Packet Drop**

| Time | Overall Detection Probability |
|---|---|
| 5 | 1.6 |
| 10 | 1.21012 |
| 20 | 1.2093 |
| 30 | 1.20878 |
| 40 | 1.12911 |
| 50 | 0.949279 |

**Table 2. Simulation Result for Overall Detection Probability**

**Implementation of Miss-Detection Probability in Random Packet Drop**

| Time | Miss-Detection Probability |
|---|---|
| 5 | 1.6 |
| 10 | 1.31025 |
| 20 | 1.30913 |
| 30 | 1.30858 |
| 40 | 1.23898 |
| 50 | 0.949196 |

**Table 3. Simulation Result for Miss- Detection Probability**

**Implementation of False-Alarm Probability Accuracy in Random Packet Drop**

| Time | False-Alarm probability |
|---|---|
| 5 | 1.02 |
| 10 | 1.55986 |
| 20 | 1.5607 |
| 30 | 1.56122 |
| 40 | 1.62088 |
| 50 | 1.55072 |

**Table 4. Simulation Result for False-Alarm Probability**

**Implementation of Impact of Control Packet Dropping**

**Rate in Control Packet Drops**

| Time | Detection error Probability |
|---|---|
| 5 | 1.6 |
| 10 | 1.26075 |
| 20 | 1.25951 |
| 30 | 1.25888 |
| 40 | 1.16918 |
| 50 | 0.949329 |

**Table 5. Simulation Result for Impact of Control Packet Dropping Rate**

**Implementation of Impact of L-data in Control Packet Drops**

| Time | Detection error Probability |
|---|---|
| 5 | 1.6 |
| 10 | 1.36012 |
| 20 | 1.3593 |
| 30 | 1.35878 |
| 40 | 1.28911 |
| 50 | 0.949279 |

**Table 6. Simulation Result for Impact of L-data**

**Implementation of Impact of PGB in Control Packet Drops**

| Time | Detection error Probability |
|---|---|
| 5 | 1.02 |
| 10 | 1.52924 |
| 20 | 1.53049 |
| 30 | 1.53112 |
| 40 | 1.59081 |
| 50 | 1.62067 |

**Table 7. Simulation Result for Impact of PGB**

**Implementation of Random Packet Drops in block-based algorithms**

| Time | Detection error Probability |
|---|---|
| 5 | 1.02 |
| 10 | 1.51925 |
| 20 | 1.52049 |
| 30 | 1.52112 |
| 40 | 1.59082 |
| 50 | 1.62067 |

**Table 8. Simulation Result for Random Packet Drops**

**Implementation of Sample packets in block-based algorithms**

| Time | Detection error Probability |
|---|---|
| 5 | 1.02 |
| 10 | 1.50925 |
| 20 | 1.51049 |
| 30 | 1.51112 |
| 40 | 1.57082 |
| 50 | 1.62067 |

**Table 9. Simulation Result for Sample packets**

**Implementation of Selective Packet Drops in block-based algorithms**

| Time | Detection error Probability |
|---|---|
| 5 | 1.02 |
| 10 | 1.49925 |
| 20 | 1.50049 |
| 30 | 1.50112 |
| 40 | 1.55082 |
| 50 | 1.62067 |

**Table 10. Simulation Result for Selective Packet Drops**

**Simulation result of the output screen**
**Overall Detection - Error Probability**

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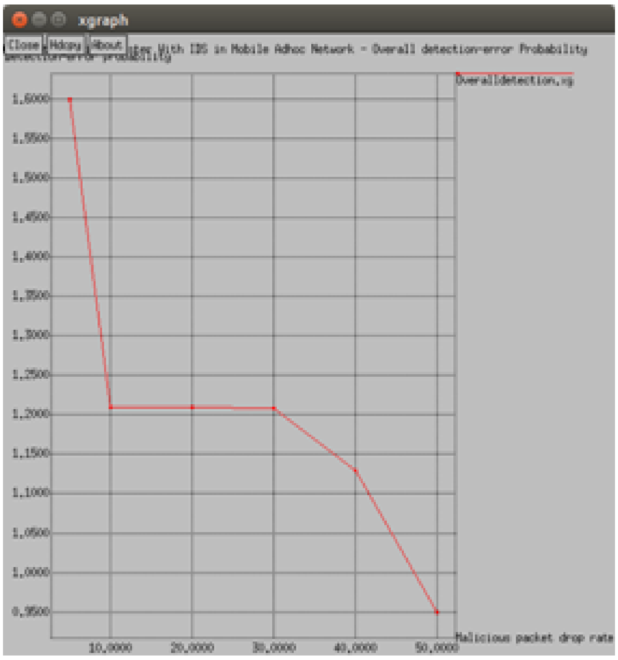


**Figure 4: Implementation of Packet Drop Attack Using Cluster with IDS in MANET - Overall Detection-Error Probability**

## Miss Detection Probability

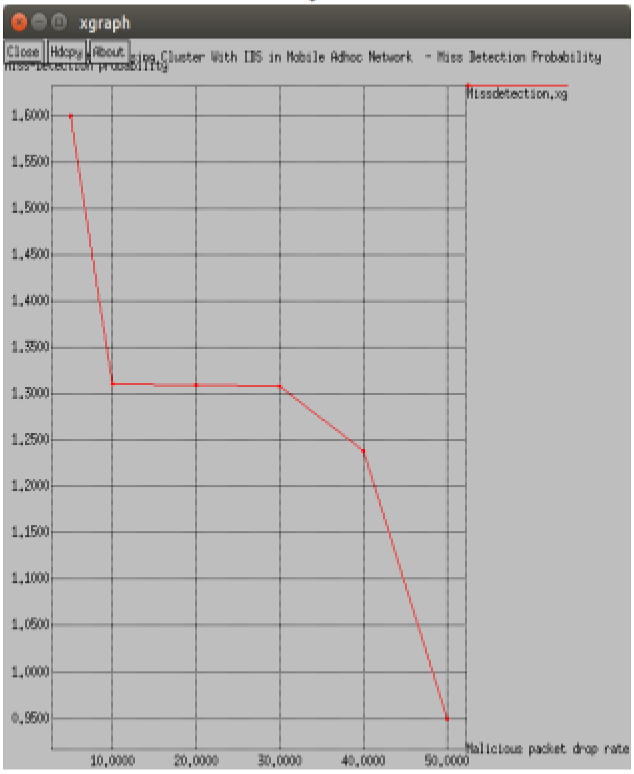


**Figure 5: Implementation of Packet Drop Attack Using Cluster with IDS in MANET - Miss-Detection Probability**

## False-Alarm probability

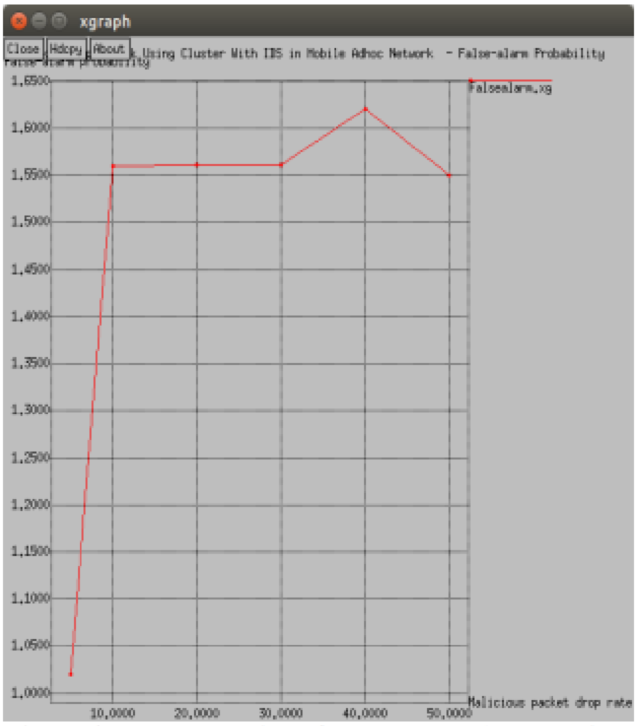


**Figure 6: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – False Alarm Probability**

## Impact of Control Packet Dropping Rate

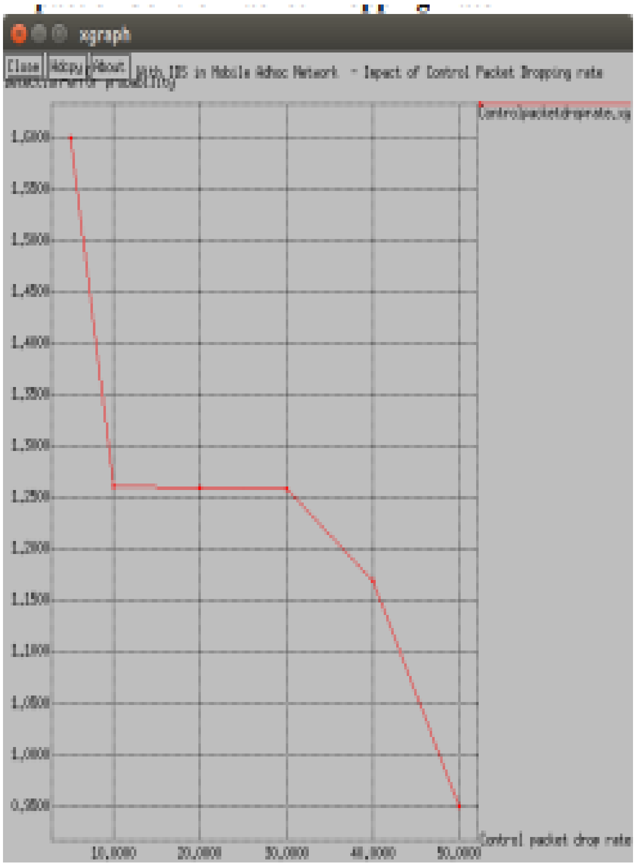


**Figure 7: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – Impact of Control Packet Dropping Rate**

**Impact of L-data**

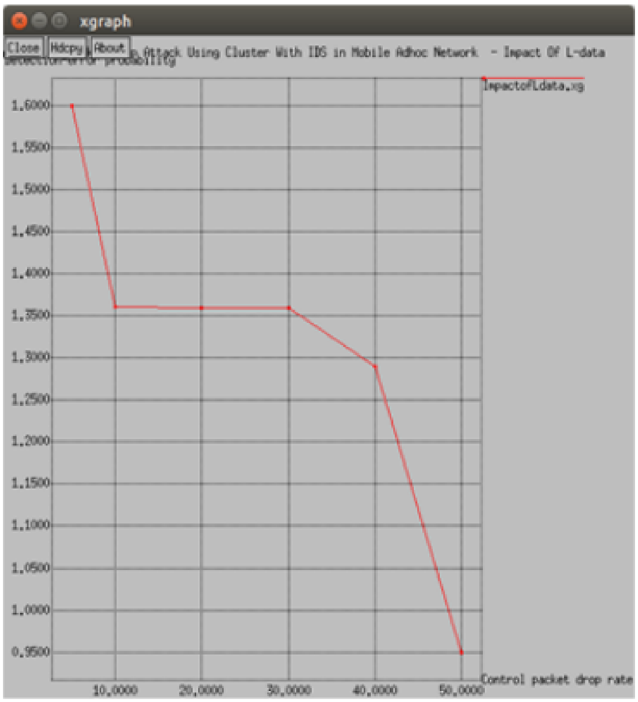


**Figure 8: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – Impact of L-data**

**Impact of PGB**

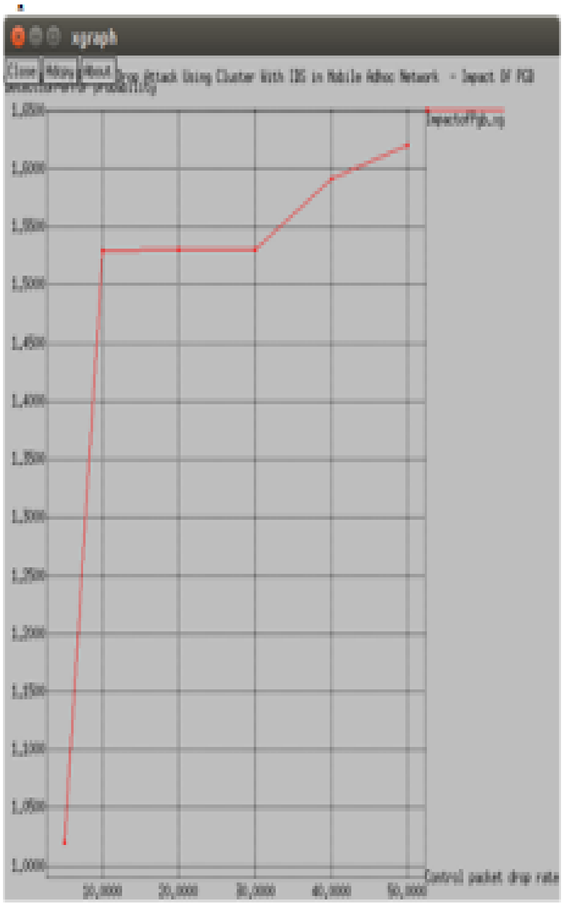


**Figure 9: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – Impact of PGB**

**Random Packet Drops**


**Figure 10: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – Random Packet Drops**

**Impact of Sample Packets**

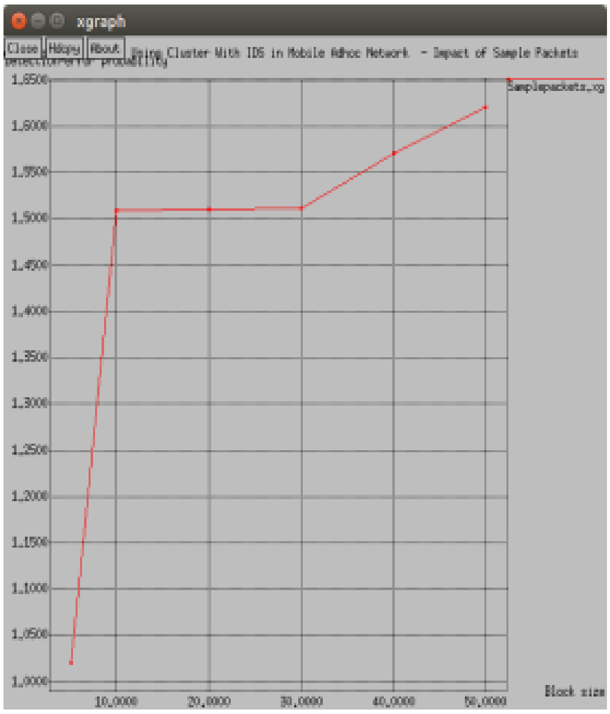


**Figure 11: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – Impact of Sample Packets**

### Selective Packet Drops


**Figure 12: Implementation of Packet Drop Attack Using Cluster with IDS in MANET – Selective Packet Drops**

## V. CONCLUSION

Network's lifetime is extended with the GBC and Verification algorithm's in this paper. The newly designed approach uses a Grid-based clustering process to find a CH to reduce an energy process and Verification algorithm to find the best path from CH. A new method is applied wherein centralized cluster formation by the mobile sink is applied for GBC along with dual CHs to achieve enhanced energy balance in the network to extending network lifetime. GBC is used for representing the conditions of clustering method. The newly designed GBC algorithm ensures the reduced latency and overhead. Wastage of energy and privacy is not assured with GBC. In future, privacy of data and nodes energy is conserved by improving the algorithm.

## REFERENCES

1. Bi .Y, Sun .L, Ma .J, Li .N, Khan .I.A and Chen .C, "HUMS: An autonomous moving strategy for mobile sinks in data-gathering sensor networks," Eurasia Journal of Wireless Communication and Networking, Special Issue on Novel Techniques for Analysis and Design, December 2007.
2. Chandrakala .C.B, Prema .K.V and HAREESHA .K.S, "Energy Efficient and Entropy based Clustering for MANET", Indian Journal of Science and Technology, Vol. 9(S1), pp.1-7, December 2016.
3. Kotishwaran Thanigaivelu and Krishnan Murugan," Grid-based Clustering with Predefined Path Mobility for Mobile Sink Data Collection in WSN", IETE TECHNICAL REVIEW, Vol.29 (2), pp. 133-147, MAR-APR 2012.
4. Li .J and Mohapatra .P, "Analytical modelling and mitigation techniques for the energy hole problem in sensor networks," Elsevier Pervasive and Mobile Computing, Vol.3 (8), pp.233-254, 2007.
5. Lin .K, Chen .M, Zeadally .S and Rodrigues .J.J.P.C, "Balancing energy consumption with mobile agents in wireless sensor networks", Elsevier Journal of Future Generation Computer Systems, Vol. 28(2), pp.446-456, February 2012.
6. Martaa .M and Cardei .M, "Improved sensor network lifetime with multiple mobile sinks," Elsevier Pervasive and Mobile Computing, Vol. 5(5), pp. 542-55, Oct. 2009.
7. Sandeep Singh, Rajinder Singh, "Detection and Isolation of Selective Packet Drop Attack in MANET" International Advanced Research Journal in Science, Engineering and Technology, Vol.4 (7), pp.94-99, July 2017.
8. Sherin Joy C." Grid Based Energy Efficient Multipath Routing Protocol In Wireless Sensor Network Using Fuzzy Approach". International Journal of Engineering Research & Technology (IJERT), Vol. 3(4), pp.1122-1126, April 2014.
9. Thanigaivelu .K and Murugan .K, "Impact of Sink mobility on network performance in wireless sensor networks" in proc of IEEE International conference on Networks and Communications, (NetCoM-2009), pp. 7-11, 27-29, Dec- 2009.
10. Wu .X, Chen .G, and Das .S.K, "Avoiding energy holes in wireless sensor networks with non-uniform node distribution", IEEE Transactions on Parallel and Distributed System, Vol.19 (5), pp. 710-200, May 2008
11. Younis .O and Fahmy .S, "HEED: A hybrid, energy-efficient, distributed clustering approach for Ad Hoc sensor networks", IEEE Transactions on Mobile Computing, Vol. 3(4), pp. 366-79, Oct-Dec. 2004.
12. Received from https://en.wikipedia.org/wiki/Neighbourhood_components_analysis
13. https://www.igi-global.com/dictionary/probability-of-false-alarm-/46090
14. https://en.wikipedia.org/wiki/Probability_of_error
15. https://www.igi-global.com/dictionary/miss-detection-probability/46227
16. https://en.wikipedia.org/wiki/Packet_loss

## AUTHORS FROFILE

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