Performance Assessment of Novel Modified Parametric Location Identification (MPLI) for AODV in MANET

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***Abstract*— There are many issues in MANETS which addresses the areas such as IP addressing, radio interference, routing protocols, power Constraints, security, mobility management, bandwidth constraints, QOS, etc;. As of now some hot issues in MANETS can be related to the routing protocols, routing mobility and position updates have raised lot of interest of researchers. Let us understand by it an actual scenario of ad hoc network i.e. a message sent by a node reaches all its neighbouring nodes that are placed at distances up to the transmission radius. Because of the limited transmission radius, the routes between nodes are normally created through several hops in such multi-hop wireless networks. The use of the nodes' position for routing poses evident problems in terms of reliability. The accuracy of the destination's position is an important problem to consider. In some cases the destination is a fixed node (e.g., a monitoring centre known to all nodes, or the geographic area monitored), and some networks are static. The problem of designing location update schemes to provide accurate destination information and enable efficient routing in mobile ad hoc networks appears to be more difficult than routing itself. [1].**

***Index Terms*— Mobile Ad-Hoc Network (MANET), Location Detection, MPLI, location Updates.**

I. INTRODUCTION

The mobile ad hoc network (MANET) is not dependent on an underlying architecture as its predecessors. The mobile nodes making up the network are dynamically and arbitrarily located in such a way that connections between nodes may change on a continual basis. Unlike traditional networks, the ad hoc network does not rely on pre-existing infrastructure. Instead, all nodes in the network collaborate to transfer data between points in the network. Such networks are a necessity in environments such as a natural disaster area or a military operation, where no assumptions can be made about any pre-existing infrastructure. While, ad hoc networks provide additional flexibility when compared with traditional networks, they also have increased cost of operation that must be considered in designing any protocols that operate on top of such topologies.

In such an environment, resources such as bandwidth and power are extremely limited. Of primary importance is the need to keep the amount of resources used during any operation to a minimum.[2]

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The proliferation of mobile computing and communication devices (e.g., cell phones, laptops, handheld digital devices, personal digital assistants, or wearable computers) is driving a revolutionary change in our information society. We are moving from the Personal Computer age (i.e., a one computing device per person) to the Ubiquitous Computing age in which a user utilizes several electronic platforms at a single instance through which he can access all the required information whenever and wherever needed.

A final factor is the growth of the Global Positioning System (GPS) [3,4]. This system has enabled mobile devices to know their exact geographic location and has spawned a number of protocols that make use of geographic information to provide efficient routing in ad hoc networks. More recently, algorithms have been proposed that make use of such location information to provide content discovery to users in the network.

A variety of content location protocols have been proposed in recent years. These can be categorized into two major groups - centralized and peer-to-peer systems. Centralized systems depend on a central directory server which will handle the content location on behalf of a requesting client. Such approaches are easier to implement and generally more reliable than the strictly peer-to-peer protocols as the central server is considered to have universal knowledge of the content available on the network. Peer-to-peer (P2P) approaches do not depend on a central server. Instead, the nodes in the network collaborate to provide the desired content location service.

A common assumption made by the majority of both centralized and P2P protocols is the abundance of resources in the network, most notably bandwidth. This assumption fails in an ad hoc network and an entirely different approach is necessary. Several protocols have been proposed to solve the problem of content location in ad hoc networks. However these solutions do not take sufficient care to lower the protocol overhead as they either depend on broadcasting information throughout the network or do not take into account link costs. [5]

II. BACKGROUND

A mobile ad hoc network (MANET) is a group of devices or nodes that transmit across a wireless communication medium mainly based on radio frequency without any fixed infrastructure or centralized control. Cooperation of nodes is important to forward packets on behalf of every different once other destinations are out of their direct wireless transmission vary. There will be no centralized control or network infrastructure for a MANET to

be set up, thus making its deployment quick and inexpensive. The nodes ability to move freely ensures a flexible and versatile dynamic network topology which is another important feature of a MANET [6]. Some of the MANET applications includes emergency disaster relief, military operations over a battlefield (vulnerable infrastructure), and wilderness expeditions (transient networks), and community networking through health monitoring using medical sensor network (MSN). Wireless network refers to any type of computer network that is wireless, and is commonly associated with a telecommunication network whose interconnections between nodes are implemented without the utilization wires. Wireless telecommunication networks are generally implemented with some type of remote information transmission system that uses electromagnetic waves, such as radio waves, for the carrier and this implementation usually takes place at the physical level or levels of the network.

A Multi-hop Wireless Network consists of a set of mobile hosts that carry out basic networking functions like packet forwarding, routing, and service discovery without the help of an established infrastructure. Nodes of an ad hoc network relay on one another in forwarding a packet to its destination, due to the limited range of each mobile host's wireless transmissions. An ad hoc network uses no centralized administration.This ensures that the network will not cease functioning just because one of the mobile nodes moves out of the range of the others. Nodes should be able to enter and leave the network as they want. Because of the limited transmitter range of the nodes, multiple hops are generally needed to reach other nodes. [7]

III. Literature Survey

In this approach Layered Square Quadrant (LSQ) location management scheme is used for location management. In this scheme we have incorporated the layered square architecture and have applied the concept of multi-level location information with the aim to reduce the costs associated with location update and location query. In our proposed Layered Square Quadrant (LSQ) location management scheme we have assumed that each node is equipped with GPS system through which the node can acquire its current geographic location. In this scheme, the entire network area is divided into L level of square regions. The arrangement is such that each level i square region encapsulates the level (i-1) square region and is encapsulated by level (i+1) square region. Here l denotes the level number and s depends on the node density. The innermost region is the level-1 square region and the outermost region is the level-L square region. The square region at each level is further subdivided into four sub-regions. Each level have four location server regions, where each location server region is a square area having side length of r. All the nodes residing in the location server regions act as location servers. These location servers are responsible for keeping track of the location information of the nodes.[8]

In this method position based routing protocols need not store the route information. Here the main component is the geographic location information of the nodes. Several location service schemes have been proposed in the literature: GLS, SLURP, SLALoM and DLM during the last few years. In this paper a new scheme is proposed based on Layered Square Location Management (LSLM) scheme, which have assumed that each node is equipped with GPS system through which the node can acquire its current geographic location. It also assumes that each node has a transmission range of rt. This scheme divides the entire network area into L level of square regions. The arrangement is such that each level i square region encapsulates the level (i-1) square region and is encapsulated by level (i+1) square region. Each square region has a side length of 2.2l.s, where l denotes the level number and s depends on the node density. The innermost region is the level-1 square region and the outermost region is the level-L square region. In this paper, we have presented Layered Square Location Management (LSLM), a novel scheme for the management of location information of the nodes in mobile ad hoc network. The effectiveness of a location management scheme depends on reducing the costs associated with the major location management functions-location update and location query. In case of a location service scheme it can reduce the location query cost by employing various caching strategies which is not possible for location update cost. In the above scheme, by dividing the entire network area into L levels of square regions and using multi-level location information, have been able to provide a unique way to reduce the cost associated with both location update and location query. Further investigation on performance analysis of this.[9]

The idea in GLS may be a new distributed location service that tracks mobile node locations. GLS combined with geographic forwarding permits the development of ad hoc mobile networks that scale to a larger number of nodes than potential with previous work. GLS is localized and runs on the mobile nodes themselves, requiring no fixed infrastructure. every mobile node periodically updates a small set of different nodes (its location servers) with its current location. A node sends itsposition updates to its location servers while not knowing their actual identities, power-assisted by apredefined ordering of node identifiers and a predefined geographic hierarchy. Queries for amobile node's location conjointly use the predefined symbol ordering and spatial hierarchy to find alocation server for that node. Simple geographic forwarding combined with GLS compares favorably with Dynamic supply Routing (DSR): in larger networks (over two hundred nodes) the approach delivers additional packets, but consumes fewer network resources. [10]

In this approach a distributed mobility-management scheme using a class of uniform quorum systems (UQS) is proposed for ad hoc networks. In the proposed scheme, location databases are stored in the network nodes themselves, which form a self organizing virtual backbone within the flat network structure. The databases are dynamically organized into quorums, every two of which intersect at a constant number of databases. Upon location update or call arrival, a mobile's location information is written to or read from all the databases of a quorum, chosen in a nondeterministic manner. Compared with a conventional scheme [such as the use of home location register (HLR)] with fixed associations, this scheme is more suitable for ad hoc networks, where the connectivity of the nodes with the rest of the network can be intermittent and non-contiguous and also

the databases are comparatively unstable. It also introduces UQS, where the size of the quorum intersection is a design parameter that can be tuned to adapt to the traffic and mobility patterns of the network nodes. It is also shown by the experimental evaluation of above proposed approach that partitioning of the network is sometimes necessary to reduce the cost of mobility management.
Some more authors had worked on above quorum based location updates as mentioned in [11].

This process of stateless greedy forwarding based on physical positions of nodes is considered to be more scalable than conventional topology-based routing. However, the stateless nature of geographic forwarding additionally prevents it from predicting holes in node distribution. Thus, frequent topologyholes will considerably degrade the performance of geographic forwarding.. So far the approaches mostly depend on excessive state maintenance at nodes to avoid forwarding failures at topology holes. This paper proposes and analyzes spatial aware geographic forwarding (SAGF), a new approach that proactively avoids constant topology holes caused by spatial constraints while still preserving the advantage of stateless forwarding. Geographic source routes (GSR) based on intermediate locations are selected to bypass topology holes. Proactive route selection based on the spatial knowledge is a general approach, and thus can be used with any geographic forwarding algorithms. It also evaluates the proposed approach by extending greedy forwarding with spatial knowledge. Simulation results comparing with GPSR show that even simple spatial information can effectively improve the performance of geographic forwarding.[12]

IV. Existing Issues

MANET is a kind of ad-Hoc network which works with remote areas or wireless medium. It is used for various business and disaster relief applications. In mobile ad hoc network, mobile nodes are free to move from one location to another location means that position of mobile nodes is frequently changed. In MANET, nodes are free to join or leave the network and they may move randomly. So in some cases identification of position of mobile node or devices is necessary and causes huge dependency on it. Thus in such cases to get accurate location information is critical issues in above network. It directs various global positioning systems for localization identification.

Thus establishing a location of nodes in MANET is derived from various location discovery algorithms proposed over the last few years and mentioned in literature of this work. This node uses more frequent updates from their positions and is regularly updated in some central repository which is updating their information with respect to their positions. They all are based on the assumptions about their positions and is not accurate. The existing mechanism is only considering few parameters for localization such as their x and y coordinates and in some cases distance and angle is also taken into consideration. All the above parameters can't be able to give correct estimation regarding the movable nodes or dynamically changing topologies [13]. They all consider the position to be changed with few parameters only. The above mechanism is needs to be updated so as to improve the location identification and hence this work identifies few areas of research which is been unknown to others. These are:
Identified Problem 1
The complexity of accurate location updates require heavy calculation load on each server of different quadrant and the information flow between those quadrants servers needs also be maintained which is quite difficult [14].

This work uses a proxy nodes and some filters is applied which separates the active nodes form idle nodes. This will also process the regular updates.
Identified Problem 2
The management of four regions is difficult and complicated and in existing system uses few parameters of nodes (radius and angle) for location management. It does not give accurate identifications [15,16].

Thus this work proposes a solution calculating parameters like quadrant no., value of x-coordinate, value of y-coordinate, distance and angle.

In MANET, the region based node organization with energy efficiency capability is a critical issue and here the work is concerning to the problem of location management. The work also proposes Design Architecture for Energy Efficiency Based MPLI scheme along with the simulation result.

V. Proposed Solution

This paper evaluates the proposed novel modified parametric location identification (MPLI) initially the source (S) wants to communicate with the destination (D) and hence the MPLI location detection starts working. Aim is to identify the accurate and real time detection. For any communication region there is a dedicated proxy for each them and hence as the request for location is reached then the proxy starts the location detection modules. S sends the request hello message to proxy for location of destination D. Also the proxies is manly considered with location detection of any existing node in a network and position updating from the node is frequently identified and informed to every node within the same network. Proxy node divides the overall network into four equal size circular quadrants (Q0, Q1, Q2, and Q3). Proxy is located at centre of these quadrants. Now proxy identifies the nodes motion between any two different quadrants termed as inter quadrant and if the motion is within the same quadrant is termed as intra quadrant movement. For inter quadrant the value of quadrant must be inserted in the hello packet. Now firstly the quadrant is identified an then later on other parameters is detected which includes x coordinate, y coordinate, angle, distance based on TTL and signal strength.

Now as the positions parameters values is detected the actual location of the node is identified which later on inform to the requested node that is source. Now the source node acknowledges the proxy on this identified location message reception. Proposed protocol is also called as a Reactive Protocol and work as an on demand routing protocol. In Reactive protocols, nodes only discover routes to destinations on-demand. Reactive protocols often consume much less bandwidth than proactive protocols, but the delay in determining a route can be substantially large. Proactive protocol is suitable for small network not for larger network because protocol need to maintains node entries for each and every node in the routing table. At the initial level of research

work the approach is promising the strong presence in near future.

Mathematical Evaluations

A. Average Residual Energy

Let Pij and Ep be the energy required to route data packet from node i to node j and the energy required to calculate position by the node respectively then the energy consumed by the node in the network Ec is

$$Ec=\sum i=1 \text{to } n \; Pi+Ep$$

Let Ee be the total initial energy of a node and Ec is the energy consumed by the node in the network. Therefore the average residual energy of each node Er may be calculated as Er = Ee – Ec. Total energy consumed by the node in the network is equal to the energy required to route packet from one node to another node plus the energy required to calculate the position of the node. The average residual energy level of nodes and hence of the network is given by equation.

$$Ea= (\sum r=1 \text{ to } n \; Er)/n$$

Where n is the total number of nodes. The proposed protocol ensures less number of hop counts which in turn reduces Pij. This factor in turn increases the average residual energy level of each node and hence of the network. The lower computational complexity towards calculation of location information in making routing decision minimizes energy consumption per routing tasks.

B. Control Overhead Estimation for MPLI

With HELLO Packets, the number of control packets generated between all the nodes (N) in an ILCRP in simulation time (Tsim) is N. The HELLO packets generated between all the cluster heads(C) in Tsim is

$$C. (Tsim/Tref).\sum i=1 \text{ to } c \; Hij$$

Where Tref is the refresh period between each HELLO message. After Cluster formation, the number of control packets generated between all the nodes (n) in a cluster is n. (Tsim/Tref). Therefore for C clusters, control packets generated will be n.C. (Tsim/Tref)

Hence the total number of control packets generated in MPLI in Time Tsim is

$$N+ C. (Tsim/Tref).\sum i=1 \text{ to } c \; Hij + n.C. (Tsim/Tref)$$

Where
N – Total number of Nodes in the network
C – Number of clusters in the network
Tsim – Simulation Time
Tref – Refresh Period
Hij– no of Hop counts
n – Number of nodes in a cluster

C. Packet Delivery Ratio for MPLI

The maximum packet delivered per node is $\mu\sqrt{N}$ where μ the channel capacity is and N is the number of nodes.

MPLI Algorithm

```
SET-N     // Number of Mobile Nodes
 T   // Simulation time
 q1, q2, q3, and q4  // Four quadrants of circular area
       CPx, CPy   //middle point with respect of x and y of the circular area
       X Y //Topography area in term of XxY
 INITIALIZE
       x←$11, y←$13   // Initialize the coordinate value of x and y from trace file.                X←800
       // x-axis of Topography area
       Y←600   // y-axis of Topography area
        CPx ← X/2
        CPy← Y/2
        Node[i] // Node[i] is node array
BEGIN
       For i← 1 to N         // To find quadrant number of nodes is located
       Do
       If ((CPx<x) && (x<=X) && (CPy<y) && (y<=Y))
       Then   Node[i] ← $n
        x1← (x-CPx)           // To find x position of nodes
       y1← (y-CPy)           // To find y position of nodes
       b1← (x1*x1)
       b2← (y1*y1)
       c1← (b1+b2)
       a1[i]←sqrt (c1)
        m1← (y1/x1)
        r1← tan-1(m1)
        d1[i]←r1*57.30        // Angle
 Continue all above steps for remaining quadrants and nodes.
 EXIT
```

Thus, by achieving the above functionalities, suggested improvements over the nodes location detections and its updation mechanism can be improved. It serves the effective location identification with higher accuracy due to its multiple parameters based evaluations.

VI. Performance Factors

In order to validate the proposed protocol and show its efficiency in future we present simulations using network simulator version 2 (NS-2). NS-2 is a very popular network simulation tool. It uses C language for protocol definition and TCL scripting for building the simulation scenarios [18]. The simulation environment settings used in the experiments are shown in Table II. The scenario of nodes mobility is generated randomly based on random way point model where a mobile node moves to a new position and pauses there for time period between 0 to 3 seconds, then it move to another position. To prepare simulation for desired network utility the following given simulation parameters are considered.

Table 1 Simulation Parameters

Radio-propagation	Propagation/TwoRayGround
Antenna model	Antenna/Omni Antenna
Routing protocol	AODV
Simulation dimension	750 X 550
Initial energy in Joules	100
Simulation time	50 seconds
Traffic	TCP
Channel type	Channel/Wireless Channel
Number of nodes	15
Queue Size	50
Packet Size	512 bytes

Analysis of the result for proposed implemented work is done on the basis of following matrices.

A. Packet Delivery Rate
B. Throughputs
C. Routing-load
D. Energy

A. Packet Delivery Rate

It is defined as the ratio of total number of packets that have reached the destination node to the total number of packets originated at the source node. The location information of the nodes make the packets route loop free which results in high packet delivery ratio. On increasing the mobility i.e., speed of the nodes, the delivery ratio decreases since most of the nodes move away from each other. After studying the below graph of PDR values, it is clear that the suggested mechanism is proving its effectiveness then other existing mechanism.

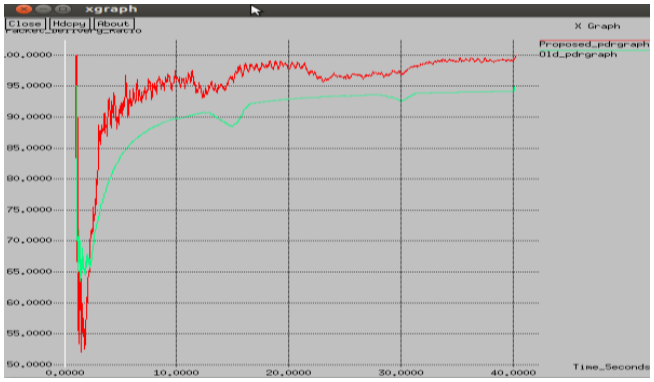

Figure 3: Comparison of PDR for Proposed and Existing Scheme

B. *Throughput*

Throughput is the amount of data received by the destination. The Average Throughput is the throughput per unit of time. The graph interpretation shows the proposed MPLI model is giving better results than existing LAR scheme.

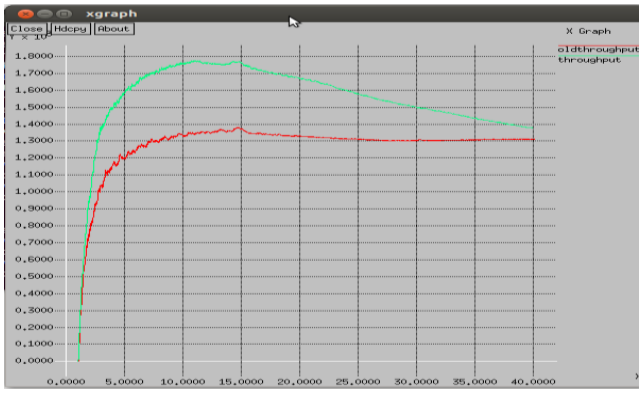

Figure 4: Comparison of Throughput for Proposed and Existing Scheme

C . *Routing-load*

The amount of routing packets transmitted per information packet delivered at the destination. Every hop-wise transmission of a routing packet is counted joined transmission.

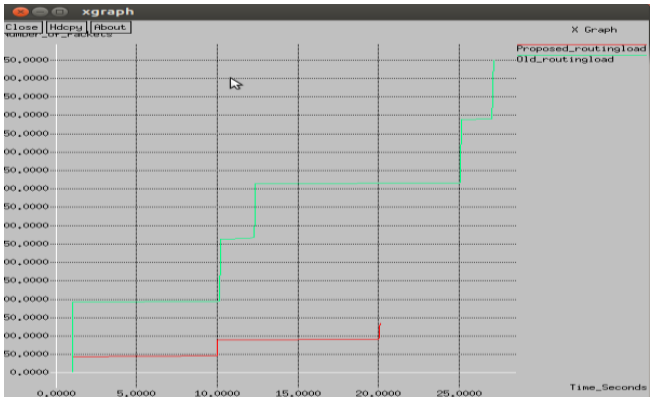

Figure 5: Comparison of Routing load for Proposed and Existing Scheme

D. *Energy Consumed*

The figure 6 & 7shown below is that the graph of the remaining energy of every node within the network when simulation in existing approach and proposed approach. Every node is indicated with totally different colours. And also the graph is drawn between 2 parameters energy of nodes and time; here energy decreases with relevance time. The energy consumption is additional here and remaining energy of the nodes of the network is a smaller amount.

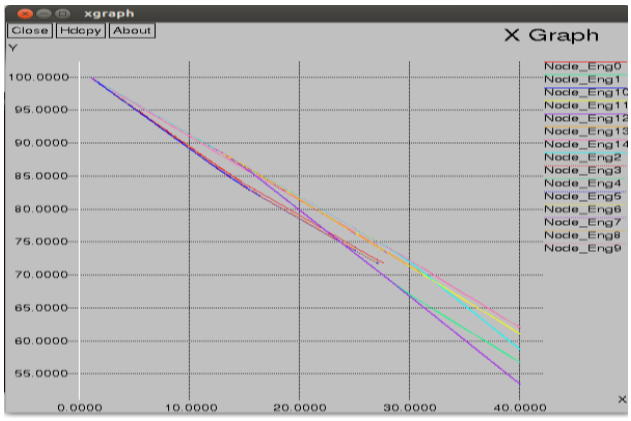

Figure 6: Energy Representation of Existing Scheme

The representation of energy of the above graph can be understand by taking the individual nodes energy at the start combined together and let it subtract from the total remaining energy gives the residual energy. It is a well known factor of evaluating the routing protocol.

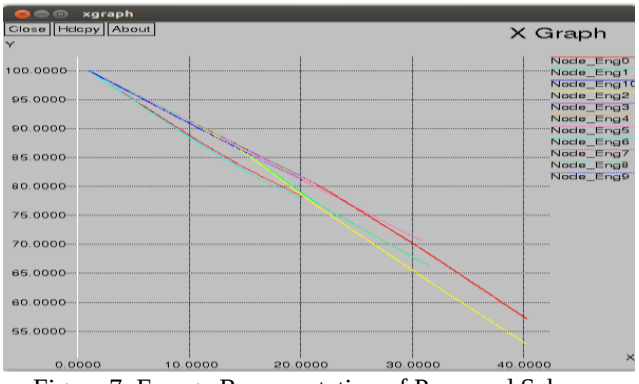

Figure 7: Energy Representation of Proposed Scheme

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VII. CONCLUSION

The result graphs and above feature table of comparison shows the variance in residual energy with respect to the number of nodes and mobility (speed) of nodes. But with respect to residual energy, MPLI protocol scores higher compared to LAR protocol due to energy consumption by the GPS utility. Most of the LAR based protocols stress upon the fact that energy consumption is more when GPS enabled. Most of the protocols are for either GPS free or GPS scarce clusters. Though all the nodes are GPS enabled in the proposed protocol, the GPS utility is made to sleep when not in function as well as when there is no mobility for the node in order to reduce the power consumption.[17] Only the cluster head's GPS function will be active during the functioning of the network. This review did not include discussion of relevant issues such as physical requirements, experimental design, location updates, congestion, scheduling node activity, topology construction, broadcasting, and network capacity. The successful design of localized single-path loop-free algorithms EEMPLI with guaranteed delivery is an encouraging start for future research. The search for localized routing methods that have excellent delivery rates, short hop counts, little flooding ratios, and power efficiency is much from over. However, the research on position-based routing is scarce. Further research is needed to identify the best GPS-based routing protocols for numerous network contexts. These contexts include nodes positioned in three-dimensional space and obstacles, nodes with unequal transmission powers, or networks with unidirectional links. Finally, the mobility-caused loop needs to be further investigated, and solutions found and incorporated in position-based routing schemes.[18]

VIII. FUTURE WORK

Some problems and concepts that remain unaddressed and can be performed in future are as follow:

A. In future with the help of Distance and Angle of a node, we can identify the node which perform warm activity within the network. For this, we can place IDS (Intrusion Detection System) in central node position.

B. We also embed source code of our proposed scheme in NS2.

C. In our proposed scheme, I am simulating following network parameter: x-coordinate, y-coordinate, distance, angle. In future we can also simulate some other network parameters such as network diameter, radius etc.

D. In future we can also identify those nodes which have gone out of network area with the help of distance and angle.

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