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Location Error Minimization with the Help of Run Time Coordinates Estimation Method

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Abstract

The energy is the limited resource of communication in Wireless Sensor Network (WSN). The nodes proper functions in WSN are depend on the battery power. The each node in network are mobile and having different mobility speed. The topology in WSN is forming completely dynamic and change according to time instance. The signal strength of node/s is varying according to power capacity of nodes. The less energy of sensor nodes is shows weak signal strength that means having weak Received Signal Strength (RSS). If the signal strength of nodes are reduced that means the nodes have insufficient energy. In this research we proposed the Location based RSS scheme to improve energy utilization. In this research we compare the performance of protocols like existing AIES-RSS and proposed Location based RSS. The performance of proposed scheme is better than AIES-RSS and the performance of proposed scheme is provides better routing performance in WSN as compare to AIES-RSS. If the RSS of any node in network is weak that means the nodes energy level is down. If the node/s having sufficient amount of energy then their signal strength is high. The Location records of sensor nodes are provides the information of location that's why routing efficiency is improves and also the energy consumption is reduced. The proposed method is improves the energy utilization and also the residual energy cost is maximum after complete simulation. The proposed scheme is provides the strong connection by that the packet dropping and overhead is minimized.

Keywords:- RSS, Routing, Location, AIES-RSS, Energy, proposed RSS, WSN,

I. INTRODUCTION

WSN (Wireless Sensor Network) consists of sensor nodes deployed in a structured or unstructured manner over a chosen area of interest. Wireless sensor networks are made of many small sensor nodes. Each node can send messages to sink through the network or controlling device. The nodes can forward messages to other nodes to perform network organization tasks and other functions [1].A typical sensor node consists of a power unit, radio, sensing unit, and a processing unit [2]. Networking these nodes presents several challenges due to device constraints, e.g. limited computational capability, energy, data storage and communication bandwidth. As sensor nodes operate on limited battery power, energy usage should be considered in WSN [3]. A node in a wireless sensor network (WSN) is a small embedded computing device that interfaces with sensors/actuators and communicates using short-range wireless transmitters [2]. Such nodes act autonomously but cooperatively to form a logical network in which data packets are routed hop-by-hop towards management nodes, typically called sinks or base stations. A WSN comprises a potentially large set of nodes that may be distributed over a wide geographical area, indoor or outdoor. Wireless sensor networks enable numerous sensing and monitoring services in areas of vital importance such as efficient industry production, safety and security at home, and in traffic and environmental monitoring. When a sensor node is depleted of energy, it will die and disconnect from the network which can significantly impact the network performance. Sensor network lifetime depends on the number of active nodes and connectivity of the network, so energy must be used efficiently in order to maximize the network lifetime [2, 3]. The size of the network varies with the monitored environment. For indoor environments, fewer nodes are required to form a network in a limited space whereas outdoor environments may require more nodes to cover a larger area. A message traverses the network by being relayed from one node to another node until it reaches its destination (multi-hop communication). Since the nodes are moving, the network topology regularly changes and so finding a delivery path to a destination is a challenging task [4].

The best example is the use of sensor networks for safety industrial applications [5]. This network may employ sensors to find the presence of dangerous materials, and also provides the early detection techniques and identifies the leaks of chemicals or biological effects prior to extreme loss which can result in public. The wireless networks

uses the various routing protocol in distributed fashion, they have different path for routing, and can be maintained and healed by itself for further issues, they also resilient in an explosion or extreme inflicted loss to the industrial application, which provides public trust with critical conditioned data inside the hard constraints. The operations which are not processed due to consistently small sizes, sensor nodes are always at higher risk of being captured physically and having their compromised security in the network. The power of sensor nodes is not replaceable and the nodes consist of less battery power. Reducing the energy consumption for data transmission and security for transmitting the information through sensor nodes are very essential in wireless sensor network.

II. Challenge in WSN

It is significance noting that WSN, although having great potential, are yet to reach their optimal effectiveness. This is largely due to the inherent challenges that they exhibit and the ever growing scope of demand from applications. These challenges have ignited much research interest in the past decade. Some of the challenges [4] are given below:-

A. Energy of nodes

Energy conservation is central to the development of WSNs. Since sensor nodes run on a limited battery [1]; it is vitally important to use energy wisely and efficiently to significantly prolong the lifespan of the network. In other instances, the energy source could be replenished through solar and other means. However as WSNs grow, it could get difficult to replenish the power source which could lead to the complete disposition of the sensor nodes as envisioned in [6].

B. Communication

Communication in WSN is through a wireless medium guided by different IEEE specifications operating under the unlicensed industrial, scientific, and medical (ISM) frequency bands. IEEE defines the PHY and MAC layer for Low-Rate Wireless Personal Area Networks (LR-WPAN). Wireless Personal Area Networks (LR-WPAN). IEEE 802.15.1 (Bluetooth) and 802.15.4 are the two most viable protocols for WSNs. These protocols have to coexist mutually with other wireless protocols operating on the same ISM band such as IEEE 802.11a/b/g (WLAN) and IEEE 802.15.3 (ultra-wideband: UWB). WLAN and UWB are not ideally suited for resource constraint wireless sensors. WLAN and UWB are high bandwidth wireless communication technologies for devices with high processing power and consistent or easily rechargeable power sources.

C. Routing

WSN topologies are unstructured and therefore many traditional routing protocols are not suitable. Also, the fact that they are not IP-based makes routing a very challenging yet interesting aspect. Flooding is a common technique in wireless networks where a node reactively broadcasts hello/control packets to its neighbors for possible route determination.

D. Security

WSNs, like other wireless networks, are susceptible to security threats. Some of the security measures and suitable cryptographic algorithms are discussed in [1]. Furthermore [7] have identified the fundamental security requirements that must be reached in WSNs: *Data Authentication, Data Confidentiality, Data Integrity, Availability and Redundancy.*

E. Configuration

Manual configuration of any network device is challenging and tedious especially when the network grows. Sensor nodes need to respond swiftly to any change in the network and thus need a dynamic configuration management. Christin in [8] states that the role of sensor nodes could extend to offer autonomous functions such as self-healing, self-discovery, thus a more delicate and energy efficient approach is needed.

III. Literature Survey

The number of authors are previously detect the location error in network and also every research is provides the something new concept of minimizing the location error. The some of them are mention below:-

Sudha H.Thimmaiah, Dr. Mahadevan.G in [9] proposed a RSS (Received signal strength) based localization technique and also proposes an adaptive information estimation to reduce or approximate the localization error in wireless sensor network. Dada info comes both from measurements made between pairs of nodes and a subset of nodes that know a priori their bounds. A infrastructure self-calibration estimator calculated the unknown nodes bounds. Let consider, distributed clock synchronization in an infrastructure could be accomplished by nodes perceiving pair-wise timing offsets when just a small number of devices are synchronous.

Swagatika Bohidar Sasmita Behera Chitta Ranjan Tripathy in [10] proposed the survey of Localization error minimization i.e. one of the most important subject in WSN because the location information is typically useful

for coverage, deployment, routing, location service, target tracking and rescue. Although GPS is an important tool in localization for military, civil & commercial users, the greatest disadvantages of these techniques are (i) high cost in terms of both hardware & power refinement, (ii) weak performance in case of indoor or under dense foliage, (iii) non-availability of GPS signals in confined environment prevent their use in large scale sensor networks. RSS use a theoretical or empirical model to translate signal strength into distance.

In previous approaches can derive a high performance in terms of energy consumption, there still exist some problems; that is how to take the energy saving into the localization problem. How to balance energy consumption and localization accuracy is also a difficult problem. To solve these difficult problems they [11] proposed a multi-objective optimization algorithm that balances the tradeoff between the energy consumption and positioning accuracy. We adopt an advanced version of the Non-dominated Sorting Genetic Algorithm called NSGA-II to minimize the positioning error and effectively allocate the transmit power of the anchor nodes at the same time. The problem is formulated as multi-objective functions optimization problem with constrains of decision variables.

Navpreet kaur Sukhwinder singh Sran Lakhwinder kaur in [12] proposed the protocol that select path for routing that is based on the location and residual energy of nodes. The contribution of this paper is twofold. First, the location and residual energy of sensor nodes are considered to make the decision for the route using greedy forwarding mechanism. It jointly makes routing decisions which provide paths having good residual energy and provide positive advancement towards the sink. Secondly, The Multiple- metric path evaluation module is used to select the best possible path from the paths selected by path formation phase. It uses metrics such as residual energy of the path, second minimum residual energy of the path, bandwidth, next hop id etc. The push back module allows the path forwarding mechanism to route packets around connectivity holes. This algorithm checks for all nodes whose residual energy is nearly zero and declares them as dead nodes. It then forwards this information to path formation module.

L. Buttyán, P. Schaffer in paper [13] proposed Position based aggregator node election protocol (PANEL). Isin this scheme geographical position based algorithm is which uses location of nodes for determining the nodes aggregators. The whole network is divided into number of geographical clusters and for each cluster; a reference point is calculated in reference to the bottom left corner of cluster. Then that node is selected as CH which is closest to the reference point. Transmission can be intra-cluster or inter-cluster. Most of the data aggregation algorithms are synchronous in nature, but PANEL has the advantage to support asynchronous applications also. However the infrastructure cost of this algorithm is high due to requirement of special hardware and software for implementation on the basis of geographical knowledge of nodes.

The work [14] presents a survey with its focus on the scalability of routing protocols. It classifies them according to motivations such as control overhead reduction, energy consumption mitigation, and energy balance. The work [15] gives an exhaustive overview of intelligent routing protocols. It first defines network lifetime in three aspects. Then, it categorizes the protocols based on such algorithms as reinforcement learning, ant colony optimization, fuzzy logic, genetic algorithm, and neural networks. It also highlights the performance analysis results and applications of each surveyed routing protocol.

A. Woo and D. E. Culler in [16] proposed the concept that the application layer itself also introduces phase shifts. While jittering at the data-link layer aims to cause small transmission variations between neighboring nodes, we think, that phase shifting at a higher layer can be achieved on a larger time scale. To handle buffer based congestion (packet drops due to buffer overflow) one may employ the other two methods, a) traffic control or b) resource control as these would help in emptying the buffers of intermediates sensor nodes. It is possible to have more than one types of congestion occurring at the same time.

IV. Problem Identification

The discovery and recovery procedures are also time and resource consuming. Once the path breaks, data packets will get lost or be delayed for a long time until the reconstruction of the route, causing transmission interruption. Pre-determination of an end-to-end route will be constructed before data transmission also no guarantee the data will send to destination. Without knowing location requires more time and energy to discovery and recovery the route to send data. So, there is a need for routing protocol which take advantage of location information is required for high amount of data delivery in highly dynamic mobile ad hoc networks.

The problems that are occurring due to not identified exact location of sensors and energy depletion of sensor nodes is:-

1. The numbers of nodes forwarded request packets again and again in network for finding the location of destination and because of that energy of nodes are also deplete.
2. The senders are forwarded the route request packets in network for same destination then the overhead in network is also enhanced.

3. The nodes energy in WSN is limited and each node is required sufficient energy for communication. The weak received signal strength is enhances the possibility of unreliable communication in between sender and receiver.
4. The location error is also enhances the possibility of delay in network. The right expectation of destination mismatch is enhances the extra effort is proper communication.

V. Proposed Approach for Location Error Minimization

In this section describe the proposed algorithm that minimizes location error through coordinate estimation method. While the nodes are communicate with each other, that destination routing effect agent (DREAM) provide location information of each interconnected nodes but not gives the correct location of nodes. So in our proposed approach real time x-axis and y-axis information of nodes are captured that helps to measure the distance of each nodes and identifies the location error. In the below formal definition of algorithm are describe.

Algorithm:

Input:

W: mobile devices
S: source node
R: receiver node
M: mediator node
x_i: x-axis of i^{th} node
y_i: x-axis of i^{th} node
t_i: time
d_e: effective distance
d_a: actual distance
e_d: distance error
rss: receive signal strength of i^{th}device
r_d: radio range
Proto: AODV

Output: location error, data send, receives, drop, NRL, PDR

Procedure:

execute-broadcast-AODV(S, R, r_d)
ifM in r_d& M != R **then**
M← generate route table
Forward route packet to next hop M= M+1
Calculate-location (M, x_i, y_i)
rss of M node
else-if M == R **then**
Calculate-location (R, x_i, y_i)
rss of R node
reverse route(R, S, route-table)
else
node unreachable;
end if

Location (M, x_i, y_i)
if M node in route **then**
t_i←expected time
x_i←x coordinate of i^{th} node
y_i←y coordinate of i^{th} node
p= x_i*x_i
q= y_i*y_i
z= (p+q)
l(z, power(0.5))
d_e= l
d_a= real location
e_d=(d_e– d_a)
rss_i←receive signal strength of i^{th} node
Store (e_d, rss_i)
Calculate (PDR, ARE)
end if

The received signal strength (rss) of any node is week or not recognized at the instance of communication that means the node is not capable for communication in dynamic network. The nodes functioning are completely depending on the energy strength or node/s is properly in communication range of other nodes. The proper location identification is reduces the location error and enhance the routing performance.

VI. Simulation Parameters

The system environment used is windows 7 enterprises 64- bit operating system with 4GB of RAM. We have used Network Simulator (NS-2) tool. We have conducted simulation study on following parameter for localization and path gain and compared proposed performance with existing AIES-RSS and we have consider the 30 nodes in simulation and conducted simulation study, simulation parameters are given in table 1. These devices (nodes) are placed in a random manner in a simulation area of 800 X 800 which is two dimensional. For each mobile anchor node radius of transmission and area of transmission is 250 meters. The performance evaluation strategy is adopted by varying the number of nodes in case of localization error and in only one scenario the performance of packet dropping. Packet receiving and residual energy is considered.

Table 1 Considered Simulation Parameters

Simulation Parameter	Values
Simulator Used	NS-2.31
Number of nodes	30
Dimension of simulated area	800m×800m
Routing Protocol	AODV
Simulation time (sec)	100
Traffic type	CBR (3pkts/s)
Packet size (bytes)	512
Number of traffic connections	5
Node movement at maximum Speed (m/s)	Random, 8m/s
Transmission range	250m

VII. Result Analysis

A. Data Packets Sending Analysis

The location of sensor nodes is continuously changes and because of that possibility of link breakage is more. In this graph the data send performance of AIES-RSS and proposed Location based RSS is evaluated. The number of data sends in network in proposed is maximum in both node density scenarios. In WSN nodes are at any time ready to transfer data, because the channel is free that means bandwidth is available for communication and also no other node is present for sending the data at same time instance. The reason of less packet transmission is to sender wait for the proper response of receiver and due to delay in response the new transmission is affected and also the communication of other nodes are affected.

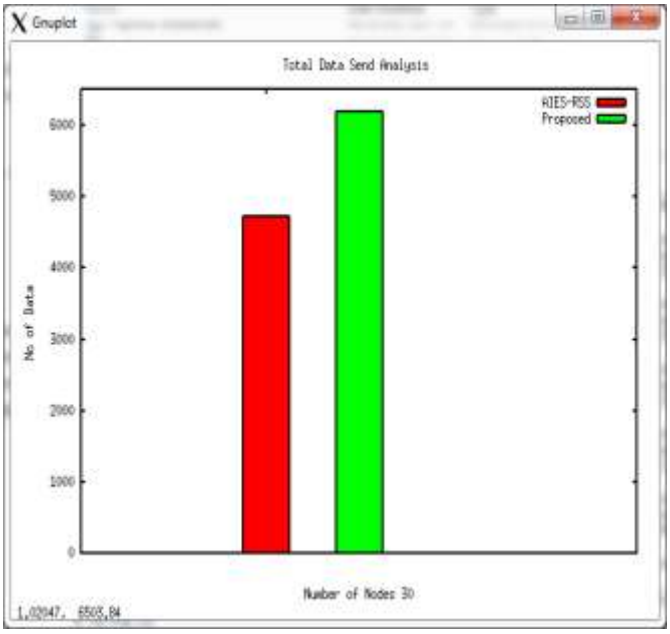

Fig.1 Data Send Analysis

B. Data Packets Received Analysis

The number of data packets receiving is shows the improvement in network performance. The proper data receiving is shows the better performance of protocol. If the data receiving in network is poor, in that case it is sure the performance of network is degrades and also other metrics are provides unsatisfactory results. In this graph the data receiving performance of AIES-RSS protocols are comparing and examine that the performance of proposed Location based RSS is better. The packet receiving of proposed protocol is maximum and because of that routing performance of protocol is improved. The proposed protocol is provides better routing technique for communication that is also energy efficient.

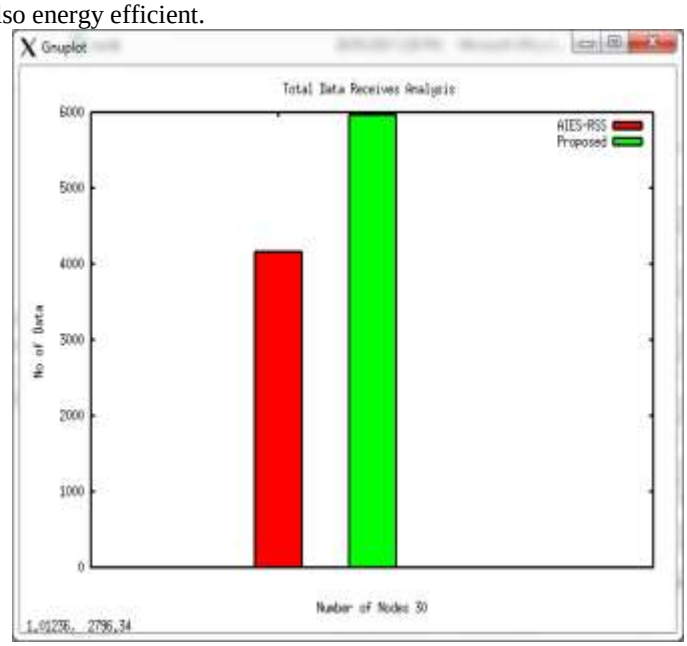

Fig.2 Packets Receiving Analysis

C. Data Packets Receiving Percentage Analysis

The percentage of packets receiving is provides the better results because of data receiving are really good. The better data receiving is really improves the network performance and utilizes the energy of nodes data packets forwarding and receiving. The number of senders in network is sending data packets and receivers are receiving the data packets. The percentage ratio of received packets and send packets represents by packet receiving performance metrics. In this graph the 30 nodes density performance is measured and identified that the receiving of proposed location based received signal strength is better and also it represents better energy utilization. The performance of AIES-RSS protocols is less than proposed Location based RSS.

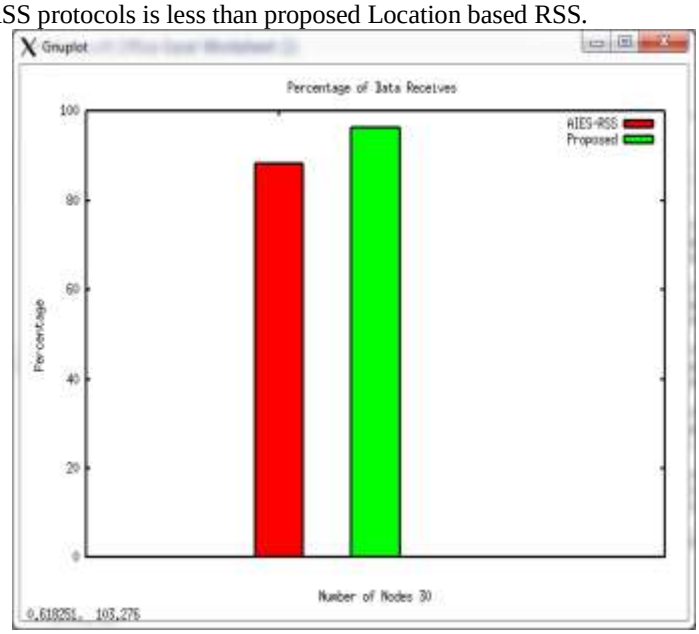

Fig.3 Percentage of Packets Receiving Analysis

D. Average Residual Energy (ARE) Analysis

The energy of nodes is remains more in network shows better life time of network. If the link is break suddenly due to any reason it means the again sender is flooded routing packets in network that consumes energy in network. The average residual energy analysis is measured in this graph in presence of both the protocols in dynamic network. The average remaining energy in proposed Location based RSS scheme is provides better results due to efficient route selection. The better route selection is provides the stability in link between nodes and enhance energy utilization. The energy is more remains in proposed location based scheme that shows the better energy efficient routing performance.

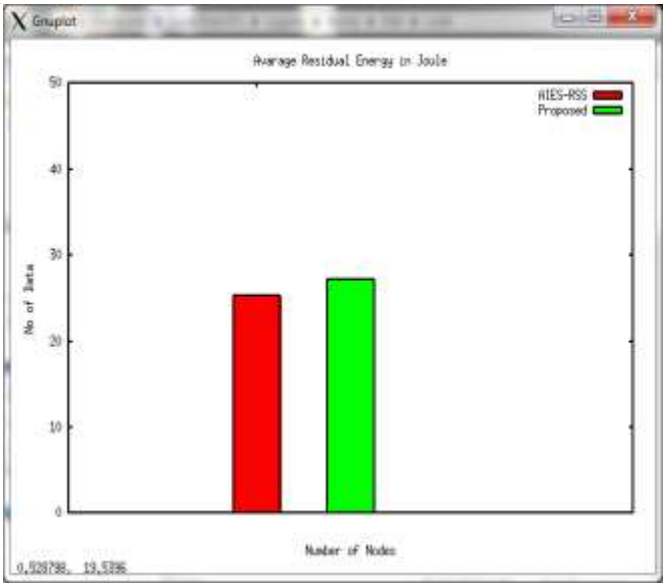

Fig.4 Residual Energy Analysis

E. Location Error Finding Analysis

The number of nodes in WSN is start the movement on the particular location and the location of nodes are changing according to time.

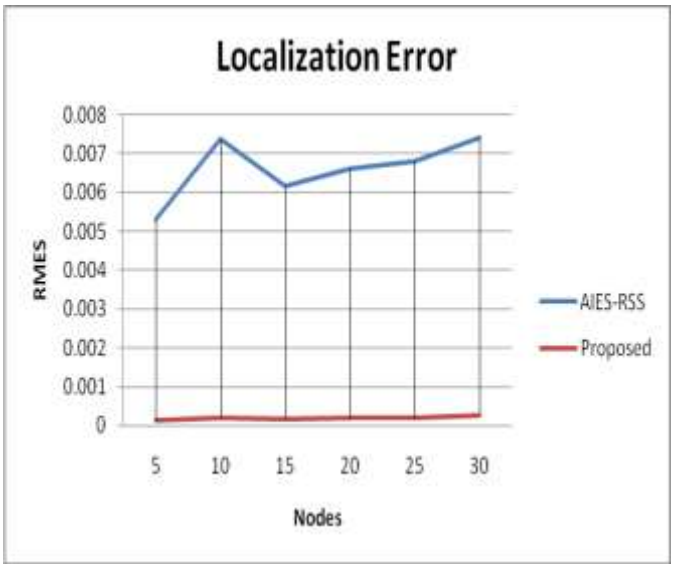

Fig.5 Localization Error Analysis

In this given graph the Residual Mean Square Error (RMES) value of nodes is measure in six different node density scenario and the error are in proposed scheme is count about negligible in dynamic network. It means the proposed scheme is finding the accurate position of nodes. The proposed scheme is more efficient existing AIES-RSS and provides better results.

VIII. Conclusion and Future Work

The sensor nodes in WSN are moves with different mobility speed. The nodes are communication range is fixed and beyond the communication range it is not possible to communicate with neighbour. Energy of sensor

nodes is very valuable source of function in dynamic network. The nodes having sufficient amount of energy is also better RSS. The signal strength of nodes may be equivalent and different. The proposed location based route selection is provides the better path for sending and receiving data in dynamic network. The proposed location based performance is better than previous AIES-RSS. The proposed scheme is reduces the energy consumption and improves the residual energy. The nodes are aware about the location information of neighbours and each neighbour are also maintain the information of other connected nodes. The location identification procedure is maintained with respect to each node that is participating in routing. The sender is selected the path in network having higher RSS and having location of neighbours. The proposed protocol is minimizes the routing packets flooding and in both the scenario of 30 nodes. Same as the PDR performance of proposed Location based RSS is better than the old or existing AIES-RSS protocols. The average energy consumption is more in AIES-RSS but in proposed the energy consumption is reduced and residual energy is more remains in network. The packet receiving percentage performance is also provides performance is favour of proposed scheme. The proposed approach is utilizes energy consumption efficiently and maintain strong connection in between sender to receiver.

The better signal strength is provides better performance. In future the same concept of Location based RSS is used for identifying the Sybil attacker presence in network. The Sybil attacker has multiple IP address for communication in routing layer. The misbehaviour of attacker is identified by the weak signal strength and also by particular original identification of mobile sensors. The performance of security scheme and attack effect is measure in static and dynamic network.

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