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Modified Convex Hull Algorithm for Recovering Smashed Wireless Sensor Networks

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ABSTRACT

Because of its minute form factor and also inadequate onboard energy, sensor nodes are prone to failure. As a component of two step network design, a set of relay nodes is supplemented into the sensor network to enable collating data from the sensor nodes. The sink is supposed to receive data from multiple relay nodes simultaneously. Thus will create a collision between the nodes and affect efficient data delivery in partitioned network. The primary aim of this paper is to examine an approach in order to restore unattended mobile sensor node from damage through the placement of relay nodes, mainly collects data without data traffic. This particular scheme introduces a convex hull algorithm to reestablish the connectivity in an unpredictable environment of large scale relay deployments. Such a topology reduces the delay and enhances performance and further avoids compromization. Efficiency of this recovery algorithm is proven through the simulation results.
Keywords: Convex Hull Algorithm, Sensor, Nodes Delay Wireless Sensor Networks.

I. INTRODUCTION

In a wireless sensor network, the structure of dispersed sensors are implanted in the physical world. The examination of the phenomena that were earlier not possible is permitted by this sensor networks. They are utilized in a vast array of domains such as research concerning habitation, environment, and examination of marine environment. Also in the field of engineering such as industrial and civil. Besides it is also utilized for military and commercial purpose concerning identification of objects and phenomena. However developing realistic and consistent sensor network systems is a huge impediment that needs to be overcomes. The challenges of the conventional embedded systems comprises scale, lack of resources and surroundings that are volatile for its operations. Amongst nodes there should be appropriate harmonization and fault tolerance.

The primary focus here is of fault tolerance. Sustaining application precision and accessibility despite the faults is a significant suggestion.

A node can be partly or entirely unresponsive on account of software bugs. Node malfunction, burst overlooking on links, segregation of network, and incidents of reconfiguration concerning node inclusion and removal are few network and hardware dynamics which can fully halt nodes or amend their program condition.

Suppose, a software program for vehicle tracking, wherein a set of nodes agreeably and repetitively refines their approximation of the existing position of a vehicle in motion. The resulting estimate can be erroneous if during the heart of computation one or more nodes ceases to function. It is due to the fact that only limited data from the operational nodes is utilized. Therefore, based on the level and position of failure, the program may be even incapable to configure an effective approximation even making it nonexistent. Failures of such nature are more common in sensor networks, wherein several nodes are bare to a changeable surroundings compared to conventional distributed systems.

Sensor nodes collates data and directs it to sink nodes in a sensor network. Directing multi-hop data by way of sensor nodes utilizing extended paths reduces the energy intensity of sensor nodes rapidly because energy consumption is the major impediment in sensor nodes. Therefore clustering the sensor nodes consisting of cluster head for each cluster is an innovative solution and can be named as a two tiered wireless sensor network. And these cluster heads can be considered as pillar nodes wherein every sensor nodes will direct data to the pillar node in their cluster. And by utilizing a communication channel non-identical to the channel used by sensor nodes, the pillar nodes form a backbone network among them and direct the data to the sink nodes by means of the backbone network. Normally when compared to sensor nodes, the pillar nodes possess superior energy levels and also have the potential to restore/recharge. Thus the problem of energy constraints of backbone/pillar nodes doesn't influence the process.

The sensor nodes may be positioned in group in such a way that few clusters are remote from one another. So in such situation, the positions of cluster-heads are beyond control. So constructing a backbone network among the backbone nodes is still required. And power control cannot be used to join them since backbone nodes can be very remote from each other.

For every backbone node, we suppose a predetermined transmission range. To reduce the threat of reduced degree connectivity and loss of coverage which may be caused due to a node which is defective, the network typically employ inessential nodes. So those nodes either act as a inactive standby or choose extra load in case of failure of some nodes. Particularly, this type of approach enables the tolerance of node malfunction in the course of network arrangement. Other approaches are more reactive involving altering the position of some nodes to reorganize the way in which the constituent parts in the network are arranged. But, taking into account the unwelcoming surrounding where WSNs function, occasionally, the network experience extensive damage involving many nodes. For example, in the aftermath of a heavy snow, storm, or other natural disasters some sensors may lay covered or can be damaged by the incendiary device of the enemy. During this kind of situation, the network may get segregated and its services would turn out to be restricted. In order to defy a notable structural damage, a provisioned tolerance or sporadic malfunction of single nodes at the network design level would render ineffective.

Also parallel alteration of the position of nodes will not be viable because of the disconnect of the network connectivity such that the extend of the damage will not be possible to determine and many nodes will fail to reach other nodes. Because of the fact that sinks are usually remote from data sources and sensor nodes possess restricted range of communication, the undeviating communication from data sources to sinks is considered not realistic. Therefore, establishment of wireless multi-hop course to direct data is required. However, sensor nodes concerned with data forwarding may take in huge amount of energy because of the transmission. This challenge can be countered by the two-tiered network model and can be considered as a framework that can be accomplished for sensor networks.

Fig.1 shows a two-tiered wireless sensor network and Fig 2 shows clustered two-tiered wireless sensor network in which the radii of dotted circles occurring mainly at relay nodes indicates the communication ranges of sensor nodes.

The figures indicate that sensor nodes are clustered and relay nodes act as cluster heads. With regards to energy storage, computing and communication potential, a relay node is more potent than a sensor node.

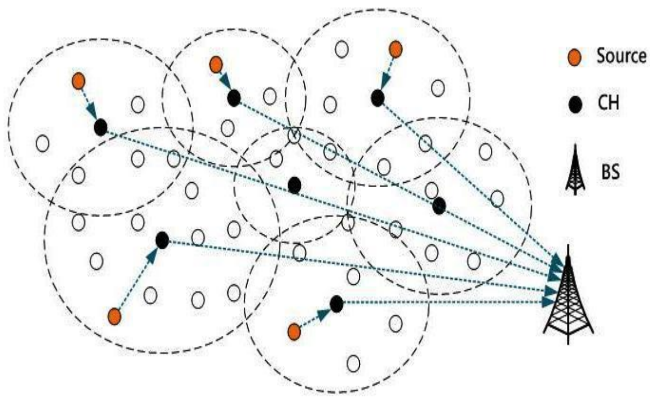

Figure 1 : A two-tiered wireless sensor network

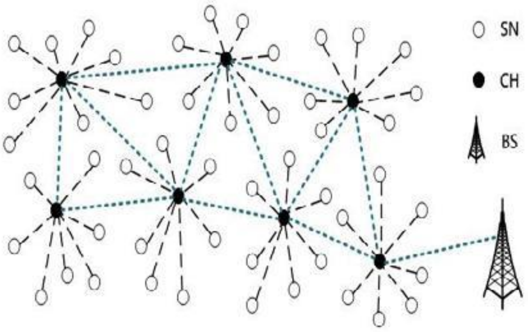

Figure 2 : Clustered two-tiered wireless sensor network

It can calculate valuable details and also eliminate idleness in data packets collated from sensor nodes in its cluster. Similar to sensor nodes, relay nodes may not succeed for many reasons. Inability of relay nodes to succeed may separate the network and impede the collated data from making it to the sink node.

Therefore sheltering of each sensor node by at least two relay nodes assures some amount of fault -tolerance in the network. As such each pair of relay nodes in the network is flanked by two course of node-disjoint. So even in case of failure of single relay node, there is possibility of sensor data to each the sink node. On account of the cost of RNs and the various limitations in assigning them, it is advantageous to curtail the calculation of the required nodes. Majority of the associated schemes found in the writing endeavor to create a Steiner minimum tree(SMT) f or the various segments (i.e., partitions) to form a path between each duo of division. SMT-base topology generally produces the least spanning tree making some nodes a hot destination with regards to the traffic load.

It also restricts the attainable network amount of materials flowing through and may cause the attainable internode association inadequate for particular application tasks. This paper is distinct from other schemes because the scheme it proposes enables to enhance the network interconnection and improve the load extension among the relays that are deployed. The simulation results establishes the performance advantages of the convex hull algorithm with regards to the necessary RN count and the value of service concern, which is evaluated by the standard node degree, path length that is anticipated and node coverage.

II. RELATED WORK

A sensor node has inadequate communication, energy and processing power. The task of the sensors is to provide the need of one or multiple in situ users. Sensors jointly search their background and advance the detection towards the interested user above a multi hop path [1]. For application-level communication and data routing, inter sensor connectivity is necessary. The WSN functions in ruthless surroundings, where sensors [2] in the nearness of an event are vulnerable to failure. The failure of many sensor nodes impedes the connection of the network since it breaks the arrangement of the constituent into remote parts hindering the operation. Therefore, it is paramount to recuperate from such damage. Fig. 3 shows an articulation

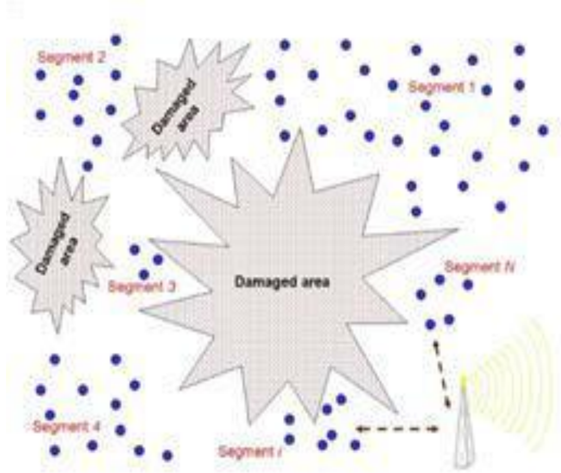

Figure 3 : Articulation of a damaged WSN that was partitioned into multiple disjoint segments

A relay is considered to be a more potential node possessing higher energy reserve and longer range of communication compared to sensors. Relays primarily carry out data aggregation and forwarding.

They are preferred in the recovery process, because it is les challenging to precisely lay them compared to sensors. In addition, their larger communication range enables and speeds up the connectivity restoration among the disjoint segments. The Fig 3 shows Articulation of a damaged WSN that was partitioned into multiple disjoint segments.

The amount of occupied relays must be reduced because of the fact that they are more costly. It is supposed that R is the communication range for all deployed relays. The distance between every pair of segments may be larger than 2R. Therefore, multi relay intersegment paths would be essential.

The concepts of latency, throughput and delay jitter were not the main concerns in majority of the published work because sensor network energy consideration has dominated most of the research in sensor networks. However, the transmission of imaging and video data needs cautious handling so that the end-to-end delay and the disparity in such delay are not beyond the tolerable range. Such performance metrics are generally referred to as quality of service (QoS) of the communication network.So, collating sensed imaging and video data need energy and QoS aware network protocols. This will guarantee the usage of thesensors in an efficient way and also proper admittance to the congregated measurements [3-4].

Concurrent target tracking in battle surroundings and evolving event triggering in monitoring applications are few among the many applications of QoS protocols in sensor networks. Let us suppose the following situation [5]: In order to recognize a target in a battle, imaging sensors should be deployed. Subsequent to locating a target using modern types of sensor such as acoustic, imaging sensors can be turned on to capture a picture of such a target occasionally for sending to the gateway. Real-time data swap between sensors and controller is paramount in order to take the proper actions because of the fact that it is a battle environment [6-8]. Providing such time-constrained data necessitates a definite bandwidth with least possible delay. Therefore a service differentiation mechanis m will be required to assure appropriateness.

III. PROPOSED METHODS

A. Modified Convex Hull Algorithm

Naturally, detection of nodes in near proximity to the network boundary is vital to efficiently setup and sustain the action of many sensor network procedure and applications. Many virtual coordinate constructions rely on the extreme set of nodes as signals and sensing applications may find useful the knowledge of the network edge.

This paper proposes local convex view (lcv) by which the nodes in near proximity to the network edge can be identified. It is inspired by the hypothesis that some structural information germane to the network is buried within few of many nodes. It is a localized algorithm which makes it different from others. Nodes using live may create neighborhood coordinates if no location information is accessible. In such cases where the required information is absent, we implement a simple probabilistic model to settle on the boundary status of a node.

The sensor nodes near the convex hull line join with and deliver data. The moving sensor nodes inside a cluster or segment closer to the hull are selected as cluster heads. It then collates information from all the surrounding nodes and forward to the sink which moves along the hull. This averts the chance of collision of no data forwarding by cluster heads from multiple segments. We identify the metrics for evaluation and compare via simulation the performance of lcv against the existing methods with similar properties.

In this algorithm, the recognition of a failed node directs to the communication links among non-failed actor nodes to be reconstructed via sensor nodes. Identifying a failed actor, selecting the shortest path, and forming the selected path through sensor nodes are the three parts of the mechanism. When actor neighbors of an actor node do not receive any response from that actor node, they consider it as failure. At this time, the neighbors of the failed node have to examine whether this failure has caused partitions. If there is no partitioning, then nothing is done except updating the neighbor lists in nodes. But, if there are some separated partitions then a new path should be selected and formed. We assume that each actor node has information about its instant neighbors (1-hop neighbors) and 2-hop neighbors (the neighbors of the neighbors). Depending on this information, non-failed actors can recuperate their communication links by detecting the failed (intermediary) actor.

These links are formed based on the node degree information (the number of immediate neighbors) and on the relative distance between actor nodes. This paper concentrates particularly on the self-recovery mechanism via sensors, due to lack of space. Our formalization shows that, given networks of sensors and actors, the actors can always reconstruct coordination links between themselves, by using local information and sensors as intermediate nodes. To establish this property, we model the network at three increasing levels of detail so that each model is a refinement of the previous one. In the preliminary model, we identify the actor network and the recovery mechanism of the direct actor links. In the model following the first, we add new data and events to model the list of 1-hop and 2-hop neighbors for every node and model the recovery via indirect actor links. Finally, we differentiate among sensorand actor nodes and their parallel networks and model the recovery via the sensor infrastructure. Here is the description of these three recovery models.

The problem will be defined and the convex hull algorithm heuristic for connectivity will be described.

- *Motivation and Problem Definition*

Securing the bandwidth desirable for accomplishing the required QoS is a classic subject for common wireless networks. Bandwidth restriction will be a burning subject for wireless sensor networks. Blend of real-time and non-real-time traffic can burst the sensor network traffic. What wil not be acceptable is allocation of available bandwidth solely to QoS traffic.

C. Node mobility:

Node mobility is another fascinating subject for QoS routing protocols. Majority of the existing procedures believe that the sensor nodes and the sink are at a standstill. But there can be circumstances such as battle environments where the sink and perhaps the sensors need not be fixed. As such, the energy of the nodes may greatly exhaust due to the regular update of the location of the command node and the sensor nodes and the propagation of that information through the network. Clever QoS routing and MAC protocols are needed in order to handle the overhead of mobility and topology changes in such energy-constrained environment.

D. Energy and delay trade-off:

The utilization of multi-hop routing is typical in wireless sensor networks. This is because the power of communication of radio is relative to the distance squared or even higher order in noisy surroundings or in areas that are not flat. Augmenting the number of hops diminishes the energy taken for data gathering. But the accumulative holdup in packet becomes larger. Packet line up dominates its dissemination delay thereby the increase in the number of hops can, not only lead to sluggishness in packet delivery but also the investigation and the management of delay-constrained traffic gets more problematic. So there is probability of QoS routing of sensor data sacrificing energy effectiveness to gather to the delivery necessities.

Furthermore, unnecessary routing of data can be eliminated to manage with the characteristic high rate of error in
wireless communication.

IV. METHODS AND PERFORMANCE

One of the primary issues in WSN design is device deployment. It regulates many inherent properties of a WSN, such as coverage, connectivity, cost, and lifetime. With regards to its impact on coverage and connectivity been examined.

However, what has not been addressed so far is the importance of deployment on lifetime in a haphazardly deployed network wherein device location cannot beaccurately identified. Some research have attempted to make effective use of the device placement with regards to system lifetime. But all these previous research assumed the relay nodes (RNs), or high profile nodes to be placed intentionally. A set of relay nodes is supplemented into the sensor network in order to facilitate data collation from the sensor nodes in the two tiered network framework. Inside a distance of T,a relay node can correspond with any sensor node. So it is said that a sensor node is covered by a relay node, when the relay node is inside its communication range. The communication range of each relay node enables to correspond with other relay nodes. It’s a spontaneous aim to add a lowest amount of relay nodes in a way that each sensor node is covered by some relay nodes and enables to accomplish the task of gathering data.

S = the set of sensor nodes;

F = the set of unchosen possible positions of relay node;
H =the set of chosen positions for relay nodes,
G' = (V, E), where (G') = F U H a n d (q, q ') ƐE, if and only if distance (q, q') ≤ R,

All the relay nodes should be in a position to correspond with one another through a multi-hop path because the gathered data reports must reach the sinks. Following the failure of one relay node, each sensor node should still be enclosed by some relay node. And multi-hop path must enable its correspondence between any two relay nodes.

This approach is substantiated by simulation. The research setup, performance metrics its conclusions are discussed in this section. In assessing the performance, the below metrics are considered.

A. Performance metrics:

These metric reports the total number of RNs required to restore connectivity. As mentioned earlier, RNs are generally more costly than sensor nodes. Thus, this metric reflects the cost of repairing the network. In all existing algorithms, the number of RNs almost linearly increases with the number of partitions.

In addition, with the increase in the number of partitions, the cost grows at a higher rate for Spider Web than the baseline approaches. The reason for the widened performance gap between 1C-SpiderWeb and the baseline approaches is that, in addition to establishing connectivity, it is necessary to create topologies with more features, e.g., node degree, path length, and recovery time. This metrics show the average number of neighbors for each node in the resulting topology. A higher node degree not only indicates stronger connectivity but helps in spreading the traffic to balance the load among nodes and reduce data latency as well. The performance advantage for convex hull algorithm is quite significant. Therefore, convex hull algorithm produces topologies with balanced traffics and reduced latency, load balancing, because it yields better connectivity.

The predictable path length among two chosen divisions are indicated in this metric. It is advantageous to choose a small path length since it will lessen the time taken for data transmission between partitions. This enhances the communication range and ultimately performs better.

This metric correspond to the time required to re-establish the link when a disseminated execution is sought. Here, the RNs are considered to be either portable or conveyed via a mobile robot for keeping them at the chosen place. For few vital monitoring applications such as border control, reducing the recovery time can be paramount. l. The results confirm that the recovery time needed for existing Spider Web concept is constantly shorter compared to the baseline approaches with the increase in partitions. It is due to the fact that Spider Web assigns RNs from the convex hull toward the center. Therefore, at some point within the convex hull there is the furthermost RN from the provider segment. Results confirm that communication range does not play a vital role for the recuperation.

A set amount of time needed for a signal to disseminate from every starting terminal to all ending terminals for a network is defined as delay constraint.

V. RESULT AND IMPLEMENTATION

To demonstrate this simulation setup, we assume that there are 250 sensor nodes in a round with a radius 90 meters. Randomly select one source and another one destination. After selection, it will follow as source and destination throughout the simulation. There is no peculiar way to follow the selection of source and destination. By using the Modified Convex Hull Algorithm, we will initiate the simulation. For data sending and receiving we will create some sort of key which is formulated by the source node. This will be recomputed in every intermediate node when data transfer is happening. If the acknowledge received from the intermediate node is evaluated by the source node using the identity of intermediate node with their pre-computed formulas. We have generated training data under various simulation parameters.

The mobile infrastructure is confronted by these attacks on Wireless Sensor Networks s wherein nodes can unite and depart without difficulty with dynamic requests devoid of a stationary routing course.

A. NS2 Simulator on Ubuntu

A distinct event simulator intended for networking study is known as 'NS2'. In order to simulate TCP, routing and

The Fig.5 illustrated as identifies the damaged nodes, here we are applied the Modified Convex Hull Algorithm, this algorithm is detect the damaged nodes.Event scheduler to list the events such as packet and timer termination. Centric event scheduler handles the events one at a time and multicast protocols over wired and wireless networks, Ns give considerable support. BasicallyNs- 2 is a centric distinct event scheduler to list the events such as packet and timer termination. Centric event scheduler handles the events one at a time and is unable to precisely imitate events handled simultaneously in the real world. Nevertheless, this is not a huge impediment in majority of the network simulations, since the events here are frequently temporary. Further, ns-2 executes diverse network mechanis ms and protocols.

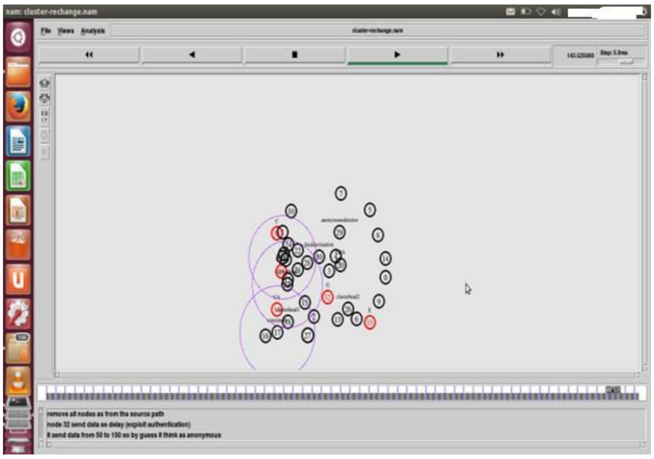

Figure 4 : Wireless Sensor Node Creation in NS2 Simulator

The Fig.4 shows using NS2 simulator created WSN nodes, here whatever nodes are moving to the origin it will form like cluster. Then one particular node automatically will take charge cluster head. This cluster head will identity the damaged nodes.

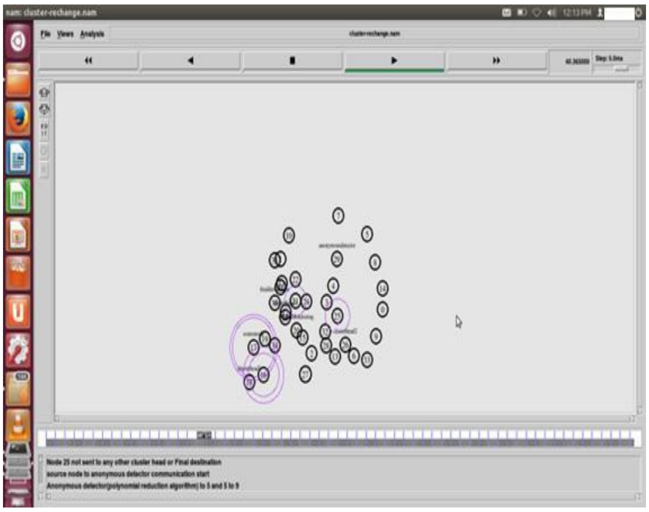

Figure 5 : Identifies the damaged nodes in WSN

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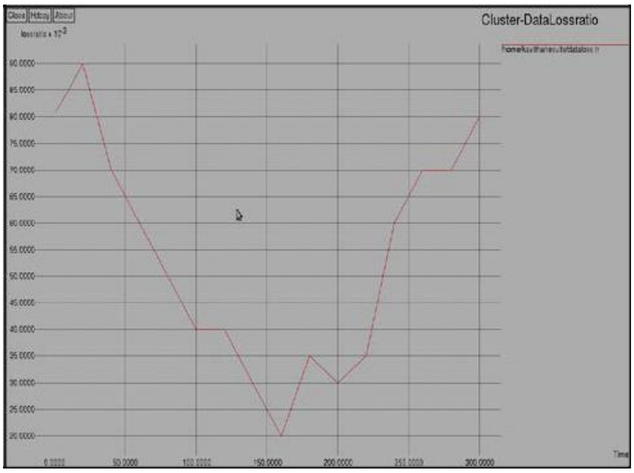

Figure 6 : WSN Cluster Data Loss Ratio

The Fig.6 illustrated as WSN cluster Data Loss Ratio, Loss is the number of nodes with number of the packet and time of travel. In this graph time is in x axis.

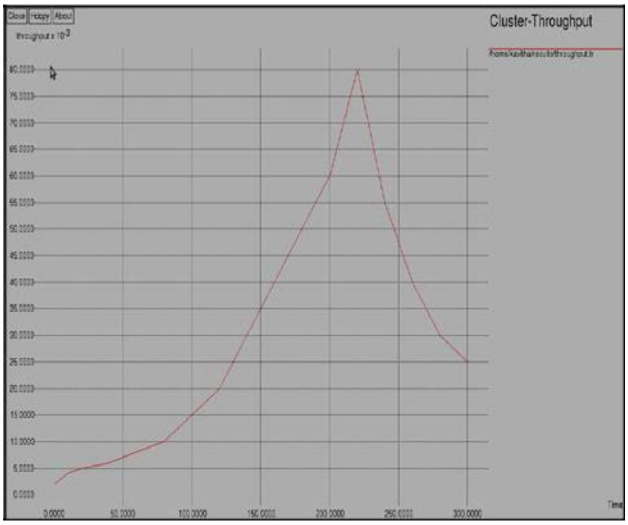

Figure 7 : WSN throughput

Fig.7 shows Convex Hull Algorithm describes about the cluster throughput. Loss is the number of nodes with number of the packet and time of travel. In this graph time is in x axis.

VI. CONCLUSION

In certain circumstances such as battle environments the sink and perhaps the sensors are required to be mobile. This creates data traffic as more than one node concurrently tries to create connection to the sink. The proposed approach introduces an automated self-segment sink node using convex hull algorithm. The self-segmented relay node collects data from the cluster heads closer to the convex hull and hence the traffic collision from multiple segments is minimized. Such a topology enhances performance and further avoids compromization. The simulation results have confirmed that the topologies created as a result of running the convex hull scheme decrease the average intersegment path length while increasing the network coverage and average node degree. As future work, we plan to extend our approach for overcoming buffer size limitation, supporting removal of redundancy, and to propose an energy-Aware QoS Routing Protocol to improve connectivity

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