Optimization of Enhanced Ant Colony Optimization Algorithm using Quad-Constrained FANTs and Multi-Criteria based BANTs in Mobile Adhoc Network

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ABSTRACT
Portable specially appointed system comprise of hubs that are versatile. The hubs are interconnected with no brought together control. The correspondence between the hubs is completed by utilizing the versatile hubs which are going about as switches. Steering in a versatile specially appointed system is critical issues. The greatest test in systems is to discover the way between the correspondence end focuses. MANET hubs working on battery attempt to seek after the vitality productivity by lessening the vitality they devoured. In this paper just utilize the idea of Nature Inspired calculations (Swarm Intelligence Technique, for example, Ant Colony Optimization calculation. Fundamentally the convention is in view of swarm discernment. It is utilized to take care of complex issues by participation. The principle objective of this paper is to diminish overhead, upgrade the vitality, end to end delay. This paper just presents the utilize the idea of quad-constrained FANTs and multi-criteria based BANTs to course the information.

Keywords
Swarm Intelligence, Mobile ad hoc networks (MANETs), Ant Colony Optimization algorithm (ACOA).

1. INTRODUCTION
Current situation in remote correspondence frameworks and difficulties in Data correspondence structures are making quickly and this conveys a degree of new challenges in steering [3]. MANET shaped by remote hosts which may be portable. As we know there is no prior framework. Versatile impromptu frameworks are constituted by remote portable hubs scattered without the need of predefined establishment; where every hub has the same level in the framework and they can go about as client or server. The hubs are allowed to join or there is no base. Remote frameworks are increasing persistent essentialness because of the organizations offered by the high advancement of the contraptions. There are a couple of issues of medium access, Productive steering, security and "Nature of Service" (QoS), Power organization. As the hubs think about over remote associations, all the centers must fight against the whimsical character of remote channels and interference from the additional transmitting center points. These components make it a testing issue to adventure on data throughput paying little respect to the likelihood that the customer obliged QoS in remote impromptu frameworks is accomplished. Courses between hubs might conceivably contain different trusts (Nodes goes about as switch to forward bundles for one another). Because of the spread of sensor contraptions, laptops, PDAs and other convenient electronic devices, specially appointed remote systems are extending in notoriety. So as to speak with each other without a framework to rely on upon, these contraptions need directing traditions that can work with no passage to interface with. Swarm knowledge has been utilized to tackle improvement issues in information systems. One such enhancement issue is directing where swarm discernment has been connected.

2. MOBILE ADHOC NETWORKS
Lately, huge changes have occurred in the innovation used to fabricate computerized gadgets, Micro-Electro-Mechanical Systems (MEMS) and remote correspondences. There has been an enormous measure of examination concerning directing in remote sensor systems. As correspondence between hubs is key to most procurements, steering in remote sensor systems is viewed as exceptionally basic. The fundamental structural planning of MANET comprises of hubs that are progressively self-composed into discretionary and interim system topology with no foundation help. The preference of utilizing MANET is to offer a substantial level of opportunity at a negligible cost in correlation to other systems administration arrangements. The simplicity and pace of organization of these systems make them perfect for recuperation after a common or synthetic fiasco, business partners imparting data amid a gathering or meeting, and military interchanges in a war zone. Versatile Ad-Hoc Networks are overseeing toward oneself and decentralized remote systems. MANETs include portable hubs that are permitted to move done and finished the framework. Hubs are the gadgets that are versatile and that take an interest in the systems, for example, cellular telephone, smart phone, individual computerized aid, MP3 player and PC. They can structure self-conclusive topologies relying on their incorporation with one another in the system. These centers are gifted to organize themselves and in light of this intriguing capacity, they could be passed on frantically without the need of any base. MANET may need to navigate numerous connections to achieve a destination. Versatility reasons course changes.

3. ROUTING PROTOCOLS IN MANETS
Steering is described as the demonstration of moving data from source to destination in a system. The essential destination of directing conventions is to minimize postponement, intensify the system throughput, amplify system lifetime and expand vitality effectiveness. Deciding ideal directing way and internetwork parcel exchange are the two fundamental exercises included in steering. Portable Ad-Hoc Network is the quick creating designing from the past 20 years. The increment in their commonness is as a consequence of the simplicity of sending, foundation less and their element nature. MANETs made an alternate set of solicitations to be completed and to give capable better end-

to-end correspondence. MANETs steering conventions are classified into three principle classes.

- Table driven/ Proactive
- Hybrid

Demand driven / Reactive

3.1 Proactive Protocols

Proactive protocols are also known as table driven protocols. Nodes in a mobile ad hoc network consistently evaluate routes to all reachable nodes and attempt to maintain consistent, up-to-date routing information using a proactive routing protocol. When a network topology change occurs, respective updates must be propagated throughout the network to notify the change. Routes to all destinations are maintained by sending periodical control messages. This type of routing protocols has its advantages and disadvantages. One of its main advantages is the fact that nodes can easily get routing information and it's easy to establish a session. There is unnecessary bandwidth wastage for sending control packets. Proactive routing protocols are not suitable for larger networks, as it needs to maintain route information every node's routing table. This causes more overhead leads to consumption of more bandwidth. Some protocols that are considered as table- driven are: Destination sequenced Distance vector routing (DSDV), Wireless routing protocol (WRP), Fish eye State Routing protocol (FSR), Optimized Link State Routing protocol (OLSR), Cluster Gateway switch routing protocol (CGSR), Topology Dissemination Based on Reverse path forwarding (TBRPF).

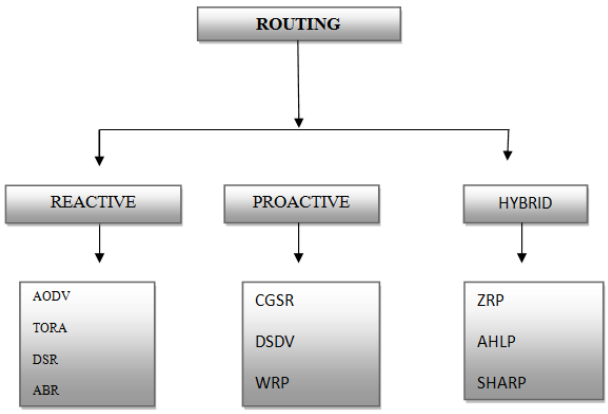

Fig. 1 Hierarchy of Routing Protocols

3.2 Reactive Protocol

Responsive steering conventions for portable specially appointed systems are alluded as "on interest" directing conventions. On-interest steering is a famous directing class for remote impromptu directing which gives a versatile answer for generally huge system topologies. The responsive conventions are alleviating the downside of proactive conventions since it spares the force which was unnecessarily utilized prior as a part of proactive conventions. In this configuration of convention it finds the course alertly. The hub correspondence begins with the start of a procedure called as course find transform in which the sending hub telecast course demand to its adjoining hubs and they will further proceed with and focus the course from the sending hub to the destination. The Reactive conventions are extremely favorable as they are data transfer capacity proficient. Dissimilar to the proactive conventions, the courses are made on interest just which brings about much movement overhead [1]. Diverse sorts of On- Demand conventions are: Ad hoc On Demand Distance Vector (AODV), Dynamic Source steering convention (DSR), transiently requested directing calculation (TORA), Associatively Based steering (ABR).

Comparison of Proactive Routing Protocols

Sr. No	Parameters	CGSR	DSDV	WRP	GSR	FSR
1	Route Selection	Shortest Path	Link State	Shortest Path	Shortest Path	Shortest Path
2	Route	Single or Multiple	Single	Single	Single or Multiple	Single or Multiple
3	Broadcast	Full	Full	Local	Local	Limited
4	Update	Periodic	Hybrid	Hybrid	Periodic	Periodic
5	Method	Broadcast	Broadcast	Broadcast	Broadcast	Broadcast
6	Loop free	yes	yes	Yes	Yes	Yes

Fig. 2 Comparison of Proactive Routing Protocols

Comparison of Reactive Routing Protocols

Sr. No	Parameters	DSR	AODV	ABR	TORA	SSR
1	Route Selection	Shortest Path	Link State	Shortest Path or Single Strength	Shortest Path	Stability or Associatively
2	Route	Multiple	Multiple	Single	Multiple	Single
3	Broadcast	Full	Full	Full	Local	--
4	Update	Event Driven	Event Driven	Event Driven	Event Driven	Event Driven
5	Method	unicast	unicast	Bro or Uni	Broadcast	Broadcast
6	Loop free	yes	yes	Yes	No	Yes

Fig. 3 Comparison of Proactive Routing Protocols

4. RELATED WORK

The fundamental key of Ant Colony Optimization is to looking the nourishment. In which most astounding pheromone level is best way to course. In BECA/AFECA [2] was one of the first papers to propose force spare convention. It proposed two basic conventions. the Basic-Energy Conserving Algorithm(BECA) and the Adaptive Fidelity Energy-Conserving Algorithm (AFECA), with AFECA being expansion of BECA that takes favorable circumstances of hub thickness to permit hubs in thick ranges to rest for more time of time. ACO [7] The quickly changing and eccentric nature of Mobile Ad-hoc systems. Its extensive variety of difficulties like productive steering, burden blockage evasion, vitality Consumption.

5. INTRODUCTION TO ANT COLONY OPTIMIZATION

As clarified by CH. V. Raghavendran[7], as of late, the enthusiasm of established researchers in ACO has been expanded. In view of strength, and versatile nature, ACO has at last figured out how to think that its applications in directing, task & planning. The essential thought behind burrowing little creature based steering calculation is nourishment seeking method of genuine ants. They assess unique courses as they begin looking sustenance from their home and walk towards the nourishment. The ants are considered as the little control parcels, appointed the undertaking to discover a way towards their destination and accumulate data about it. A state of ants has an extensive variety of obligations like gathering nourishment, building/guarding the home, evacuating the dead ants, and so

on and has basic balanced correspondence. The individual messages passed between ants are extremely immaterial, yet the aggregate messages help in composed work control of ants without the vicinity of a brought together control framework. Ants utilize a synthetic substance pheromone for correspondence among them which they store on the ground while meandering around for hunt of sustenance. Ants have capacity to smell this pheromone. They can deliver few diverse sorts of pheromones – typically one each to connote distinctive work classifications like gathering sustenance trails, implying crisis, moving dead ants, and so forth. The wellspring of ACO is the pheromone trail laying and taking after conduct of ants which utilize pheromone as a correspondence medium. The ants store pheromones on the ground while hunting the earth down sustenance. This pheromone draws in different ants and the ants have a tendency to take after trails of past ants. This system empowers the ants to discover most limited ways between the home and a sustenance source. There are risks that when ants fan out to discover nourishment, any ground dwelling insect discovers a short way to another sustenance source. It then brings some sustenance with it and goes again to the home. Since it is pulled in by its own particular pheromone trail, it is likely that the burrowing little creature tails its own way once again to the home, consequently leaving a second pheromone trail. On the off chance that different ants happened to take a more drawn out way to the sustenance source, they land after the first ground dwelling insect and, when attempting to go once again to the home, there is a decent risk for them to be pulled in by the short way, where two pheromone trails have been laid. This strengthens the short way significantly more and makes it more appealing. Concerning the more extended way, pheromones have a tendency to dissipate after sooner or later, so over the long haul the long ways will be overlooked and pretty much all ants will take the short way. The qualities of ants are like the attributes of MANETs. This helps us to apply the nourishment hunting qualities of ants down steering bundles in MANETs. The essential standard of a burrowing little creature steering calculation is chiefly the saving of pheromone on the way emulated by the ground dwelling insect. They take after basic standard of emulating the way which has higher centralization of pheromone. The pheromone focuses on a way permit alternate ants to discover some way or another to the sustenance source. Subsequently more ants take after the same way and more pheromone is saved on the way which is the most limited course to the sustenance source.

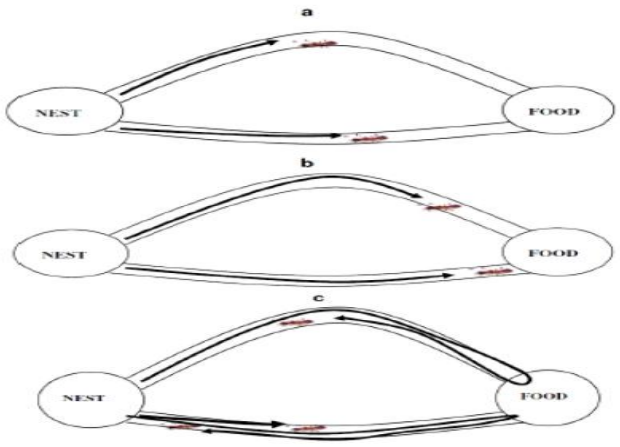

Fig.4 Basic Ant Routing Principle

6. PROBLEM FORMULATION

Nature inspired routing protocols have been becoming the focus of research because they achieve the complex task of routing through simple agents which traverse the network and collect the routing information in an asynchronous fashion. In mobile ad hoc networks the on demand multi-path routing protocols addresses certain issues such as message overheads, link failures and node's high mobility. More message overheads occur due to increased flooding. Packets are dropped by intermediate nodes due to frequent link failures. Moreover the overall throughput and the packet delivery ratio are reduced in high mobility scenarios [23]. Energy consumption is the most challenging issue in routing protocol design. In ad hoc networks mobile devices are battery operated and the battery technology has not been enhancing that well. Therefore power consumption is likely to remain an issue in mobile wireless network routing. The overall lifetime of the entire ad hoc network can be increased by improving the power consumption balance among nodes and the network connection. In most of the existing protocols, a mobile node may consume all its energy to participate in the operation without considering the remaining energy.

7. EXISTING APPROACH

In existing methodology Source Broadcast forwards ants in all the directions to find a route to destination. The intermediate nodes re-broadcast these forward ant agents until they reach the destination. Forward ants upon reaching the destination calculate the pheromone level for all the paths. They get converted to backward ant agents and reach the source. In last source chooses the path having highest pheromone level.

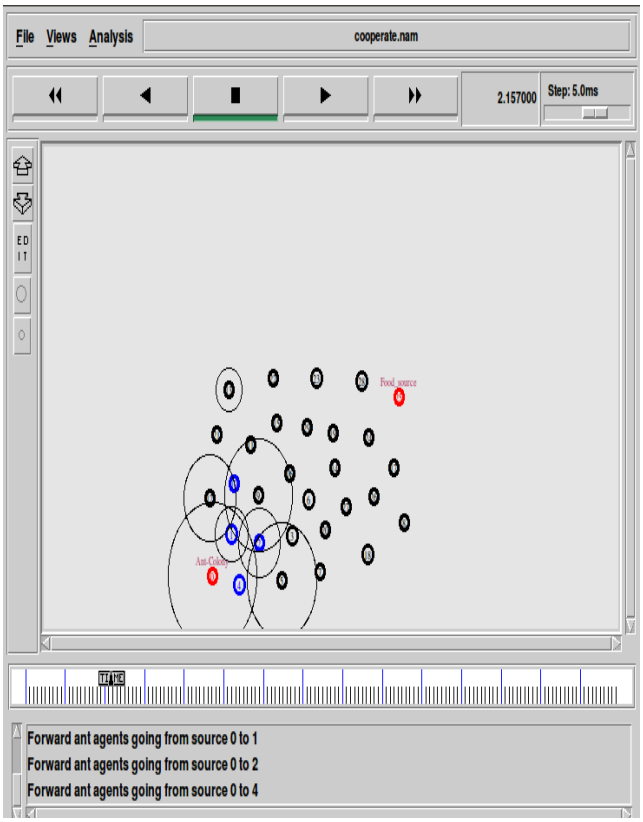

Fig.5 Existing ACO Algorithm

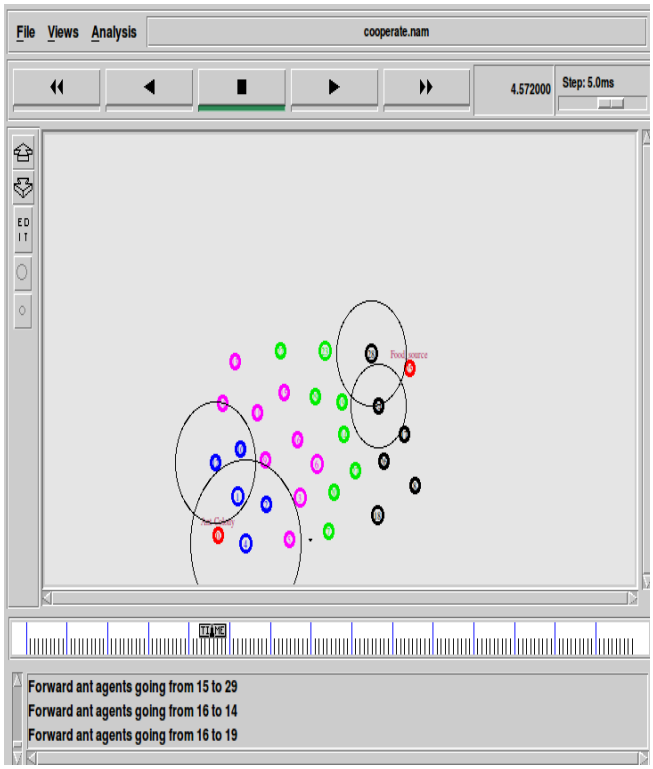

Fig. 6 Packet Dropped

In fig.6 Whenever data is sent through nodes from one source to destination sometimes some packets are destroyed or dropped.

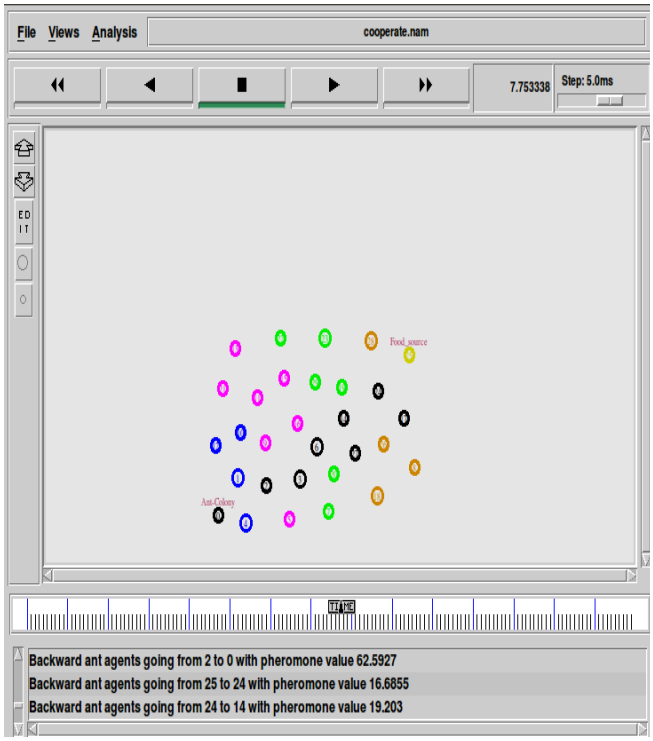

Fig. 7 Shortest Path Decide(Black Dots)

Above figure demonstrate nodes communicate each other and sends the data to the neighbor nodes. So in which data fastly send to the neighbor nodes. Finally it will be decided the shortest path.

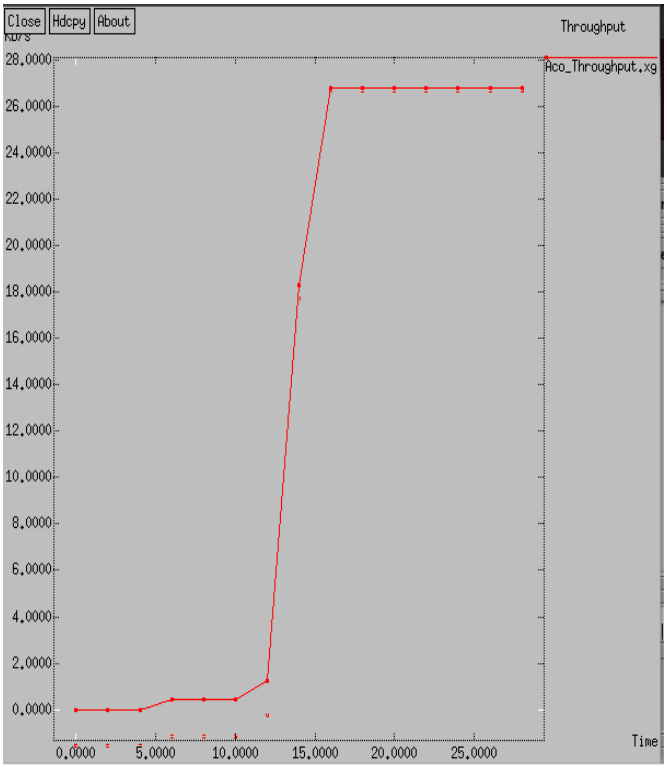

Fig. 8 Throughput

Above chart demonstrates the throughput. Throughput is measure of the information that is gotten at the destination in the system.

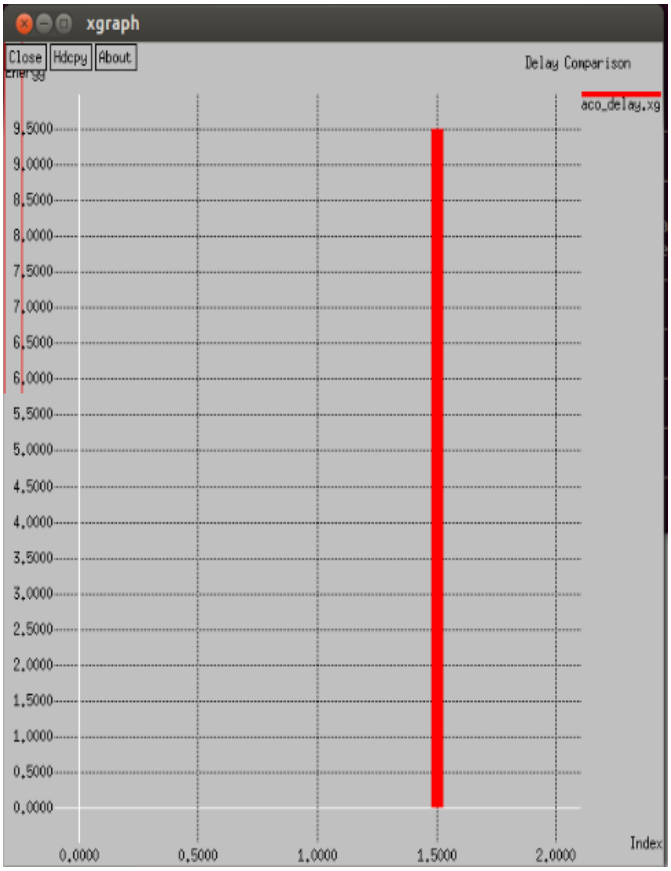

Fig. 9 Delay

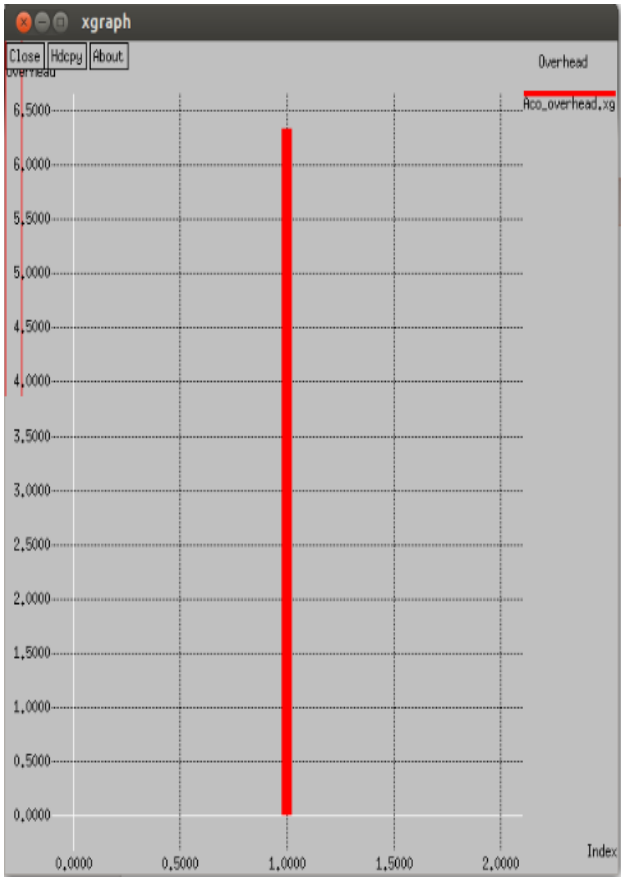

Fig.10 Overhead

In Fig 10 when multiple packets send through nodes . source to destination increases the overhead.

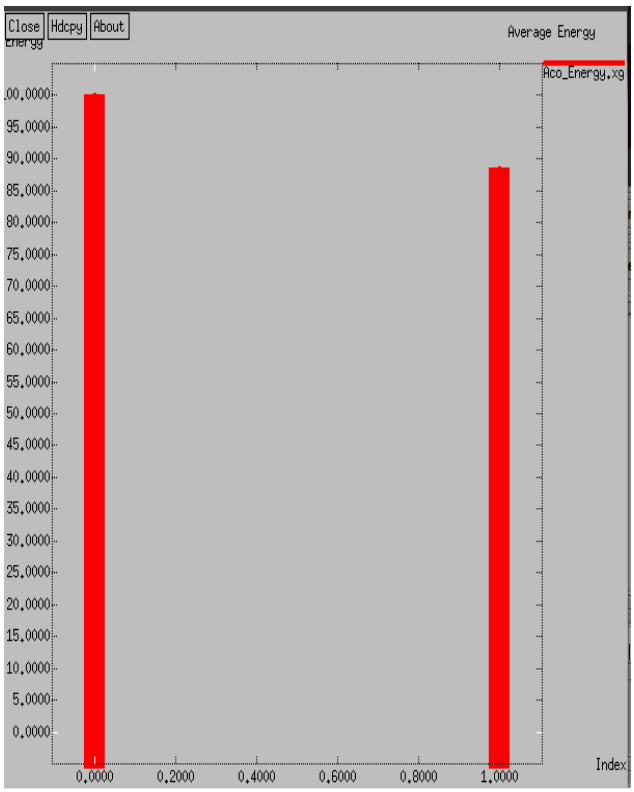

Fig. 11 Average Energy

7.1 Existing Methodology

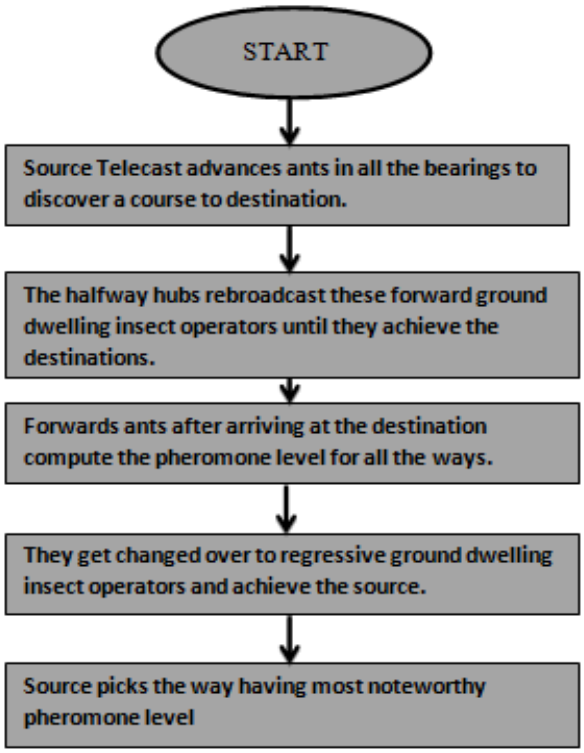

Fig12:- Flow chart of Existing Approach

Current research on routing in mobile ad hoc networks mostly focused on protocols that are energy aware to maximize the lifetime of the network, possess scalability for enormous sensor nodes and tolerant to sensor damage and battery exhaustion. To achieve an efficient and robust routing operation, major features of typical mobile ad hoc networks should be taken into consideration. As nodes are often located in unattended places and they use a limited power supply, the chances of occurrences of failures are more in communication nodes in mobile ad hoc networks in comparison to classical networks. Therefore the network should not be affected by a node's failure and should be in an adaptive structure to maintain the routing operation.

It is utmost crucial to consider the energy efficiency of the underlying algorithm while designing a protocol, as such networks has strict power requirements. Swarm intelligence-based routing which utilizes the behavior of real biological species searching for food through pheromone deposition while dealing with problems that need to find paths to goals has been proposed to deal with some of the challenges of the mobile ad hoc networks .The ability of social insects to self-organize relies on four principles: positive feedback, negative feedback, randomness, and multiple interactions.

Burrowing little creature steering essential guideline can be characterized as:

1. Each one system hub sends various revelation bundles - forward ants (F-ANT) towards the chose destination hubs of the system.

2. The stochastic tables supplant the steering at every hub keeping in mind the end goal to pick next jumps according to the weighted probabilities accessible.

3. The directing tables are changed for choice of the following hub in the system.

4. At the point when forward ground dwelling insect (F-ANT) achieves the destination hub, it creates a retrogressive burrowing little creature (B-ANT) and after that kicks the bucket. Thus in MANETs directing, the new parcel made and sent again to the source will engender through the same way chose by the forward burrowing little creature (F-ANT).

5. Presently regressive burrowing little creature (B-ANT) stores pheromone on the crossed connections. It implies that it redesigns the steering table of the hubs along the way took after by forward burrowing little creature (F-ANT).

6. After landing to the source hub, the retrogressive ground dwelling insect (B-ANT) kicks the bucket [7].

8. PROPOSED APPROACH

In the proposed study every we will likewise utilize the idea of quad constrained television strategy, where the FANTs will be shown by each one halfway hub amid the course arrangement transform in a specific quadrant towards the destination. This will be upgraded course revelation system. By this strategy, the hubs abstain from television the FANTs in all the bearings towards the destination. So our study will primarily concentrate on the constrained TV and multi-criteria (pheromone to cost degree) in the development of the way from source to the destination so as to enhance the execution of the system.

In our study we take the ratio of the pheromone value and the cost value (based on the residual energy of the nodes) of the various paths traversed from source to destination. The highest ratio value path will be selected by the backward agents in routing.

8.1 Proposed Methodology

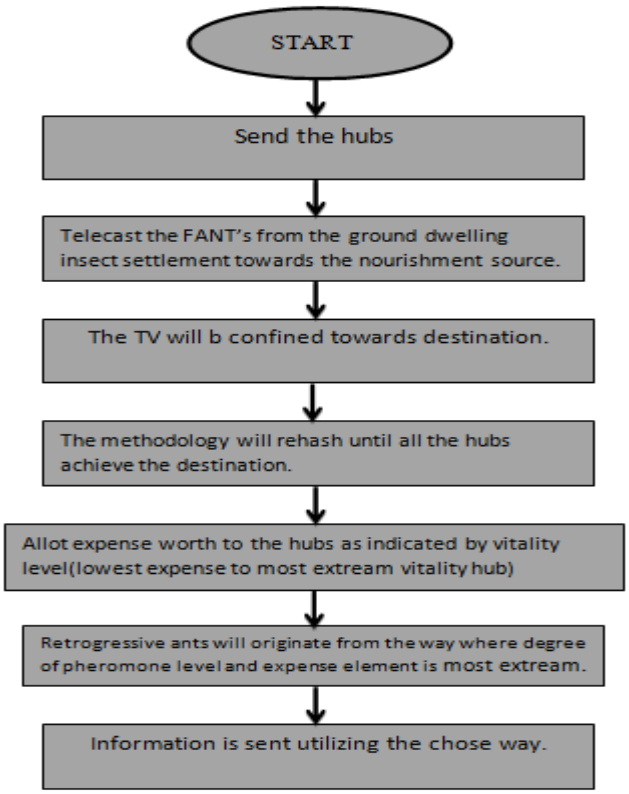

Fig13:- Flow chart of Proposed Approach

9. SIMULATION AND RESULTS

In this section, the proposed method has been simulated in NS2.35 and the simulation results are presented. The below graphs show the comparison of the energy consumed in ACO and proposed work. Initially 100 joules of the energy was supplied to the network and after the data is sent through selected path, it was observed that energy consumed in proposed approach is less in comparison to energy consumed in ACO.

9.1 Graphical Analysis

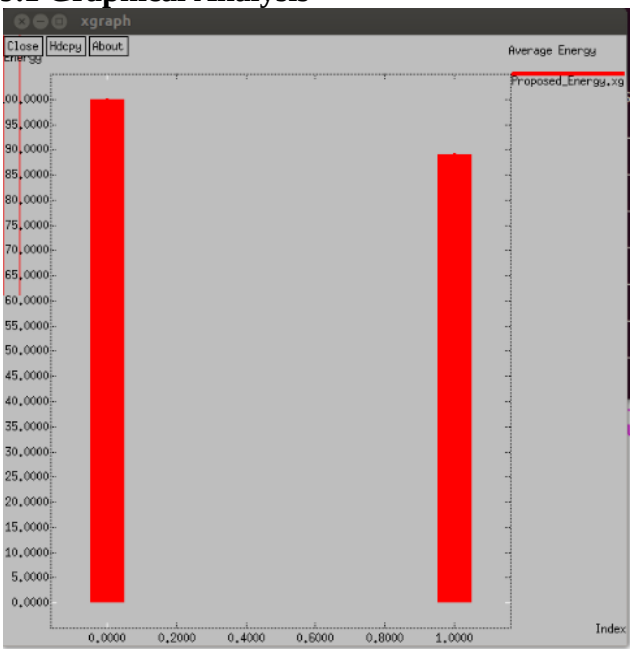

Fig.16 Energy

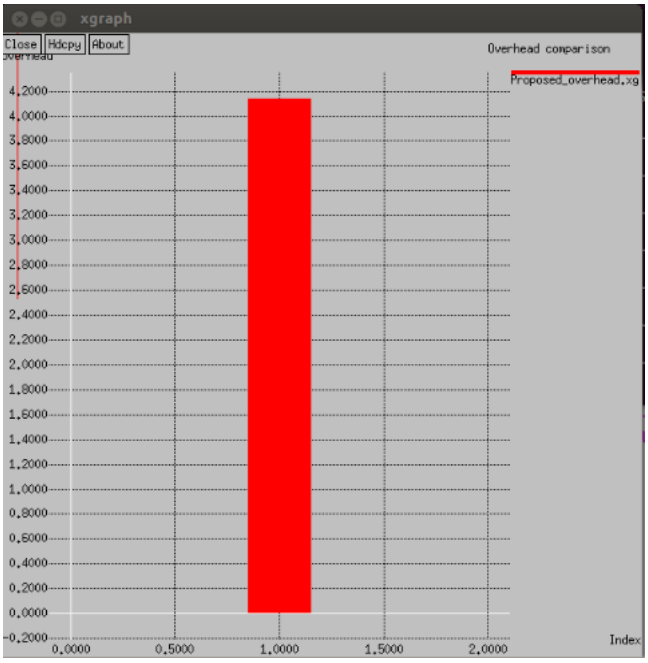

Fig.14 Overhead

At whatever point the information is sent from any hub, it adds a header on the bundle. More the steering parcels being sent in course revelation period of the system, more is the directing overhead. The steering overhead for any system ought to be less.

$$\text{Overhead} - \frac{\text{number of routing packets sent}}{\text{Number of data packets received}}$$

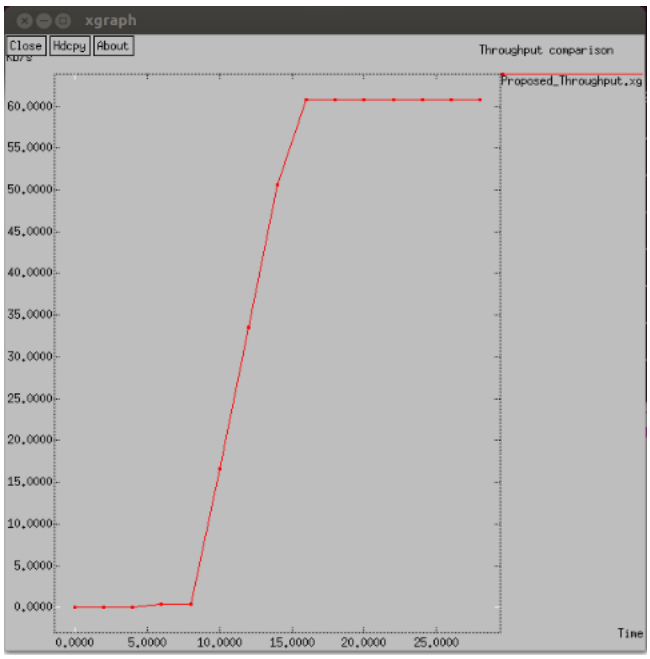

Fig. 15 Throughput

Throughput is measure of the data that is gotten at the destination in the framework. More the throughput better is the execution of the framework. Since throughput in proposed arrangement is 62Kbps and is 27Kbps in ACO, so it is exhibited that proposed arrangement performed better than ACO

$$\text{Throughput} - \frac{\text{Number of packets * packet size}}{\text{time}}$$

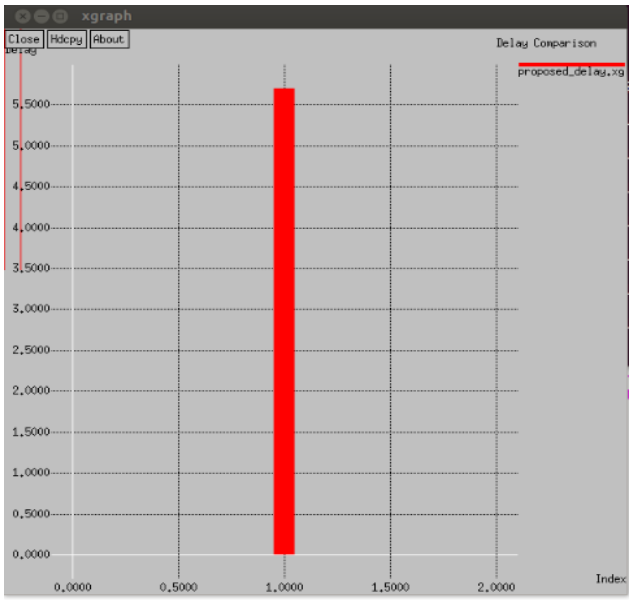

Fig. 17 Delay

This outline shows the deferral examination. Lesser the deferral, better the framework's execution.

Fig: 18 Remaining Average Energy

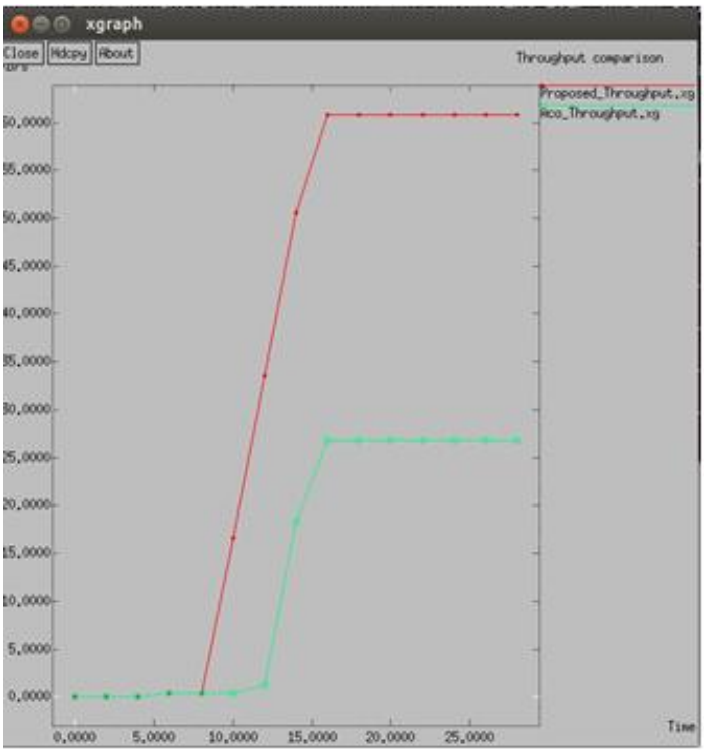

Fig:19 Throughput

Above chart demonstrates the throughput correlation in the middle of ACO and proposed methodology. Throughput is measure of the information that is gotten at the destination in the system. More the throughput better is the execution of the system. Since throughput in proposed plan is 62Kbps and is 27Kbps in ACO, so it is demonstrated that proposed plan performed better than ACO.

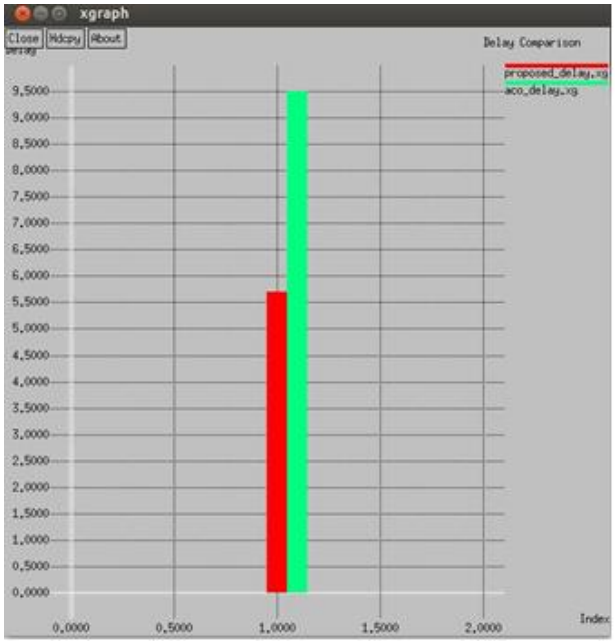

Fig:20 Delay

This fig demonstrates the deferral examination. Lesser the deferral, better the system's execution. Proposed plan demonstrates the deferral of approx 5.7 sec while the postponement on account of ACO was around 9.5 ms.

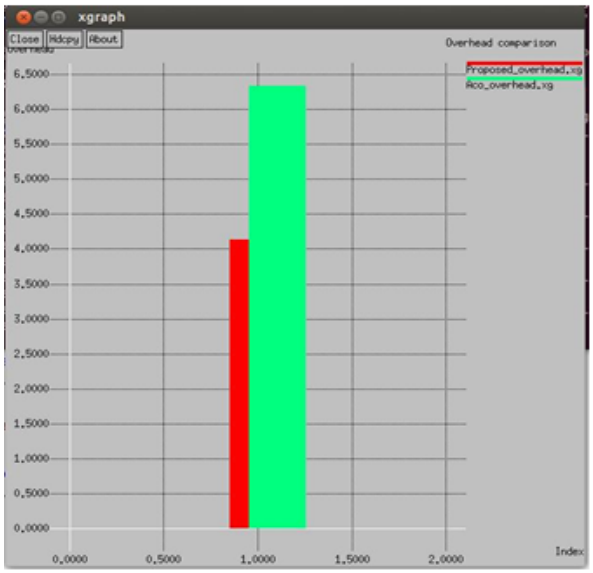

Fig:-21 Overhead

Whenever the data is sent from any node, it appends a header on the packet. More the routing packets being sent in route discovery phase of the network, more is the routing overhead. The routing overhead for any network should be less. Proposed approach exhibited less routing overhead than the ACO.

9.2 Simulation Set up

Table:- 1 Parameters values of ACO and EACO

Parameter	Value
Simulator	NS2.35
Number of Nodes	30
Channel	Wireless
Propagation Model	Two Ray Ground
Queue	Drop Tail
Antenna	Omni Direction
Area	1100*1100
Initial Energy	100 J
Energy Model	Radio dissipation Energy

10. CONCLUSION

The exceedingly fast topology of Ad Hoc frameworks and their limited transfer speed makes the directing assignment more troublesome. The work mirrors the thought that by utilizing the straightforward conduct of ants and honey bees streamlining and advancements in directing conventions could be possible, that help outflank the standard MANET steering conventions like AODV. We reproduced both Proposed plan and the ACO and looked at the execution of both the conventions. The different execution parameters considered for the correlation are- vitality utilization, throughput, overhead and the postponement. Proposed plan showed the preferable execution over ACO. This segment concentrates on guaranteeing future examination headings in light of our flow research. Then again, we might further want to extend our exploration and apply proposed plan in mix with hereditary calculations to improve the execution of the system.

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