International Journal of Advance Research, IJOAR .org
Volume 3, Issue 11, November 2015, Online: ISSN 2320-9194

A STUDY OF SWARM INSPIRED ROUTING PROTOCOL FOR WANETS

Er.Gaganjot Kaur, Er.Sandeep Kad

Er.Gaganjot Kaur, Mtech Scholar (CSE), Amritsar College of Engineering and Technology, PTU University, Amritsar, er.gagan.acet@gmail.com
Er.Sandeep Kad, Associate Professor (CSE), Amritsar College of Engineering and Technology, PTU University, Amritsar, sandeepkad@acetamritsar.org

Keywords
WANETS, Routing Protocols (AODV, AOMDV, DSR, DSDV, BEEIP), ACO, BCO, Swarm Intelligence.

ABSTRACT

Wireless networking technology is evolving being a cheaper alternative for building federated and community networks. Besides its cost-effectiveness, a decreased profile network brings operational efficiencies, namely mobility to the end user. An Ad-Hoc network generally supports multi-hopping, certainly where a data packet may travel over multiple hops to achieve its destination. The best way to route packets efficiently in wireless networks is actually a problem. Many different wireless routing solutions have been proposed up to now to increase the quality of service. This paper presents a survey around the number of the popular routing algorithms proposed for wireless networks. In a wireless network, routing algorithms are differentiating into various categories like Geographical, Geo-casting, Hierarchical, Multi-path, Power-aware, and Hybrid routing algorithms. The general objective of this paper is to study Swarm Intelligence based routing protocols especially Bee-Inspired based routing protocols for providing multipath routing in Wireless ad hoc networks (WANETs). WANETs influence an agent-based routing protocol that defines a no of rules including that many of the participating nodes follow. Using routing technique, nodes are interconnected with each other so because of this reduces computational and resource costs. Swarm Intelligence uses agent-like entities from insect's societies being a metaphor to mend the routing problem. Various insects interchange details associated with their activities been performed along with the environmental surroundings in which they operate so that to complete their tasks inside an adaptive, efficient and scalable manner. The general objective of this paper is to research the limitations of swarm inspired routing approaches for mobile Ad hoc networks. To get the objectives the comparison is drawn some recognized swarm intelligence based techniques. Comparison has clearly shown the fact that virtually no technique is good for all issues of MANETs.

I. INTRODUCTION

1.1 Wireless Ad hoc Network

An Ad Hoc network could be the network connection that is accumulates for single session of communication between two entities. The Ad Hoc network isn't making use of a router or a wireless base station. They may be formed without getting a central administration therefore the nodes transmit packets on the behalf of other nodes. [8] If you want to transfer your personal files through your mobile to your friend's laptop, you make use of Bluetooth. In this particular communication session, Bluetooth acts just as one Ad Hoc. It takes no router or a wireless base station. Mobile ad-hoc sites can run in a very standalone style or may very well be placed on a more substantial network like the Internet. Mobile ad-hoc sites can customize the desire of getting connected "everywhere and whenever they want" into reality. A Mobile Ad hoc Network is a pair of independent mobile nodes that may communicate together via radio waves. The mobile nodes that are in radio choice of the other can directly have a wireless interface to talk with each other. Figure.1 shows a simple ad-hoc network with 3 nodes. Node1 and node3 aren't within choice of the other; however node2 permits you to forward packets between node1 and node2. The node2 will become a router these three nodes together form an ad-hoc network. [27]

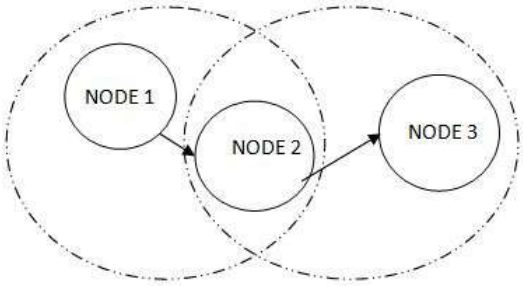

Figure 1: MANETS

1.2 Features Of Mobile Ad hoc Networks

1) MANETS are the wireless communication network in which nodes are not in the direct range of each other.
2) They separately establish their communication by using the different nodes to forward the data between them.
3) They will occur without any fixed infrastructure and also comes under the multi-hop wireless networking.

1.3 Characteristics Of MANETS [27]

i. **Distributed operation**: There is no background network for your central power over the network operations; the power over the network is shipped one of the nodes. The nodes involved in a MANET must cooperate jointly and communicate among themselves and every node shifts when needed, to employ specific functions including routing and security.

ii. **Multi hop routing:** Whenever a node efforts to send information to other nodes which may be out of its communication extent, the packet need to be transport via a number intermediate nodes.

iii. **Autonomous terminal**: In MANET, every mobile node is an impartial node, which could act as both a host and a router.

iv. **Dynamic topology**: Nodes are liberated to move arbitrarily with different speeds; thus, the network topology may alter randomly as well as at unpredictable time.

v. **Shared Physical Medium**: The wireless communication medium is obtainable to any entity with the correct equipment and adequate resources. Accordingly, admittance to the channel cannot be restricted**.**

1.4 Routing In Wireless Ad-Hoc

The connectivity and routing with the Ad-Hoc and the Infrastructure-based networks depend largely on different facets of the network functionalities. In combination with maintaining connectivity, the consumer with the Ad-Hoc network may well perform routing. A great routing solution needs the characteristics of being decentralized and self-healing. Routing is considered decentralized when routing decisions are the responsibility of each and every node (router) separately, according to some certain pre-approved protocol between these nodes. Self-organization is an operation of evolution where the introduction of an alternative and complex structure happens primarily in and via the system itself. Power awareness is extremely important inside of a mobility-based wireless network, particularly within the Ad-Hoc network, where nodes could decrease their power consumption to raise their battery lifetime generally if the nodes typically are not connected to some power outlet. In these cases, the communication power should really be carefully chosen ever since the decrease in the transmission power level can lead to a decrease in the space which your node can cover or what is called ‘‘communication range' . Thus, a node could not be able to directly hook up with other distant nodes with the network, which alter the principle of multi-hopping to be able to carry traffic among various pairs of nodes.

Figure 2 shows a wireless Ad-Hoc network, in which every node (end-user node) is capable of forwarding the data packets for other nodes. The biggest objective associated with the Ad-Hoc network is almost always to keep up with the node's connectivity and reliably transport the data packets. Additionally, each node dynamically determines its next hop using the network topology. One of the types of Ad-Hoc network may be the Mobile Ad-Hoc Network (MANET). MANET is usually a self-assemble network of mobile which could form a dynamic topology. The topology from the wireless network may change

rapidly and unpredictably. Such a network may operate at a standalone fashion, or may be connected to the rest of the Internet.

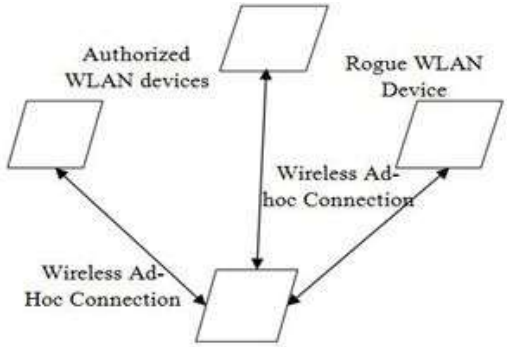

Figure 2: Wireless Ad hoc Network

II. ROUTING PROTOCOLS

Routing is the fundamental part of any ad hoc network that is responsible for balancing load between the source and the destination. It is a mechanism of finding a suitable route between the source and the destination in order to send the packets between them. They are split into two basic types which are [32]:

1) Static Routing: Static Routing is the type of routing which is done manually by the administrator. Administrator personally assigns the route to send the packet in the network. From this it has been concluded that the source and the destination are fixed during the whole transaction. Here the router is not responsible for building a routing table.

2) Dynamic Routing: Dynamic routing is the routing technique which is responsible for building and exchanging the routing table information. It is much more flexible than the static routing since it detects congested paths. It comes under the following three categories:[32]

a) Reactive Protocols: They are also called On Demand routing protocols because it does have any prior knowledge about the routes between the nodes until the source node sends a Route Request to the destination node. They are used to reduce the no of control overhead by determining routes to a destination whenever required. This can be achieved by a process called two-phase route discovery which is initiated by source node. This includes Route Request Packet (RREQ) and Route Reply Packet (RREP).Ad hoc On-Demand Distance Vector Routing Protocol (AODV) is an example of on-demand protocol. Ad hoc On-Demand Multi–path Distance-Vector (AOMDV) is also a multi-path extension to AODV. DSR is also a reactive approach which is used to reduce control overhead in the existence of high rates of node mobility.

b) Proactive Protocols: It is the first step in designing the routing protocol. They include two protocols DSDV and GSR which are used to maintain the routes to all nodes within the network. DSDV is considered to be the de facto standard in the area of proactive routing in MANETs. They contain full information regarding the routes between each pair of nodes whether the nodes need to send data or not. This lead to disadvantage of having lack of scalability and large no of overhead. This can be removed by introducing two protocols i.e. OLSR and TBRPF by reducing the no of re-broadcasting nodes in the network.

c) Hybrid Protocols: It is a combination of both reactive and proactive protocols to utilize the advantages of each of them. The most popular example of the hybrid routing is Zone Routing Protocol (ZRP). In these routing protocols all the network nodes are divided into zones. The nodes lying under the same zone taken as the proactive protocol where as the nodes lying under the different zones taken as the reactive protocols.

III. SWARM INTELIIGENCE TECHNIQUES

It is an artificial intelligence (AI) technique based on the collective behavior in decentralized, self-organized systems. It is a promising research on 'ants' behavior in which many ants are blind and communication between them is based on adoption of chemicals like substance known as pheromones, produced by the ants and deposited on the paths while walking in search of food [14]. With the help of this sensing pheromone trail forgers can easily find their paths to food which is discovered by other ants. The most popular example of swarm intelligence technique is the Swarm of Bees. The two most common SI Algorithms are:

3.1 Particle Swarm Optimization

Particle swarm optimization (PSO) is a population based stochastic optimization technique which was inspired by social behavior of bird flocking or fish schooling. PSO optimizes the problem by using a population of candidate solutions. The particle's position and velocity is specified by the dubbed particles and also by moving these particles around the search space based on simple mathematical formulae. Every particle's movement is integrated by its local best known position but it also focused on the best known position in the search space which results as a better position found by another particles. A simple variant of the PSO algorithm is work upon the population of the candidate solution which is known as a particle's. These particles are moving across the search-space based on simple formulae. The motion of the particles is controlled by

their own best known position in the search-space as well as the entire swarm's best known position. The usual PSO contributes a swarm of S potential solutions, taken as particles, which fly by using a D-dimensional problem space hunting for the worldwide optimum position which makes the best fitness of a target function. Initially, each particle i is randomly assigned a position x_{id} and also a velocity v_{id} i= (1, 2, ….S) where d= (1, 2, …. D), each particle keeps track of its personal best position pbesti and the worldwide best position on the whole swarms gbest.

PSO Algorithm

The PSO algorithm contains the following steps: [38]
1: for each particle do
2: initialize particle
3: end for
4: while target fitness or maximum epoch is not attained do 5: for each particle do
6: calculate fitness
7: if current fitness value better than (pbest) then
8: pbest¼current fitness
9: end for
10: set gbest to the best one among all pbest
11: for each particle do
12: update velocity
13: update position
14: end for
15: end while

How Velocity & Position Is Calculated

After calculated the two best values, the particle i updates both its velocity and position repeatedly by using the equation (1a) & (1b) respectively.

v_{id} (t+1)= w * v_{id}(t) + c1*r1*(pbest i(t)- x_{id} (t)) + c2 * r2 *(gbest(t)- x_{id}(t)) (1a)

x_{id} (t+1)= x_{id} (t) + v_{id} (t+1) (1b)

Here, r1 & r2 indicates the random variables between [0, 1]
C1 & c2 indicates the learning factors
w indicates the Weight factor that helps to control the velocity of the particle.

3.2 Ant Colony Optimization

Ant Colony Optimization (ACO) is actually a routing technique currently in use to find the shortest path between two nodes. Ants have applied successful routing to find the shortest path between the food sources and their nest by means of a pheromone trail laid by way of the other ants. This is known as a stigmergy and Ant Colony Optimization routing [33]. ACO is actually a swarm intelligence based optimization technique whose main objective is to find the shortest path between the source node and the base station as well as to maximize the network lifetime. An asynchronous agents or ants are combined to produce a partial solution while moving the various states of the problem. Each ant while travelling incrementally generates a solution for the problem. When final solution is generated, the trail information of the components is altered by the ants by evaluating the clear answer that'll influence the issue solving mechanism of future ants. In the ACO algorithm you will find two more mechanisms i.e. trail evaporation and daemon actions. Trail evaporation is employed to decrease trail value with respect to time. As we know in WSN, energy is just a major concern. So ANT technique is employed to offer minimum cost path for energy. Figure 3 shows the basic working of the ACO algorithm.

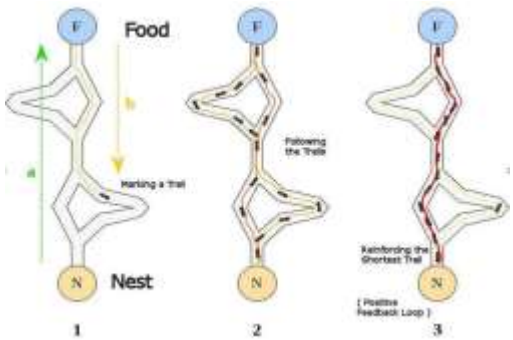

Figure 3: Working of Ant Colony Optimization

Basic ant based routing for wireless sensor network

ANT technique is mainly used to resolve the optimization problem. Implementation of ANT NET algorithm can be defined as:
1. Every node launched the forward ant over the network at a specific instant of time whose main objective is to find the path. The history of each and every node is identified by an ant and stored in a memory Mk.

2. For choosing the next node, initial node 'r' follows the same approach similar to ACO.

$$p_k(r,s) = \begin{cases} \frac{[T(r,s)^{\alpha}][E(s)]^{\beta}}{\sum \mu \epsilon M_k [T(r,\mu)]^{\alpha}[E(\mu)]^{\beta}} & \text{if } s \neq M_k \\ 0 & \text{otherwise} \end{cases} --(\text{I})$$

Here, $p_k(r,s)$denotes the probability of selecting a particular path, T denotes the storage of pheromone data of path(r,s), E denotes the visibility and expressed as:

$$\frac{1}{C - e_s} \quad ---(\text{II})$$

Here, C denotes the initial energy

Es denotes the actual energy of node

α, β: Denotes the control trails and visibility parameters

3. Now forward ant gets changed to backward ant which updates the pheromone data.

4. The total amount of pheromone data dropped by ant is calculated at the destination is expressed as:

$$\Delta T_k = \frac{1}{N - Fd_k} \quad ---(\text{III})$$

Here, N denotes the no of nodes;

Fd_k : denotes the total no of nodes transmitted by the forward ant.

5. The pheromone data can be updated by the backward ant while reaching a particular node and is expressed as:

$$T_{k(r,s)} = (1-\rho)T_k(r,s) + \Delta T_k ---(\text{IV})$$

Here, ρ denotes the parameters for the trail evaporation.

6. Finally the backward ant is deleted while reaching the source node.

3.3 Artificial Bee Colony Optimization

Within the ABC model, the colony includes three teams of bees: employed bees, onlookers and scouts [25]. It is assumed that you have just one single artificial employed bee for each and every food source. Employed bees go with their meal source and revisit hive and dance on this area. The employed bee whose food source is abandoned turns into a scout and starts to search for choosing a new food source. Onlookers watch the dances of employed bees and select food sources determined by dances. Artificial Bee Colony (ABC) is regarded as the recently defined algorithms which were motivated through the intelligent behavior of honey bees. ABC just as a one optimization tool offers a population based search procedure during which individuals are foods positions are modified through the artificial bees along with the bee's aim using the places of food sources with high nectar amount and then finally the one with the best nectar. Figure 4 below the flowchart of ABC algorithm

The ABC algorithm steps are summarized as follows: [37].

1. Initial food sources are produced for many employed bees.
2. Repeat the following items

i. Each employed bee goes to a food source in her memory and determines a neighbor source, then evaluates its nectar amount and dances within the hive.

ii. Each onlooker watches the dance of employed bees and chooses certainly one of their sources according to the dances, and then visits that source. After selecting a neighbor around that, she evaluates its nectar amount.

iii. Abandoned food sources are determined and are replaced with the new food sources discovered by scouts.

iv. The best food source found up to now is registered.

3. UNTIL (requirements are met)

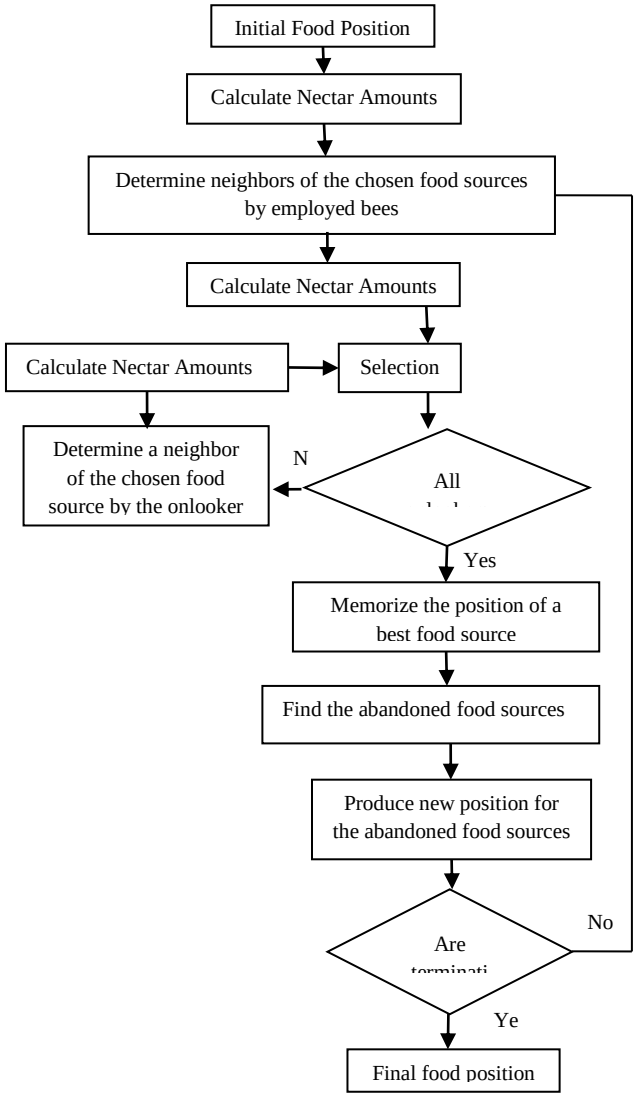

Figure 4: ABC Algorithm [37]

3.4 The BEEIP Routing Protocol

It is a new routing protocol inspired by honeybee based on the collaborative behaviors of honeybee foragers [31]. This routing protocol is used whenever data is being shared between the nodes. The main purpose of this BEEIP routing protocol is to monitor and evaluate the performance of the discovered paths and select the optimal one based on selection mechanism. It expresses the ability of honeybees to perform the foraging and to communicate with each other through the hive, so that to achieve efficient and productive recruitment. This BEEIP routing protocol is basically used to discover multiple paths between the sources and the destinations and also distribute the traffic across them in a scalable, robust and efficient manner.

Adaptive Scouting

Here, whenever a route is required between the source and the destination, a scout packet is generated and sent by broadcast to the rest of the network. This scout packet is responsible for discovering available path to its destination [31]. If the receiving node is the required destination, an ack_scout packet is created and sent back by to the source node to confirm the successful path. A destination node is allowed to create multiple ack_scout, depending upon a no of scouts it receives from the network, allowing multiple paths to be discovered.

Adaptive Foraging

The scouting process is taken successful when numerous ack_scout is received by the source node. BEEIP concentrates on monitoring and constantly evaluating multiple paths [31]. Every time a forager is received because of the destination node, it delivers piggybacked data for the transport layer and converts with an ack_forager. Just like the true honeybees which spend some time to the flower to get pollen or perhaps the nectar, the ack_forager stays with the destination node until some data packets must get back to the first source. While travelling back, it collects up-to-date information in the nodes it visits and all the links between them. This lets it to monitor the actual path's quality and manage to report the finding back for the source.

IV. RELATED WORK

Gautam, et al. [2] analyzes the Swarm Routing Protocol for Mobile Ad Hoc Networks. A new on demand ad hoc routing protocol, called SWARM used mechanisms of swarm intelligence to select good routes to destinations. SWARM was Scalable, Adaptable, and Autonomous and has good Fault tolerance capability. Dengiz, et al., [4] proposed a dynamic mobile ad hoc network (MANET) management system to enhance network connectivity. A brand new strategy to measuring connectivity having a maximum flow formulation is proposed which is both responsive and tractable. Furthermore, user's locations are predicted for a several time steps ahead and this is shown to enhance network connectivity across the network operation period. Saleem, et al. [5], presented the survey on the Swarm Intelligence which is based on routing protocol for wireless sensor networks. A large part on the research in swarm intelligence has focused on reverse engineering along with the adaptation of collective behaviors witnessed in natural systems with the goal of designing effective algorithms for distributed optimization. Adamu Murtala Zungeru **et al.** [10] conducted a survey on SI based routing protocol for WSN and also did a comparison between different routing protocols. Shirkande, et al. [15] proposed a survey on ACO based routing algorithms for MANETs. Ant Colony algorithm is inspired from self-organizing behavior of ants which fall under Swarm Intelligence. Asaju LA ARO Bolaji, et al. [16] observed the ABC algorithm. Artificial Bee Colony Algorithm (ABC) is nature-inspired Meta heuristic, which imitates the foraging behavior of bees. ABC has been tailored successfully, to solve a wide variety of discrete and continuous optimization problems. Aarti, et al. [18] analyzed the mobile ad-hoc network and its characteristics, challenges, application, security goals and different type's security attacks at different layers. Due to its fundamental characteristics, such as wireless medium, dynamic topology, distributed cooperation, MANETs is vulnerable to various kinds of security attacks like worm hole, black hole, rushing attack etc. Tripti Sharma, et al. [23] observed that the Ant Colony Optimization, a Swarm Intelligence based routing technique is widely used in network routing. LEACH (Low Energy Adaptive Clustering Hierarchy) is one of the most popular clustering algorithms. Yahya Tashtoush **et al.** [22] presented the Fibonacci Multipath Load Balancing protocol (FMLB) for Mobile Ad Hoc Networks (MANETs). The FMLB protocol distributes transmitted packets over multiple paths through the mobile nodes using Fibonacci sequence. Such distribution can increase the delivery ratio since it reduces the congestion. The FMLB protocol's responsibility is balancing the packets transmission over the selected paths and ordering them according to hops count. The shortest path is used more frequently than the other ones. The simulation results show that the FMLB protocol has achieved an enhancement on packet delivery ratio, up to 21%, as compared to the Ad Hoc On-demand Distance Vector routing protocol (AODV) protocol, and up to 11% over the linear Multiple-path routing protocol. Also the results show the effect of nodes pause time and speed on each of the data delivery ratio and End-to-End (E2E) delay transmission time. Finally, the simulation results are obtained by the well-known Glomosim Simulator, version 2.03, without any distance or location measurements devices. Alexandros Giagkos, **et al.** [21] proposed the Swarm Intelligence based routing protocols, along with a newly proposed bee-inspired routing protocol for providing multi-path routing in wireless ad hoc networks of mobile nodes.

V. GAPS IN LITERATURE

1) The use of Swarm Intelligence is ignored in maturity of the existing protocols for wireless ad hoc network. Ad hoc Networks can be used in wide range of future applications as they have the capability to establish networks at anytime, anywhere without aid of any established infrastructure. It is a challenging task to find most efficient routing due to the changing topology and the dynamic behavior of the nodes in MANET. The Swarm Intelligence (SI) can give better results as they are highly suitable for finding the adaptive routing for such type of volatile network. [20]

2) However, some protocols are based on Swarm Intelligence theory, but have ignored the use of compression algorithm. The data compression scheme is one that can be used to reduce transmitted data over wireless channels. This technique leads to a reduction in the required inter-node communication, which is the main power consumption in wireless networks. [21]

3) The effect of network coverage is also ignored in majority of existing research. In this case, the sufficient data gathered by the nodes, they have to cover the total network so that the complete information of the whole environment could be estimated rationally [41].

VI. COMPARISON TABLE

Table 1: Comparison of Various Techniques

Ref No	Authors	Year	Technique	Features	Limitations
[2]	Osagie, E.	2008	PACONET: improved Ant Colony Optimization Routing Algorithm	Mobility levels and traffic load.	Average throughput is not considered
[3]	Zne-Jung Lee, et al	2008	GA-ACO: Genetic algorithm with ant colony optimization	multiple sequence alignment, diversity of alignments	GA-ACO algorithm is to enhance the performance of genetic algorithm (GA) by incorporating local search but it is not applicable for global search
[4]	Jianping Wang, et al	2009	HOPNET	Scalability, PDR, mobility	Control Overhead is not taken into consideration
[5]	Daisuke Kadono, et al	2010	ACO routing algorithm based on robustness of paths for MANETs with global positioning system (GPS)	packet delivery ratio, communication cost	Average Throughput and End- to- End Delay is ignored
[13]	Dhurandher, et al	2011	CMMBCR: ACO scheme on Energy efficient protocol Conditional Max-Min Battery Capacity Routing	energy, packet delivery ratio	End-to-End delay and average throughput is not ignored
[14]	Adamu Murtala Zungeru, et al	2012	SWARM, RMASE	Computational Complexity network structure, energy efficiency, path establishment	QoS awareness, real-time implementation is not taken into account
[15]	M. Dhivya, et al	2012	TSO: Tabu Swarm Optimization	Energy consumption, prolong the lifetime of distributed sensor network	It is implemented for only static network configuration. Hardware implementation in FPGA or VLSI is ignored
[16]	Jun Li, et al	2012	Markov swarm mobility model	hop count, routing overhead, and average end-to-end delay	Packet Delivery Ratio is ignored
[17]	Hamid Ali, et al	2012	a multi-objective solution by using multi-objective particle swarm optimization (MOPSO)	degree of nodes, transmission power, and battery power consumption	End-to-End Delay &Throughput is ignored
[18]	Alireza Sajedi Nasab, et al	2012	novel multicast routing in mobile Ad Hoc networks based on particle swarm optimization	speed, performance and efficiency	Multicast is a mechanism in the network that a node sends data to a set of nodes in the network. So, average throughput is not considered here.
[19]	RamKumar	2012	Angle of arrival (AOA),	E-T-E delay, packet loss, no of	The drawback is to install an

	KR, et al		Time of arrival (TOA)	retransmission of packets are enormously reduced	extra hardware to receive signal strength (RSS) which is overcome by embedded system development
[22]	Shahram Jamali, et al	2013	BPSO: Binary Particle Swarm Optimizatio	Prolonging the lifetime of a network	Here, total delivered data is considered, but it not to focused on the end- to- end delay and average throughput
[23]	Woungang, I.	2013	ACO-EEAODR	Conservation of energy and lifetime of a network	Control overhead is not considered here.
[30]	Gurpreet Singh, et al	2014	ANTALG	No of data packets sent, throughput, E-To-E delay, jitter, window size	Security features for communication along the Ants is ignored
[31]	Alexandros Giagkos, et al	2014	PSO, Network Connectivity	Connectivity of MANETs, deploying agents, predicting movements of user nodes	The problem could be formulated as a multi-objective decision problem considering these tradeoffs
[33]	Tripti Sharma, et al	2014	ACO, LEACH	Energy efficiency, network lifetime	Try to apply an algorithm for selection of cluster heads so that we could optimize the procedure
[35]	Ya-li WANG, et al	2014	IAMQER: an improved ant colony-based multi-constrained QoS energy-saving routing algorithm	average energy consumption, packet delivery ratio, the end-to-end delay	Here, the control overhead is ignored.
[36]	R. Vallikannu, et al	2014	ALEEP-with-ACO: Autonomous Localization based Eligible Energetic Path-with-Ant Colony Optimization	total energy expenditure, prolonging the lifetime of network , Packet Delivery Ratio (PDR), throughput	Control Overhead and End to end delay is ignored
[38]	Riham S.Y. Ellhabyan, et al	2015	PSO, Multi-Hop, two-tier PSO, RSSI	Scalability, PDR, Total data packets	An adaptive power control method to enhance the network energy efficiency is ignored
[39]	Ziane Sara, et al	2015	Inter-Domain Routing	Overhead is minimized and robustness of routing is enhanced	Not suitable for a large scale interconnected MANETs

VII. CONCLUSION AND FUTURE WORK

The overall objectives of mobile ad hoc network are to exchange a packet from node to node till it reaches its destination. But the packet size may reduce the performance of protocols which are designed for mobile ad hoc networks. The packet size is depends upon the actual application of MANETs. But high size data packets bring about poor packet delivery ratio, end-to-end delay and throughput of the network. It also increases the overheads because each node is responsible for getting and forwarding that particular packet. This paper has focused on Swarm Intelligence based routing protocols especially Bee-Inspired routing protocol for providing multipath routing in MANETs. In order to achieve the objectives the comparison has been drawn some renowned swarm intelligence based techniques. Comparison has clearly shown that the absolutely no technique is perfect for all issues of MANETS. But it has been observed that the Bee-Inspired routing has not used compression algorithm to utilize the bandwidth in more proficient manner. So, in near future the LCBEEIP protocol will be proposed which will utilize BEEIP protocol along with the feature of Loss Less data compression. This paper has not design and implemented any technique so in near future an appropriate simulation will also be considered for experimental purpose.

REFERENCES

[1] Sim, Kwang Mong, and Weng Hong Sun. "Ant colony optimization for routing and load-balancing: survey and new directions." Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on 33, no. 5 (2003): 560-572.

[2] Osagie, Eseosa, Parimala Thulasiraman, and Ruppia K. Thulasiram. "PACONET: imProved ant colony optimization routing algorithm for mobile ad hoc networks" Advanced Information Networking and Applications, 2008, AINA 2008, 22nd International Conference on. IEEE, 2008

[3] Lee, Zne-Jung, Shun-Feng Su, Chen-Chia Chuang, and Kuan-Hung Liu "Genetic algorithm with ant colony optimization (GA-ACO) for multiple sequence alignment.",Applied Soft Computing 8, no. 1 (2008): 55-78.

[4] Wang, Jianping, et al. "HOPNET: A hybrid ant colony optimization routing algorithm for mobile ad hoc network." Ad Hoc Networks 7.4 (2009): 690-705.

[5] Kadono, Daisuke, et al. "An ant colony optimization routing based on robustness for ad hoc networks with GPSs." Ad Hoc Networks 8.1 (2010): 63-76.

[6] Gautam, Sumanlata, "Swarm Routing Protocol for Mobile Ad Hoc Networks", Advances in Computing, Control and Telecommunication Technologies (ACT), 2010 Second International Conference on. IEEE, 2010

[7] Villalba, LJ García, Delfín Rupérez Cañas, and Ana Lucila Sandoval Orozco, "Bio- inspired routing protocol for mobile ad hoc networks." IET communications4.18 (2010): 2187-2195

[8] Dengiz, Orhan, Abdullah Konak, and Alice E. Smith. "Connectivity management in mobile ad hoc networks using particle swarm optimization" Ad Hoc Networks 9.7 (2011): 1312-1326.

[9] Saleem, Muhammad, Gianni A. Di Caro, and Muddassar Farooq, "Swarm intelligence based routing protocol for wireless sensor networks: Survey and future directions." Information Sciences 181.20 (2011): 4597-4624.

[10] Saleem, Muhammad, et al. "On the reliability of ad hoc routing protocols for loss-and-delay sensitive applications." Ad Hoc Networks 9.3 (2011): 285-299.

[11] Kumar, Sumit, and Rama Chaudhary. "Optimization of routing algorithms in ad-hoc networks using swarm intelligence." Information and Communication Technologies (WICT), 2011 World Congress on IEEE, 2011

[12] Ali, Zulfiqar, and Waseem Shahzad. "Critical analysis of swarm intelligence based routing protocols in adhoc and sensor wireless networks." In Computer Networks and Information Technology (ICCNIT), 2011 International Conference on, pp. 287-292. IEEE, 2011.

[13] Dhurandher, Sanjay K., Mohammad S. Obaidat, and Mayank Gupta. "Application of Ant Colony Optimization to Develop Energy Efficient Protocol in Mobile Ad-Hoc Networks." Wireless Information Networks and Systems (WINSYS), 2011 Proceedings of the International Conference on. IEEE, 2011.

[14] Adamu Murtala Zungeru, Li-Minn Ang, Kah Phooi Seng, "Classical and swarm intelligence based routing protocols for wireless sensor networks: A survey and comparison," Journal of Network and Computer Applications 35, (2012): 1508-1536.

[15] Dhivya, M., and M. Sundarambal. "Lifetime Maximization in Wireless Sensor Networks using Tabu Swarm Optimization." Procedia Engineering 38 (2012): 511-516.

[16] Li, Jun, et al. "Swarm mobility and its impact on performance of routing protocols in MANETs." Computer Communications 35.6 (2012): 709-719.

[17] Ali, Hamid, Waseem Shahzad, and Farrukh Aslam Khan. "Energy-efficient clustering in mobile ad-hoc networks using multi-objective particle swarm optimization." Applied Soft Computing 12.7 (2012): 1913-1928.

[18] Nasab, Alireza Sajedi, et al. "Energy-aware multicast routing in manet based on particle swarm optimization." Procedia Technology 1 (2012): 434-438.

[19] Ramkumar, K. R., and C. S. Ravichandran. "Analog Based Routing Algorithm using Ant Agents for MANETs (ABRAAM)." Procedia Engineering 38 (2012): 3139-3151.

[20] Singh, Gurpreet, Neeraj Kumar, and Anil Kumar Verma. "Ant colony algorithms in MANETs: A review." Journal of Network and Computer Applications 35, no. 6 (2012): 1964-1972.

[21] Srisooksai, Tossaporn, Kamol Keamarungsi, Poonlap Lamsrichan, and Kiyomichi Araki. "Practical data compression in wireless sensor networks: A survey." Journal of Network and Computer Applications 35, no. 1 (2012): 37-59.

[22] Sivakumar, D., B. Suseela, and R. Varadharajan. "A survey of routing algorithms for MANET." In Advances in Engineering, Science and Management (ICAESM), 2012 International Conference on, pp. 625-640. IEEE, 2012.

[23] Ismail, Nurul Halimatul Asmak, and Rosilah Hassan. "6LoWPAN local repair using bio inspired artificial bee colony routing protocol." Procedia Technology11 (2013): 281-287.

[24] Jamali, Shahram, Leila Rezaei, and Sajjad Jahanbakhsh Gudakahriz. "An Energy-efficient Routing Protocol for MANETs: a Particle Swarm Optimization Approach." Journal of applied research and technology 11.6 (2013): 803-812.

[25] Woungang, Isaac, et al. "An ant-swarm inspired energy-efficient ad hoc on-demand routing protocol for mobile ad hoc networks." Communications (ICC), 2013 IEEE International Conference on. IEEE, 2013.

[26] Shirkande, Sudarshan D., and Rambabu A. Vatti. "ACO based routing algorithms for ad-hoc network (WSN, MANETs): A survey." Communication Systems and Network Technologies (CSNT), 2013 International Conference on. IEEE, 2013.

[27] Asaju la ARO Bolaji, Ahamad Tajudin Khader, Mohammed Azmi al-Betar and Mohammed A. Awadallah, "Artificial Bee Colony Algorithm, Its Variants and Applications: A Survey", Journal of Theoretical and Applied Information Technology, Volume 47, 2013: 434-459.

[28] Liu, Hongzhi, Liqun Gao, Xiangyong Kong, and Shuyan Zheng. "An improved artificial bee colony algorithm." In Control and Decision Conference (CCDC), 2013 25th Chinese, pp. 401-404. IEEE, 2013.

[29] Aarti, Dr S.S Tyagi, "Study of MANET: Characteristics, Challenges, Application and Security Attacks", International Journal of Advanced Research in Computer Science and Software Engineering,Volume 3, Issue 5, May 2013,pp 252-257.

[30] Rekaby, Amr, A. A. Youssif, and A. Sharaf Eldin. "Introducing Adaptive Artificial Bee Colony algorithm and using it in solving traveling salesman problem." In Science and Information Conference (SAI), 2013, pp. 502-506. IEEE, 2013.

[31] Shi, Pei, and Suling Jia. "A Hybrid Artificial Bee Colony Algorithm Combined with Simulated Annealing Algorithm for Traveling Salesman Problem." InInformation Science and Cloud Computing Companion (ISCC-C), 2013 International Conference on, pp. 740-744. IEEE, 2013.

[32] Singh, Gurpreet, Neeraj Kumar, and Anil Kumar Verma, "ANTALG: An Innovative ACO based Routing Algorithm for MANETs." Journal of Network and Computer Applications 45 (2014): 151-167.

[33] Alexandros Giagkos, and Myra S. Wilson, "BEEIP –Swarm Intelligence based routing for wireless ad hoc networks", Information Sciences 265 (2014): 23-35.

[34] Yahya Tashtoush a, Omar Darwish a, Mohammad Hayajneh b, "Fibonacci Sequence Based Multipath Load Balancing Approach for mobile ad hoc network", Science direct journal, 2014

[35] Tripti Sharma, Bijesh Kumar, Karan Berry, "Ant Based Cluster Head Election Algorithm in Wireless Sensor Network to avoid redundancy", Fourth International Conference on Communication Systems and Network Technologies, 2014 IEEE, 83-88.

[36] Yi, Yujang, and Renjie He. "A Novel Artificial Bee Colony Algorithm." InIntelligent Human-Machine Systems and Cybernetics (IHMSC), 2014 Sixth International Conference on, vol. 1, pp. 271-274. IEEE, 2014.

[37] WANG, Ya-li, et al. "Improved ant colony-based multi-constrained QoS energy-saving routing and throughput optimization in wireless Ad-hoc networks." The Journal of China Universities of Posts and Telecommunications 21.1 (2014): 43-59.

[38] Vallikannu, R., A. George, and S. K. Srivatsa. "Autonomous localization based energy saving mechanism in indoor MANETs using ACO." Journal of Discrete Algorithms (2014).

[39] Mohd Nadhir Ab Wahab, et al, "A Comprehensive Review of Swarm Optimization Algorithms", PLoS One,2015

[40] Elhabyan, Riham SY, and Mustapha CE Yagoub. "Two-tier particle swarm optimization protocol for clustering and routing in wireless sensor network."Journal of Network and Computer Applications 52 (2015): 116-128.

[41] Yang, Hao, Keming Tang, Jianjiang Yu, and Licai Zhu. "A practical information coverage approach in wireless sensor network." Information Processing Letters115, no. 1 (2015): 6-10.

[42] Sara, Ziane and Mekki Rachida, "Energy Efficient Inter-Domain Routing Protocol for MANETs", Procedia Computer Science 52 (2015): 1059-1064.