Recent Trends in Ant Colony Optimization algorithm for Mobile AD HOC Network

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Abstract: A mobile ad hoc network (MANET) is a collection of wireless mobile nodes. Mobile ad hoc network has no need of base station and not need of base station and not need of infrasturure. MANET is temporary available network. MANET is used in military and rescue operation. Swarm intelligence technique have been widely used in the science and engineer domains such as mobile ad hoc network (MANETs) and wireless network (WSNs). Swarm based routing algorithm uses the operation of biological behavior of insects such as ants, honeybees, birds, termites, fish, fog etc. In Ant colony optimization is technique to find out shortest path between sources to destination. ACO combine using routing protocol in MANET. Also the observe the various parameter with using simulator. In this paper, recent survey of various ANT colony optimization (ACO) based routing algorithm is done and have been summarized various attributes to provide a status of research work done in this field.

***Index Terms* – MANET, Ant colony Optimization (ACO), Routing protocol**

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I. INTRODUCTION

1.1. Mobile ad hoc network (MANETs):-

In mobile ad hoc network (MANETs), the nodes and routers are free to move randomly in any direction i.e. random network. Ad hoc is Latin word it means "For This Purpose". A mobile ad hoc network is continuously self configuring, self organizing and no need of infrastructure network of mobile devices without wires. It is also known as "on-the-fly" network or "Spontaneous networks". MANET closely related to VANETs (Vehicular ad hoc network) [10]. VANET are used for communication between vehicles and roadside equipment. MANET has high performance network and also no installation charges so it is not expensive. MANET gives quick distribution of message around sender [2] [5]. There are several applications of MANET is used such as military environment, rescue operation etc. In Military environment it is used for soliders, tanks and planes to communicate between the solider. In civilian environment it is used in taxi cab network, meeting rooms, sports stadiums, boats and in small aircrafts. It is also used for personal area networking for cell phone, laptops, earphones etc. For emergency operations, it is used for search and rescue, policing, fire fighting, seismic activities and in medical applications.

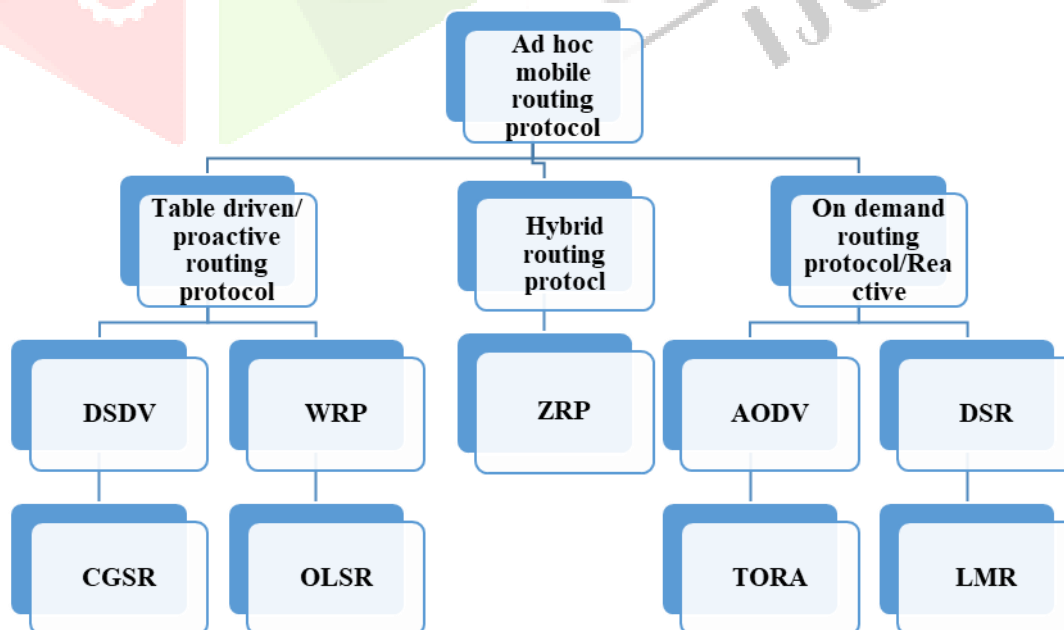### 1.2. Routing protocol in MANET:-

Fig.1. Types of Routing protocol in MANET

1.   **Table- driven/Proactive Routing protocols**:-

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   a. Destination Sequenced Distance Vector routing protocol (DSDV)
   b. Wireless Routing Protocol (WRP)
   c. Cluster Switch Gateway Routing protocol (CGSR)
   d. Optimized Link State Routing (OLSR)

2. **On- demand/ Reactive routing protocols**:-

   On demand routing protocols find route to a destination only when it required.
   The on demand protocols have two phases--------

   i. Route discovery
   ii. Route Maintenance

   In route discovery procedure, a node make to communicate with another node initiates a discovery mechanism if it doesn't have the route already in its cache. The destination node replies with the valid route[7]. The route maintenance phase involves checking for broken links in the network and updating the routing table. Some of routing protocols under this concept are following

   a. Dynamic Source Routing (DSR)
   b. Ad hoc On-demand Distance vector (AODV)
   c. Temporally-Ordered Routing Algorithm (TORA)
   d. Low Based Multipath Routing (LMR)

3. **Hybrid Routing Protocols**:-

   Hybrid routing protocols inherit the characteristics of both on-demand and table-driven routing protocols. Such protocols are designed to minimize the control overhead of both proactive and reactive routing protocols. The working of hybrid routing protocols is illustrated with an example – The Zone Routing Protocol (ZRP).

1.3. Ant Colony Optimization (ACO):-
   Ant algorithm is selected to optimize the communication process in the secure protocol. There are many bio search algorithm has developed such as Evolutionary Computation (EC), Including genetic algorithm (GA), Iterated Local Search (ILS) ,Simulated Annealing(SA) and Tabu Search (TS) compare the above algorithm with ant algorithm. So the ant algorithm is most appropriate. Ant algorithm has some characteristics such as dynamic topology, local work, link quality, and support for multipath. Ant colony optimization (ACO) algorithm has shown to be a good technique for developing routing algorithms for ad hoc networks. ACO based routing is an efficient routing scheme based on the behavior of searching of food by ants. The collective behavior behavior of ants helps find the shortest path from nest (source) to a food source (destination) by deposition of the chemical substances called pheromone on the visited nodes. Ant algorithm has some advantages such as optimal path, multiple routes, autonomous, decentralized and link quality.
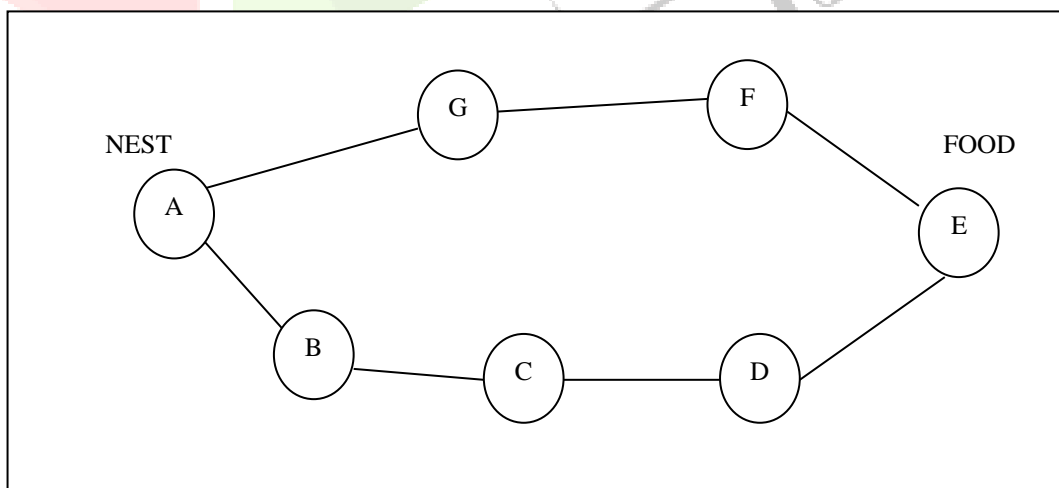

Fig.2. Ant colony Optimization

   Consider, the fig.2 shows that, ants will start from A the nest i.e. source and look for E the food i.e. Destination. At every step, they will upgrade the routing table and as soon as first one reaches the food they decide the best path will be known thus allowing the communication between source to destination i.e. food E to nest A. In Ant colony Optimization technique is find shortest distance between source to destination. Therefore, Ants travel from node A-D-F-E i.e. shortest distance form nest to food and food to nest.

II. LITERATURE SURVEY

Survey of ANT colony optimization:-

In this section, various research achievements for routing protocol with ant colony optimization:-

Jeevan Kumar et al. (2016) proposed routing protocol for wireless sensor networks using swarm intelligence ACO with ECPSOA. A routing algorithm that has an Ant colony Optimization (ACO) [2] algorithm with an endocrine co-operative particle swarm optimization algorithm (ECPSOA) is used to improve the various parameters in WSNs routing [1]. ACO algorithm uses mobile agents as ants to identify the most possible and best path in a network. In the ECPSOA, finds the best solution for enhance the capacity of global search and improve the speed of convergence and accuracy of the algorithm. This routing algorithm has an improved performance when compared with the simple ACO algorithm in terms of delay, power consumption, communication cost, and distance. Simulate with the help of network simulator OMNNET++ and analysis the result [1].

Ashima Rout et al. (2011) proposed optimized ant based routing protocol for MANET. In this paper, we introduce a new ant based routing protocol to optimized the route discovery and maximize the efficiency of routing in the terms of packet delivery ratio (PDR) using the blocking expanding ring search (Blocking- ERS) third party route reply , local route repair and n hop local ring technique. NS-2 is used to evaluate the performance of various parameters such as packet delivery ratio, End-to-End delay, mobility, Normalized Routing load etc. All round simulation are carried out and it is observed that optimized Ant performs better than AODV [2].

Anuj K. Gupta et al. (2011) proposed MANET routing protocols based on ant colony optimization. Ant colony optimization is good technique for developing routing algorithms for ad hoc networks. In this paper , we have brought some characteristics as well as performance analysis of the proposed ACO based ad hoc routing protocols and compare them with the well known ad hoc routing protocols such as AODV, DSR, SDVR, DYMO, ZRP, HOPNET. The results presented in the last also help the researchers to understand the differences among various ACO Based routing algorithms and to choose appropriate protocol for their research work [3].

Abdur Rahaman Sardar et al. (2014) proposed an efficient ant colony based routing algorithm for better Quality of Services in MANET. In this paper, we have presented a new on demand QOS routing algorithm for mobile ad hoc network with the concept of Ant colony optimization. This algorithm is based on swarm intelligence. It is inspired by the behavior of the biological ants of finding optimal path of the food source in collective but decentralized manner with better quality of service support Ant colony optimization with metaheuristic based model for QOS based optimized route selection. This proposed algorithm is an on demand QOS routing algorithm. This algorithm can use for future work for comparison with other related algorithm [4].

Anjali Jagtap et al. (2017) proposed implementation of optimized Ant based routing algorithm for MANET. In this paper, Ant based routing algorithm (ARA) is implemented for different network condition with evaluation parameter such as throughput, packet delivery ratio, routing overhead and energy consumption to determine properties such as reliability and timeliness of data transfer. This algorithm uses two mobile agents FANT and BANT. This paper work implemented and simulated ARA for MANET in NS2 for various network conditions [5].

Chintan Kanani et al. (2013) proposed ant colony optimization based modified AOMDV for multipath routing in MANET. In this paper, modified ad –hoc on demand multipath distance vector (AOMDV) for multipath routing using ant colony for mobile ad hoc networks (MANET) is presented. For this purpose, Ant AODV is used for comparison with ANT-AOMDV. It can be seen that the number of dropped packets is more in AODV-Ant Compared to AOMDV-Ant, thus congestion is increased [6].

WAN- JUN Yu et al. (2008) proposed ant colony optimization for routing in mobile ad hoc networks. In this paper, ACO-AHR (Ant colony optimization- ad hoc hybrid routing) algorithm is used. This algorithm is a hybrid algorithm, consist of two parts first one is reactive routing setup second is proactive routing probe and maintain. Finally the simulating result show that ACO-AHR is effective than AODV routing protocol. The simulation software is NS2 (Network Simulation Version 2) to compare various parameters [7].

B. Nancharaiah et al. (2014) proposed modified ant colony optimization to enhance MANET routing protocol. The modifications have been incorporated in ad hoc on-demand distance vector (ADOV) routing. The modified ant colony optimization algorithm better compared to existing algorithms (AODV & cooperative opportunistic routing in mobile ad hoc network i.e. CORMAN in terms of end-to-end delay, throughput and packet delivery ratio [8].

Dr. Madhumita Dash et al. (2014) proposed routing problem: MANET ant colony algorithm. MANET is a collection of wireless mobile nodes. It is temporary network and not need of base station. In MANET, the biggest challenge is to find a path between communicating nodes i.e. source to destinations. In this paper, Study the ant colony based routing algorithm carried out by taking into consideration two of the most popular algorithm i.e. ant based algorithm, ant hoc net & Ant routing algorithm(ARA) [9].

A. M. oranj et al. (2016) proposed routing algorithm for vehicular ad hoc network based on dynamic ant colony optimization. VANET is new field of technology which has used widely in autonomous systems. In this paper, we used a routing

algorithm based on ant colony optimization and DYMO (Dynamic MANET on demand) protocol. The simulation on NS2 simulated to compare with the 2 parameter i.e. delay time and path reliability and also compare with AODV [10].

Moresh Mukhedkar et al. (2018) have done the comparative performance analysis of routing algorithm. In their paper, they used a routing algorithm based on DEA and BCS. The simulation on MATLAB to compare with the four parameter i.e. Throughput, end to end delay, packet delivery ratio [11].

III. PERFORMANCE EVALUTION:-

In this section various ant colony based routing protocols, studied in previous section are compared with respect to different performance parameters and network parameters. In network parameter, we consider the area of the network, number of nodes, transmission range of node and network simulator.

Table 1. Simulation parameter

Ref.	Year	Domain	Author	Routing protocol	Performance parameters	Network Parameters			
						Area (m²)	Nodes	Transmitted Range (m)	Simulator
[1]	2016	WSNs	Jeevan Kumar et al.	ECPSOA	Path delay, Communication cost, Power consumption (mW), Distance	1000 X 1000	100	250	OMNNET++
[2]	2011	MANETs	Ashima Rout et al.	Ant protocol	Normalized routing load (NRL), End-to-End delay, packet delivery ratio (PDR)	500 X 500	50 100 150 200	250	NS2 (Network simulator Version 2)
[5]	2017	MANETs	Anjali Jagtap et al.	AODV	Throughput, Packet Delivery Ratio (PDR), Normalized Routing Load (NRL), Energy Consumption	1000 X 1000	10 20 30 40 50	–	NS2
[7]	2008	MANETs	WAN-JUN Yu	AODV	Throughput, End-to-end delay, Packet Delivery Ratio.	800 X400 1000 X 300	50 10-100	–	NS2
[10]	2016	VANETs	A.M. Oranj et al.	AODV	Path discovery, Delivery ratio	500 X 500	–	80	NS2
[11]	2018	MANET	Moresh Mukhedkar et.al.	DEA & BCS	Throughput, End to End Delay	-	Up to 100	-	Matlab

IV. CONCLUTION

In this paper, various ant based routing algorithms are reviewed and compared in terms of protocol attributes, performance parameters and network parameters. Ant colony approach is widely used to provide QoS parameter for routing protocols. There are three major work of this paper first is MANET, then second is routing protocol in MANET and last one is Ant colony optimization (ACO) concept. The comparisons of papers are useful to refer to establish new theory on ant colony optimization to future research work.

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