STUDY AND PERFORMANCE EVALUATION OF ANTHOCNET AND BEEHOCNET NATURE INSPIRED MULTIHOP ROUTING PROTOCOLS FOR EFFECTIVE ROUTING IN MANET

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ABSTRACT

There are multiple algorithms and protocols which are present in MANET but no one is perfect for each situation because of the presence of high topology changes and dynamicity of number of nodes. That’s the reason of opting biological algorithm like Ant based or Bee based algorithms which are swarm intelligence based nature inspired algorithms which finds out the best route as per the real time status of network. In communications network research, there is currently an increasing interest for the paradigm of autonomic computing. The idea is that networks are becoming more and more complex and that it is desirable that they can self-organize and self-configure, adapting to new situations in terms of traffic, services, network connectivity, etc. To support this new paradigm, future network algorithms should be robust, work in a distributed way, be able to observe changes in the network, and adapt to them. Nature’s self-organizing systems like insect societies show precisely these desirable properties. Making use of a number of relatively simple biological agents (e.g., the ants) a variety of different organized behaviours are generated at the system-level from the local interactions among the agents and with the environment. The robustness and effectiveness of such collective behaviours with respect to variations of environment conditions are key-aspects of their biological success. This kind of systems is often referred to with the term Swarm Intelligence. Swarm systems have recently become a source of inspiration for the design of distributed and adaptive algorithms, and in particular of routing algorithms.
1. INTRODUCTION

MANeT Ad-Hoc networks are defined as networks formed by users or devices wishing to communicate, without the necessity for the help or existence of any infrastructure or previously established relationship between the potential network members. Ad-hoc communication can take place in different scenarios and is independent of any specific device, wireless transmission technology, network or protocol. Some examples of the possible uses of ad hoc networking include sensor networks, search and rescue operations, vehicle communication networks, and possible military applications, etc.

In particular, we expect that ad hoc networks will be formed in situations where no infrastructure is available. As for the mode of operation, they are basically peer-to-peer multi-hop wireless networks where information packets are transmitted in a store and forward manner from a source to an arbitrary destination, via intermediate nodes. The network topology changes dynamically and in an unpredictable manner since the nodes can move freely. Therefore, out-dated topology information must be updated or removed. Since there is no centralized entity to keep the topology up-to-date, a distributed algorithm is required. Finding a route to a destination requires exchange of control information among the nodes. Thus, the amount of update traffic can be quite high when the number of highly mobile nodes is large. Thus, the highly dynamic nature of ad hoc networks motivates the study of routing protocols, which aim at achieving routing stability.

Again the wireless communication media has a limited bandwidth, which is susceptible to various interferences that can lead to establishment of useless routes, low throughput and other problems. Some of the protocols assume that the communication links are symmetric. Although this assumption is not always valid, it is usually made because routing in asymmetric networks is a relatively hard task. In certain cases, it is possible to find routes that could avoid asymmetric links, since it is quite likely that these links imminently fail. The issue of symmetric and asymmetric links is one among the several challenges encountered in ad hoc networks. Mobile hosts are powered by battery. Hence, energy efficient routing protocols are required to minimize power consumption.

2. SWARM INTELLIGENCE

In communications network research, there is currently an increasing interest for the paradigm of autonomic computing. The idea is that networks are becoming more and more complex and that it is desirable that they can self-organize and self-configure, adapting to new situations in terms of traffic, services, network connectivity, etc. To support this new paradigm, future network algorithms should be robust, work in a distributed way, be able to observe changes in the network, and adapt to them. Nature’s self-organizing systems like insect societies show precisely these desirable properties. Making use of a number of relatively simple biological agents (e.g., the
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ants) a variety of different organized behaviours is generated at the system-level from the local interactions among the agents and with the environment. The robustness and effectiveness of such collective behaviours with respect to variations of environment conditions are key-aspects of their biological success. This kind of systems is often referred to with the term Swarm Intelligence. Swarm systems have recently become a source of inspiration for the design of distributed and adaptive algorithms, and in particular of routing algorithms. Routing is the task of directing data flows from sources to destinations maximizing network performance. It is at the core of all network activities. Several successful routing algorithms have been proposed taking inspiration from ant colony behaviour and the related framework of Ant Colony Optimization (ACO). Examples of ACO routing algorithms are AntNet. One type of networks where the need for autonomic control is intrinsically necessary is Mobile Ad Hoc Network (MANETs). These are networks in which all nodes are mobile and communicate with each other via wireless connections. Nodes can join or leave at any time. There is no fixed infrastructure. All nodes are equal and there is no centralized control or overview. There are no designated routers: nodes serve as routers for each other, and data packets are forwarded from node to node in a multi-hop fashion. Ant Based Algorithms are nature inspired adaptive routing algorithm for mobile ad hoc networks (MANETs) inspired by ideas from Ant Colony Optimization (ACO). In common MANET terminology, Ant Algorithms are defined as hybrid algorithm, as it combines both reactive and proactive routing strategies. Specifically, the algorithm is reactive in the sense that it does not try to maintain up-to-date routing information between all the nodes in the network, but instead concentrates its efforts on the pairs of nodes between which communication sessions are taking place. It is proactive in the sense that for those ongoing communication sessions, it continuously tries to maintain and improve existing routing information. While the ant-based path sampling is the typical mode of operation of ACO routing algorithms, the pheromone diffusion process is in its working more similar to Bellman-Ford routing algorithms. AntHocNet combines both processes in order to obtain an information gathering process that is at the same time efficient, adaptive and robust. The way path sampling and information bootstrapping are combined here is very different from other combinations of these approaches to learning that exist in the reinforcement learning literature and is specifically targeted at working highly dynamic non-stationary environments.

In nature several animals tend to live in large swarms like insect colonies, bird flocks or fish schools. Many social insects like ants, bees, termites, or wasps live in colonies or hives. They exhibit an astonishingly well-developed social behaviour and are able to self-organize, even in the absence of a central leader like a queen. Honey bees communicate locations of food sources by the language of dance that is understood by all nearby honey bees. On the other hand, many insects use a form of indirect communication called stigmergy. Stigmergy works by leaving traces in the environment that can be understood by other insects. Termites use stigmergy to build complex nests by simple rules. A termite constructing a nest deposits material like a mud ball and invests it with pheromones, a chemical that can be smelled by other termites. The smell of pheromones encourages other termites to deposit their material close to freshly deposited pheromones. This way, a group of termites can manage to synchronize so that they all work on the same spot.

Swarm Intelligence (SI) is an Artificial Intelligence technique based on the study of collective behaviour in decentralized, self-organized systems. Swarm intelligence is “The emergent collective intelligence of groups of simple agents”. It gives rise to
complex and often intelligent behaviour through simple, unsupervised interactions between a total numbers of autonomous swarm members. Usually there is no centralized control structure dictating how the individual agents should behave, but local interactions between such agents often lead to the emergence of a global behaviour.

Swarm is considered as biological insects like ants, bees, wasps, fish etc. The quick coordinated flight of a group of birds with very little visual communication and the concerted effort of an ant colony in gathering food, building nests etc. are some of the vivid examples of emergence in natural world. SI has found immense applicability in fields like Robotics, Artificial Intelligence, process optimization, telecommunications, routing, software testing, networking etc.

Our objective is to Study and Performance Evaluation of AntHocNet and Our Introduced Extension BeeHocNet Nature Inspired Multihop Routing Protocols for Effective Routing in MANETs using NS-2 which is emerging and open source software to test and simulate various network protocols.

3. RELATED WORK

D. Karthikeyan and M. Dharmalingam [4] in his paper, Ant based Intelligent Routing Protocol for MANET propose an energy efficient routing algorithm for MANETs based on ACO for minimizing energy consumption of the nodes and prolong the life of the overall communication system. The performance of the proposed algorithm is simulated on the network tool NS2 and is also compared with existing algorithm’s performance.

Mohammad Arif1 and Khalid Imam Rahmani2 [5] in his paper, Adaptive ARA (AARA) for MANETs proposed a more efficient and modified version of ant colony based routing algorithm for routing in mobile ad hoc networks.


Vivekanand Jha, Kritika Khetarpal and Meghna Sharma in his paper, A Survey of Nature Inspired Routing Algorithms for MANETs provide a comprehensive overview of the nature inspired routing algorithms for mobile adhoc networks and compare them and also bring out their main merits and demerits.

Eslam Al Maghayreh, Salam Abu Al-Haiaj, Faisal AlKhateeb and Shadi Aljawarneh [8] in his paper, Bees Ants Based Routing Algorithm propose a novel routing algorithm called Bees Ants algorithm. This algorithm is a combination of Ant colony based Routing Algorithm (ARA) and Beehive based Routing Algorithm. The proposed routing algorithm depends on splitting the network into two parts; one is a fixed network and the other is a mobile ad hoc network (MANET), then applying the Ant colony based Routing Algorithm on the mobile part and the Beehive based Routing Algorithm on the fixed one. After comparing the proposed algorithm with the ARA algorithm, it shows promising results in terms of propagation delay, queue delay, and number of hops.

L.J.G. Villalba D.R. Canas and A.L.S. Orozco [9] in his paper, Bio-inspired routing protocol for mobile ad hoc networks design for the protocol lies in a heuristic, based on swarm intelligence, which takes into account the limited resources and highly dynamic environment, as well as the restriction on the exchange of routing information. So, the key aspects of the proposed protocol are the disjoint-link and
disjoint-node routes, separation between the regular pheromone and the virtual pheromone in the diffusion process and the exploration of routes, taking into consideration the number of hops in the best routes which the authors have previously found out.

M.M.Goswami, R.V. Dharaskar and V.M.Thakare[10] in his paper, Fuzzy Ant Colony Based Routing Protocol For Mobile Ad Hoc Network proposes a novel approach called fuzzy ant colony based routing protocol (FACO) using fuzzy logic and swarm intelligence to select optimal path by considering optimization of multiple objectives while retaining the advantages of swarm based intelligence algorithm. Simulation results show that the proposed protocol is superior over existing swarm intelligence based routing protocols for routing in MANET.

Sanaz Asadinia, Marjan Kuchaki Rafsanjani and Arsham Borumand Saeid [11] in his paper, A Novel Routing Algorithm Based-on Ant Colony in Mobile Ad hoc Networks propose a new routing algorithm for MANETs, which combines the idea of ant colony optimization with zone based hierarchical link state (ZHLS) protocol. The algorithm is based on ants jump from one zone to the next zones which contains of the proactive routing within a zone and reactive routing between the zones. The proposed algorithm will improved the performance of the network such as delay and packet delivery ratio than traditional routing algorithms.

4. PROPOSED SYSTEM

The protocol is based on swarm intelligence and especially on the ant colony based Meta heuristic. The routing algorithm consists of three phases. In the first one, Route Discovery Phase, new paths are discovered. The creation of new routes requires the use of a forward ant (FANT), which establishes the pheromone track to the source node, and a backward ant (BANT), which establishes the track to the destination node. FANTs are broadcasted by the sender to all its neighbours. Each FANT has a unique sequence number to avoid duplicates. A node receiving a FANT for the first time creates a record (destination address, next hop, pheromone value) in its routing table. The node interprets the source address of the FANT as destination address, the address of the previous node as next hop, and computes the pheromone value depending on the number of hops the FANT needed to reach the node. Then the node relays the FANT to its neighbours. When the FANT reaches destination, it is processed in a special way. The destination node extracts the information and then destroys the FANT. A BANT is created and sent towards the source node. In that way, the path is established and data packets can be sent. BeeHocNet, the proposed algorithm is an on-demand multi-path routing algorithm for mobile ad hoc networks inspired from the foraging principles of honey bees. BeeHocNet works with four types of agents: packers, scouts foragers and swarms. The packers locate a forager and hand over the data packet to the discovered forager. Scouts discover new routes from the launching node to the destination node through broadcasting principle and an expanding time to live (TTL) timer. Foragers, the main workers of BeeHocNet, receive the data packets from the packers and transport them to the destination. Transportation of foragers back to the source node, in case of unreliable transport protocol, is the key role of swarms.

5. SIMULATION AND RESULTS

To evaluate the effectiveness of proposed scheme, we simulate the scheme using network simulator version 2 (NS2). In simulation, we used the number of nodes as 50 and carried out simulation 5 times on every scenario at different time intervals and get
the results. We implement the random way point movement model for simulation in which nodes start at 0 position with simulation time 25 seconds, PDR values varies from 0 to 1, delay values 0 to 500 ms, throughput 0 to 850 out of 1000 and energy consumption from 0 to 800 if 1000 parts applied with the two cases i.e. case including only implementing the ant based algorithm on NS2 network and after implementing extended version of Ant based i.e. by implementing bee based extension (BARA). We take one ant based algorithm i.e. Ant Routing Algorithm (ARA) by taking consideration of different parameters like throughput, packet delivery ratio, energy consumption and delay time taken by average packet to reach the destination. Here are the simulation results. Which clearly shows the improvement after implementing the extended version of bee based algorithm on ant based algorithm

![Graph Shows the Decrease in Delay Values with Ant Based vs Bee and Ant Based Algorithm](image1.png)

**Figure.1:** Graph Shows the Decrease in Delay Values with Ant Based vs Bee and Ant Based Algorithm

![Graph Shows the Increase in Packet Delivery Ratio Values with Ant Based v/s Bee and Ant Based Algorithm](image2.png)

**Figure.2:** Graph Shows the Increase in Packet Delivery Ratio Values with Ant Based v/s Bee and Ant Based Algorithm
6. CONCLUSION

Nature inspired algorithms has a lot of capabilities because they are emerged with time and facing a lot of problems like environments, natural calamities, geographical differences etc. Methodologies for survival by protection against various attacks have been proposed mainly for ad-hoc and sensor networks. It is new for infrastructure based networks. However, it is not less significant. Therefore, even after working a lot on different protocols and success up to a certain extent in different situation, swarm intelligence i.e. nature inspired algorithms are proved to be best because of real time
decisions and tested over time by different species. Swarm Intelligence is best among all other networks as shown by the results.

REFERENCE


