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# Design and Implementation of Rank Based ACO approach for Multipath Routing Mechanism with Load Balancing in Ad hoc Network

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**Abstract**: Ad-Hoc wireless networks are self-organizing multi-hop wireless networks. Ad-Hoc networks can quickly and inexpensively be set up as needed Therefore, they are highly applicable in many fields such as emergency deployments and community networking. Mobile ad hoc networks have some challenges like the design of an efficient routing protocol. The multipath routing protocol with load balancing provides a solution for the congestion network and increases its capacity. To consider that the use of multiple paths simultaneously for transmission data allows to improve the network performance, we propose a protocol LB-AOMDV (Load Balancing-AOMDV), a solution to achieve better load balancing mechanism. In this paper, we also apply the Ant Colony optimization technique to the routing problem, after that we apply a extension of ACO that is ranked based ACO approach. We refer to the new modified protocol as the LB-AOMDV Rank Based Ant Colony Optimization algorithm .The main goal in the design of the protocol will be reduce the routing overhead, response time, end-to-end delay and increase the performance**.**

**Keywords**: Ant Colony Optimization Algorithm; Ad-Hoc Networks; load balancing; AOMDV; LB-AOMDV; Rank Based-ACO-Approach.

## I. INTRODUCTION

A mobile ad hoc network (manet) consists in a Collection of wireless mobile nodes, which form a temporary network without relying on any existing infrastructure or centralized administration [1].

Ad hoc network presents many specific problems which had influence on solution that assure QoS. The main problems are: node mobility and link failure. However, node mobility provides dynamic change topology and route breaks occur frequently providing degradation of upstream on wireless network because not only high loss of packets but also delay occurs to search new route. The routing problem is to determine an optimal forwarding for data packet according to some criteria of QoS. In ad hoc network, the challenge is to find a forwarding method for high number of nodes in environment distinguished by their limited power, processing, and memory resources as well as high degree of mobility.

The multipath routing appears an efficient solution for the ad hoc networks [2]. It can provide load balancing and route failure protection by distributing traffic among a set of diverse paths [3,4]. But this repartition is more efficient if we use a load balancing mechanism allowing distributing the traffic through the less congested route. The work presented in this report aims to improve the existing routing strategy by using a multipath routing protocol with load balancing in order to distribute the traffic effectively along all nodes on the network.

Ant colony algorithms consider the ability of simple ants to solve complex problems by cooperation. Ants do not need any direct communication to find the solution; they communicate using the principle of stigmergy which refers to the indirect communication of individuals through modifying their environment. Several algorithms which are based on ant colony optimization were introduced to solve different problems such as scheduling problems, assignment problems, data mining, classification, traveling salesman problem, and many others.

The authors of [5], [6], [7] have introduced a routing algorithm based on ant colony optimization that explores the network aiming to build routing tables while keeping them adapted to network conditions. In this paper, we will analyze the performance of (Load Balancing-AOMDV), Rank Based Ant Colony Optimization algorithm.

## II. ROUTING ON ADHOC NETWORK

The routing is a method which attends to forward the information to destination along the network. It consists to determine an optimal forwarding for packets along the network according to certain criteria (hop number, e.g.). The problem consist to find the investment with minimum cost of nominal capacity and reserve that provide the routing of nominal traffic and guarantee its reliability in case of any failure of link or node. On other hand, the routing on Ad Hoc network is far away to be evident because the environment imposes news limitations compared to wired environment. The routing strategy must take the usual change of the topology, the bandwidth (which is limited) and other factors into account.

The Ad hoc network, that we consider, is multi hopes. In these networks, the communication range of a node is

often limited and not all nodes can directly communicate with one another. Nodes are required to relay packets on behalf of other nodes to facilitate communication across the network.

Therefore, if a mobile want to communicate with another that don't reach, the message must be transmitted to neighboring step by step to reach the destination. The basic technique to ensure the forwarding of packets is the flood. But certainly, the flood consumes many resources such as Bandwidth and energy [11].

## III.ANT COLONY OPTIMIZATION FOR MANET ROUTING PROBLEM

The ant colony optimization meta-heuristics is a particular class of ant algorithms. Ant algorithms are multi-agent distributed algorithm, which consists of agents that simulates the behavior of individual ants [9].

### *A. Real Ants Mechanism*

The basic idea of the ant colony optimization meta heuristic is taken from the food searching behavior of real ants. When ants are on their way to search for food, they start from their nest and walk toward the food. When an ant reaches an intersection, it has to decide which branch to take next. While walking, ants deposit pheromone, which marks the route taken. The concentration of pheromone on a certain path is an indication of its usage. With time the concentration of pheromone decreases due to diffusion effects. This property is important because it is integrating dynamic into the path searching process. This behavior of the ants can be used to find the shortest path in networks. Especially, the dynamic component of this method allows a high adaptation to changes in mobile ad-hoc network topology, since in these networks the existence of links are not guaranteed and link changes occur very often [10].

## IV. AOMDV PROTOCOL: ADHOC ON DEMAND MULTIPATH DISTANCE VECTOR

To reduce interruption of communications in ad hoc network, the discover procedure of routes must be efficient especially with the continuous mobility of the nodes and also the frequent change of network topology, many routing protocols are proposed such as AOMDV: the multipath routing protocol [8] that extends the single path AODV protocol to compute multiple path routing.

### A. *Routing Definition*

The main idea in AOMDV is to compute multiple paths during route discovery procedure for contending link failure. In fact, the main goal to concept this protocol is to search multiple routes during the same route discovery procedure, but only the best path based on some metric (number of hop) is chosen and is used for data transmission between source and destination. The other paths are used only when the primary path fails. This protocol is intended for ad hoc network where the mobility of nodes is very important and consequently the route breaks frequently. AOMDV use the information available in AODV, but to compute multiple paths it adds additional number of control packet "overhead". AOMDV is based on two essential mechanisms:

- A route update to establish and maintain multiple Loop-free paths at each node.
- A distributed protocol to find link-disjoint paths.

### B. *AOMDV Problems*

In such protocols a link failure in the primary path, Through which data transmission is actually taking place, causes the source to switch to an alternate path instead of initiating another route discovery. A new route discovery occurs only when all precompiled paths break. The problem with these Multipath protocols [10] is that although during the route discovery process multiple paths are discovered, only the best path based on some metric is chosen and is used for data transmission. The other paths are used only when the primary path fails. Actually, the compute and the maintenance of multipath between source and destination require a very important occupation of routing table, achieve tremendously memory resource at every node and increase the heading packet size. These constitute a handicap, in view that we have only one path to transmit [11].

## V. IMPROVEMENT TO AOMDV MULTIPATH PROTOCOL (LOAD BALANCING-AOMDV RANK BASED ACO APPROACH)

In this part, we propose an extension to AOMDV Protocol in order to support certain mechanism and technique to improve its performance.

### A. *A new proposed metric*

In the new proposed metric, the methodology targets the route stability and current load on the node. The stability of the paths can be assured by the use of received signal strength and the queue length in the node. The weighted formula is used to calculate the load of the node, which will be carried by the ants

**Load = alpha * signal strength + beta * queue length + gamma*active path count**

Here "alpha", "beta" and "gamma" are constants and alpha + beta + gamma =1.
They are the weight coefficients.

Load formula is used to distribute load over network. Path with minimum load are selected for data transmission. In normal AOMDV path with minimum hop count is taken primary. But the propose approach will concentrate on paths with least load. So the selected path by the proposed approach will be most stable and least loaded path. Strength will be used to decide the weight of pheromones on the link (pheromone is nothing but the routing information or data about links) once the route discovery phase is over AOMDV picks three paths. One is used as primary and other two are used as backup routs. To meet the quality of service requirements of mobile users, several metrics can be considered for selecting a source destination routing path.

**Signal strength: -**Packet receives value. It should be high. If the signal strength value is low then packet drop ratio should be high.

**Queue Length:-**The number of data packets in a buffer. The queue length gives us the idea about how busy our route is. Its higher value depicts high load on the route. It determine heavily loaded route.

**Active Path Count: -** In the active path count we use the path with minimum load out of different paths.

B. *Rank Based Ant System*

After the load technique we used Rank Based Ant System. All solution are ranked according to their length. The amount of pheromone deposited is then weighted for each solution, such that solutions with shorter paths deposit more pheromone than the solutions with longer paths**.**

**Algorithm: Pseudo-code for Ant Colony Optimization**

- **1. Initialize pheromone values**
- **2: while not stop-condition do**
- **3: Create all ants solutions**
- **4: Perform local search**
- **5: Update pheromone values**
- **6: end while**

## VI. METHODOLOGY

In this section we describe our simulation environment and performance metrics.

A. *Simulation Environment*

We have used ns-2 for our simulations. As mentioned earlier, we have performed our study with Load Balancing AOMDV and the proposed protocol Ranked Based ACO Approach. NS is a name for series of discrete event network simulators, specifically **ns-1**, **ns-2** and **ns-3**. All of them are discrete-event network simulators, primarily used in research and teaching. Ns-3 is free software, publicly available under the GNU GPLv2 license for research, development, and use. The goal of the ns-3 project is to create an open simulation environment for networking research that will be preferred inside the research community [20]

B. *Performance Metrics*

We use the following performance metric to evaluate the effect of each scheduling algorithm:

*(1) Average End-to-End Delay:* This is the average overall delay for a packet to traverse from a source node to a destination node. This includes the route discovery time, the queuing delay at a node, the transmission delay at the MAC layer, and the propagation and transfer time in the wireless channel.

*(2) Traffic Overhead:* Number of routing packet with respect to data. Excess of data packets**.**

*(3) Packet Delivery ratio:* It's a ratio between Total number of packet receives to total number of packets send. PDR is greater it means better performance.

*(4) Throughput:* Rate of data packet delivers in per Second.

## VII. CONCLUSION

In this paper, we will modify the route discovery mechanism of AOMDV for load balancing in Mobile Ad hoc Network by estimating Signal Strength and Active Path Count of node to provide stable energy aware routing. We will focused on load balancing mechanism to fairly distribute the traffic on different active routes selected between source and destination node, So that it will Improves the network performance and Throughput, and traffic overhead will be decreases. We will implement Rank Based Ant System (AS rank) optimization technique to find the best path out of the multiple paths obtained from route discovery so that end to end delay will be decreases. In the future work, we will be implement the proposed approach and compared to existing protocols

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