RANK BASED ACO APPROACH FOR AOMDV WITH LOAD BALANCING IN AD HOC NETWORK

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Abstract— An Ad hoc network is Wireless network with no fixed infrastructure. Each host is mobile and act as a router. The multipath routing protocol with load balancing provides a solution for the congestion network and increases its capacity. 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. The main goal in the design of the protocol was to 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 is defined as a collection of mobile platforms or nodes where each node is free to move about arbitrarily. Each node logically consists of a router that may have multiple hosts and that also may have multiple wireless communication devices. 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].

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.

II. 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. 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].

III. 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.

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. Routes are established on-demand, as they are needed. However, once established a route is maintained as long as it is needed. Reactive (or on-demand) routing protocols find a path between the source and the destination only when the path is needed 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 problem consist to find the investment with minimum cost of nominal capacity and reserve that provide the routing of nominal traffic. 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.[24]

V. IMPROVEMENT TO AOMDV BY USING (LOAD BALANCING-AOMDV RANK BASED ACO TECHNIQUE)

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.

\[
\text{Load} = \alpha \times \text{signal strength} + \beta \times \text{queue length} + \gamma \times \text{active path count}
\]

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.

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

**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.

**Network connectivity**: - Connectivity and topology characteristics of a MANET are determined by the link dynamics. These are fundamental issues to network design, since they determine the system capability to support user communications and their reliability level.

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.

**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.

**TABLE 1**

**PARAMETERS OF SIMULATION**

- **Node**: A node is a compound object composed of a node entry object and classifiers. There are two types of nodes in network.
- **Unicast**: A unicast node has an address classifier that does unicast routing and a port classifier.
- **Multicast**: In multicast node, has a classifier that classify multicast packets from unicast packets and a multicast classifier that performs multicast routing.

**Link**: A link is another major compound object in networks simulation. When a user creates a link using a duplex-link member function of a Simulator object, two simplex links in both directions are created. One thing to note is that an output queue of a node is actually implemented as a part of simplex link object. Packets dequeued from a queue are passed to the Delay object that simulates the link delay, and packets dropped at a queue are sent to a Null Agent and are freed there. Finally, the TTL object calculates Time To Live parameters for each packet received and updates the TTL field of the packet.

**Packet flow**: Until now, the two most important network components (node and link) were examined. Internals of an example simulation network setup and packet flow. The network consist of two nodes (n0 and n1) of which the network addresses are 0 and 1 respectively. A TCP agent attached to n0 using port 0 communicates with a TCP sink object attached to n1 port 0. Finally, an FTP application (or traffic source) is attached to the TCP agent, asking to send some amount of data. packet received and updates the TTL field of the packet. Trace:-In network simulation, network activities are traced around simplex links. If the simulator is directed to trace network activities (specified...
using $ns trace-all file or $ns namtrace-all file), the links created after the command will have the following trace objects inserted as shown in Figure 4. Users can also specifically create a trace object of type between the given $src and $dst nodes using the create-trace {type file $src $dst} command. Queue monitor:-Basically, tracing objects are designed to record packet arrival time at which they are located. Although a user gets enough information from the trace, he or she might be interested in what is going on inside a specific output queue. For example, a user interested in RED queue behavior may want to measure the dynamics of average queue size and current queue size of a specific RED queue (i.e. need for queue monitoring). Queue monitoring can be achieved using queue monitor objects and snoop queue objects.

VII. PERFORMANCE EVALUATION
We use the following performance metric to evaluate the effect of performance. 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.

A. Parameter to evaluate
With the aim to evaluate our Rank based ACO LB-AOMDV protocol, we compare it with AOMDV protocol l. We study the variation effect on the following metrics:

- Packet Deliver Ratio
- Routing Overhead
- End to end Delay

VIII. SIMULATION RESULTS
A. 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.  . Fig 1 shows that the value of packet deliver ratio of AOMDV is low compared to ANT AOMDV. It shows better performance.

Fig 1: Packet deliver ratio of AOMDV versus PDR of ANT_AOMDV.

When the number of connections increases with the increment of PDR the ant_AOMDV perform better. Communication between the nodes is better compared to simple AOMDV. When the number of connection is 10. The packet deliver rate is higher.

B. Throughput:
Rate of data packet delivers in per Second. If the packets sent in high speed ,it means network has a high throughput.fig 2 shows that ant_AOMDV has higher throughput as compared to AOMDV.As the number of connections increases throughput increases, when the no. of connection is 5 the ant_AOMDV has 146.25 kbps and the simple AOMDV have 143.17 kbps, which is lesser than ant_AOMDV.

Throughput increases when the packet deliver rate should be higher and lower the ratio of traffic overhead.Which improves the network performance. In our simulation throughput is higher than the AOMDV.
When the number of connection increases the throughput of ant_AOMDV increases. when the number of connection is 25, the AOMDV have 697.48 kbps and the ant_AOMDV have 716.73 kbps, which is higher than the AOMDV.

C. Traffic Overhead

Number of routing packet with respect to data. Excess of data packets. In Fig 1 shows that the traffic overhead decreases as compared to AOMDV by the use of best route. In AOMDV have more traffic. With the use of Ant AOMDV we get better result.

When the number of connection increases the throughput of ant_AOMDV increases. when the number of connection is 25, the AOMDV have 697.48 kbps and the ant_AOMDV have 716.73 kbps, which is higher than the AOMDV.

When the traffic overhead increases the packet deliver ratio should be decreases. But in our case traffic overhead is lesser compared to AOMDV, which improve the performance.

IX. CONCLUSIONS

Rank Based ACO approach for Multipath Routing Mechanism with Load Balancing in Ad hoc Network is proposed for minimizing the delay, distributes the load on each node and improves the performance. The main objective achieved is:

- To 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.
- To design and implement Rank Based Ant System (ASrank) optimization technique to find the best path out of the multiple paths obtained from route discovery.
- To compare and analyze the proposed approach with the existing different routing protocols on the basis of parameters.

X. REFERENCES


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