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Optimization Routing Using Secure Reverse Multicast Bellman Ford Adhoc Routing and Ant Protocol in Manet

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ABSTRACT

In the technical world all the computer networks tend to become more and more complicated. The more difficulty here is to manage the routes and find which route is the best route. In this paper introduce a novel multiple constraints QoS multicast routing optimization algorithm in MANET called SRMBAR (Secure Reverse Multicast Bellman Ford Adhoc Routing) with the combination of ant colony optimization algorithm(ACO) that ensure Quality of service (QoS) guarantee by allowing reverse multicast routing on possible multiple paths between source and. The proposed SRMBAR and ACO can improve reliability of data transmission and optimize the maximum link utilization which achieves data integrity and then reduce the consumption of time and the transmission delay. Experimental results show that the reverse multicasting approach is efficient when compared with an existing algorithm, has promising performance in multicast traffic engineering and for evaluating the route stability in dynamic mobile networks.

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INTRODUCTION

MANET is collection of mobile nodes that communicate with each other over a wireless medium [1] without fixed infrastructure. Since, the topology of the network changes frequently, the problem of routing packets between two nodes becomes a challenging task, which has a significant impact on the performance of the network. Moreover, routing plays a vital role in deciding the QoS (Quality of Service). Various metrics associated with QoS includes packet delivery ratio, delay, pause time, control overhead, routing overhead and so on. The QoS of the network can be improved by minimizing the link failure probability, by reducing delay in transferring the packets, by providing alternate path in case of link or node failure, by reversing the resources that are utilized in the path for packet transmission and also by ensuring security of the nodes. Ensuring QoS of the routing protocol optimizes the routing paths.

Another challenging issue of MANET is multicast routing. The multicast routing protocol transmits packet from a source to more than one destination. A major issue is to ensure the robustness of the link failures and flexibility to attackers. Multicasting supports a wide variety of applications that are described by the close degree of collaboration [2]. As the nodes of the MANET are mobile, link or node failure occurs or intruders arise to collapse the entire network. Thus, an optimized multicast routing is essential for ensuring robustness and resilience against these attacks.

In addition to these vulnerabilities, there exists another problem in MANET associated with communication. In MANET, nodes transfer packets from one node to another in a multi-hop fashion. Multi-hop refers to the situation where a node communicates with its intermediate node and the data passes through several intermediate nodes from source to the destination node. A problem that arises under this scenario is a hidden terminal problem. Under this condition, a blind / hidden node does not obtain any control packets, so that the packets sent to the visible nodes would result in packet loss or collision. There exist several situations, under which a node can be hidden. First, is the network with worst throughput, where all the nodes of the network are hidden, another case is where all the nodes are visible and contend with each other for resources and finally, both the contending and hidden nodes appear together.

This paper aims to overcome the above mentioned challenges. Ad hoc on demand multipath distance vector routing (AOMDV) is employed to achieve multicast routing. Here, a novel Secure Reverse Multicast Bellman

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Ford Ad hoc Routing has been proposed for achieving optimized multicast routing. Moreover, a Routing Interference Communication framework has been proposed to avoid routing overhead and the hidden terminal problem. The proposed approach also ensures QoS by allowing reverse multicast routing.

The rest of the paper are organized as follows: section II presents the related work, section III provides routing between nodes using ANT, section IV our new improved concept, section V provides presents simulation result and finally section VI concludes the paper.

Related Works:

To upgrade the performance of the Mobile Adhoc networks, a different variety of routing protocols have been proposed by many researchers in network environment. The routing protocols are always selected based on the protocol's popularity, interesting characteristics and features. The dynamic topology of MANET is a major challenge in the design of a MANET routing protocol. In the [3], the author compared the four popular protocols such as OLSR, AODV, DSR and TORA. The combined effect of these protocols is investigated on an 802.11 MANET in OPNET simulation environment. The results of OLSR and DSR protocols provides better performance with low mobility, OLSR and AODV offer better performance in medium-sized network with node mobility and finally TORA and OLSR offer better performance in large networks. Based on the QoS (end-to-end delay, throughput), load in routing and retransmissions of packets, the performance of four MANET routing protocols with the different simulation model and configurations are systematically analyzed and drew more complete conclusions.

It is found that there are a various unsolved difficulties that need to be tended to design QoS routing protocols for mobile ad-hoc networks. These are maximization of exactness of QoS routing protocols, minimization of control overhead, route maintenance, resource reservation, cross layer configuration, power utilization, robustness and security. Understanding the existing QoS routing issues require the design and development of new QoS routing.

Routing between nodes using ANT Colony:

During network transmission many applications through a communication network require send information from a single source to multiple destinations. It already discussed by many people but the current standard is Djikstra's shortest path algorithm, uses dynamic programming to solve the problem. Essentially what the shortest path problem deals with is if you have a graph G = (C, V); where C is a set of nodes or locations and V is a set of vertices that connect nodes in N where V is a subset of CxC. The substation of the ants into an algorithm is made with the help of agents. The movement of ANT is depicted in Figure[1].These ants-agents are taking the whole responsibility for locally and autonomously to take the routing decisions. This algorithm is sharing between a large number of ant agents that is used to perform tasks simultaneously instead of having only one decision-maker for the whole colony. This shortest path consists of three major subroutines they are: Expose, Select, and Reproduce. In the Expose subroutine, the each ant in the population is run against the camera Trail [4] as well as each ant's score is recorded. In the Select subroutine, statistics are generated for the previous Expose run. Each ant's score is compared to the maximum score attained in the population. One of two selection strategies is employed to choose an ant for the reproduction [5].The fraction of ants only with the highest scores is marked for reproduction only if the user has selected a truncation strategy,. In the Reproduce subroutine, the genes of ants which are not marked for reproduction are overwritten by copies of those which are marked, and then crossover and mutation are applied. There are some important differences between artificial and real ants [6]:

- The artificial ants are used to live in a very discrete world.
- The pheromone update is not accomplished in exactly the same way by artificial ants as by real ones. It is done only by some of the artificial ants.
- Some of the implementations of artificial ants use some type of the additional mechanism that not very much exists in the case of real ants. Examples include look-ahead, local search. The Comparison between the nature Ant and the computer science Ant is depicted in table [1].

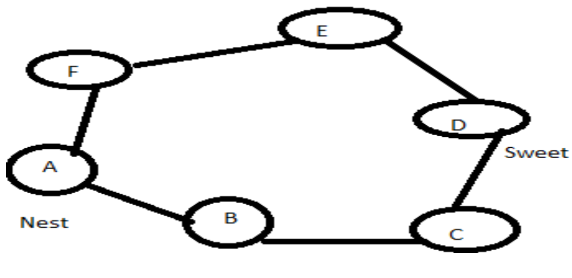

Fig. 1: Ant moving between each node.

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Table 1: Comparison between nature ant and computer science ant.

Nature	Computer Science
Natural habitat	Graph (nodes and edges)
Nest and food Nodes in the graph	start and destination
Ants Agents	our artificial ants
Visibility	The reciprocal of distance, η
Pheromones	Artificial pheromones ,τ
Foraging behavior	Random walk through graph

Our Newly proposed Ant Colony Optimization Concept:

The Ant Colony Optimization

Here we have to assume that nO is source node, and A= {A1, A2 … um} denotes a set of destination nodes, the smallest bandwidth constraint, and by the algorithm for finding the k shortest paths in reference, we can find the candidate route set from source node to each destination node i (i.e. Ui = {U1, U2,……….,Un}). This procedure can be performed as the following steps:

First we should initialize the network nodes. Here Define the source and destination nodes M= {M1, M2 … Mm} Set NC =0 (NC is considered as a loop counter.).Make for each destination node as ui ∈ U, Kept Pi be the set of the shortest paths for the destination node ui. Also assign an initial value $\tau_k = 0;$ to the pheromone intensity of every pk, k=1,2,…n, Now start the first tour; Assume m ants are moving from s to ui on Pi equally (Consider the ants number in each path pk is equal).Calculate the pheromone amount left by x ants at pk ($\Delta\tau_k$) by using the following equation: $\Delta\tau_k^{total} = \frac{Q}{C_k} * x;$. Update the local pheromone $\tau_k;$ $\tau_k = (1-\rho)\tau_k + \Delta\tau_k^{total};$ .Here ρ ∈ (0, 1] is the evaporation rate. Start a new tour Assign NC=NC+1; Calculate the corresponding probabilities function fk for each pk as follows:

$$f_k = \begin{cases} \frac{[\tau_k]^\alpha * [\eta_k]^\beta}{\sum_{j\in n}[\tau_j]^\alpha * [\eta_j]^\beta}; & k \in n \\ 0 & otherwise \end{cases}$$

Where $\eta_k = \frac{1}{d_k}$; dk is computed by using the above given Equation and α, β denote the information accumulated.

Analysis Results and Discussions:

Sample Number 1:

Refer the Figure 2. Here it listed with 8 nodes and the connection between the each node is depicted in this figure.

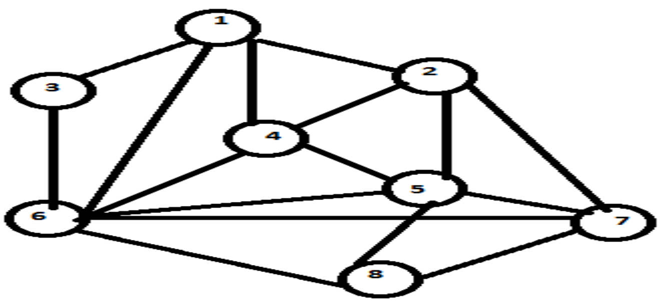

Fig. 2: Sample Toplogy.

Using our new developed algorithm we found the shortest path distance between each corresponding nodes with a minimal number of packet loss. Refer the below given table [2]. It listed the details above bandwidth, delay vector, delay in Jitter and the packet loss rate. We can find from this table that the packet loss is very less.

Table 2: Packet Loss rate for each link vector.

Link Vector	Bandwidth Factor	Delay Vector	Delay in Jitter	Packet Loss Rate
1 to 2	50	10	11	0.04
1 to 3	80	55	15	0.01
1 to 4	100	10	21	0.1
1 to 6	60	20	15	0.009
2 to 4	75	60	30	0.001
2 to 5	150	62	25	0.04
2 to 7	120	55	13	0.04
3 to 4	60	30	24	0.09
3 to 6	90	20	13	0.02
4 to 5	60	80	15	0.03
4 to 6	80	40	26	0.0431
5 to 6	65	30	18	0.06
5 to 7	70	50	17	0.5
5 to 8	80	40	30	0.004
6 to 7	100	70	22	0.1
6 to 8	120	50	12	0.04

Finally we found the multicast tree as shown in Figure [3] with minimal cost=14.

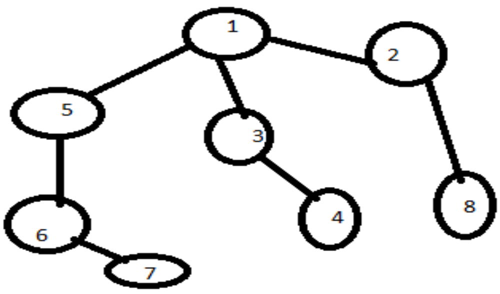

Fig. 3: Our Obtained Multicast Tree.

Figure [4], Figure [5], Figure[6], Figure [7], Figure [8], Figure [9] shows the number of ants on each path (1-2,1-3,1-4,1-6,2-4,2-5,2-7,3-4,3-6,4-5,4-6,5-6,5-7,5-8,6-7,6-8) respectively. The factors like bandwidth, delay vector, delay in jitter, packet loss rate represents by the horizontal axis the tour number and the vertical axis represents the number of ants.

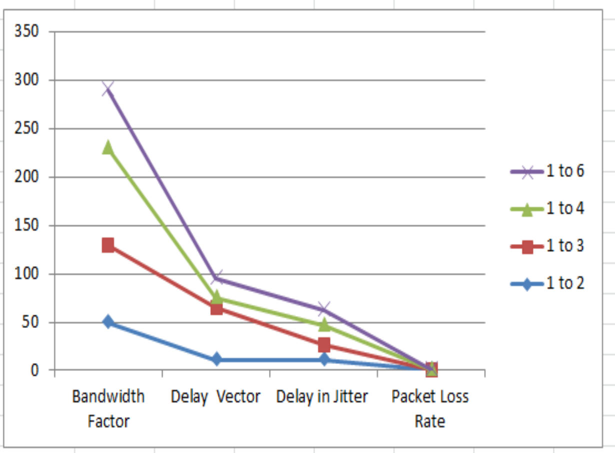

Fig. 4: Path flow from Node number 1.

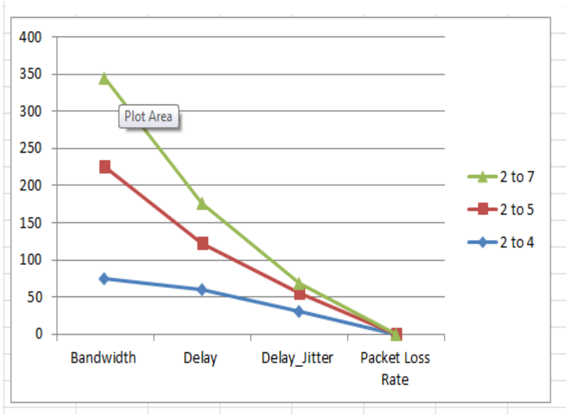

Fig. 5: Path flow started from Node number 2.

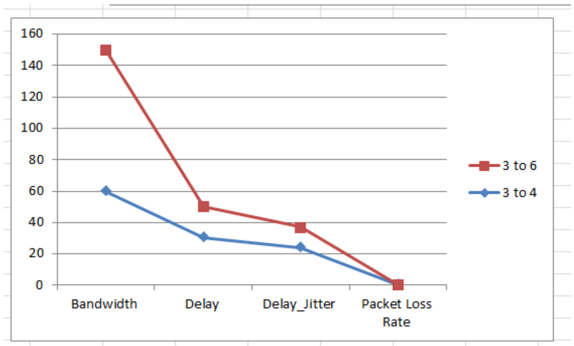

Fig. 6: Path flow from Node number 3.

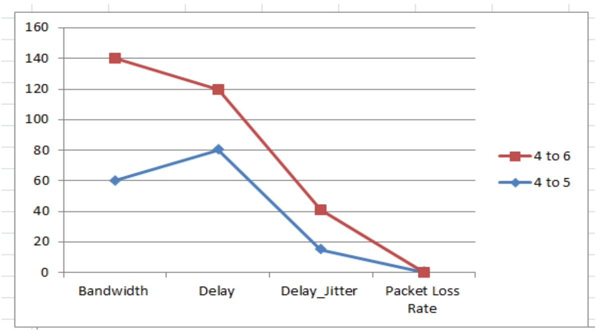

Fig. 7: Path flow started from Node number 4.

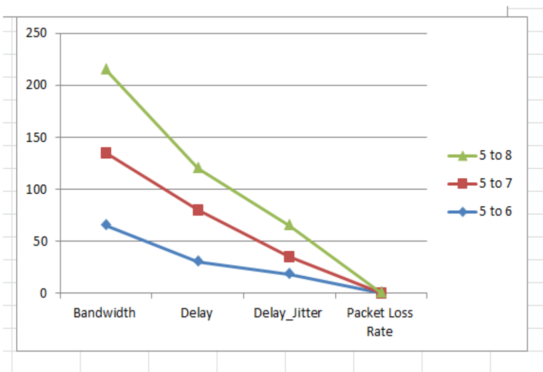

Fig. 8: Path flow from Node number 5.

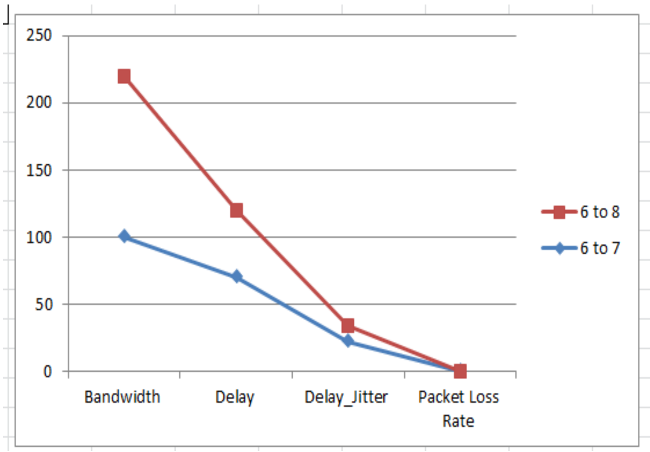

Fig. 9: Path flow started from Node number 6.

The below Figure [10] shows the comparison of convergence time when we compare the result performance of the Ant Colony Optimization (ACO) and Secure Reverse Multicast Bellman Ford Adhoc Routing (SRMBAR) and the Figure [11] represents the Comparison of multicast tree performance between ACO and Secure Reverse Multicast Bellman Ford Adhoc Routing (SRMBAR).

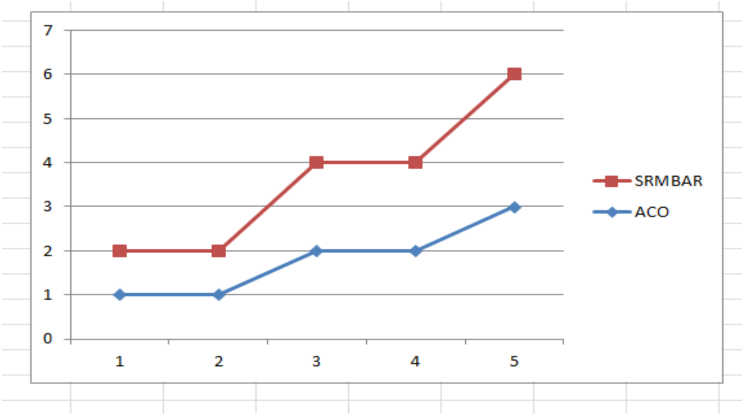

Fig. 10: Comparison of Convergence Time.

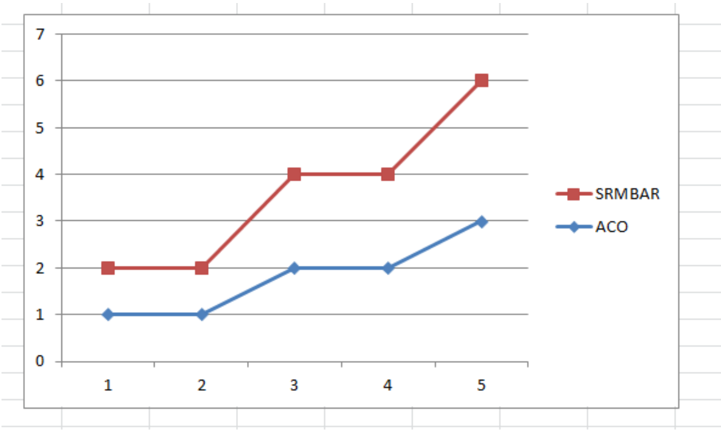

Fig. 11: Comparison of multicast tree performance.

The multicast tree obtained from this route is shown in Figure [12].

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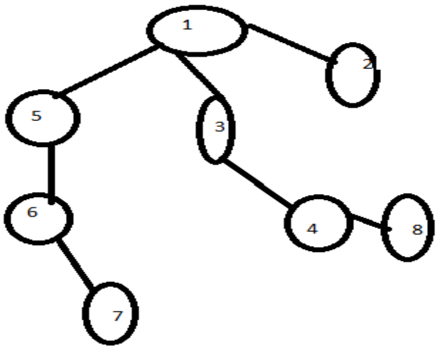

Fig. 12: The Multicast Tree obtained.

Conclusion:

This Ant algorithm and SRMBAR is used for solving QoS multicast routing problem based on bandwidth and delay constraints. By comparing the previous results we observe that the multicast tree obtained by the proposed algorithm is quite similar to the multicast tree .This means that the proposed algorithm is working properly as well the performance is compared between ACO and SRMBAR.

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