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A Comparison Of Smart Routings In Mobile Ad Hoc Networks(MANETs)

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ABSTRACT:*The importance and the massive growth of many wireless networks, has consequently lead to creation of many different routing types, that each of them have tried to improve the network capabilities with different parameters.From this it can be deduced that , there is an essential need to develop an optimal routing network which as a complete routingshould be more flexible than the existing ones. In the field of traditional routing, intelligent routing and the swarm intelligentsuch as ARA, several algorithms have been written that neither of them have been totally rejected nor used widely as the rule of thumb.In this paper it is tried to prove that by combination of several different routing algorithms, which have been presented so far, an intelligent routing network can be achieved that analyzes the properties in the different conditions and matches it with required routing types.Simulation results show that, the offered combined algorithm in general, has had a significant improvement in thevarious wireless network parameters , compared with each algorithm that are used separately .*

Keywords:*Ad Hoc Networks Routing Algorithms, Swarm Intelligent.*

I. INTRODUCTION

Wireless Mobile Ad Hoc Networks that are called MANETs,have been considered more thanone decade[1]. The most significant point about this kind of network is that, it has no infrastructure and can be used quite easily in critical situation with minimal cost. This network has moving nodes that can link to other nodes in two ways: direct and indirect. In the direct method, source node is located in the neighborhood of the destination node and the communication is done very easily, but in the indirect method as the origin node is not in the neighborhood of the destination node, middle nodes (as many as required) are used to carry the data in the communication [2].

Many routing algorithms have been presented, one of them is Ant Colony Optimization (ACO) algorithms [3] that is been used from 2002 until now in many different ways. Attention to other aspects of networking such as energy has produced many algorithms like EAAR[4]. It should be noted that improving all the parameters of a network for overall quality of service (QoS) lead to a better network completely but it is impossible due to network and environment conditions such as energy, mobility, traffic and many other parameters that are effective as well. Every algorithm under certain condition can improve only two or just a few parameters.In a paper [5] we have chosen few algorithms from several existing algorithms in ARA field but by considering and simulatingdifferent domains and routings under combined routing algorithms we have shown that the combined algorithms will produce a better result.

In this paper by combining and comparing several algorithms and applying them in various network conditions, a new algorithm is presented which is useful for networks that do not have a stable environmental situation.Simulationshows general improvements compared to the ones that are currently used separately.
We initially examine types of routing tasks performed currently, then the combined routing algorithm is presented and briefly explained, and finally, simulation results and conclusion are presented.

II. KINDS OF ROUTING AND RELATED WORKS

In total there are 3 Routing categories, which are as follows: Proactive, Reactive and Hybrid.
1- proactive or (Table Driven):in this category, each node in the routing domain sends continuous messages to the other nodes in its neighborhood and the surrendering environment and stores the obtained information from

other nodes in the domain and maintains in a table of routes. However the used energy is quite high, this method has the advantage of being high-speed because the routes for the destination already are defined in the tables. Many algorithms in this category can be mentioned such as DSDV[6],WPR[7],GSR[8],FSR[9],STAR[10] and many other protocols.

2- Reactive routing (on demand): in this type of routing, only when there is a request at the source node to contact to the destination the routing beings and the transmission of the data begins just after the routing destination is been found. As it can be observed, this method is much slower than the proactive type because the destinations are not defined readily. There are also many routings in this category such as AODV[11],DSR[12],ROAM[13],TORA[14] and LMR[15] protocols.

3- Hybrid:as the name of this model suggests, it is a combination of two types of proactive and reactive routing. The tendency for this routing is obvious. In a Hybrid routing, proactive routing is used for near destination and proactive routing for farther destinations. ZRP[16], ZHLS[17], DDR[18] are some of the routings in this category.

III. THE PROPOSED ALGORITHMS AND USED ROUTINGS

In this part we briefly describe those routing algorithms that are going to be used in our intelligent combined algorithms. And finally we explain how they are combined. The routing that have been selected to be combine will cover a wide range of scenarios in a complex networks.

A)DSDV: that is an interactive (proactive) algorithm which is very convenient for small and compressed networks. The way that this algorithms works is as follow: as a proactive protocol, it works based on the shortest distance. DSDV has a table of all destination nodes, updates its tables frequently and contacts to all of its neighboring nodes. This frequent updates requires a massive bandwidth with a high energy consumption, however it does nothave a dead-end and never fail to find the required destination node.

B)OLSR:this algorithm acts on bases of Link-state (contrary to Distance-Vector), it creates a graph of the paths and the relationship between the nodes. On request it will choose the best route to the destination node from the saved information. The advantage of this method is that, the topology information is reviewed and updated at each count, and reduces the amount of control packets. Therefore OLSR is suitable for networks that are only active during specific periods of time and would not require to occupy bandwidth for a long time.

C) ARA & ARAMA:both of these algorithms are part of reactive algorithms and based on the move of ants in search of food. Therefore it can be said that these two algorithms find the route to the destination node by probability model. The simplified relationship in this algorithms is shown in equation 1, that $P_{i,j}$ is the probability of node j for choosing node i.

$$p_{i,j} = \begin{cases} \dfrac{\rho_{i,j}}{\sum_{k\in Ni}\rho_{i,k}} & ,if\ \ j\in N_i \\ 0, & if\ \ j\notin N_i \end{cases} \qquad (1)$$

One of the problems with this method is that the broadcast of the requested route in the network is not suitable for large networks with many nodes and does not consider the energy factor.So all types of ARA are not suitable for networks with lots of nodes and low-energy scattering.

D)EAAR:is another algorithm which is based on move ants algorithm with an obvious difference that specifically focuses on energy and the routehas an appropriate longevity. In addition to this, there is a future for alternative routing in this algorithm which eliminate the need for any rerouting in the case when there is a missed route. The general formula for the probability of selecting the next node in this algorithm is shown in Equation 2.

$$P_{n,d} = \frac{(T_{n,d}^{i})^{\beta}}{\sum (T_{j,d}^{i})^{\beta}} \qquad (2)$$

$\beta$is a scaling factor. Therefor it can be said that EAAR is suitable for networks with sparse and non-conventional energy with almost anynumber of a nodes.

E) ZRP: This routing algorithm works on the bases of regions or the Zone Code. The way it works is as follow: in any particular zone, there are routes from one node to all other nodes in that zone and it works in proactive or reactive way. But to find a node in a different area, the route is identified on the bases of the distance and selectingthe central node for connection to destination node in other area, as shown in Figure 1 (an overview of routing domains).

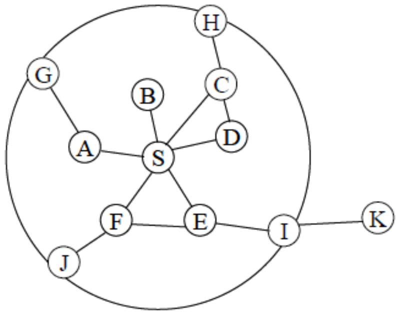

Figure 1: Classification of zone in ZRP

Therefor ZRP is suitable for networks that have less mobility and the nodes are scattered in specific areas that can be classified in zones.

F) DST[20]: in this Algorithms, graphs are formed in the shape of trees, within these graphs are nodes which can communicate with other trees. The advantage of this model is that because the routing between the trees may communicate (it has a specific time period) if the entry of new nodes into the network is large or nodes are taken out of the network, they all will be taken into the account. In this method only finding the destination is important and the paths taken is of no importance.So DST is appropriate for networks with wide spread nodes, where the rate of adding and removing nodes are high.

We have called our proposed algorithms ICRA (Intelligent Comparison Routing Algorithm). This comparison routingis a hybrid routing. All nodes before the call to any specific destination will collect data from their neighboring nodes on a continuous cycling base. Some important parameters are stored in the routing tables for each node, such as total number of neighboring nodes, the total free energy of them and network bandwidth which at the time of a request would be used to determine the type of algorithms in routing connection. For saving each of these parameters a set of standards has been defined.This has been illustrated in Table 1.

Table 1: Conditions of Selecting Algorithms

TypeAlgorithm	*conditions*
DSVD	*The Number of neighboring nodes more than 50% of initial nodes*
OLSR	*Freebandwidthof1.5MB andno change inthe number ofneighboring nodes*
ARA	*Number of neighboring nodesis less than50% of the initial nodesorthetotalenergy is under10,000joules*
ARAorEAAR	*Excessive energy difference of neighboring nodes*
ZPR	*The Number of neighboring nodes about 30% of initial nodes andspatial stability ofneighbors*
DST	*The numberof nodes ineachupdateperiodismore than 20% ofprevious state*

In our simulation at the time of the request by programming and using some instructions, the right algorithm(s) would be chosen and applied to the routing process. If more than one algorithm can be used for a specific request, thenour algorithm picks the algorithm that has minimum delay and also uses the least energy.

IV. SIMULATIONANDRESULTS

Our simulations has carried out using Matlab2007b. Before considering details and results, there are couple of points which are so important and should be mentioned. On the one hand, the technology of sensor, battery and memory storage on a mobile phone or other devises have improved and on the other hand the importance of time is also much more critical. Therefore it can be assumed that nowadays, the priority is on less routing delay than on saving power consumption that has been considered in our method.

In our simulations it is tried to use parameters that are used in majority of networks and in the simulations, these can be seen in Table 2.

Table 2: Simulation assumptions

Parameter	***Defaults***
Dimension	*mumixaM*2000×2000m^2
Initialnumber ofnodes	Up to100
CommunicationRange	350 Meters
Layer protocol MAC	IEEE 802.11
MobilityModel	Random Way Point
PathLossModel	Free space
InitialEnergyof Nodes	Upto 1000 Jules
PacketLength	64 & 128 Kb
Traffic Model	CBR
Channel Capacity	2 MB
Simulation Time	Each Time 1000 Second

There are several network performance parameters for assessing the performance of network. Energy consumption, packet delivery, delay, lost packet and number of missingnodes. Some of the most important of these parameter are considered in our algorithm. Simulation has been carried out many times using different algorithms.The number of delivered packets in 4 different duration of simulation has been noted and shown in the figure 2 for comparison.

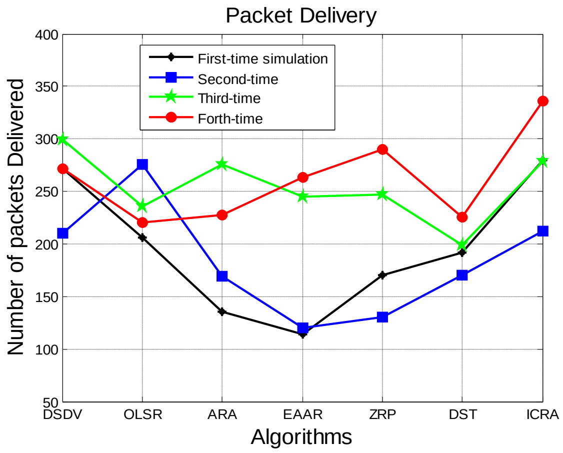

Figure 2: Number of delivered packets

The reason for running the simulationmany times was because the conditions, the size and power of the network and the number nodes are random. As it can be seen in Figure 2, depending on the routing algorithm that is used, the number of delivered packages are different, but almost in all cases, this parameter of the proposed algorithm is better in comparisonwith the other algorithmswhich has predicted.
Next parameter which is considered, is the number of lost packets. The existing routing algorithms and multi-streaming EAAR is expected to have the least number of lost packets. Figure 3 shows the number of lost packets in the used algorithms.

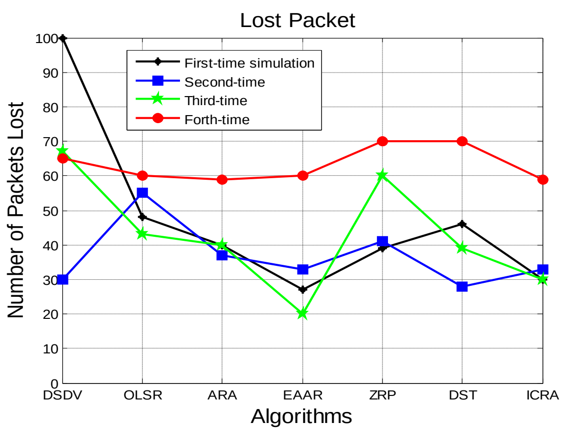

Figure 3: Number of Lost packets

As expected, in all cases EAAR algorithm has the lowest number of lost packetsand in comparison to our algorithm is generally better than the other modes.Comparisons lost an delivered packets separately is not enough. For this problem the ratio of delivered packetsto total packets in all simulations in Figure 4 has been illustrated that shows ICRA as a better algorithm.

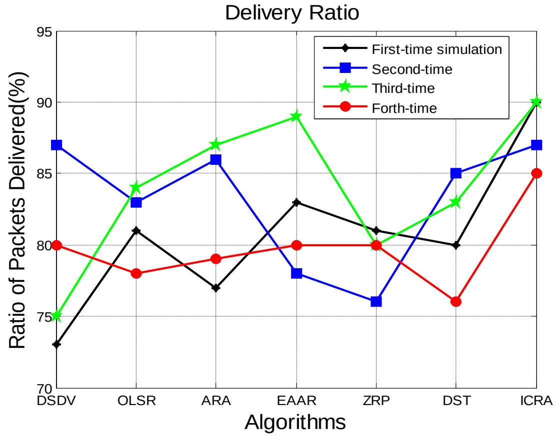

Figure 4: Ratio of Delivered Packetsto total packets

In Figure 4 we can see that our algorithm ICRA in more than 75% has better delivery ratio and according to this the reason of having inappropriatenumber of lost packets in Figure 2 is also explained.
The next parameter is the energy consumption of the entire network. High energy consumption due to rational calculation and data analysis which is performed at each node, is predictable. Table 3 shows the Energy consumption in the entire network, and end to end delay in all of them.

Table 3: Energy and end-to-end delay

Averageend-to-end delay(sec)	*Averageenergy consumptionof the entire network(kj)*	*Algorithm*
0.9	*37*	*DSDV*
0.75	*42*	*OLSR*
1.2	*40*	*ARA*
1.1	*42*	*EAAR*
1	*51*	*ZPR*
1.2	*59*	*DST*
1	*76*	*ICRA*

As you can see in table 3, the proposed algorithm ICRA as was expected consumes more energy, but the calculations are reasonable and the delay is not relatively high. However, as mentioned earlier, it should be noted that nowadays, the energy consumption has a lower prioritythan the delay of the packets. Therefore the more energy that is used in the ICRA algorithm can be justified with more routing packets that have been sent by ICRA algorithm.
In Figure 5, the average total simulation time that each algorithm has spent can be observed.

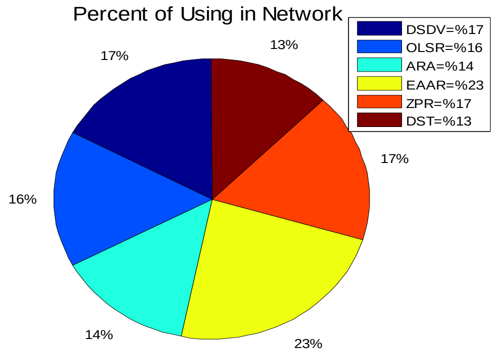

Figure 5: Percentage of total time of each algorithm during the simulation

Use of any routing algorithm during the total time of simulation is not predictable.However the basic parameters such as network size, nodes and the energy are selected randomly and it seems to be natural that each algorithm is used in different periods of time, but the differences between times are not high.

V. CONCLUSIONS

According to simulations that are performed and the recorded results we can conclude that however that the combination of routing algorithms does not affect the overall quality of the network, but is better to use theses in a collection than using them separately. However increasing the number of routing algorithms that are used in these models is limited due to the limitation on high energy consumption, it would be much more effective and better presented for networks that have no energy constraints and are connected to a data center .

Future Works

For more comprehensive and thorough investigation, our aim is to extend our simulation via software NS2 and use new algorithms such as PSO. This model also provides an algorithm for wireless sensor networks that we are going to study and simulate it.

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