Improving the Performance Quality Parameters of Routing Protocol for MANET Networks

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Abstract

Routing and mobility in the network is a major in the field of wireless networks MNAET research and contributes greatly to the improvement of the performance of these networks, and achieving the best advantage of the available package which increases the yield and reduces network congestion. The importance of research is that it seeks to provide solutions for routing in MANET networks effectively and with high reliability and that the solutions offered are adapted to changes in the network topology. In addition to the above, it highlights the quest to find a solution to the two types of malfunctions resulting from roaming contracts, which has become necessary to ensure the best performance for this type of network, where you get these malfunctions in the most current routing algorithms.

Keywords: Manet; network; nodes location; algorithms

1. Introduction

Ad Hoc mobile networks (MANET) are a key component of the architecture of next-generation networks. Unlike a wired or cellular network, a MANET network is a network without a fixed infrastructure that does not depend on centralized management, and is an autonomous system consisting of wireless nodes that move quickly, randomly and self-organize themselves. Therefore, the topology of an Ad Hoc network is dynamic, and it changes rapidly and in an unpredictable way; this leads to the connection between nodes constantly changing. In general, the connection between a source node and a destination node in MANET networks is established by means of several intermediate nodes. Thus any failure of communication between two nodes in a given path leads to a complete failure of communication between the source and the target.

Purpose and importance of research:

The importance of the research lies in the fact that it seeks to provide advanced solutions that ensure the performance of routing functions in MANET networks with high efficiency and reliability, provided that the proposed solutions are adapted to changes in the network topology. In addition to the above, the quest to find a solution to the two types of problems resulting from roaming nodes is to provide the information that the server node has and move the server node from its place, which has become necessary to ensure better performance of this type of network, these failures may occur in most current routing algorithms.

This research aims to present a new routing algorithm, and this algorithm works on moving nodes without the need for a fixed architecture, so that the proposed service achieves the following:

- Reduce the time required to find a node that has information about the location of a particular node.

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- Reduce the path length between the node requesting the location information of another node, and between the node providing this information.

Research methods and resources:

Proactive Routing Protocols:

In this type of Protocol [1] each node keeps routing information in routing tables for all other nodes in the network or for nodes located in special areas, the routing tables are updated periodically or when there is a change in the network topology. Protocols differ from each other in the way routing information is collected and updated, and the type of information that each routing table maintains, in which routes to all nodes in the network are formed in advance, including OLSR.

Reactive Routing Protocols:

In these protocols [2,3,4] the path is determined on request by the node that performs the path discovery process. These protocols reduce the additional load in proactive protocols by retaining only active routes; route detection always occurs by flooding the network with Route request packets and from them:

AODV: Ad hoc On-demand Distance Vector.

DSR: Dynamic Source Routing.

These protocols work within two strategies:

• Hop-by-Hop routing.

• Source routing.

Location-based Routing Protocols:

The role of the contract is according to its position [4].

Energy Conservation Protocols:

In them, energy consumption is taken into account when forming tracks [5].

Hybrid Routing Protocol:

Each node within the zone maintains network connectivity a priori, and each node outside the routing zone determines routes interactively [6,7,8]. Also, the node can be located in more than one area of different size figure (1-2) where we have:

Internal node: Interior Nodes which is located at a distance less than the radius of the region r and represents the largest number of jumps to the surrounding nodes starting from a central point (node) provided that the broadcast range of the central node does not exceed.

Peripheral nodes: Peripheral Nodes that are located at a distance equal to r and from which:

ZRP: Zone Routing Protocol

Divided into two protocols:

- IntrA-zone Routing Potocol (IARP): used within the zone, based on a proactive routing algorithm.
- IntEr-zone Routing Potocol (IERP): used for communication between zones based on an interactive routing algorithm.

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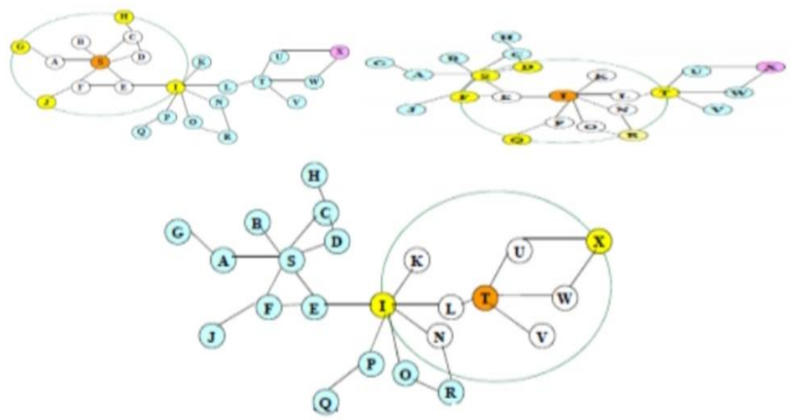

Figure (1-2): the process of Route detection in the ZRP protocol

The cluster model

The researchers proposed a routing protocol for MANET networks based on the cluster model [8,9,10] Cluster Model. The use of the cluster model aims to reduce the average delay time between the beginning and the end of the route, in addition to improving the rate of packet delivery from the source node to the destination node in order to reduce network overload and improve the scalability of the network. They called the proposed hybrid routing algorithm CRP (Cluster Routing Protocol). Each cluster has a head that coordinates with the rest of the clusters in the network, as shown in Figure 1-3.

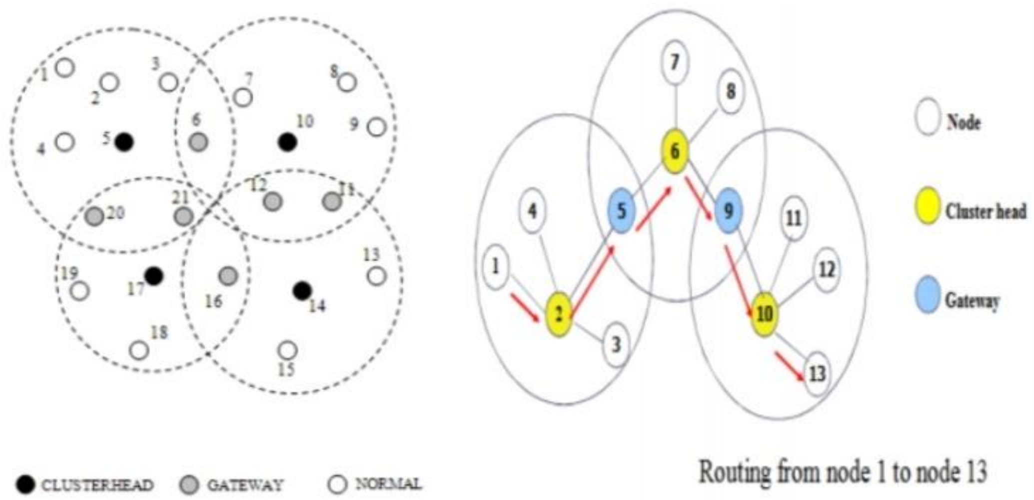

Figure (1-3): the mechanism of Path detection in the cluster model.

Figure (1-3) the mechanism of Path detection in the cluster model.

The algorithm proposed by the researchers was tested using the simulation program NS-2, where the results shown in Figure (2-3) showed a significant improvement in the delivery rate of PDR packets, in addition to a significant decrease in the average delay time in the delivery process, compared to other protocols such as the ad hoc on-demand Distance Vector (AODV) protocol.

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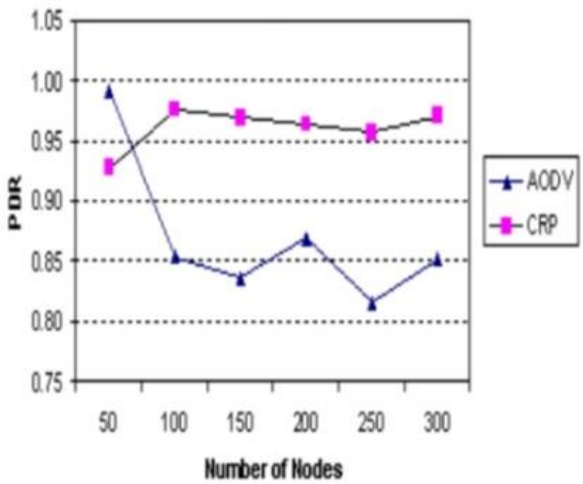

Parameter	Value
Number of nodes	50-300
Size of network	500m x 500m
Speed of the nodes	5-20Km/h
Transmission rang	30-300 m

Figure (2-3): performance of the CRB protocol as a function of various values of the number of nodes in the network.

Roaming models

All research on Manet networks depends on simulation to provide valuable methods for comparing different protocols and studying their performance, therefore, when simulating a protocol running on MANET networks, it is necessary to use one of the available roaming models, this model represents roaming nodes and their movement in the network space in which the nodes are distributed. It is only within this scenario that the success or non-success of the proposed protocol can be determined, and the roaming model plays an important role in routing in MANET networks. There are many roaming models that have been presented by researchers in previous years, where [11] Turgut et al. Introducing four roaming models:

- The imperative paradigm.
- The partially deterministic model.
- Brownian motion model
- Brownian motion with a drift model

In the deterministic model, the motion of all nodes is fully known, in the partially deterministic model, the directions of all nodes are known with a certain probability, and assume a dependent probability distribution of the direction of motion, but in the Brownian motion model, the direction of motion is a constant random variable in the field[0-2π] in addition, the speed at any given time is random. In Brownian motion with a drift model, the nodes move randomly, as in the previous model, but there is a general direction of movement. Many roaming models represent roaming nodes whose movement is independent of each other (such as: the Random Waypoint Mobility Model) and also many of them represent roaming nodes whose movement is not independent of each other (such as: (group mobility models in general, mobility models are classified [12] into random-based models and group models and the following are some roaming models based on randomness:

- Random Walk Mobility Model.
- Random Waypoint Mobility Model.
- Random Direction Mobility Model.
- A Boundless Simulation Area Mobility Model.

Johansson proposed a model for calculating the roaming factor based on the relative speed between nodes [13] by defining the M_{xy} between node x and node y as follows:

$$M_{xy} = \frac{1}{T}\int_0^T |v(x,y,t)|\,dt \qquad (1)$$

The total roaming factor is:

$$M = \frac{1}{|x,y|}\sum_{x,y} M_{xy} \qquad (2)$$

Where |x, y| The number of distinct node pairs (x,y).

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Larson and Hedman proposed [14] a model for calculating a factor called mobility M, used to describe the difficulty of routing in an ad hoc network depending on the roaming of nodes and the calculation model is:

The M_{xy} of node x represents the change in the median distance (Ax) from node x to all n nodes between successive time steps is Δt, if T is the total simulation time, then":

$$M_x = \frac{\sum_{t=0}^{T-\Delta t} |(A_x(t) - A_x(t+\Delta t)|}{T-\Delta t} \quad (3)$$

And the average roaming factor is:

$$M_{Avg} = \frac{\sum_{i=1}^{n} M_i}{n} \quad (4)$$

Location service based on the server area:

The main characteristics that must be provided in the service of good sites to ensure balance are:

Ensuring the availability of location service information in the event of a node failure containing this information. The failure of a node should not affect the accessibility of other nodes. The volume of storage of information about sites and the cost of connection should not swell with the rise in the number of nodes. The search time for the location of a node should be as small as possible. Ensure the availability of up-to-date data at any time. All these requirements were taken into account during the development of the service: initially, the ad HO network is divided into a number of concentric circular rings with ascending diameters (1-5). Of course, the Central Circle is chosen, which is approved by all nodes. The radius of the circle is the smallest and r=R/2, where R is the transmission range of the node. The diameter of the circle increases as we move away from the central circle by a value. r divides the service into four steps::

- Choosing the server locations so that the number of server nodes at the beginning of the simulation is only two and changes with time, but the algorithm maintains at least one number of server nodes by expanding the server area.

- Update the web server.

- Exchange of data between site servers.

- Request information about a location.

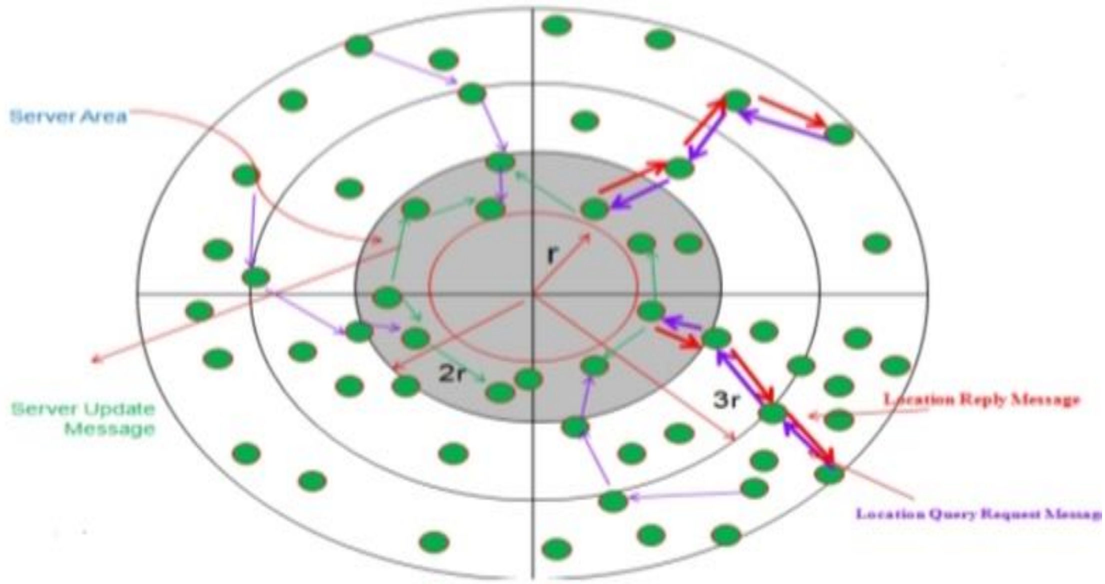

Figure (1-5): diagram of the segmentation of the studied network

Formation of letters and packages

• Hello Message (Node ID, Node location).

• Update Message (Node ID, Node Location, Message Sequence No.).

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• Server Update Message (The server ID, The server location, the server radius, Nodes list).

• Location Query Request Message (Source ID, Source location, the packet sequence No).

• Location Reply Message (Source ID, Source location).

2. Results and discussion:

The main objectives of the following experiments are: first, to measure the efficiency and effectiveness of the algorithm for serving sites offered in ad hoc mobile networks within several environments and under a range of conditions, and secondly, to measure the algorithm's reaction to changes in the network topology. To achieve the previous goals we used NS-2 as a simulation tool [15].

In our attempt to generate results in the simulation that are representative of some real-world scenarios, which the proposed algorithm can face, we worked on the implementation of the simulation with values of converters close to real values. The service evaluation was based on a simulation of 50 wireless nodes in some scenarios, and a different number of nodes ranging from 50 to 200 nodes in other scenarios; in each scenario we have two server nodes initially. These nodes form an Ad Hoc network roaming over an area (1000mx1000m) for 500 seconds of simulation time.

The offered service was evaluated by measuring the average and minimum number of servers at any given time during the simulation period. In addition to the site update success rate, node location query success rate, CBR connection percentage, and average CBR connection delay, each mentioned performance indicator was evaluated under several scenarios : network sizes scenario: to evaluate the performance of the offered service with different numbers of nodes, and to examine the feasibility of increasing the number of nodes.

Speed scenario: to evaluate the service with different values of speed.

In general, the values of the simulation variables set out in the table were adopted (1-6):

The value of the transformer	Description of the transformer	The name of the mutant
10sec	Contract downtime in the roaming model random Waypoint	Pause time (s)
50	The total number of wireless nodes in the network	Number of nodes
1000m x1000m	The area covered by the grid	Grid area(Length x Width)
50/1000x1000	The number of nodes divided by the network area	Density of nodes (node\ M2)
196,428	The area of a circular radius is the broadcast distance of one node	Coverage area(m2)
9.817	It is the quotient of dividing the coverage area by the density of nodes	Average number of adjacent nodes
125m	The smallest limit of the basin radius Servers	The radius of the server Basin
25	The necessary threshold of distance for updating the site	Threshold distance (m)
500, 500	Network area Center	Coordinates of the center
10	Number of data generating nodes	Number of sources (node)
10	Average contract speed	Speed (m\s)
CBR	Method of generating data parcels	Pattern of data
64	The size of the data parcel generated by the data-generating nodes	Package size Data (bytes)
2	Channel capacity used in the network	Channel capacity(Mbps)
4	The rate of sending data parcels per second	Parcel rate (parcel\s)
250	The broadcast range of one node in the network	Broadcast range (m)
3	The number of times site query requests are resubmitted	Number of retries In site requests
500	Simulation time	Simulation time (s)

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1	The period after which the HELLO packet is sent back	Hello_Interval (Sec)

Minimum and average number of servers

This indicator shows the average and minimum number of servers in the network during the simulation period. Figure (1-6) shows that the average number of servers in the network increases with the number of nodes in the network. Figure (2-6) confirms that there is always at least one server and the minimum number of servers is always greater than zero. This is based on the principle of using a dynamic server zone, which says that when the number of servers reaches zero, the radius of the server zone increases to include other servers.

The percentage of delivery of data parcels

The data parcel delivery ratio is the number of data parcels received by their intended destination divided by the number of data parcels sent by the source node. It can be seen from figure (3-6) and figure (4-6) that the percentage of delivery of data parcels decreases slightly with an increase in the number of nodes and the speed of nodes depending on the resulting bottleneck and roaming nodes. The percentage remains approximately 95% until the number of nodes becomes 150 and gradually decreases until it reaches 81.5% at 200 nodes.

Average delay in parcels

It includes all the delays that are usually due to path exploration, delays due to ARP, or latency. It can be seen from figure (5-6) that the average delay steadily increases with the number of nodes depending on the congestion on the network. While the impact of the node speed and stop time on it is minimal, because the parcel does not depend on established paths from the source to the destination, but each node passes the parcel to the next nodes in the direction of the destination node and is as close as possible to the destination node. During scrolling, if the package is passed to a server or to a node that has more recent location information about the destination node.

This indicator indicates the number of location update packages generated in the network in order to update the servers and provide them with the geographical location of the node. Consider the location update threshold, where a node must send its location update to the location server if it moves a distance .Dub assuming the average speed of node n is VN, the time that node n needs to send a location update packet is: $T_{update}(n) = \frac{D}{V_n}$ (5)

And taking into account the simulation time (Tsim), then the number of site update parcels sent by node n is:

$$P_{update}(n) = \frac{T_{sim}}{T_{update}(n)} \qquad (6)$$

Taking the number of nodes into account (N), then the number of site update packets generated in the network:

$$P_{total\_update} = \sum_{n=1}^{N} P_{update}(n) = \sum_{n=1}^{N} \frac{T_{sim}}{T_{update}(n)} = \sum_{n=1}^{N} \frac{T_{sim}V_n}{D} \qquad (7)$$

And when the average speeds of all nodes are convergent and equal to V, then:

$$P_{total\_update} = NP_{update} = \frac{NT_{sim}}{T_{update}} = \frac{NT_{sim}V}{D} \qquad (8)$$

AssumingT_{sim}, do V is invariant if:

$$P_{total\_update} = K_{co\,eff}N \qquad (9)$$

Where

$$K_{co\,eff} = \frac{NT_{sim}V}{D} \qquad (10)$$

For example, if T_{sim}=500secand D = 25mo V = 5m/Se, the number of position update parcels generated in the network theoretically calculated by Equation (1) and the result of simulation for a different number of nodes will be visible in Figure (8-6). It appears from the previous figure that the number of site update packets generated in the network by simulation is less than theoretically calculated; this is because the nodes are not equal in their speeds. Figure (9.6), figure (10.6) and figure (11.6) show the number of site update packets generated in the network depending on the number of nodes, their speeds and roaming (downtime).

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It can also be noted that the parcels generated are increasing with the increase in the number of nodes and their speed. It decreases as the downtime increases (as nodes become more stable) until the number of parcels is close to zero when the downtime is 500 where all nodes are stable and do not need to generate site update parcels.

3. Conclusions and recommendations:

This study suggested an improved service that is adaptable to changing Node locations; it tracks the locations of roaming nodes. In this service, we have overcome the basic problems caused by the use of static fixed-location servers.

The service has also secured most of the results we were trying to reach, and all the features of the site service that should ensure adaptability and balance with the number of nodes, the speed of nodes, and mobility. The results have shown an increase in the yield in Manet networks, and this yield increases with the increase in the number of nodes served by the network.

The most prominent recommendations for future work is to study the effectiveness of the proposed service for large files, such as video transmission within MANET networks.

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