SGMRP-Utilizing a Mobile Ad Hoc Network to Develop a Scalable Geographic Multicast Routing Protocol for Localization

https://doi.org/10.3991/ijim.v17i04.37675

Abdalilah. G. I. Alhalangy
Department of Computer Science, Qassim University, Buraydah, Saudi Arabia
a.alhalangy@qu.edu.sa

Abstract—Group's communications using Mobile Ad hoc Networks (MANETs) have recently drawn a lot of interest. Information is delivered to a group of receivers simultaneously through a process known as multipath. Therefore, to enable team communication activities, an effective and efficient multipath routing protocol is essential. Enhancing multicast routing has been the subject of numerous initiatives. However, they don't account for scalability. A scalable geographic multicast routing protocol was proposed in this research (SGMRP). This protocol's primary goal is to create a compact, adaptable multipath routing strategy that works regardless of the number of broadcast participants or the magnitude of the network. Using a prediction model and cross-validation techniques, the model performance evaluation tool assesses model effectiveness. The satisfaction with the service was also evaluated using a question. In addition to reducing the number of participating nodes in localization, the proposed method also gets rid of duplicate packets between clusters. The article introduces the framework's fundamental idea, details its transparent implementations, and finishes with a preliminary assessment of the framework based on typical mobile software kinds.

Keywords—Scalable Geographic Multicast Routing Protocol (SGMRP), Mobile Ad hoc Networks (MANETs), GPS, localization, multicast routing

1 Introduction

Recent developments in wireless and portable computing technology are creating fascinating new opportunities for the development of mobile wireless networking. The expectation of wireless customers has changed as a result of this rapid adoption. Over the past two decades, MANETs have seen significant development and are now regarded as one of the most significant and crucial technologies for supporting upcoming ubiquitous computing situations. A multi-hop autonomous network without even any network infrastructure, a MANET is made up of movable nodes that can self-organize and are linked together wirelessly. Due to its huge potential in numerous sectors of application, MANETs have attracted a great deal of attention and appeal in Figure 1. Applications will require numerous users to interact closely across MANETs have been increasingly popular during the past few years. In these types of applications, multiplex communication is crucial to lowering the cost of group interaction.

There are several advantages to multicasting. The multiplex source can send just one version of the data while the intermediary nodes can send many copies of the data, making it more efficient replicate it as necessary. The data will only be transmitted to nodes that are a member of the target group. The importance of broadcasting in MANETs is clear. The ability of a mobile device to determine its location was made possible by the ongoing advancements in wireless communications and the falling price of wireless technology. By limiting the broadcast zone of routing packets, knowledge of location information has improved scalability and performance. As a result, location-based routing is now a practical defeating method. Position data is used by location-aware multicast routing techniques to produce reliable routes and reduce maintenance expenses. Nevertheless, there are numerous difficulties in establishing scaled and dependable multicasting via wireless technology. For instance, in a geographical unicast route, an information packet's header includes the receiver's location to help determine how to transmit the packet. In contrast, multicast routing, which is more prevalent in MANETs, treats a group of locations as multiplex receivers, increasing payload size and routing costs of a massive scale. Despite these difficulties, research has identified them and has sought to create scalable and effective multipath routing methods [1].

Geographic-based routing algorithms have gained significance in the realm of MANETs because of their localized functioning, decreased storage and computation cost, and scaling with the necessary number of routers. GMRS with low control channel latency and effectual bandwidth utilisation are needed for GPS-enabled floating units in MANETs. When it comes to mobility, these plans, however, have some drawbacks. The limitations of changing network topology have been addressed by proposing reactive beaconless spatial routing schemes [2].

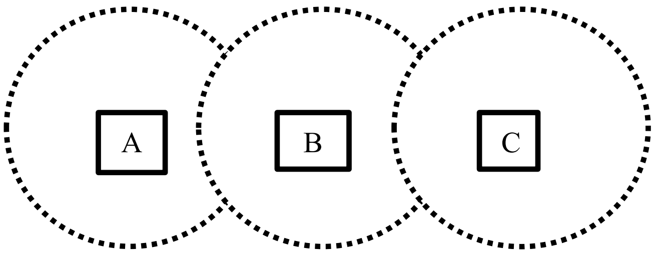

Fig. 1. The Manet

The contributions of this article can be summed up as follows:

- It represents the SGMRP, a suggested prediction geographic-based multicast routing algorithm in MANETs, along with a thorough description of its data model.
- For academics who want to use Opt system Modeller to implement their suggested protocols, we offer step-by-step instructions on how to add the EGMP as a novel routing algorithm.

- On how to integrate the SGMRP scheme into the Operating system, we give sample scenarios.

The essay's subsequent sections are organised as follows. Section 2 presents the research on the relevant earlier work. Section 3 provides a description of the characteristics of the suggested system, including its proposed system architecture, implementation model, components of the graph-based technique, and data analysis. The effectiveness of the system is assessed and the implementation environment is described in Section 4. Section 5 presents the resolution.

2 Related works

Qabajeh, M., Abdalla, A., Khalifa et.al [3] a MANET is made up of several mobile nodes that connect via wireless networks. These systems' key characteristics include mobile nodes; interconnectivity, self-organization, self-configuration, and self-administration. Every node in MANETs can simultaneously function as a host or a router. To send messages to their objectives, nodes must cooperate through single-hop and multi-hop pathways of intercommunication. Topology change modifications, a lack of infrastructure, capacity restrictions, and a shortage of resources are a few issues that MANETs must deal with. Working on MANET is more difficult than it is in the wired environment because of these factors.

Saravanan, S., Jayanthi et.al [4] based on the location of the nodes and a standard origin, it is possible to determine the zone where the anode is placed. The area structure is created virtually. A cluster is often created around a cluster leader with node one hop or k hops distant in topology-based cluster building. The cluster will vary continuously as the network topology shifts. To build and maintain the geographical zones suggested in this work, which are essential to supporting more effective and reliable communications across a dynamic MANET, however, there is no need to incur a significant overhead. By using the location data, EGMP could design packet distribution paths fast and effectively and consistently sustain the forward paths in the face of network density brought on by shaky wireless links or regular node migrations.

Kaur, H., Singh, H., & Sharma et.al [5] Each MANET node might be equipped with a different kind of radio device with erratic transmits and receives performance, and they might even use several asymmetric frequency band linkages, which could lead to diversity in the radio device's ability to convey information. The main concerns with ad-hoc routing protocols include the choice of multicast or data packets routing, the changing network topology that results from mobile nodes moving from one ground station to another, and the speed of the mobile nodes. Active routing, Responsive routing, and mixed routing are the three components of MANET routing in Figure 2. In proactive routing, the path is already known, meaning that if a node wishes to send data, it already knows the route to take. Every node continuously updates its routing table. The source and destination addresses are shown in the routing table.

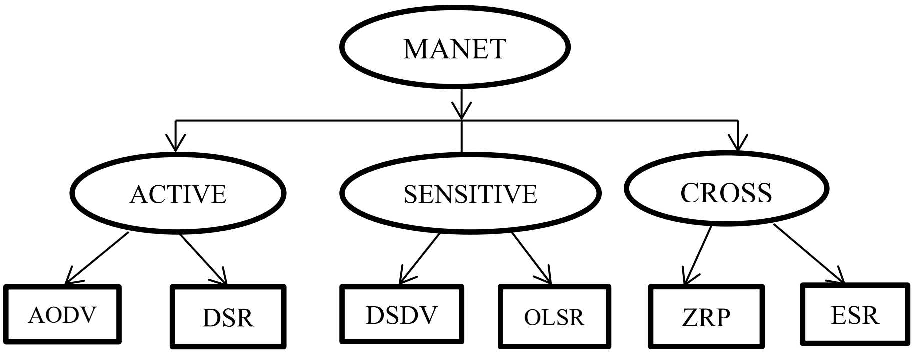

Fig. 2. MANET routing protocols

Latake, S. P., Shinde, G. R., & Kulkarni et.al [6] Dynamic routing protocols are often used to describe "table-driven" multicast routing techniques. A proactive multicast router makes use of one or more tables to represent the network architecture. To keep route discovery current, each node in the network regularly updates such tables. Routing for reactive multicast creates routes as needed. Reactive protocols establish a route whenever a node needs to communicate with a node to which it lacks a route. In contrast to proactive routing methods, reactive routes are scalable. Before forwarding data packets, reactive multicast routing techniques may experience lengthy delays caused by route searching.

Transier, M., Füßler, H., Widmer, J., Mauve et.al [7] we will now discuss the two components of our algorithm. For multicast groups, the group management scheme is in charge of disseminating membership data so that forwarding nodes are aware of the location of recipients. A forwarding node uses the multicast forward algorithm to decide which neighbours ought to obtain a duplicate of a particular multicast packet. The information the group management programme has provided supports this decision. The following will assume that each network node is pinpointing its exact location, perhaps with the help of GPS. The forwarding node must be aware of the destinations' positions for to enable situation broadcast. Directly adding as the cluster affiliations rises, the scaling of all of the destinations in the packet data headers becomes problematic. To improve scalability, our system includes multilevel group identification management.

Janakavi, R., Keerthana, V., Ramya et.al [8] When a multipath routing system for the fixed network is utilized in wireless networks, various issues arise since these methods are made for stable hosts, therefore they expect permanent positions when building the multicast distribution tree. However, there are several design concerns with multicasting routing protocols in wireless networks. Computational power, topology change's structure, low capacity, routing overhead, Quality of Service, the requirement for the unicast protocol, resource management, congestion management, energy-aware consumption of resources, transportation forecast, link consistency, multi-source multihoming, dependable multicasting, safety in multipathing, and bandwidth allocation are some of these factors. There are three main categories for multicast algorithms on the MANET. A clever strategy is to overload the network with only traffic. Every node floods its neighbours with received messages. The proactive strategy computes all of the routes in advance and stores the results in the routing table. The network receives occasional scatterings of the routing information. The proactive or request approach is the final strategy.

Houmer, M., Ouaissa, M., Ouaissa, M., & Hasnaoui et.al [9] A significant and essential issue for ITS support is router protocol design for Vehicular networks. VANETs and MANETs differ primarily in their unique mobility paradigm and quickly customizable topology. Applying current MANET routing techniques to vehicle networks is not practicable. Multichip communication, on which routing is based, allows communication between several nodes even when they are outside of one another the ranges of radio transmission**.** To establish a plan that ensures constant network access, many characteristics of Vehicular ad hoc networks must be considered in the routing strategy (changes in architecture, high flexibility, restricted radio link bandwidth, etc.). Since the recipient might not be within the origin address's broadcast range, the relaying technique is used, in which the intervening networks can act as a relay to transport the packets to the intended destination.

Abolhasan, M., Wysocki, T., & Dutkiewicz et.al [11] the resource dependence of MANETs make it difficult to create an effective and dependable routing system. Utilizing the scarce resources properly while also being responsive to changing network conditions like node density, traffic volume, and separate network calls for an intelligent routing approach. In addition to this, the routing algorithm would need to offer various QoS levels to various kinds of users and services.

3 Methods and materials

The phase of network design is covered in detail in this section. The fundamental goal of creating this simulated maintaining a solid network backbone is necessary for our protocol to perform efficient routing and handle an expanding number of nodes. Possessing a more scalable routing mechanism is also important.

3.1 The geographic routing protocol

We reviewed the geographic routing protocol (GRP) and position-based route techniques in the chapter before this one. Geographic routing is a concept that the GRP routing protocol uses to convey information. Topology-based routing's drawbacks are addressed by position-based routing or geographic routing. Because packages are routed to their destinations taking into account their positions, it delivers better performance in variable topologies. Each node establishes its own location, and several locating techniques, including GPS, GPRS, etc., are utilized to establish the position of each communication link. Geographic routing protocols are not required for a connection setup or upkeep when applying the idea of position-based routing. When using hybrid routing, the nodes are not required to store or keep their routing tables current to transfer data. The information is simply transmitted from the originating point to the destination after it locates the destination in the network. This protocol's method of information transmission is based on the destination site information and one-hop neighbours. Greedy Forwarding and Face-2 Routing Perimeter are two kinds of forwarding algorithms used in hybrid routing to convey data [5].

The sender is aware of the predicted location of the receiving node when using the Greedy forwarding mechanism. The recipient node's closest neighbour gets the message. The positioning system, or GPS, gathers the message. The neighbours two-faced in the path of the receiving node receive the data from the intermediate node. Up until the data is received at the receiving node, this procedure remains ongoing. Each of the network's nodes has a table on its own in which each node's position is mentioned. Choosing the precise neighbour node to deliver the data to presents the biggest challenge in greedy forwarding. The various routing algorithms are utilized to choose the neighbour node. According on expansion, distance, and orientation toward the receiving station, many routing algorithms are used in greedy forwarding. In greed routing, there are three distinct routing techniques: Compass Routing, Nearest with Forwarded Progress, and Most Forwarded within R. A node can decide which neighbour node the packet should be sent to by choosing from among the several techniques. Figure 3 displays these techniques.

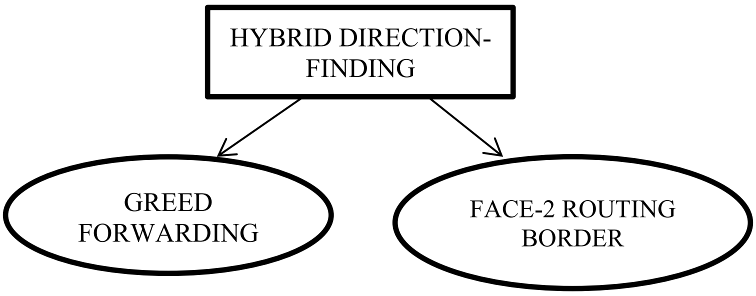

Fig. 3. Hybrid Routing Types

The coverage or max distance of the S is shown by the round area with r. The key initiative is to deliver data from S to the node that is situated closest to D. This approach is known as the Most Divisional inside R (MFR) and it is tried to reduce the number of hops to transfer the message from R to E. In the example cited, this node may be node C, which is nearest to the destination network within the service area of the destination network D. In situations when the packet does not modify wifi signal for transmission between S and D, MFR is typically used. Conversely, a different approach, known as nearest with Relayed Progress, is utilised in the circumstance where the packet adjusts or adapts its signal intensity. In NFP, the communication is forwarded to the sender's closest neighbour who is also the recipient's closest neighbour. In the example provided, that node is A. If all nodes use the NFP method, the likelihood of packet collisions during delivery can be significantly reduced. Circular Routing, which chooses the neighbour nearest to the direct line connecting the Destination address, is another method used in greedy forwarding. The compass route node in the shown figure is node

B. The goal of this routing approach is to reduce the distance a packet must travel from destination to source.

The second hybrid routing method, known as Face-2 routing or Boundary Routing, is used to decide the destination when the packet arrives at a node where it is unable to find a neighbour node that is close to the destination using the greedy forwarding routing method. Figure 4 depicts the routing protocols for ad hoc networks. In this kind of routing strategy, if any node is unable to locate the forward path, the packet is delivered to the node with the least amount of backward movement. Although forwarding packets toward the target with solid changes does not have this issue, this method has the issue of looping packets. The face-2 approach is built on the planner network traverse, where a node doesn't need to retain any extra or insufficient data. As the packet gets closer to its target and enters the improvement phase, it switches to the greedy forwarding mode.

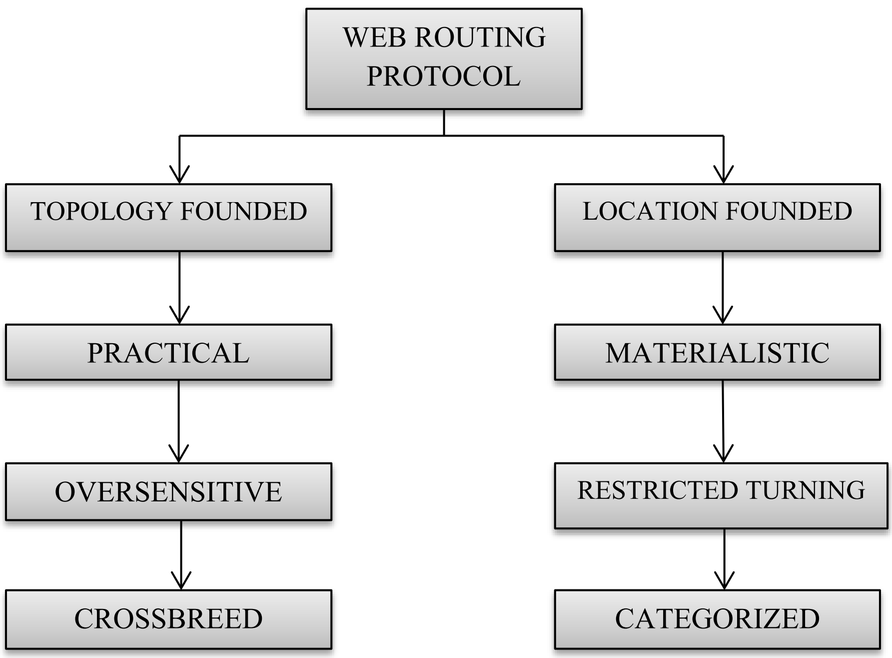

Fig. 4. Routing protocols for ad hoc networks

3.2 Routing for Ad-hoc multicast

AMRoute is a proactive multicast routing technology built on trees. It utilizes unicast tunnels to connect members of multicast groups. Each multicast group contains a minimum of one core. In the beginning, every group member identifies as a core. By regularly broadcasting JOIN-REQ, disjoint partitions are found. Upon receiving JOIN-REQ, individuals from various partitions respond with JOIN-ACK and designate the node as a neighbour. The node that receives a JOIN-ACK also identifies the JOIN-ACK sender as a neighbour. A member who wants to quit a multicast group notifies its neighbours by sending JOIN-NACK. It stops functional reasons to group members after sending JOIN-ACK to neighbours. A branch can still form even after the architecture has changed as long as there are mesh pathways connecting the members of the group. To keep tunnels between group members open, protocol depends on the unicast protocol. The throughput on AMRoute is decent. [6].

Irrespective of whether the path is actually required or otherwise, proactively protocols enable a network node to utilize the routing table to store routing data for every other node. Each item in the table contains the very next hop node used in the journey to the destination. To reflect changes in the network architecture, the table needs to be updated often, and it should also be broadcast to the Neighbours on a regular basis. This plan might result in increased overhead, particularly in networks with significant mobility. However, access to routes will always be possible [12] if required. Proactive routing protocols typically use two types of network techniques: link state strategy and shortest path strategy, and they often rely on the shortest path algorithms to decide which path will be picked. A "bar counter" routing algorithm is another name for a proactive routing mechanism. Nodes in a mobile ad hoc network continuously assess routes to all available nodes using a proactively routing mechanism in an effort to preserve consistent, up-to-date route discovery. So, if a source code requires a routing path, it can receive one right away. To inform the network of a change in network, the appropriate updates must be broadcast throughout the network [13]. Therefore, the control overhead to keep current network topology information is rather large if we take into account changes in the network topology in MANETs. Route Maintenance and Route Maintenance are both completely demand-driven processes. In instance, unlike other protocol, DSR doesn't demand any form of periodic messages at any level within the network. For instance, DSR does not depend on any underlying network protocols for the operations of periodic routing advertisement, link status sensing, or Neighbour identification packets. When all nodes are roughly stationary with regard to one another and all routes required for current communication have already been identified, the completely on-demand behaviour and lack of regular activity allow the number of excess packages generated by DSR [14] to grow all the right to nothing.

3.3 Multicast routing

The nodules make use of the data kept in their membership tables to distribute multicast messages from a sender to the subscribers in the group [7]. Geographical regions are created by segmenting the network into quad-trees, which can be used to distribute broadcast information to team members who are physically adjacent to one another. The intelligence about nearby nodes is used to determine how to move forward. Every node keeps track of every other node that is in its transmission range in a table. Each node periodically broadcasts beacon messages that contain the networking node's identity and location to achieve this nodes do not forward broadcast messages. In the below figure, multicast routing protocol classification is illustrated [8].

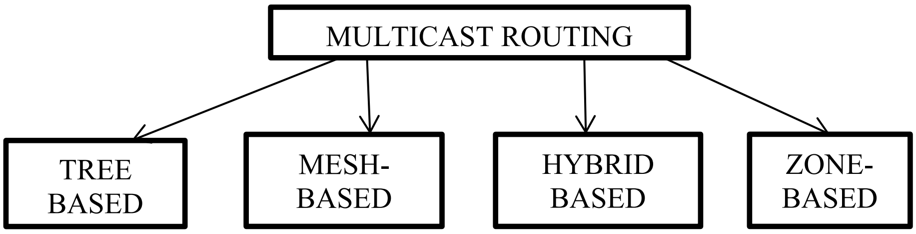

Fig. 5. Multicast Routing Protocol Classification

The forwarding algorithm is shown in Algorithm 1. The algorithm needs three inputs: the packet p, the current node n, and the gradient of neighbours N. The container has two fields: a group address field that identifies the company the packet is sent to, and a comprehensive outline field that is originally established to one entry that includes the whole network. The first thing the algorithm does after it is invoked is determined if the multicast group to which the message is being transmitted includes the current node n. When this happens, the packet is forwarded. The method then examines each element in the listing of recipient's field of the packet. The entry is divided into squares of the following row if the regional or global connection tables provide a de-aggregation of the entry bottom elevation which includes representations for the group the packet is moved to. The square is changed to the ID of the nodes that are group mates at level 1, which completes a de-aggregation. Think about the instance where a node in square "449" transmits a broadcast package for group no. 1. The multicast address is set to 1 and the transmission is initialized with the entire network as one particular destination. Following that, the forward algorithm accepts the packet. Following the determination of whether node c is a multicast location data is de-aggregated for group 1 listener. The two channels squares "2", the level-1 square "41," and the autonomous node 23 in the same level-0 square as the routing algorithm can be used to partition the whole network according to the participation tables for multicast group 1 supplied in Table 1.

The proposed geographical multicast routing protocol. First, problem definitions and notations are supplied in this section. Next, a location prediction method for forwarding neighbours is shown. The final subject we discuss is the proposed scalable, on-demand, and predictive spatial multicast routing technique.

Predicting the location of a forwarding neighbour node. In this article, we take into account a Pointillist made up of forward nodes M, a source node R, and many multicast destination E. Geographic multicast tree's source S serves as its root, while multicast recipients are represented by E, and forwarding Neighbour nodes are represented by M. The origin node R sends packets of data to E using one-hop Logistics Company $Q1j$ if for each $Q2j$ there is an $Q2j$ inside S and the detachment between Mi and Ej is the lower limit [1]. Assume that D is the set of m multicast destinations (i.e.$E = e1, e2, \ldots. En$), N is the set of K transmitting routing information.

Consider a network with three dimensions and the representation of multicast communications in Iov as a graph, G. Consider the connected undirected graph with vertex U and edge F denoted by the symbol H. R, M, and E make up the vertices set U in this graph, hence H = (U, F) and R, M, E 3 U. If and only if the Euclidean distance (i.e., $F_{adjust}(q1, Q2)$) among source node R and neighbour node Mj is less than or equal to r, the edges set E for source node S and neighbour node M includes unguided edge (R, Mi). The calculation of the Distance measure in an n-dimensional gap between two points Q1 and Q2 is:

$$F_{adjust}(q1, Q2) = \sqrt{\sum_{j=2}^{m}(Q1j - Q2j)} \quad (1)$$

Where $Q = (Q1, Q2, Q3 \ldots\ldots Qm)$ and n is the dimensionality, $F_{adjust}(q1, Q2)$ specifies the Euclidean distance between the two locations Q1 and Q2. For example, $Q1j - Q2j$ in this article depicts the Euclidean distance in three dimensions between the source node R and the neighbour node Ni with three independent variables, where point R = (Q1, Q2, Q3) and point Mj = (Q4, Q5, Q6). As previously said, let's assume that M and E stand for the set of K advancing neighbour nodes and m multicast destination, accordingly. The expression for the minimal separation between M and E is given by the notation min $F_{adjust}(M, E)$.

$$minF_{adjust}(M, E) = minj, i\{F_{adjust}(M1, E1)\}, j = 2{,}3 \ldots and\ M = 2{,}3 \ldots \quad (2)$$

Where $F_{adjust}(M, E)$ is the multicast destinations node Ej's Euclidean distance from the forwarding neighbour node Mi. We must identify a geographic multipath routing structure that connects a source R to every multicast destination D by employing a subset of M neighbour nodes as forwarders, given the parameters H = (U, F) and R, M, E 3 U.

$$Y_{PRED-LOC} = Y_{CURRENT\_LOC} + RQDx_{direction} * q_{(n\_discovery)} \quad (3)$$

$$P_{PRED-LOC} = P_{CURRENT\_LOC} + RQDx_{direction} * P_{(n\_discovery)} \quad (4)$$

$$Q_{PRED-LOC} = Q_{CURRENT\_LOC} + RQDx_{direction} * Q_{(n\_discovery)} \quad (5)$$

where $Y_{PRED-LOC}$ is the predicted value for Mj's Y coordinate, $P_{PRED-LOC}$ is the predicted value for Mi's Q coordinate, and $P_{CURRENT\_LOC}$ is the predicted value for Mi's Q coordinate, $Y_{CURRENT\_LOC}$ is the present value of Ni's x-coordinate at the beginning of neighborhood finding, and $Y_{CURRENT\_LOC}$ is the location of Mi's y-coordinate at that same time, $Q_{PRED-LOC}$ is the present value of Mi's z-coordinate at the opening of neighbour discovery, where $Y_{CURRENT\_LOC}$ is the time immediately following the timeout for neighbor discovery, tn revelation is the time at the beginning of the current neighborhood discovery, and RQDx orientation, $RQDx$ are the co-ordinate instructions.

$$RQDx_{direction} = \frac{Y_{PRED-LOC} = Y_{CURRENT\_LOC}}{(q_{\left(n_{discovery}\right)} - q_{(n_{prev}discovery)}} \quad (6)$$

$$RQDx_{direction} = \frac{P_{PRED-LOC} = P_{CURRENT\_LOC}}{(q_{\left(n_{discovery}\right)} - q_{(n_{prev}discovery)}} \quad (7)$$

$$RQDx_{direction} = \frac{Q_{PRED-LOC} = Q_{CURRENT\_LOC}}{(q_{\left(n_{discovery}\right)} - q_{(n_{prev}discovery)}} \quad (8)$$

where $Y_{PRED-LOC}$ detection regarding the time value of the previous transmitting member nodes, Xprev location is the x-coordinate value of Mj in the prior accelerating neighbour detection, $P_{PRED-LOC}$ is the earlier forwarded neighboring discovery's Mj's y-coordinate quantity, $Q_{PRED-LOC}$ is the previous downstream neighbor probe's Mi's z-coordinate values, and so forth.

Algorithm 1:

```
1. Node m, packet q, and list of neighbours N are
   required.
2. If m∈mouthpiece (collection q) before
3. distribute(q)
4. close if
5. Q← 1
6. for every destination (Q)do
7. if mysquare ∈ q then
8. Q← d partitioned (q)
9. New
10. Q← d partitioned (q ∪ D)
11. Close if
12. Close for
13. G[n]← 0
14. For all E ∈ Q do
15. E← 0
16. If recuperate (Q) then
17. For all E ∈ Q do
18. Q← righthand(PrevHod,f)
19. Else
20. Q← forward(PrevHod,Q,M)
21. Close if
22. If Q=0 then
23. Q← righthand(n,d)
24. If Q=1the
25. Drop (D)
26. close if
27. close if
28. E[Q]=E[Q] ∪ D
29. Close for
30. For all E ∈ Q do
31. If E[U]=0 formerly
32. Send (Q,V,E[u])
33. Close if
34. Close for
```

After the destination has been de-aggregated, the best neighbour sending the package to every recipient is determined. In a similar way to position-based data packets routing, the source examines the geographic movement of each neighbour for the destinations and chooses the neighbour with the highest progress as the best a packet's subsequent hop for that location. If the destination is a square, the closest point within the square is utilized to determine the target localization.

4 Implementation and experimental results

To simulate selective assaults on the vehicular ad hoc network, including Selfishness, On-off, Alteration assaults, Gray Holes, Drainage Grate and the EEGMRP protocol is implemented in NS2. 150 nodes are used in the network animator output, with 10 to 30 malicious nodes. With regards to the packet delivery rate and end-to-end latency, we simulate the difference between the original GPSR and our upgraded and secured version EEGMRP. Table 1 contains a list of all the variables that were used in the simulation.

Table 1. Modelling parameters

CONSIDERATION	SIGNIFICANCE
Imitation time	150 instants
Amount of nodes	150
Suppleness model	Haphazard waypoint
Swiftness	60 km/h
Decorum MAC	702.22p
Bundle size	178 bytes
Communication interval	2 drum/succeeding
Imitation area	2000*2000m

The Fraction of packet deliveries represents the proportion of packets transmitted by the source to those received at the endpoint. Figure 6 compares the number of malicious nodes with the packet delivery ratios for the original, secured, and improved greedy perimeter stateless routing algorithms the new GPSR version outperforms the old one in terms of performance. This is explained by the lengthening of the packet's time to live, which results from the SE-suppression GPSRs of perimeter transfer. Additionally, it is preferable to use short paths to send EEGMRP packets from source to destination. Additionally, EEGMRP picks or unselects routing elements based on its level of trust [9].

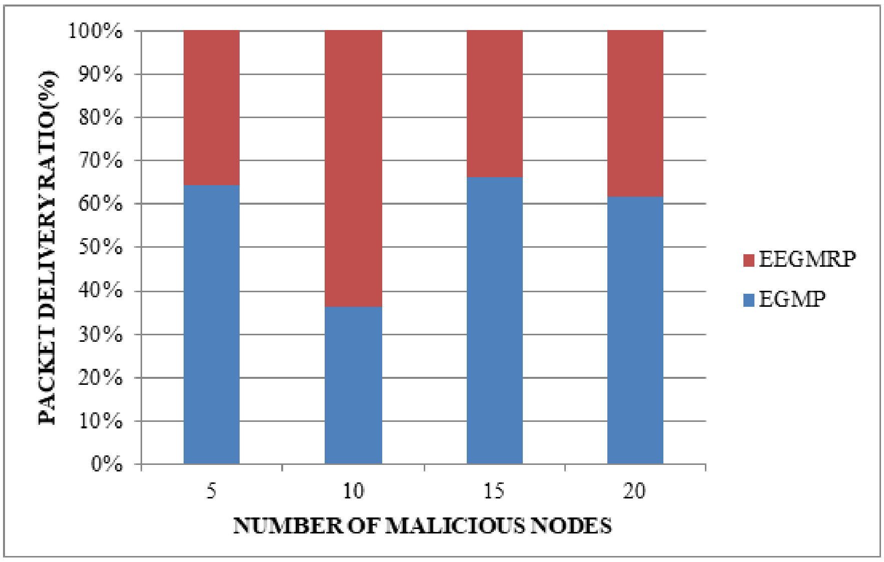

Fig. 6. Number of malicious nodes vs. Packet Delivery Ratio

The amount of energy used to forward a message to the sink node is measured by the efficiency of energy consumption. Every time EGMP sends a signal to every node on the route to the destination to transfer data packets, it uses more energy and is unable to manage large connections and organisation make. The planned research project EEGMRP addresses this issue. The energy usage issue is avoided by using the sleep-wake scheduling strategy. The contrast chart for EGMP and EEGMRP is shown in Figure 6. The cost of sending packets, receiving packets, and rejecting packets during the error time is used to determine energy usage. The current technique uses, on average, 40J of energy. The proposed technique uses an average of 25J of power [10]. The Sleep-Wake Scheduling approach significantly reduces energy use. When compared to the EGMP, with a sleep-wake pattern, the EEGMRP's energy utilization factor is terribly, exceptionally low.

When multiple places try to send a packet via the network simultaneously, the system experiences a particle collide. When compared to the current protocol EGMP, the collision rate in the proposed scheduling protocol EEGMRP is significantly lower. The comparative chart for EGMP and EEGMRP is shown in Figure 7. With the suggested work's use of sleep-wake scheduling, the collision rate is significantly reduced. The signal for receiving data or for routing data packets to other nodes is what causes the networks to wake up; otherwise, they remain inactive. Every node in the EEGMRP protocol has a predetermined sleep-wake schedule, which increases the amount of wake idle nodes, particularly when a node moves farther by way of the mobile sink. The outcome demonstrates that the EEGMRP technique is quite effective and might function more well as network size increases.

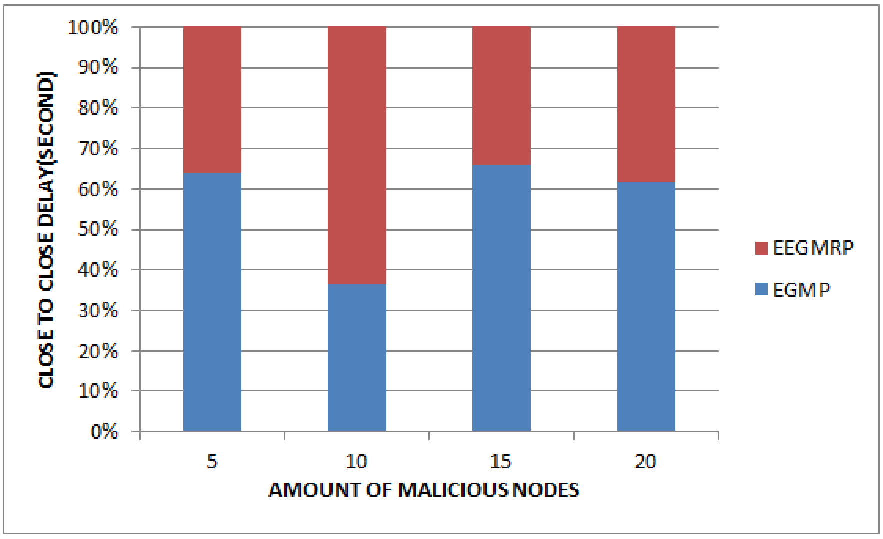

Fig. 7. Amount of malicious nodes vs. close-to-close Delay

Throughput. The amount of information that is handled at one site or transferred to the other in a specific period of time. A Throughput is a unit of measurement used to describe data transfer speeds for networks. The throughput counts the number of packets the sink node receives each second. The suggested technique makes extensive use of the Sleep-Wake schedule to significantly boost EEGMRP throughput. Sending data packets is quicker than in any other mode because the nodes are not in use. For larger networks, EEGMRP has attained throughput higher than EGMP.

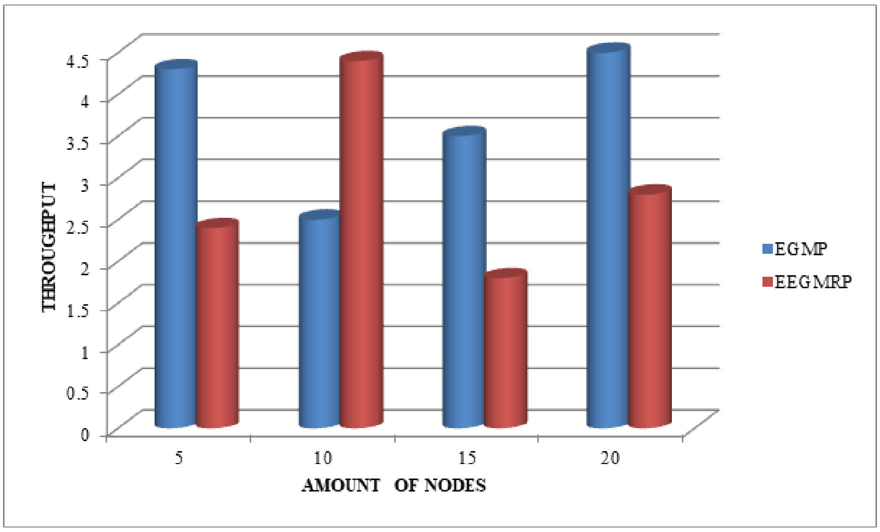

Fig. 8. Throughput Comparison Chart for EGMP and EEGMRP

As a result, the EEGMRP method is scalable and operates more effectively in bigger networks. In terms of the zone generation approach and the addition of the sleep/wake schedule method, EEGMRP performs better than EGMP. By comparing the data, in comparison to the EEGMRP, the EGMP is obviously far less flexible and effective. In EEGMRP, multicasting and energy use are scalable and effective.

5 Conclusion

Due to the difficulty of handling collective identity, route searching, and building and maintaining a spanning tree more than a changing MANET, conventional multicast protocols typically do not scale well. To address the scalability problem, the current paper suggests a multicast protocol called SGMRP. The network plane is essentially divided into various sectors by the proposed protocol. This particular design creates a multicast tree with a limited length and little message above. The protocol uses limited position-based route discovery, which may result in fewer packet broadcasts to each multicast listener with fewer hops. The EEGMRP is implemented EGMP is a unique routing method that we incorporate in the OPNET Modeler's MANET routing protocol families. The performance of EEGMRP is then evaluated against that of two other MANET routing protocols. According to the ftp application circulation, analysis of routing movement delivered and collected, increasing network, delay, and throughput the simulation time, as well as adjusting the number of installed floating nodes in various simulations performed, these protocols are evaluated. The Research will prove to be a good way to conserve resources while maintaining Mobile Ad-hoc Network performance and packet delivery ratio. This spatial routing protocol outperforms more established cluster-based routing protocols in localization.

6 References

[1] Qabajeh, M. (2022). A Novel Approach to Support Scalable Multicast Routing in Wireless Ad Hoc Networks. *International Journal of Interactive Mobile Technologies*, *16*(7). https://doi.org/10.3991/ijim.v16i07.29195

[2] Hussen, H. R., Choi, S. C., Park, J. H., & Kim, J. (2019). Predictive geographic multicast routing protocol in flying ad hoc networks. *International Journal of Distributed Sensor Networks*, *15*(7), 1550147719843879. https://doi.org/10.1177/1550147719843879

[3] Qabajeh, M., Abdalla, A., Khalifa, O., & Qabajeh, L. (2011). A cluster-based QoS multicast routing protocol for scalable MANETs. https://doi.org/10.1109/ICOM.2011.5937184

[4] Saravanan, S., Jayanthi, S., Kumaran, V., & Ramesh, J. V. N. Efficient Multicasting Support over MANET using EGMP.

[5] Kaur, H., Singh, H., & Sharma, A. (2016). Geographic routing protocol: A review. *International Journal of Grid and Distributed Computing*, *9*(2), 245-254. https://doi.org/10.14257/ijgdc.2016.9.2.21

[6] Latake, S. P., Shinde, G. R., & Kulkarni, R. J. (2013). Tree, mesh structure based and stateless multicast routing protocols in wireless networks. *International Journal of Computer Science and Information Technologies*, *4*(3), 485-488.

[7] Transier, M., Füßler, H., Widmer, J., Mauve, M., & Effelsberg, W. (2004). *Scalable position-based multicast for mobile ad-hoc networks* (No. CONF). https://doi.org/10.1016/S1570-8705(03)00038-6
[8] Janakavi, R., Keerthana, V., Ramya, S., & Devi, S. G. (2014). A Survey of Multicast Routing Protocols. *International Journal of Scientific Engineering and Technology, Volume*, (3), 418-421.
[9] Houmer, M., Ouaissa, M., Ouaissa, M., & Hasnaoui, M. (2020). SE-GPSR: Secured and enhanced greedy perimeter stateless routing protocol for vehicular ad hoc networks. https://doi.org/10.3991/ijim.v14i13.14537
[10] Balasubramaniyam, V., & Manoranjani, M. ENHANCED EFFICIENT GEOGRAPHIC MULTICAST ROUTING PROTOCOL (EEGMRP) FOR MANETS.
[11] Abolhasan, M., Wysocki, T., & Dutkiewicz, E. (2004). A review of routing protocols for mobile ad hoc networks. *Ad hoc networks*, *2*(1), 1-22. https://doi.org/10.1016/S1570-8705(03)00043-X
[12] Altayeb, M., & Mahgoub, I. (2013). A survey of vehicular ad hoc networks routing protocols. *International Journal of Innovation and Applied Studies*, *3*(3), 829-846.
[13] Thakare, A. N., & Joshi, M. Y. (2010). Performance analysis of AODV & DSR routing protocol in mobile ad hoc networks. *IJCA Special Issue on MANETs*, *4*, 211-218.
[14] Johnson, D. B., Maltz, D. A., & Broch, J. (2001). DSR: The dynamic source routing protocol for multi-hop wireless ad hoc networks. *Ad hoc networking*, *5*(1), 139-172.

7 Author

Dr. Abdalilah Alhalangy is an assistant professor of information systems, College of Science and Arts, Ar Rass, Qassim University, Saudi Arabia. He got a master's degree in information technology and a PhD in information systems from Faculty of Computer Science and Information Technology - Al-Neelain University in Sudan. He has taught at the level of higher education in Sudan (University of Kassala, Faculty of Computer Science and Information Technology) and Saudi Arabia (Qassim University) since 2006. At the University of Kassala, Sudan, he held several positions. He taught courses in the departments of computer science, information technology, and information systems. ORCID ID: https://orcid.org/0000-0003-2735-8208.

Article submitted 2022-10-18. Resubmitted 2022-11-28. Final acceptance 2022-12-01. Final version published as submitted by the author.