Source Tracking Mechanism in Mobile Ad-Hoc Networks

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ABSTRACT

Recent days it became a challenge to design a scalable and robust multicasting routing protocol in a mobile Ad Hoc network (MANET). In this paper, we propose a novel Robust and Scalable Geographic Multicast Protocol (RSGM) and simulated the design with beautiful performance analysis with the existing protocols. Our results demonstrate that RSGM can scale a large network size, and can more efficient support multiple multicasting groups in the network. Compared to existing protocol ODMRP and SPBM, RSGM achieves a significantly higher delivery ratio under all circumstances.

Keywords: zone, robust, ZID, Zone leader, Zone membership, neighbour node.

1. INTRODUCTION

Multicast is a fundamental service for supporting information exchanges and collaborative task execution among a group of users and enabling cluster-based computer system design in a distributed environment. Although it is important to support multicast in a MANET, which is often required by military and emergency applications, there is a big challenge to design a reliable and scalable multicast routing protocol in the presence of frequent topology changes and channel dynamics.

These include conventional tree based protocols and mesh-based protocols. The tree-based protocols (e.g., LAM [1], MAODV [2], AMRIS [], and MZRP [25]) construct a tree structure for more efficient multicast packet delivery, and the tree structure is known for its efficiency in utilizing network resources. However, it is very difficult to maintain the tree structure in mobile ad hoc networks, and the tree connection is easy to break and the transmission is not reliable. The mesh-based protocols (e.g., FGMP [4], Core-Assisted Mesh protocol [5], and ODMRP [6,7,8] are proposed to enhance the robustness with the use of redundant paths between the source and the set of multicast group members.

In this paper, we propose a novel Robust and Scalable Geographic Multicast Protocol (RSGM) and simulated the design with beautiful performance analysis with the existing protocols.

2. ROBUST AND SCALABLE GEOGRAPHIC MULTICAST PROTOCOL

In this section, we describe the RSGM protocol in details. RSGM supports a two-tier membership management and forwarding structure,. At the lower tier, a zone structure is built based on position information and a leader is elected on demand when a zone has group members. A leader manages the group membership and collects the positions of the member nodes in its zone. At the upper tier, the leaders of the member zones report the zone membership to the sources directly along a virtual reverse-tree-based structure.

If a leader is unaware of the position or addresses of the source, it could obtain the information from the Source Home. With the knowledge of the member zones, a source forwards data packets to the zones that have group members along the virtual tree rooted at the source. After the packets arrive at a member zone, the leader of the zone will further forward the packets to the local members in the zone along the virtual tree rooted at the leader.

A. Zone Construction

Virtual zones are used as references for the nodes to find their zone positions in the network domain. The zone is set relative to a virtual origin located at (X0,Y0) Þ, which is set at the network initialization stage as one of the network parameters. The length of a side of the zone square is defined as zone size. Each zone is identified by a zone ID (zID). A node can calculate its zID (a, b) from its pos (x, y) as follows:[9,10]

$$\begin{cases} a = \left\lfloor \dfrac{x - x_0}{zone\_size} \right\rfloor, \\ b = \left\lfloor \dfrac{y - y_0}{zone\_size} \right\rfloor. \end{cases}$$

For simplicity, we assume all the zone IDs are positive. A zone ID will help locate a zone, and a packet destined to a zone will be forwarded toward its center. The center position (Xc,Yc) of a zone with zID (a,b) can be calculated as:[11,12,13,14]

$$\begin{cases} x_{center} = x_0 + (a + 0.5)\, X\, zone\_size, \\ y_{center} = y_0 + (b + 0.5)\, X\, zone\_size. \end{cases}$$

B. Group Membership Management

The group membership is managed at two tiers. RSGM takes advantage of the virtual-zone-based structure to efficiently track the group membership and member positions. In the following description, except when explicitly indicated, we use G, S and M, respectively, to represent a multicast group, a source of G and a member of G.

C. Source Tracking

A source may move during the session time. The forwarders and receivers of the multicast packets can obtain the position of the source that is piggybacked with the packets, while other nodes including the ones that newly join the network must resort to some explicit source location or update mechanism to get the position. The conventional scheme for resource information update is through periodic network-wide flooding of source information [12]. Straightforward ways to look for a source include flooding query messages and performing an expanding ring search. However, these methods will incur excessive control overhead and search delay.

3. COST ANALYSIS

In this section, we quantitatively analyze the per-node cost of the protocol, which is defined as the average number of control messages transmitted by each node per second. We will analyze the basic two-tier scheme, and for simplicity, in most cases, we will not consider the message aggregations; thus, the analysis result is an upper bound of the cost.

With a two-tier system structure, the total cost includes the cost for upper tier management and the cost for lower tier management. Before obtaining the cost of the overall protocol, we first introduce a few lemmas, and calculate the per-node control overhead for each tier.

Theorem1. The RSGM control overhead as the average number of control message transmissions per node every second has a complexity of O(1) with respect to the network size and group size.

Proof: The overhead of the protocol is caused by the lower tier management, the upper tier management, and the periodic beaconing in the underlying geographic uni cast routing protocol. The cost of uni cast is:

$$Cost_{unicost} = \frac{1}{Intval_{beacon}} = O(1)$$

the transmissions of control messages per node every second with respect to the network size and group size is:

$$Cost_{protocol} = Cost_{lower} + Cost_{upperl} + Cost_{unicast} = O(1)$$

The analysis result shows that when the network size and group size increase, the control overhead placed on each node by the protocol will remain relatively constant. Next, we will demonstrate the scalability of the protocol by simulation studies.

4. PERFORMANCE EVALUATION

In this section, we study the performance of RSGM by simulations. We are mainly interested in the protocol's scalability and robustness in a dynamic environment. We are mainly interested in the protocol's scalability, robustness, and efficiency under the dynamic environment.

The following metrics were studied:

1. Packet delivery ratio: The ratio of the number of packets received and the number of packets expected to be received. For the multicast packet delivery, the ratio is equal to the total number of received packets over the multiplication of the group size and the number of originated packets

2. Normalized control overhead: The total number of control message transmissions divided by the total number of received data control messages of RSGM and the proactive beacons in the underlying geographic Unicast routing protocol. Each forwarding of the control messages was counted as one transmission.

3. Average path length: The average number of hops traversed by each delivered data packet.

4. Joining delay: The average time interval between a member joining a group and its first receiving of the data packet from that group. To obtain the joining delay, the simulations were rerun with the same settings except that all the members joined groups after the sources began sending data packets.

5. SIMULATION RESULTS

The performance of the protocol may be impacted by many factors. We first study the impact of zone size on the performance of RSGM, and then compare the performance of ODMRP, SPBM, and RSGM with the variation of moving speed and node density. Finally, we study the scalability of the three protocols with the change of group size, the number of groups in the network, and network size.

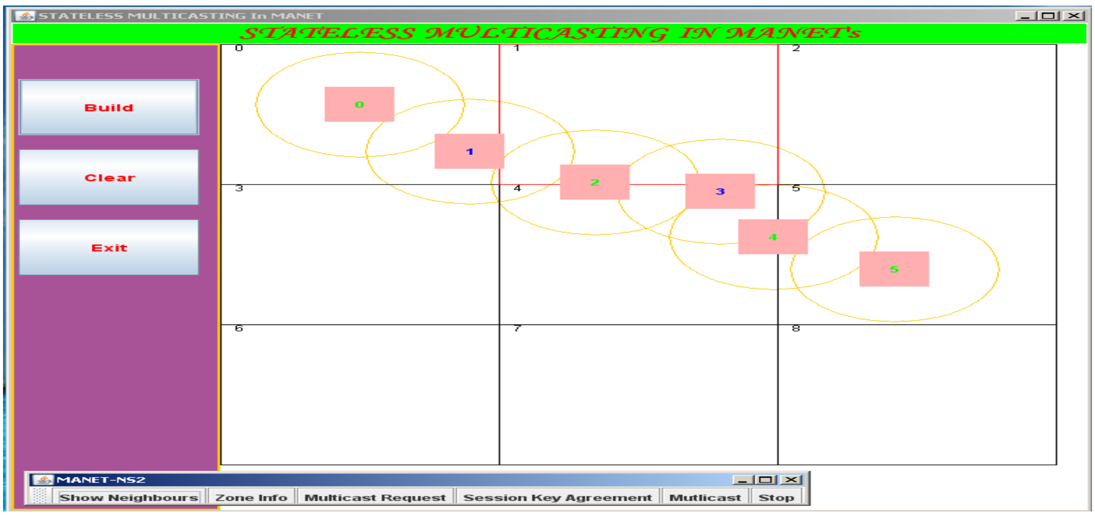

Fig 5.1 Build the Network

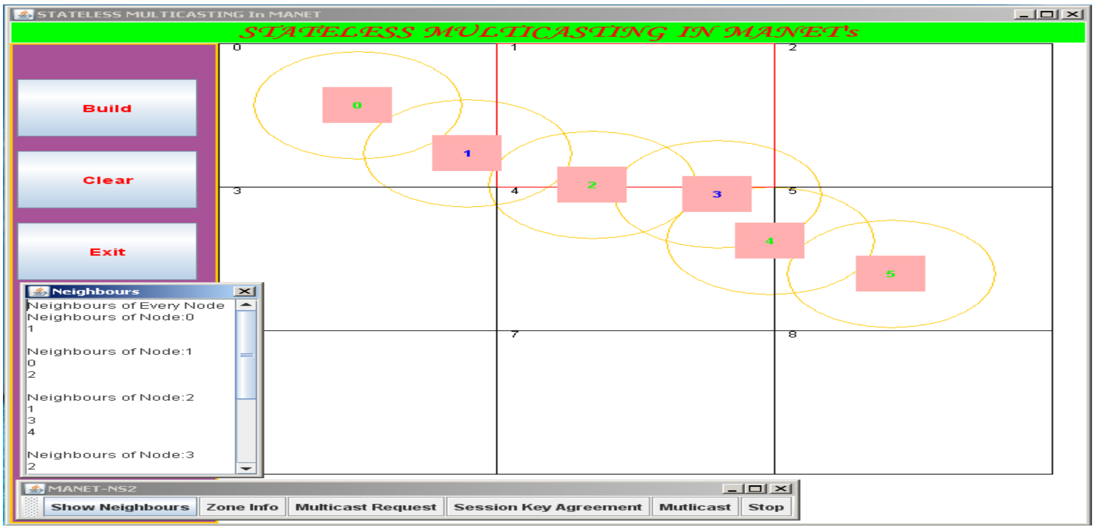

Fig 5.2 Show Neighbours

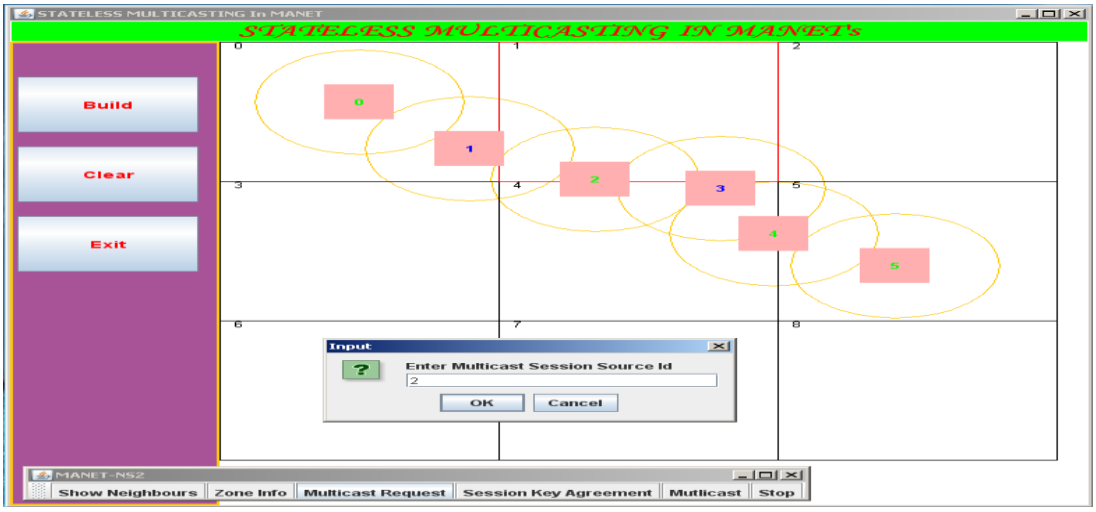

Fig 5.3 Iniatializing the Multicast Session Source

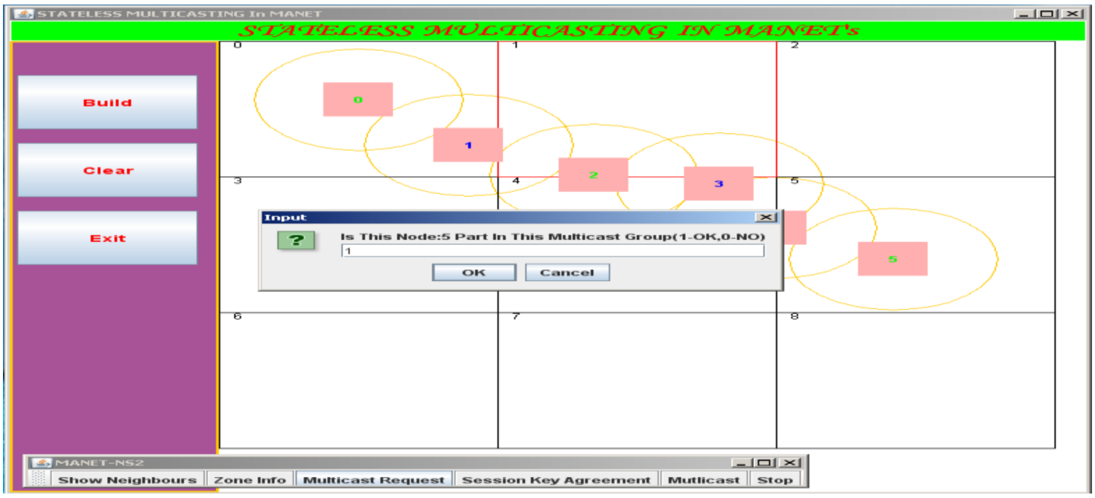

Fig 5.4 Accept/Reject of Session Request

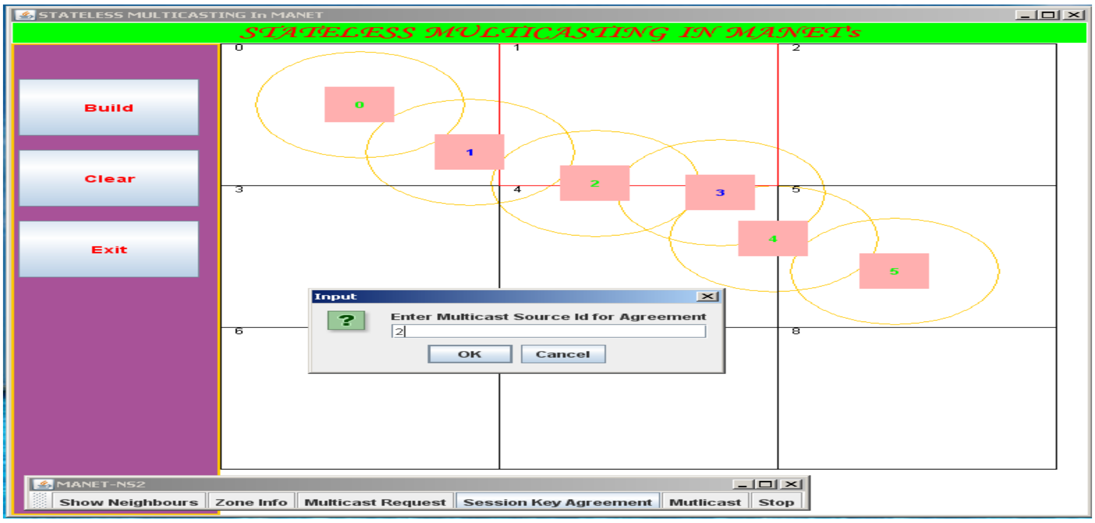

Fig 5.5 Multicast Source Aggrement

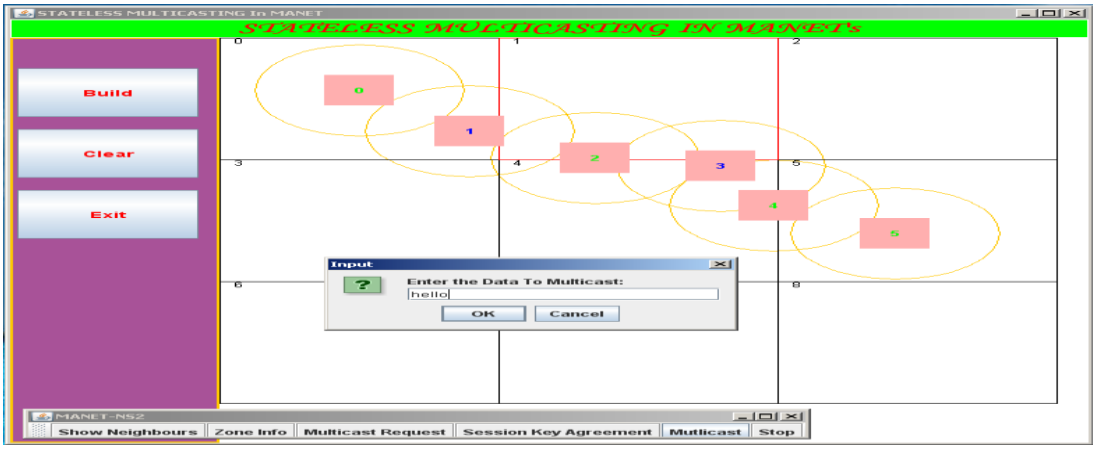

Fig 5.6 Multicast Data

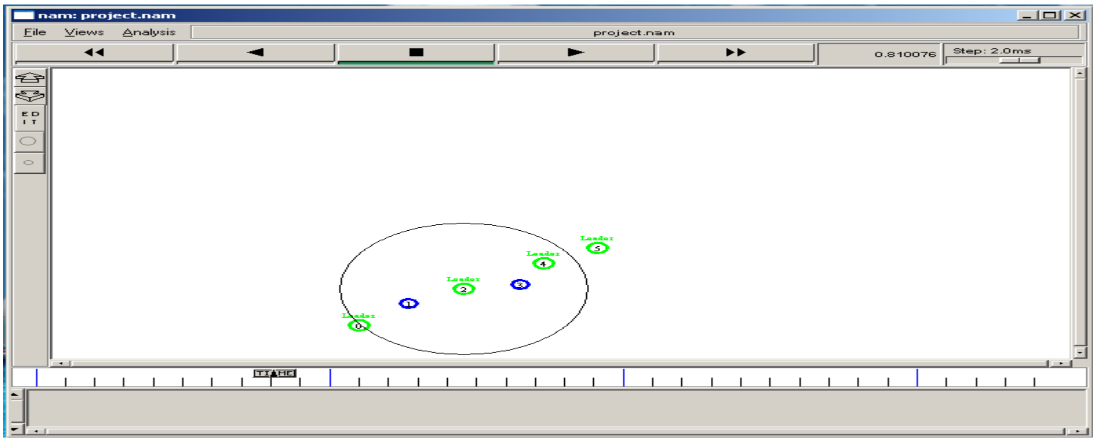

Fig 5.7 Sending Session Request

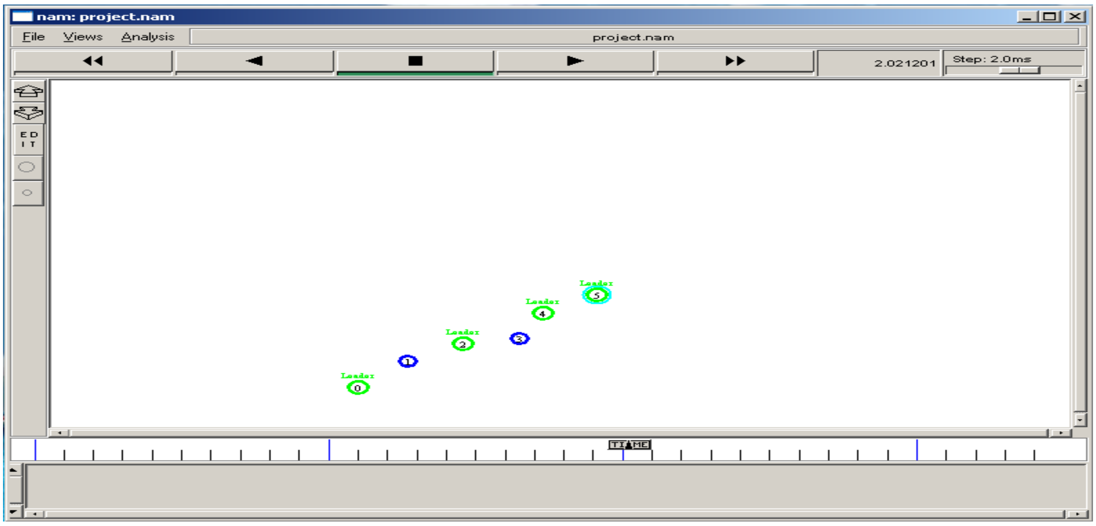

Fig 5.8 Session Request Received

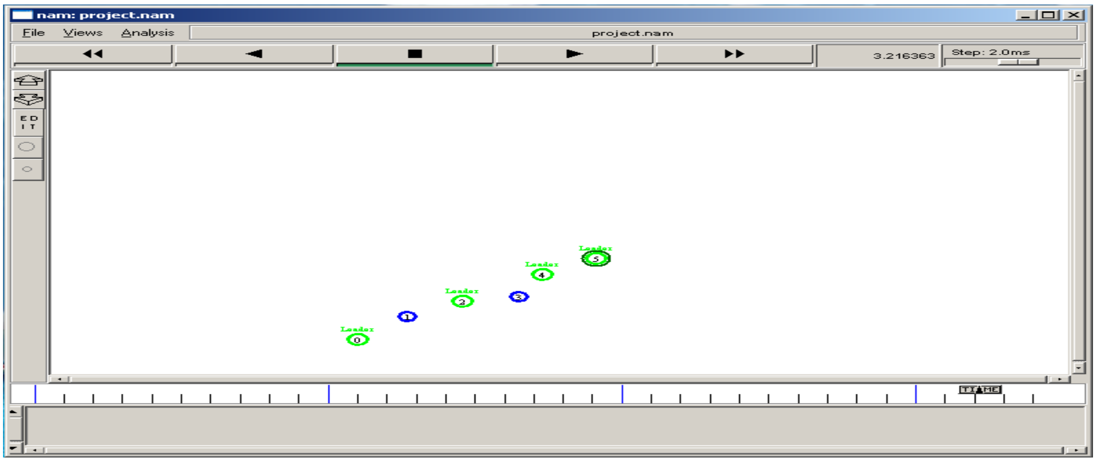

Fig 5.9 Data Received

6. OUTPUT

Node: 0

Public Key:

3081d930819106072a8648ce3e02013081850241009494fec095f3b85ee286542b3836fc81a5dd0a0349b4c239dd38744d488cf8e31db8bcb7d33b41abb9e5a33cca9144b1cef332c94bf0573bf047a3aca98c9715e442f6be07598570fbbe843ba05a81195034c2737402c0e867ebb69e7b33a73be94827789231c8d760d0c3cce30dcd5d8c857384e1f3a10b

Node: 1

Public Key:

3081d930819106072a8648ce3e02013081850241009494fec095f3b85ee286542b3836fc81a5dd0a0349b4c239dd38744d488cf8e31db8bcb7d33b41abb9e5a33cca9144b1cef332c94bf0573bf047a3aca99e477ae9715e442f6be07598570fbbe843ba05a81195034c2737402c0e867ebb69e7b33a73be94827789231c8d760d0c3cce30dcd5d8c857384e1f3a10b

Multicast Session Source:2

Session Req Received:[2] @ 3

Session Req Received:[2] @ 1

Session Req Received:[2] @ 4

Session Req Received:[2] @ 3

Session Req Received:[2] @ 5

Multicast Session Reply Received @:2 Path:[2, 5]

Session Req Received:[2] @ 0

Session Req Received:[2] @ 1

Multicast Session Reply Received @:2 Path:[2, 0]

Key Agreement Request Received:@ 5

Key Agreement Request Received:@ 0

Nodeno:0

Seession Key:9d9dc120f9cf86ee5471ce4deb0a0b5a40a4b2cb

Nodeno:5

Seession Key:9d9dc120f9cf86ee5471ce4deb0a0b5a40a4b2cb

Key Agreement Reply Received:@ 2

Nodeno:2

Seession Key:9d9dc120f9cf86ee5471ce4deb0a0b5a40a4b2cb

Key Agreement Reply Received:@ 2

Nodeno:2

Seession Key:9d9dc120f9cf86ee5471ce4deb0a0b5a40a4b2cb

Message Received @:5

Data:hello

Message Received @:0

Data:hello

7. CONCLUSION

In this paper, we propose a novel Robust and Scalable Geographic Multicast Protocol (RSGM) and simulated the design with beautiful performance analysis with the existing protocols. In the current work the intermediate nodes can not maintain the paths of neighbouring nodes and their path it will leads to cost of path search. In future this work will be extended to maintain the catch to the paths which are passing through them. It will reduce the routing cost.

8. REFERENCES

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