



Replication in Mobile Ad-hoc Network using Hopfield Network

By Tanu Chawla & Dr. Mukesh Kumar

The Technological Institute of Textile & Sciences, India

Abstract- Mobile Ad hoc Network (MANET) is a network comprises of mobile nodes connected without any centralized administration. Each node in the network has the ability to share a large number of objects with other nodes. The nodes are connected with other nodes to forward a message to other nodes until the search for node that desire meets. This paper represents a new replication method to recover the performance in distributed system. Objects are replicated on different nodes in the network to minimize the search for an object. It is observed that mobility of nodes predicted using SOM (Self Organizing Maps) technique provides less accuracy. This paper represents an algorithm that uses the network parameters as input condition to replicate objects into the nodes. The decision for each node will be taken by gathering the input conditions and feed to the Hopfield Neural Network. It is view that it will provide more accuracy and improve the performance.

Keywords: *hop field network, mobile ad hoc networks, neural networks, replication, routing, routing protocols.*

GJCST-E Classification : *C.2.0*



Strictly as per the compliance and regulations of:



Replication in Mobile Ad-hoc Network Using Hopfield Network

Tanu Chawla ^α & Dr. Mukesh Kumar ^σ

Abstract- Mobile Ad hoc Network (MANET) is a network comprises of mobile nodes connected without any centralized administration. Each node in the network has the ability to share a large number of objects with other nodes. The nodes are connected with other nodes to forward a message to other nodes until the search for node that desire meets. This paper represents a new replication method to recover the performance in distributed system. Objects are replicated on different nodes in the network to minimize the search for an object. It is observed that mobility of nodes predicted using SOM (Self Organizing Maps) technique provides less accuracy. This paper represents an algorithm that uses the network parameters as input condition to replicate objects into the nodes. The decision for each node will be taken by gathering the input conditions and feed to the Hopfield Neural Network. It is view that it will provide more accuracy and improve the performance.

Keywords: hop field network, mobile ad hoc networks, neural networks, replication, routing, routing protocols.

1. INTRODUCTION

Due to increase in the demand of the computers in our daily life, it increases the demand of connectivity. Through connectivity of various nodes in the network, these nodes in the network can easily share their data or objects. Wired network have been used for a long time. Due to some restrictions of wired network, requirement for the wireless network has been increased for sending messages, emails and communicate with other. So Mobile Ad-hoc Network (MANET) have been developed which comprises of a large number of nodes. In mobile ad-hoc network, nodes can communicates with the other nodes without any need of central administration or base station [2]. MANET is commonly used for all purpose like offices for doing work and colleges for maintain details.

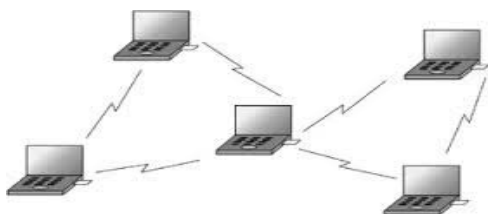


Figure 1 : Example of Mobile Ad hoc Network with having five nodes.

So today demand for the ad-hoc network enhances. Mobile Ad-hoc Network is an autonomous system of mobile routers which are connected with the wireless links and easily communicate with each other. Each node has the ability to move freely in the network at any place. In Mobile ad-hoc network, each node communicates with its neighbours by forward a query message and establishes the communication between them [3].

This shows that every node acts as a host as well as a router [4]. Such a network may be used for the large number of nodes. So this network is a multi-hopped communication network. In this network, the routing protocols are used to transmit the data between the nodes in the network. MANET is used in many applications such as military services, healthcare [1]. Inside the wired network, when one node goes outside from the network, then it disturbs the whole network and the problem will not easily solved. So these days, people prefers to wireless network

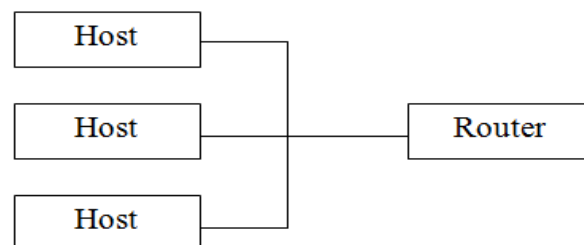


Figure 2 : Block Diagram of Mobile nodes that are act as a host as well as router.

Mobile ad-hoc network is a wireless network topology which is commonly used now-a-days. It consists of a large number of nodes that are linked with each other and share the objects between them. There are a large number of characteristics of MANET [2]. Some of these are summarized as below:

- i. Nodes can perform the role of host as well as router.
- ii. There is no need of centralized controller and infrastructure.
- iii. MANET provides limited security.
- iv. This network can be set up anywhere.
- v. MANET is a dynamic network topology.
- vi. Communication is done without the need of wires.

II. OVERVIEW ON DATA REPLICATION

Data replication is a most useful technique is commonly used today. It is used for improving reliability,

Authors ^{α σ}: Computer Science & Engineering Department, The Technological Institute of Textile & Sciences, Bhiwani- 127021, India.
e-mails: tanuchawla15@rediffmail.com, drmukeshji@gmail.com

scalability, fault-tolerance and accessibility of data services [6]. It is a technique stored on the multiple locations which reduce the search size. To be most useful, data replication should be invisible to the user. The main improvement of using replication is that if you change only single copy of the data that presents in one node then data available on other nodes changes automatically. This solves a large number of problems. So replication is commonly used.

Maintaining various copies of data is one of the most successful ways to stay away from database availability problems. After failure produced in one database, then you have the ability to use another local copy of the database or you can also competent of use the copy of the database that are present on other site. In networking, replication is well thought-out as a most important method to extend reliability [7].

III. OVERVIEW ON ARTIFICIAL NEURAL NETWORK

Artificial Neural Network (ANN) is a computing system consists of a large number of processing elements which are used to take inputs and then processing takes place and then gives response to the inputs [8]. A large Neural Network consists of a large number of processing elements [9].

Neural network is made up of a number of layers. Layers are prepared by a number of interconnected nodes which include an activation function. Patterns are represented in the network as the input layer, which has links to one or more 'hidden layers' and input layer communicates with middle layer known as hidden layer. In the hidden layer, processing is done through a number of weighted connections. The hidden layer directly linked to an output layer which has the capability to gives response to all the inputs [10].

IV. ROLE OF REPLICATION IN MANET

Replication is one of the most important techniques is most commonly used in MANET which allow the nodes to come apart the objects between them. The objective of this technique is to care for a number of object replicas in excess of the time before a node exits in decentralized and amorphous environment [11]. That is the reason that shows the need to replicate objects on the number of nodes that are linked to one another in the network, which is necessary [13].

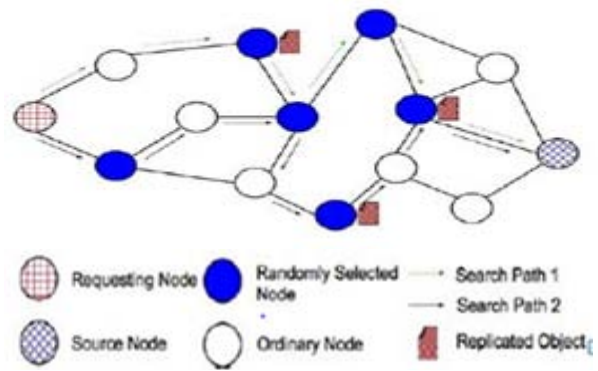


Figure 3 : Shows the replication of nodes in the network.

V. RELATED WORK

We observe a large number of replication techniques that are most commonly used. Some of them are: reactive and proactive replication. Reactive replication is the generally used algorithm. In **reactive replication**, the requesting node has the copy of the object from the source node. After completion of the search, a copy of object is produced into the node where the query was generated. In this type of replication overhead is higher. But the main advantage of using this technique is that it minimizes the storage for replicas, so it provides better results. The only problem with this replication method is more overhead.

In **proactive replication**, the object is replicated from the node that is requested to the node that is provided only in the selected nodes. Sometimes it is copied along the complete path of the successful query from source node to requested node. It is called as the path replication. After the completion of the query, replication of object is takes place in the complete path from source node to node that are requested [13]. Beyond that a new third type of replication algorithm is developed known as "**random replication**". In random replication, beyond the enquiry is completed, the objects are copied randomly in selective nodes along the path from the requester to the requested node.

VI. PROBLEM OVERVIEW

A network consists of a large number of nodes. Each node in the network has the ability to share their objects with other nodes [1]. By using one of the different kinds of search techniques, the location of the data is retrieved. A query for the certain object is initiated to perform the search among nodes. These nodes are linked with one another forward a request message from one node to another node until a search for a certain object is completed. The queries were processed on each node from source node to requested node. The message passes to the various nodes through connection between them until the node that is requested is determined. The nodes which are

used to forward a message from source node to request node is known as the path. The shorter path length has more performance than a longer path.

Replication method is the one of the method to get a good performance in a search on a distributed system [13]. This paper also calculates the predictability of the nodes. The main benefit of mobility prediction is to assign next access point before the mobile terminal leaves its current one which reduces the intrusion time in communication between terminal mobiles. Prediction is implemented using SOM (Self Organizing Maps) technique [13]. But that offers less accuracy. This paper implements new prediction technique which is Hopfield Neural Network technique used in MANET that will offer high accuracy and provide high performance.

VII. PROPOSED ALGORITHM

This algorithm is used to replicate the objects randomly on the nodes after the successful search to reduce our search and time and improve the performance of the system. This algorithm depends upon the theory of finding the conditions of the nodes that are moves out of network. According to this scheme, when a request for a certain object is created, and previously it is to be found then this algorithm is used to randomly replicate the objects along the path from source node to the node that is requested. The proposed algorithm uses the hops as an input condition to make the decision for replicate objects into the nodes. The decision made by gathering the input parameters of each node and feed this input parameters into the Hopfield Network technique.

The various steps of the proposed algorithm are as follows:

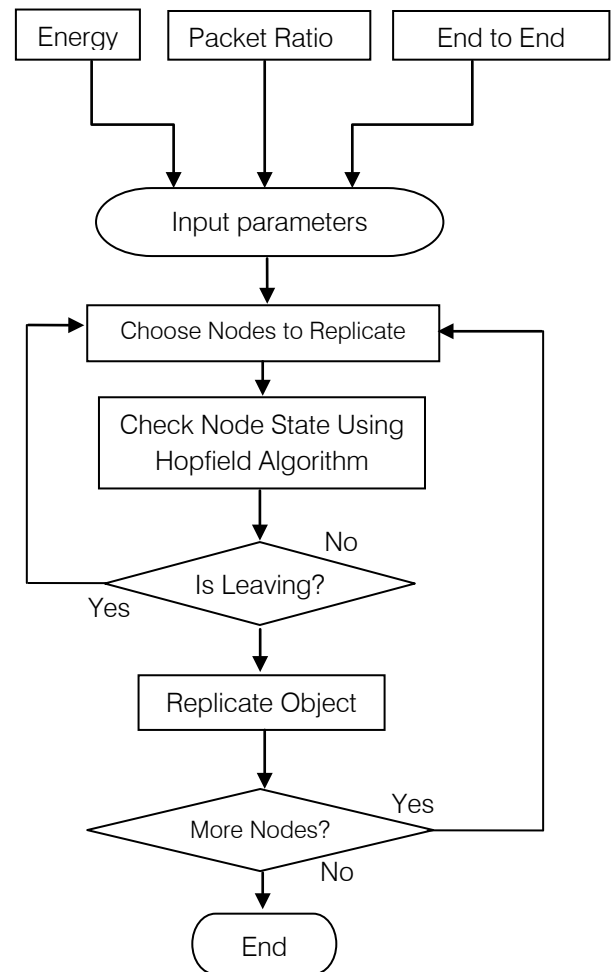
1. Firstly, a set of input parameters such as packet ratio, energy and E2E delay are gathered as inputs.
2. Then the algorithm has to choose the nodes that are needed to replicate.
3. Then it checks the state of the node using Hopfield Network algorithm.
4. The output "0" is for nodes about to leave the network and "1" for those who have enough time to stay in the network.
5. Once a nodes category is specified, the copy of the requested object is placed for those nodes whose category is set to "1".
6. On the other hand, those nodes which contains the "0" category, the replication scheme ignores the replication of object on that node.
7. Then the category for the next node to be evaluated.
8. The method keeps on going until the requesting node in the random replication is reached.

VIII. HOPFIELD NETWORK

Hopfield Network is a neural recurrent network which is used to classify input data into groups. The

data is trained using the supervised learning. So it gives better performance than using SOM Algorithm.

Flow Chart of the proposed algorithm is



A set of input parameters are fed into Hopfield algorithm as input for each node to classify the input data into the groups. Only two categories of output are produced by Hopfield network for making decisions for the nodes. These are either "0" or "1". The number "0" indicates the nodes about to leave the network and "1" for those who are not going out from the network. When the search for all the data completed, then the random replication is used to replicate the objects randomly from the source node to requested node. It firstly checks the category of each node along the path by using the Hopfield algorithm. After the category for each node is explained, then replication scheme randomly copy the requested object for those nodes whose category is set to "1". On the other hand, the nodes which contain the "0" category, the replication scheme will not produce the replication of object for that node and check the category for the next node. The method keeps on going until the requesting node in the random replication is produced.

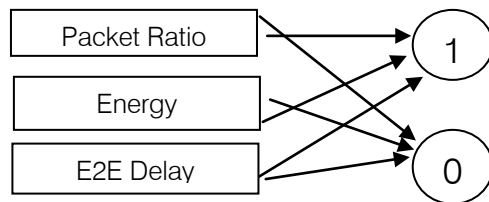


Figure 4: Example of input parameters are given to the algorithm and produces only two outputs 0 and 1.

The inputs parameters for the nodes are distance energy and round trip time (RTT) and output contains only two values 0 or 1. This process is used for each node until the node that is requested is reached.

a) Distance

In the Mobile Ad-hoc Network, each node must be able to send a message to another node and able to establish the communication between them. Each node in the network sends the message to a node that it is linked is called initial node. The distance between two nodes is intended by using the simple equation which is expressed as:

$$D = \sqrt{[(x(i) - x(i + 1))^2 + (y(i) - y(i + 1))^2]}$$

Here D shows the distance between two nodes and i shows the initial node from which we want to calculate the distance and sqrt is a square root function which is used to calculate the square root of given value.

b) Round Trip Time (RTT)

The Round Trip Time is the return time measured by sending a packet from the local node to the isolated node. In this paper, this time is used to calculate the performance of the algorithm which is proposed. The Round Trip Time is evaluated by solving the simple equation which is expressed as:

$$RTT = (2 \cdot D) / C$$

Here RTT shows the Round Trip Time and D shows the distance between two nodes and C indicates the velocity of light and the velocity of light has the value $3 \cdot 10^8$ m/s.

c) Energy

Each node in the network wants to communicate with the neighbouring nodes. Each node contains some energy. When the nodes communicate with neighbouring nodes, they consume some energy. Here energy factor is used to calculate the energy which is consumed when the nodes communicates with another nodes.

IX. RESULTS

The performance evaluation of SOM and Hopfield Network was carried out using NS-2.34. For the experiments performed, a variable-size network of size 300 sq m was randomly generated with number of nodes typically in the range of 10-100. The power of the

sensor radio transmitter was set so that any node within a 20 meter radius is within communication range and is called a neighbour of the sensor. Hopfield network provides better result than SOM Network.

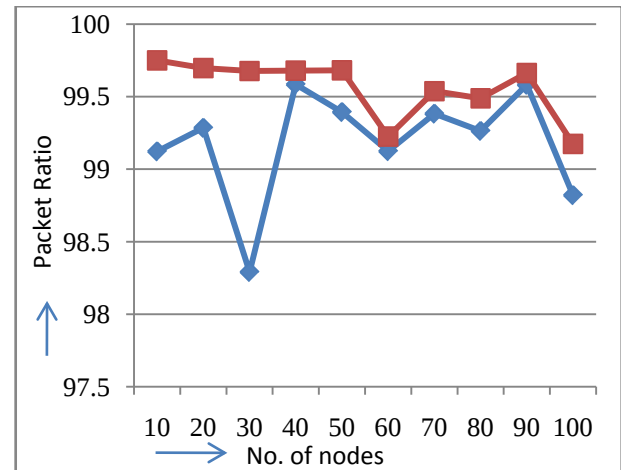


Figure 5: Indicates the packet delivery ratio produced by SOM and Compare it with the packet ratio of new proposed Hopfield Algorithm.

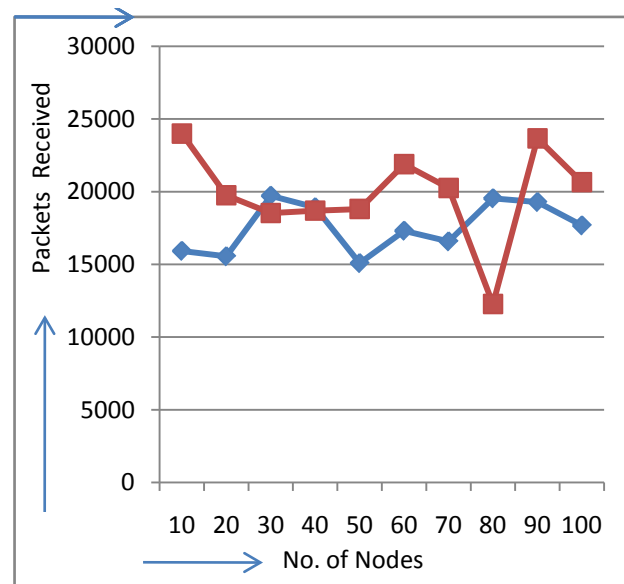


Figure 6: Indicates the packets received by SOM and Compare it with the packets received by new proposed Hopfield Algorithm.

Table 1

For 100 Nodes in a Network	Packet Delivery Ratio	End to End Delay
Existing Algorithm	98.8202	474.827
Proposed Algorithm	99.1743	362.867

It shows the packet delivery ratio and E2E Delay generated by SOM Algorithm using 100 nodes and compares it with the packet delivery ratio and E2E Delay generated by Hopfield Algorithm.

Table 2

For 100 Nodes in a Network	Generated Packets	Received Packets
Existing Algorithm	17885	17674
Proposed Algorithm	20830	20658

It shows the Generated and Received Packets by SOM Algorithm using 100 nodes and compares it with the Generated and Received Packets by Hopfield Algorithm.

X. CONCLUSION AND FUTURE WORK

This paper has proposed a scheme that is used for replicating objects on various nodes in a shapeless, self-configuring and self-motivated network, which randomly replicate the objects by determining the states of the node. If the status of the node is 1, which means that object is replicated for that node and status 0 indicates that object is not replicated for that node. For this, we proposed a new algorithm. The proposed algorithm tries to increase the accuracy and enhance the performance in MANET. As a result, data will be available at more nodes and it will be accessible vastly. Due to this, it will improve the performance of the network and provides more accuracy.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Che-Yu Liu, Isaac Woungang, Han-Chief Chao, Sanjay K. Dhurandher, Ting-Yun Chi, Mohammad S. Obaidat, "Security of Message in Multi-Path Ad Hoc Networks Using a Neural Network-Based Cipher", 2011, Fellow of IEEE and Fellow of SCS.
2. (2008) Rashmi: Mobile Ad-hoc Network [Online]. Available: <http://MobileAdhocNetwork.htm>.
3. P. Mukilan, A. Wahi, "CDRA: Consistency based Data Replication Algorithm of MANET", August 2012, International Journal of Computer Applications (0975 – 8887) Volume 51– No.14.
4. Heni Kaaniche and Farouk Kamoun, "Mobility Prediction in Wireless Ad Hoc Networks using Neural Networks", April 2010, Journal of Telecommunications Volume 2.
5. (1989) Dr. Robert Hecht-Nielsen: A Basic Introduction to Neural Network [Online]. Available: <http://networkintroduction.com>.
6. Marius Christian MAZILU, "Database Replication", Feb 2010, Database Systems Journal vol. I.
7. Matthias Wiesmann, Fernando Pedone and Andre Schiper and Bettina Kemme and Gustav Alonso, "Database Replication Techniques: a Three Parameter Classification", 2010, Research supported by EPFL-ETHZ DRAGON project.
8. Ani1 K. Jain, Jianchang Mao and K.M. Mohiuddinn, "Artificial Neural Network", March 1996, published in IEEE.
9. Hugo Larochelle, Yoshua Bengio and Jerome Louradour and Pascal Lamblin, "Exploring Strategies for

- Training Deep Neural Networks", published in Jan 2009, Journal of Machine Learning Research.
10. Carlos Baladron, Javier M. Aguiar, Lorena Calavia, Belén Carro, Antonio Sanchez- Esguevillas and Luis Hernandez, "Performance Study of the Application of Artificial Neural Networks to the Completion and Prediction of Data Retrieved by Underwater Sensors", Jan 2012, Published in ISSN 1424-8220.
11. Frank-Florian Steege and Horst-Michael Groß, "Comparison of Long-Term Adaptively for Neural Networks", 2012, Published in International Conference on Artificial Neural Networks.
12. Vorgelegt von, Jorg Hahner and Aus Dusseldorf, "Consistent Data Replication in Mobile Ad Hoc Networks", 2007, Published in IPVS.
13. Geoffrey Cantara Soriano, Yoshiyori Urano, "Replication with State Using the Self-Organizing Map Neural Network", 2011, published in ICACT.
14. M. Pushpalatha, Revathi Venkatraman and T. Ramarao, "An Approach to Design an Efficient Data Replication Algorithm in Mobile Ad hoc Networks", May 2009, International Journal of Recent Trends in Engineering, Vol. 1, No. 2.
15. S.R. Das, R. Castaneda, and J. Yan, "Simulation-based performance evaluation of routing protocols for mobile ad hoc networks", Mobile Networks and Applications, 2000, 5, pp. 179-189.
16. R. Patil, A. Damodaram and R. Das, Cross layer AODV with position based forwarding routing for mobile ad-hoc network, Proc. of the 5th IEEE Conference on Wireless Communication and Sensor Networks, 2009.
17. S.-J. Lee and M. Gerla, "Dynamic load-aware routing in ad hoc networks", Proc. of IEEE International Conference on Communications, pp .3206-3210, 2001.
18. VINT Project, The NS Manual Formerly NS Document, <http://www.isi.edu/nsnam/ns/ns-documentation.html>, 2005.
19. Mueen Uddin, Azizah Abdul Rahman, Abdulrahman Alarifi, Muhammad Talha, Asadullah Shah, Mohsin Iftikhar and Albert Zomaya, "Improving Performance of Mobile Ad Hoc Networks Using Efficient Tactical on Demand Distance Vector (TAODV) Routing Algorithm", June 2012, International Journal of Innovative Computing, Information and Control Volume 8, Number 6.
20. Pravin Ghosekar, Girish Katkar, Dr. Pradip Ghorpade, "Mobile Ad Hoc Networking: Imperatives and Challenges", 2010, IJCA Special Issue on Mobile Ad-hoc Network.
21. C. Bisdikian, An overview of the Bluetooth wireless technology, IEEE Communication Magazine, December 2001.
22. J. Broch, D. A. Maltz, D. B. Johnson, Y. Hu, J. Jetcheva, A Performance Comparison of Multi-Hop

Wireless Ad Hoc network Routing Protocols, Proc. of MobiCom'98, Oct. 1998.

23. P. Sinha, R. Sivakumar, V. Bharghavan, CEDAR: a Core- Extraction Distributed Ad hoc Routing algorithm, IEEE INFOCOM'99.
24. E. R. Royer, C.-K. Toh, A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks, , IEEE Personal Communications, Apr. 1999.
25. V. D. Park and M. S. Corson, A Highly Adaptive Distributed Routing Algorithm for Mobile Wireless Networks, IEEE INFOCOM'97, 1997.

