www.ijaceeonline.com ISSN: 2456 - 3935
International Journal of Advances in Computer and Electronics Engineering
Volume 2, Issue 6, June 2017, pp. 35–40

Intelligent Multicast Routing Algorithm for Dynamic Optimization Problem in Mobile Ad-Hoc Network

Nareshkumar R. Mustary
Research Scholar, Department of Computer Engineering, GITAM University, India
Email: nareshkumarmustary@gmail.com

Dr. S. Phanikumar
Professor, Department of Computer Engineering, GITAM University, India
Email: s.phanikumar@gmail.com

Abstract: *In mobile ad hoc network (MANET), the research makes a very large assumption that communication can only takes place between nodes and that are instantaneously accessible within the same related cloud i.e., that communication is synchronous. Actually, this communication is likely to be a deprived one, particularly for lightly or intermittently populated environments. Moreover, asynchronous communication such as email, which is by far the distinguished form of networked peer-to-peer communication, has a natural fit to such partially-connected environments, but has been relatively little discovered in the context of mobile ad-hoc networking. This is perhaps unsurprising, given the complexities involved. Certainly, the few methods have been described to date that are simplistic or lightweight. In this paper, we present the Context-Information Intelligent Routing (CIIR) algorithm. CIIR is a unique approach to the provision of asynchronous communication in partially-connected mobile ad hoc networks, based on the intelligent post of messages. Also we discuss the details of the algorithm, and then present simulation results demonstrating that it is possible for nodes to abuse context information in making local decisions that lead to good delivery ratios and latencies with small overheads.*

Keywords: *CIIR; DSDV; Epidemic Routing; Flooding; MANET;*

1. INTRODUCTION

In MANET broadcasting is a common operation for route formation and sending control and reserve messages. A consistent broadcasting in the MANET requires the delivery of messages from diverse sources to all the nodes in the network within a stipulated time. The nodes are highly mobile and the network is highly dynamic and decentralized [1]. Most of the current routing protocols in MANET have the postulation that a path exists between the sender and the receiver but the decentralized MANET is characterized by frequent network partitions and so, to achieve a reliable broadcasting is a challenging task.

Ad hoc networks represent the decentralized systems and, therefore, they inflict many challenges to cooperative communication. As significance, much ad hoc network research has attentive on the investigation of fundamental algorithms for routing on which almost everything else relies [1]. However, in order to make the problem tractable, almost all research on routing algorithms makes the over simplistic assumption that it is only meaningful to attempt to exchange messages within connected group of nodes, in other words, that all communication is synchronous in nature [1,2,3].

In the absence of special information, the problem of identifying which nodes might make good carriers in ad hoc networks is a very challenging one[4]. Likely future mobility patterns must be inferred from previous mobility patterns, but this alone is inadequate; parameters such as remaining battery lifetime are also key in determining which possible carriers are most likely to outcome in successful delivery. In this paper, we consider what types of information are available to nodes in deciding on carriers.

We use this analysis in the design of a Context-Information Intelligent Routing algorithm (CIIR).It is a general structure for the evaluation and assessment of context information for achieving efficient and delivery of messages in timely. Using simulations, we explore the performance of the CIIR algorithm with respect to epidemic routing and flooding [5-7]. Whe-

Cite this paper:

Nareshkumar R. Mustary, S. Phanikumar "Intelligent Multicast Routing Algorithm for Dynamic Optimization Problem in Mobile Ad-Hoc Network", International Journal of Advances in Computer and Electronics Engineering, Vol. 2, No. 6, pp. 35-40, June 2017.

reas, in the developed world, synchronous communication such as phone and Internet is generally cheap and easy to come by, there are several real scenarios in less developed parts of the world in which different portions of a logical network are physically disconnected. For example, this is the case in recent projects established to assist traveling groups such as the Saamis in Lapland or to assist populations in rustic areas of India [8]. In the later case, a number of villages each have their own local networking infrastructure, but there is no interconnection between peer-to-peer.

2. RELATED WORK

A number of methodologies have been proposed to empower asynchronous communication in mobile ad hoc networks.

Epidemic algorithms were proposed in the context of distributed database systems in an endeavor to guarantee data consistency after disconnections [9], where results shows using random data exchanges, all updates are perceived by all the clouds of the system in a bounded amount of time, given reasonable conventions about connectivity. The epidemic routing protocol described earlier, that forms the basis for much of the work in this field, applied this early approach to the field of asynchronous message delivery, but in a rather naive fashion.

In [10], Lindgren et al. propose a probabilistic routing approach to empower asynchronous communication among intermittently connected clouds of hosts. Their approach is based on the fact that the demoralized communication model is typically transitive and, for this reason, the probability of message delivery must be calculated accordingly: in other words, if, for example, a node NA is able to communicate with NB through NC, the overall delivery probability is derived by the multiplication of the probability that NA becomes a neighbor of NB, with the probability that NB becomes a neighbor of NC. The calculation of the delivery probabilities is based, somewhat simplistically, on the period of time of co-location of two hosts, weighted by an aging factor that is used to decrease the overall probability with the increasing age of the information on which it was based.

Chen and Murphy refined the epidemic model, presenting the Disconnected Transitive Communication paradigm [11]. Since it essentially disputes for the use of utility functions, but it provides a general context rather than a detailed instantiation, and so aspects related to the composition of calculated delivery probabilities are almost entirely missing.

Kevin Fall et al. in [12], proposes the Delay Tolerant Network architecture to solve the internetworking challenge in scenarios where partitions are frequent and a connected path between message senders and receivers may be not present for example satellite and interplanetary communication systems. This approach relies on routing mechanism presented in detail in [13], based on optimal or sub-optimal algorithms, according to the different knowledge about the topology of the networks and the sampled delivery delays, to compute the best end-to-end communication shortest path.

Zhao et al. in [14] discuss the Message Ferrying approach for message delivery in mobile ad hoc networks. Proposed a proactive solution based on the exploitation of highly mobile nodes called ferries. These nodes move according to pre-defined routes, carrier's messages between disconnected portions of the network. Tara Small, et al. in [15], describe a very fascinating application of epidemic routing protocols to a problem of cost effective data collection, using whales as message carriers. With respect to the existing work in this research area, such as [16] and [17], we have introduced a general structure for the evolution and the prediction of the mobile context to provide efficient and effective communication mechanisms in mobile ad hoc networks. Moreover, we consider that it is possible to assimilate our techniques with these approaches, since they address orthogonal aspects of the problem.

It is very essential noting that we used lightweight mechanisms, because we believe that routing algorithms that are more complex from a computational point of view. These are unsuitable for mobile devices, usually characterized by inadequacy of resources.

3. PROPOSED SYSTEM

The design goal of the proposed algorithm (CIIR) is to support the communication in a dynamically connected MANET. The key problem solved by the algorithm is the selection of the carriers nodes based on the application of the prediction techniques and multi criteria utility theory for the evaluation of different aspects of the system relevant for taking routing decisions. The key aspect of the protocol is the ability to deliver the messages synchronously i.e., without storing them in buffers of intermediate nodes when there are no network partitions between nodes and asynchronously i.e., by means of a store-and-forward mechanism when there are network partitions. The delivery process depends on whether all the nodes are present in the same connected region of the network as the sender or not.

If all the nodes are currently in the same connected portion of the network, the message is broadcast with an underlying synchronous routing protocol to determine a forwarding path. If a message cannot be broadcast synchronously, the best carriers for a message are selected which are nodes with the highest delivery probabilities. The message is sent to the host with the highest delivery probability using the underlying synchronous protocol and the message is broadcast by the carrier's nodes to those nodes that are in a

ISSN: 2456 - 3935
International Journal of Advances in Computer and Electronics Engineering
Volume 2, Issue 6, June 2017, pp. 35–40

separate cloud.

In order to understand the operation of the CIIR protocol, consider the following scenario in which two groups of nodes are connected as in Figure 1. Host H1 wishes to send a message to H9. This cannot be done synchronously, because H1 – H5 are in one cloud, & H6-H9 are in different cloud and both clouds are disconnected. In this case, the host possessing the best delivery probability to host H9 is H5. Therefore, the message is sent to H5, which stores it. After a certain period of time, H5 moves to the other cloud (as in Figure 2). Since a connected path between H5 and H9 now exists, the message is delivered to its intended recipient. Using DSDV, for example, it is worth noting that H5 is able to send the message shortly after joining the cloud, since this is when it will receive the routing information relating to H9.

Let us suppose H1 does not store any information about H9. In this case, H1 sends the message to the host in the cloud that has the highest mobility or it keeps the message itself if it has the highest mobility. In other words, the message is stored by the host that in average meets the highest number of hosts and so that it has the highest probability to get in reaches with the recipient.

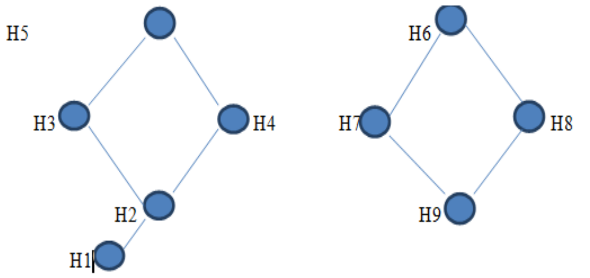

Figure 1 Two connected clouds, with associated delivery probabilities for message transmission between H1 and H9

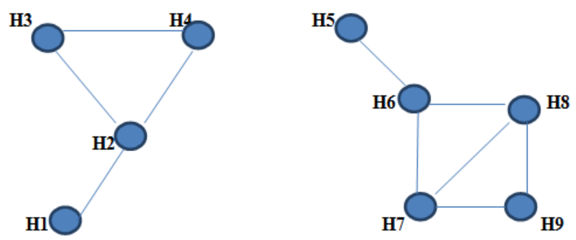

Figure 2 H5, carrier Node Movements from One Cloud to Another

4. PREDICTION AND EVALUATION OF CONTEXT INFORMATION

The universal problematic from the point of view of the sender of a message is to find the host with the best delivery probability, as calculated using the predicted values of a range of context attributes. Instead of using the available context information as it is, CIIR is optimized by using predicted upcoming values for the context, so to have more realistic values. The process of prediction and evaluation of the context information can be summarized as follows:

- Each host calculates its delivery probabilities for a given set of hosts. This process is based on the calculation of the utilities for each attribute describing the context. Then the future values of these utilities are predicted and composed making use of the multi criteria decision theory to estimate an overall delivery probability. The calculated delivery probabilities are periodically sent to other hosts in the connected cloud as part of the updating of the routing information.

- Each host maintains a logical forwarding table of tuples describing the next logical hop and its associated delivery probability for all the known destinations.

- Each host uses the local prediction of the delivery probabilities between any two updating of routing information. The prediction process is used during the temporary disconnections to calculate an accurate delivery probability.

4.1 Predictability of the Context Information

The attribute change in degree of connectivity of a certain host may not be predicted at some time. E.g. host may be unavailable or not reachable at some time and its delivery probability cannot be calculated [17]. Now, the predictability of the context information is set as 0. The predictability of the context information is computed using the following Equation 1.

The approach is based on two discrete values (0 and 1) rather than one based on continuous values (i.e., an interval between 0 and 1), since the latter would be based only on a pure heuristic choice and not on any sound mathematical basis. In other words, it is very difficult to map different scales of predictability into the values of ${}^{a}\text{predictability}_i(X_i)$.

$$ {}^{a}\text{Predictability}_i = \begin{cases} 1, & \text{if it is predictable} \\ 0 & \text{if not predictable} \end{cases} \qquad (1) $$

4.2 Evaluation of Context Information

Each host calculates its delivery probability locally by considering only the context attributes excluding the overall topology of the network. It is the key problem to measure and combine the attributes. The delivery probabilities are calculated by evaluating the utility of each host as potential carrier for a message. There are several techniques for assigning an overall utility for the context attribute and goal programming is one of them. With respect to a single attribute, the goal is to maximize its value based on the evaluation of one goal at a time so that the optimum value of a higher priority goal is never degraded by a lower priority goal. This technique is simple and easy to implement. In general, the decision problem involves multiple conflicting objectives, and for example, the attributes like the battery energy level and the change in the degree of connectivity may be considered.

The context information related to a certain host can be defined with a set of attributes (x1, x2,..xn). Those attributes denoted with a capital letter i.eX1 refer to the set of all possible values for the attribute, whereas those denoted with a lower case letter i.e x1 refer to a particular value within this set. An example of a generic attributes Xi can be the mobility of the hosts or its battery level. For instance, the value xi of the attribute battery level may be 0.99 (i.e., battery almost full).

If the set of attributes (x1, x2, ….xn) are mutually and preferentially independent characterized by the same degree of significance, the sum of the attributes is equivalent to the overall utility of the context attributes a shown in Equation 2.

$$U(X1,X2,\ldots Xn)=\sum_{i=1}^{n} Ui\ (Xi) \qquad (2)$$

where, Ui is a utility function over xi. Now, the aim is to maximize each attribute to choose the hosts as best carriers for the message delivery. Weights method is applied to choose the best carriers for the message delivery.

The goal function used in the Weights method is defined as,

$$\text{Maximize}= \quad f\,(U(X_i))=\sum_{i=1}^{n} Ui\ (x_i) \qquad (3)$$

Where, w1, w2,…wn are significant weights reflecting the relative importance of each goal.

5. RESULTS & DISCUSSIONS

The simulation of the CIIR routing protocol has been performed using NS-3 and the performance of DSDV and CIIR routing protocols are analyzed. The channel capacity of the mobile hosts is set as a constant value of 2 MBPS. The DCF of IEEE 802.11 is used for the wireless LANs as the MAC layer protocol which notifies the network layer about link breakage.

5.1 Choice of the Parameters

The protocol is simulated using the utility function based on the evaluation of two attributes:

i. The change in the degree of connectivity.
ii. The probability of being connected with the other cloud in case of partition i.e, future host collocation.

We evaluated the performance of each protocol sending 40 messages with a simulation time equal to 100 seconds. The messages were sent after 20 seconds, in order to allow for the settling of initial routing table exchanges, and the intervals between each message were modeled as a Poisson process, with $\lambda = 10s^{-1}$, and the moment that all messages are sent in about 15 seconds. The sender and receiver of each message are chosen randomly. In the CIIR simulation, each message has a field that is similar to a time to live value that is decreased each time that the message is transferred to another host. The various Simulation Parameters are depicted in Table 1.

TABLE 1 SIMULATION PARAMETERS FOR CIIR AND DSDV ROUTING PROTOCOLS

Simulation Parameters	Values
Network Size	1000 Meters
Number of Nodes	25,50,75,100,125,150, 175,200
Bandwidth	2 MBPS
Synchronous Routing Protocol	DSDV
MESSAGE_PORT	50
BROADCAST_ADDR	-1
Node Speed	5,10, 15,20,25,30 Micro Seconds
MAC	IEEE 802.11
Radio Range	300 Meters
Simulation Time	100 s
Broadcast Delay	0.01 µs
Packet Size	512 Bytes (Max 1500 Bytes)
Max packet in Interface Queue	50
Mobility Model	Random Way Point

5.2 Performance Metrics &Analysis

The comparison between DSDV and CIIR protocols on Packet Delivery Ratio is given in Figure.3. CIIR protocol produces a finer packet delivery ratio during the network partition as Compared with DSDV routing protocol. As the number of nodes increases, the packet delivery ratio decreases drastically in DSDV because more number of the control packets is transmitted by the intermediate nodes for the route establishment and maintenance. CIIR protocol produces a good packet delivery ratio as it buffers the data packets at the carrier.

The comparison between CIIR and DSDV routing protocols based on Routing Overhead is given in Figure.4. Generally, the number of routing packets transmits increases when the number of nodes increases. As the number of nodes increases, more nodes are flooding in the network with Route Requests (RREQ) and consequently more nodes are

ISSN: 2456 - 3935
International Journal of Advances in Computer and Electronics Engineering
Volume 2, Issue 6, June 2017, pp. 35–40

sending Route Replies (RREP) as well. In addition to this, the source node has to generate more RREQs to find a fresh route to the destination. DSDV protocol uses more control packets during the network partition and the routing overhead increases as the number of nodes increases. CIIR reduces routing overhead by decreasing the number of control packets transmitted during the network partitions as compared with DSDV.

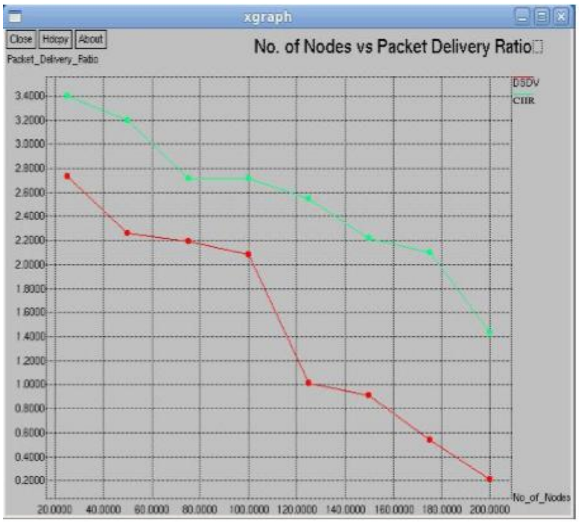

Figure 3 Comparisons between CIIR and DSDV Protocols on Packet Delivery Ratio

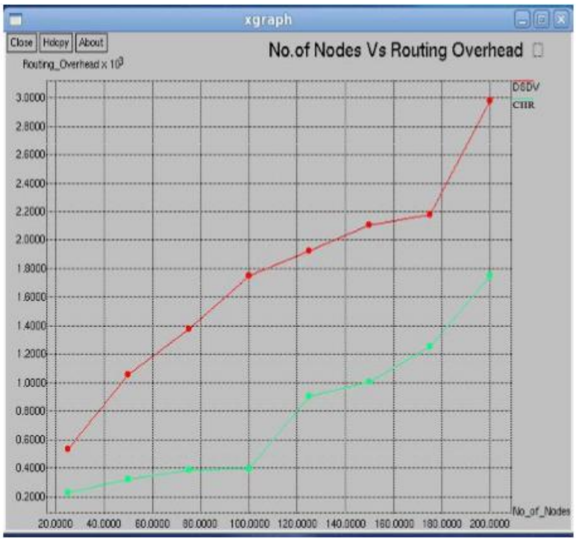

Figure 4 Comparisons between CIIR and DSDV Protocols on Routing Overhead

Comparison between CIIR and DSDV routing protocols on Packet Loss Ratio is given in Figure.5. As the speed of the node increases, the position of a node also changes quickly. The source node still uses the previous route for a destination, if it didn't get expired, but due to the fast mobility pattern, this route is often invalid causing the packet to be dropped. This causes more and more packets to time out before reaching their destinations. CIIR Protocol reduces the packet loss by buffering the undelivered packets in the carrier node as compared with DSDV protocol.

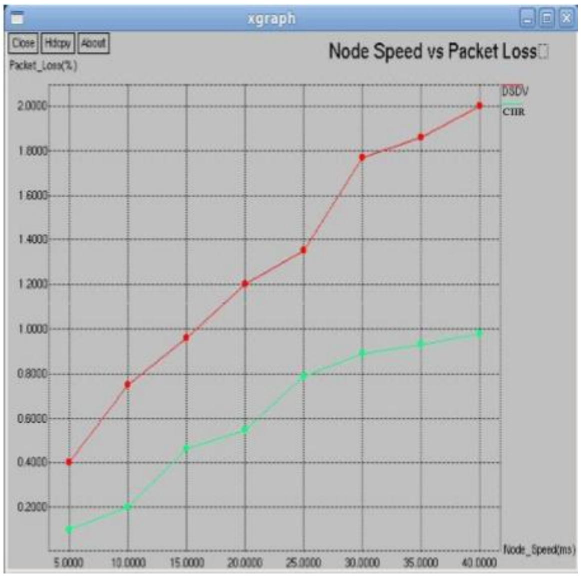

Figure.5 Comparison between CIIR and DSDV Protocols on Packet Loss Ratio

6. CONCLUSION

The design, evaluation and implementation of a new Context-Information Intelligent Routing Protocol for broadcasting in the MANET are presented. The prediction techniques are used to design store-and-forward mechanisms to deliver messages in an intermittently connected MANET in which a connected path between the source and all nodes may not exist. A generic framework is designed for the evaluation of the multiple dimensions of the mobile context to select the best carriers for message transmission.

The simulation experiments have shown that the new protocol is able to provide the guaranteed better results with a limited overhead in terms of the number of messages sent compared with other routing protocol like DSDV. The protocol maximizes the packet delivery ratio during the network partitions and minimizes the routing overhead. Compared with DSDV protocol, CIIR Protocol is more efficient in minimizing packet loss by buffering the undelivered packets in the carrier nodes.

REFERENCES

[1] Nareshkumar Mustary and Phanikumar Singhamshetty, (2016), "Computational intelligence based efficient routing in MANET:A Review", *in International Journal for Research in Engineering Application & Management (IJREAM)*, ISSN : 2494-9150 Vol-02, Issue 04, July 2016. pp. 28-34.

ISSN: 2456 - 3935
International Journal of Advances in Computer and Electronics Engineering
Volume 2, Issue 6, June 2017, pp. 35–40

[2] Elangovan Gurumoorthi, Ayyanar Ayyasamy, Maruthavanan Archana, Jayabalan Vijaya Barathy, (2017 May).“Performance Enhancement for QoS in VoIP Applications over MANET”, *International Journal of Advances in Computer and Electronics Engineering,* Vol. 2, No. 5, pp. 47-54.

[3] Rakhi Sharma, D. V. Gupta, (2017). “Effects of Selfish node on Routing Protocols in Delay Tolerant Network”. *International Journal of Advances in Computer and Electronics Engineering*. Vol. 2, No. 3, pp. 8-10.

[4] Elena Pagani and Gian Paolo Rossi. (1999), “Providing reliable and fault tolerant broadcast delivery in mobile ad-hoc networks”. in ACM/Baltzer Journal of Mobile Networks and Applications (MONET), Volume 4,Issue 3, pp. 175–192.

[5] Amin Vahdat and David Becker (2000), “Epidemic routing for partially connected ad hoc networks,” *Department of Computer Science, Duke University,* Tech. Rep. CS-2000-06.

[6] Abdelmajid Khelil, Cristian Becker, Jing Tian, & Kurt Rothermel, (2002, September). “An epidemic model for information diffusion in MANETs”. *In Proceedings of the 5th ACM international workshop on Modeling analysis and simulation of wireless and mobile systems, ACM,* pp. 54-60.

[7] Yoav Sasson, Jerry Cavin & Andre Schiper, (2003, March). “Probabilistic broadcast for flooding in wireless mobile ad hoc networks”. *In Wireless Communications and Networking, WCNC 2003, IEEE,* Vol. 2, pp. 1124-1130.

[8] Avri Doria, Maria Uden and Durga Prasad Pandey, (2002), “Providing connectivity to the Saami nomadic community”, *in Proceedings of the Second International Conference on Open Collaborative Design for Sustainable Innovation.*

[9] Alan Demers, Dan Greene, Carl Hauser, Wes Irish, John Larson, Scott Shenker, Howard Sturgis, Dan Swinehart, and Doug Terry. (1988), “Epidemic algorithms for replicated database maintenance”,*Providing connectivity to the Saami nomadic community,* vol. 22, No. 1, pp. 1-12.

[10] Anders Lindgren, Avri Doria and Olov Schelen., (2003), “Probabilistic routing in intermittently connected networks”, *ACM SIGMOBILE Mobile Computing and Communications Review* , Volume 7 Issue 3, July, pp. 19-20.

[11] Xiangchuan Chen and Amy Murphy, (2001), “Enabling disconnected transitive communication in mobile ad hoc networks”, *in Proceedings of the Workshop on Principles of Mobile Computing (POMC’01),* pp. 21–23.

[12] Kevin Fall, (2003, August). “A delay-tolerant network architecture for challenged internets”. *In Proceedings of the 2003 conference on Applications, technologies, architectures, and protocols for computer communications, ACM,* pp. 27-34.

[13] Sushant Jain, Kevin Fall and Rabin Patra, (2004).” Routing in a delay tolerant network”, *ACM.* Vol. 34, No. 4, pp. 145-158.

[14] Wenrui Zhao, Mostafa Ammar and Ellen Zegura, (2004, May). “A message ferrying approach for data delivery in sparse mobile ad hoc networks”. *In Proceedings of the 5th ACM international symposium on Mobile ad hoc networking and computing, ACM,* pp. 187-198.

[15] Tara Small & Zygmunt Haas, (2003, June). “The shared wireless infostation model: a new ad hoc networking paradigm”. *In Proceedings of the 4th ACM international symposium on Mobile ad hoc networking & computing, ACM,* pp. 233-244.

[16] Lim Sunho, Chansu Yu, & Chita Das, (2010). “A realistic mobility model for wireless networks of scale-free node connectivity”. *International Journal of Mobile Communications,* 8(3), pp. 351-369.

[17] Mirco Musolesi, Stephen Hailes and Cecilia Mascolo, (2004). “Prediction of context information using kalman filter theory”. *UCL Internal Research Note.*

Author Biography

Mr. Nareshkumar R. Mustary, completed Bachelor of Engineering (computer science & Engineering) from Rural Engineering College, Bhalki, affiliated to Visveshvaraiah Technological University, Belgaum, Karnataka with First class with distinction (74%) in 2008, Master of Technology (Software Engineering) from Al-Habeeb College of Engineering, Hyderabad with first class with distinction (76%) in 2012 & Pursuing PhD from GITAM, University, Hyderabad. I have published 9 papers in different International Journals and presented in 5 International and National conferences. My research areas of interests are: Ad-hoc Networks, Mobile Computing, Genetic Algorithms and Artificial Intelligence. Professional Society Membership is: Life Member of the ISTE.

Dr. S. Phani Kumar, Ph.D. (CSE) awarded in 2011 for the thesis titled Design of Self Configurable Dynamic Fuzzy Voter using Statistical Parameters for Safety Critical Systems from Bharath University, Chennai under the supervision of Dr. P. Seetharamaiah, Professor, Department of CS&SE, Andhra University college of Engineering, Visakhapatnam. Master of Technology (Software Engineering) from Bharath University, chennai in 2006, Bachelor of Engineering (computer science & Engineering) from Rural Engineering College, Bhalki, affiliated to VTU, Belgaum, Karnataka in 2002 & Diploma in Computer Engineering from Al-Huda Polytechnic, Nellore in 1996. Presently working as Professor & Head, Department of Computer Science & Engineering at GITAM University, Hyderabad campus. Published 14 papers in different International Journals and presented 8 papers in different International Conferences. Professional Society Memberships are: Life Member of the ISTE, Member of CSI.

Cite this paper:

Nareshkumar R. Mustary, S. Phanikumar “Intelligent Multicast Routing Algorithm for Dynamic Optimization Problem in Mobile Ad-Hoc Network”, International Journal of Advances in Computer and Electronics Engineering, Vol. 2, No. 6, pp. 35-40, June 2017.