Research Journal of Applied Sciences, Engineering and Technology 9(7): 526-530, 2015
DOI:10.19026/rjaset.9.1436
ISSN: 2040-7459; e-ISSN: 2040-7467

Submitted: October 15, 2014 Accepted: November 26, 2014 Published: March 05, 2015

Research Article

Quick Recovery from Link Failures using Enhanced On-demand Multicast Routing Protocol

[1]S. Muthumari Lakshmi and [2]K. Thirunadana Sikamani
[1]Department of Computer Science and Engineering, St. Peter's University, Chennai, Tamil Nadu, India
[2]Department of Computer Science and Engineering, St. Peter's College of Engineering and Technology, Chennai, India

Abstract: The aim of this study is to reduce the number of link failures and provide a quick recovery mechanism in MANETs. Multicasting is one of the greatest issues among MANETs due to the seamless variations in topology and link dynamics. Due to the wireless nature of the network, the nodes are under the compulsion to perform communication at adverse situations for any emergency or defense operations. The On Demand Multicast Routing Protocol (ODMRP) is one of the solutions proposed to avoid the multicasting problem in Wireless Mobile Ad hoc Network. In order to avoid excessive flooding of control messages in the network, Enhanced ODMRP was proposed that introduced short time frames to wait until the refresh messages are flooded. In this study, we propose a quick recovery mechanism that along with the EODMRP helps in the quick recovery from route failures and increases performance in the network. An analysis of the EODMRP protocol for multicasting in MANETs is presented along with the proposed quick recovery mechanism using simulations in the network simulator.

Keywords: Ad hoc network, flooding, link failure, multicasting, quality of service

INTRODUCTION

Mobile ad hoc networks have seen tremendous and swift growth in the various applications used over the last decade, especially in the military operations where mobility of nodes is mandatory during communication. To meet the requirements of the communication in the network, different strategies and protocols have been implemented by the current research. All nodes in the network perform communications at various mobility and data-rate requirements. Among the various types of communication in MANETs, multicasting is the most desirable and challenging operation. Timely delivery of data without exploitation of all the available resources is very much essential in vital application scenarios to a group of destinations.

Efficiency, simplicity, control overhead, resource management, quality of service and robustness are the characteristics of good multicast routing protocols. Multicast routing protocols proposed by Junhai *et al*. (2009). MANETs can be divided into tree based, mesh based and hybrid based routing protocols. The tree based protocols provide a single path between two nodes in multicast group that are also bandwidth efficient. In a mesh-based multicast routing protocol packets are distributed in a mesh structures. The meshed based protocols have high robustness compared with tree based protocols in high mobility environment and provide redundant paths from source to destinations while forwarding data packets. The hybrid multicast routing protocols combine with both tree based and meshed based approaches. Hybrid protocols address both efficiency and robustness. These protocols get multiple routing paths and duplicate messages to reach a receiver through different paths.

Adaptive refresh mechanism proposed by Sanjay and Ravi (2014) that refreshes the network only when there is a link failure that occurs in the network within short time frames. This has enabled the control of flooding of multicast route request and reply messages in a large scale in the network. The Refresh Request estimates the route lifetime which is the time difference between the two events that is route establishment and detection of the route breakage. The value is recorded in a Route Refresh packet and is passed to the source via network. The lack of utilizing multicast meshes in the most efficient manner results in producing lesser quality of service. In this study, we have provided a solution to use multicast meshes for quick recovery from link failures, which is the main aim of this research work. The remaining sections contain the proposed system, simulation analysis and conclusions.

LITERATURE REVIEW

ODMRP proposed by Lee *et al*. (2002) is mesh-based scheme rather than a conventional tree based multicast scheme and uses a forwarding group concept.

Corresponding Author: S. Muthumari Lakshmi, Department of Computer Science and Engineering, St. Peter's University, Chennai, Tamil Nadu, India

It applies on demand routing techniques to avoid channel overhead and improve scalability. Enhanced On-Demand Multicast Routing Protocol (EODMRP) provided by Hinds *et al*. (2013). This protocol is an enhanced version of ODMRP with adaptive refresh. Adaptation is driven by receiver's reports. The second enhancement is the unified local recovery and receiver joining scheme. The major advantage is reduced overhead. Reliable multicast routing protocol R-ODMRP proposed by Xu *et al*. (2010). This is in character with reliability of cluster based mesh, safety of multicast delivery and QoS provision. Priority based packet scheduling to abate the control overhead and network congestion. Active network technique is introduced for cluster mesh forward to distributed performs active packet acknowledgment and lost packet recovery.

MZR routing protocol is proposed by Zhang and Jacob (2004). It is a source based initiated and on-demand protocol. MZR uses the concept of zone routing. The zones in the MZR protocol will be select by the neighbor nodes based on zone radius in terms of number of hops. Problem of this protocol is the receiver node is far located when node will wait for long time. Jetcheva and Johnson (2001) proposed ADMR. This is on-demand source routing protocol. By using the shortest path from the source node to the receiver members, ADMR uses packet forwarding techniques by using a sequence number to uniquely identify the packets. Wu and Tay (1999) introduced Ad hoc Multicast Routing protocol utilizing Increasing Id-numbers (AMRIS). Here every node is assigned with multicast session id number dynamically. It used to reduce overhead. Disadvantage of this protocol is a lack of bandwidth constraints in MANETs.

AODV explained by Royer and Perkins (1999) builds multicast trees as needed to connect multicast group members. The multicast tree is distributed so that there is no single point of failure. AODV provides loop free routes for both unicast and multicast even while repairing broken links. Reina *et al*. (2013) have proposed Hybrid Flooding Scheme for Mobile Ad Hoc Networks combine the different flooding schemes in order to solve the broadcast storm issue encountered by the simple flooding scheme. This scheme to reduce the broken links due to mobility of nodes and increasing dissimilarity among the intermediate nodes also include forwarding the zone criteria. Forwarding Group Multicast Protocol (FGMP) proposed by Chiang *et al*. (1998). It provides a simple and efficient way for multicasting in mobile wireless networks. The key efficient of multicasting is a mechanism which allows the network to forward packets efficiently from senders to receivers without resorting the global flooding. Multicast using forwarding group takes advantage of wireless broadcast transmission sand reduces channel and storage overhead as well as improving the performance and scalability.

Shaikh *et al*. (2001) have introduced Optimized Link State Routing protocol (OLSR). Here link state information is generated only by nodes elected as Multipoint Relays (MPRs). This information is used for route calculation. OLSR provides optimal routes and it does not need central administrative system to handle the routing process. The great advantage of the OLSR protocol is that it immediately knows the status of the link and it is possibly to extend the quality of service information. Efficient Geographic Multicast Protocol proposed by Xiang *et al*. (2006). EGMP used the hierarchical structure to implement scalable and efficient group membership management. Zone based bidirectional tree construction is achieve more efficient multicast delivery which is efficiently reduces the overhead for route searching and tree structure maintenance.

Garcia-Luna-Aceves and Madruga (1999) have discussed Core-Assisted Mesh Protocol (CAMP) is introduced for multicast routing in ad-hoc networks. The connectivity of multicast groups is maintained by CAMP even while network routers move frequently. Within a finite time every receiver of a multicast group in CAMP definitely has a reverse shortest path to each source of the multicast group. All multicast packets for a group are forwarded along the shortest paths from sources to receivers defined within the group's mesh. Ad-hoc On Demand Distance Vector algorithm introduced by Shah and Gandhi (2010) is a quick and efficient routing protocol for reduced broadcast. Broken routes are caused by the dynamic and mobile nature of such networks. The study illustrates and examines results of implementation of an alternate route recovery scheme is Local Route Repair.

METHODOLOGY

Proposed quick recovery: In this study, we propose a multicast mechanism that allows quick recovery from link failures in the network. The mechanism adopted is by first implementing a part of the EODMRP into the network considered for simulation. The join request is first flooded by a source that needs to send information to the group of destinations. This join request is flooded by every node in the ODMRP protocol that might cause a storming effect that may cause an infinite state in the network. To avoid this many flooding control mechanisms are proposed in Han and Lee (2013). However, the recovery from such kind of a situation is a question especially because it is multicasting and not

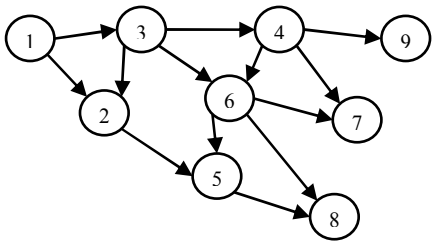

Fig. 1: Flooding of a join request in E-ODMRP

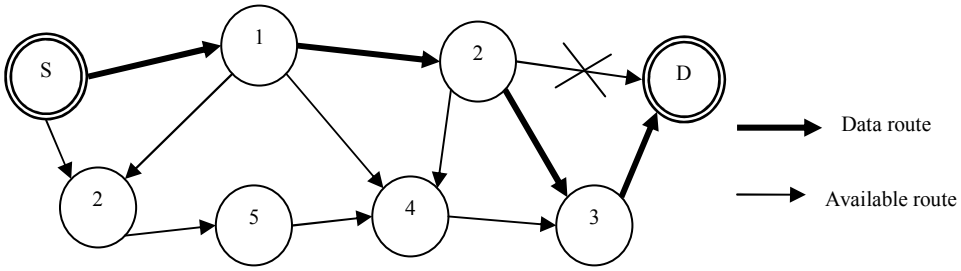

Fig. 2: Link failure in route to destination

Table 1: Simulation parameters of SRIR

Parameter	Value
Simulator	NS2 (Ver. 2.28)
Simulation time	30 msec
Number of nodes	30
Routing scheme	E-ODMRP
Traffic model	CBR
Simulation area	1000×1000
Transmission range	250 m
Mobility model	Random way point

unicasting. A link failure can be obtained for a node from the MAC layers during routing for unicasting nodes by a missing Ack (Fig. 1).

Algorithm:

S< = source
J < = no of destinations
For {I<J} {
Source send request to multicast group J
Source received reply
All intermediate nodes form multicast mesh
Send data to multicast group
If {link failure} {
Local recovery using proposed method
Continue sending data from new intermediate to destination
}
}
Local recovery using proposed scheme
{
Find previous hop to hop which link fails from the mesh
Find quick route to destination
}

The local recovery procedure is used to recover from route failures by using only the neighboring hops within the mesh and not outside the mesh. This reduces the amount of time that is used to search for new routes to the destination. Two possibilities are found here: the intermediate hop finds the next node to the destination by either initiating a new route discovery right from the source or from the previous hop to the node. Route discovery according to the reactive protocols means flooding route requests to obtain routes to the destination. This is clearly avoided by the E-ODMRP protocol. The multicast mesh in E-ODMRP consists of all intermediate nodes and associated nodes required to reach the destination.

In the given Fig. 2, the route to destination from source to destination is S-1-2-D but the link failure takes place between nodes 2 and D. So, the proposed scheme finds the hop at which link failure occurs, which is 2 here and finds a nearest node from the mesh that be used to reach the destination D. The node selected is 3, which forwards the data from the current node 2 to the desired destination D. This method is used to reduce the overhead and to improve the quality of service within the network.

SIMULATION RESULTS AND DISCUSSION

The simulation is done by using the simulator NS2. Network simulator is a discrete event time driven simulator. NS2 is open source software which uses C++ and Tool Command Language (TCL) for simulation. C++ is used for packet processing and fast to run. TCL is used for simulation description and used to manipulate existing C++ objects. It is faster to run and change. NS2 is widely used to simulate the networking concepts. The simulation parameter used in the simulation is tabulated below.

Table 1 describes that, 20 numbers of nodes are distributed in the simulation area 1000×1000 m. The mobiles are moving within the simulation area by using the random way mobility model with the speed 5 m/sec. Each and every node has the direct link with the nodes within the range 250 m. The Constant Bit Rate (CBR) traffic model is used to control the traffic flow in the network. The performance of the proposed scheme is analyzed by using the parameters packet received ratio, packet loss ratio, throughput and delay. All parameters use *t* which indicates the simulation time and *n* which indicate the number of nodes.

Packet delivery rate: Packet delivery rate indicates that the number of packets delivered to the destination for the unit time period. The packet delivery ratio PDR is calculated by Eq. (1):

$$PDR = \frac{Packet\ Delivered}{t} \quad (1)$$

where, t refers to the current instant of time.

Clearly, Fig. 3 shows that the packet delivery rate of the proposed QRODMRP scheme is greater than the EODMRP routing.

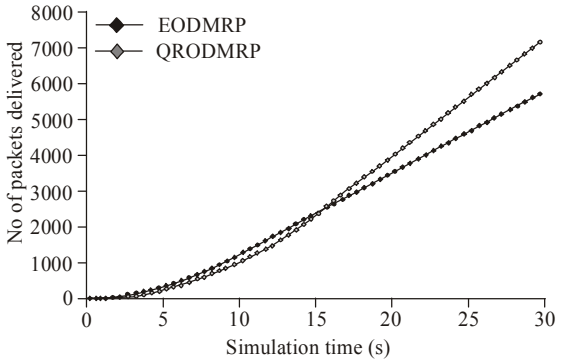

Fig. 3: Packet delivery rate

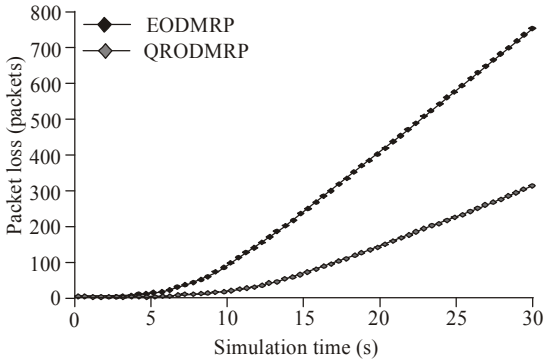

Fig. 4: Packet loss rate

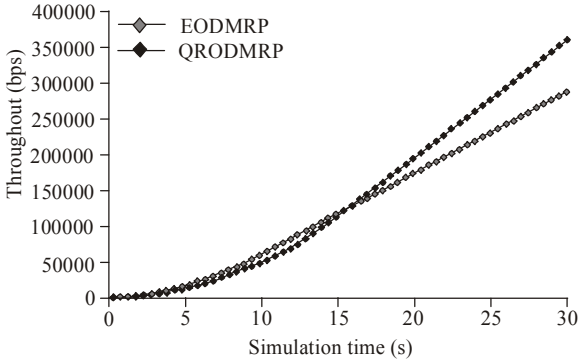

Fig. 5: Throughput

Packet loss rate: The packet loss rate is the number of packets lost per unit time. Figure 4 shows that compared EODMRP and QRODMRP, The QRDMRP is minimized the loss rate.

Throughput: Throughput is one value that is used to judge the network performance directly. Throughput is the total number of successfully delivered packets in the network. The value of throughput was calculated by Eq. (2) to plot the graph in Fig. 5:

$$Throughput = \frac{\sum_0^n Pkts\ recieved(n) * Pkt\ size}{1000} \quad (2)$$

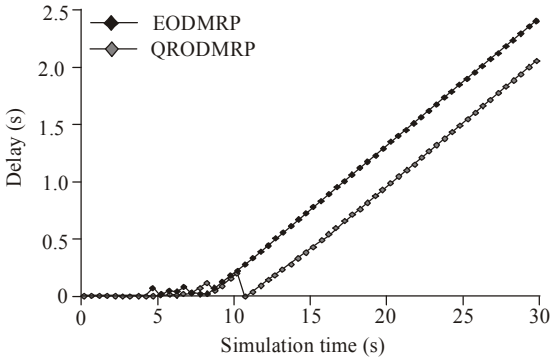

Fig. 6: Delay

Figure 5 indicate the proposed method QRODMRP is achieved high throughput ratio compared existing system EODMRP. Also it can be observed that the throughput increases uniformly for EODMRP than the QRODMRP at early stages. As the simulation time increases the QRODMRP performs much better.

Delay rate: The delay occurred during data transmission in the network is plotted using Eq. (3) in Fig. 6. This indicates that the delay occurred in data transmission has been reduced in QRODMRP when compared to the EODMRP routing:

$$\text{Delay} = t_{\text{Packet recieved}} - t_{\text{Packet sent}} \quad (3)$$

Finally, the performance is evaluated by assessing the Packet delivery rate, packet loss rate, throughput and delay and compared with existing scheme; the proposed scheme provides better performance.

CONCLUSION

A quick recovery mechanism from link failures that occur in Enhanced ODMRP is proposed here. This method obtains nearest hops between the current nodes at which link failure occur to the desired destinations from the multicast meshes formed. This scheme is simulated using the network simulator to obtain the performance over the EODMRP protocol in achieving greater throughput. While an analysis of the EODMRP protocol is also performed, the quick recovery mechanism uses simple yet efficient logic to improve network performance. In this study, the QRODMRP protocol has improved the delivery ratio and reduced loss to a considerable extent over the EODMRP.

Future works aim at real time validation of the mechanism proposed here and application of the same into the hybrid networks that are rapidly emerging.

REFERENCES

Chiang, C.C., M. Gerla and L. Zhang, 1998. Forwarding Group Multicast Protocol (FGMP) for multihop, mobile wireless networks. Cluster Comput., 1: 187-196.

Garcia-Luna-Aceves, J.J. and E.L. Madruga, 1999. The core-assisted mesh protocol. IEEE J. Sel. Area. Comm., 17(8): 1380-1394.

Han, S.Y. and D. Lee, 2013. An adaptive hello messaging scheme for neighbor discovery in on-demand MANET routing protocols. IEEE Commun. Lett., 17(5): 1040-1043.

Hinds, A., M. Ngulube, S. Zhu and H. Al-Aqrabi, 2013. A review of routing protocols for mobile ad-hoc NETworks (MANET). Int. J. Inform. Educ. Technol., 3(1).

Jetcheva, J.G. and D.B. Johnson, 2001. Adaptive demand-driven multicast routing in multi-hop wireless ad hoc networks. Proceeding of the 2nd ACM International Symposium on Mobile and Ad-hoc Networking and Computing (MobiHOC), pp: 33-44.

Junhai, L., Y. Danxia, X. Liu and F. Mingyu, 2009. A survey of multicast routing protocols for mobile ad-hoc networks. IEEE Commun. Surv. Tutorials, 11(1): 78-91.

Lee, S.J., W. Su and M. Gerla, 2002. On-demand multicast routing protocol in multihop wireless mobile networks. Mobile Netw. Appl., 7(6): 441-453.

Reina, D.G., S.L. Toral, P. Jonhson and F. Barrero, 2013. Hybrid flooding scheme for mobile ad hoc networks. IEEE Commun. Lett., 17(3): 592-595.

Royer, E.M. and C.E. Perkins, 1999. Multicast operation of the ad-hoc on-demand distance vector routing protocol. Proceeding of the 5th Annual ACM/IEEE International Conference on Mobile Computing and Networking.

Sanjay, M. and V. Ravi, 2014. Enhanced ODMRP for MANET to protect against multicast attacks. Proceeding of 08th IRF International Conference. Bengaluru, India, ISBN: 978-93-84209-33-9.

Shah, K.A. and M.R. Gandhi, 2010. Performance evaluation of AODV routing protocol with link failures. Proceeding of IEEE International Conference on Computational Intelligence and Computing Research (ICCIC, 2010), pp: 1-5.

Shaikh, A., J. Rexford and K.G. Shin, 2001. Evaluating the impact of stale link state on quality-of-service routing. IEEE ACM T. Network., 9(2): 162-176.

Wu, C.W. and Y.C. Tay, 1999. AMRIS: A multicast protocol for ad hoc networks. Proceeding of IEEE Military Communications Conference (MILCOM, 1999), 1: 25-29.

Xiang, X., X. Wang and Z. Zhou, 2006. An efficient geographic multicast protocol for mobile ad hoc networks. Proceeding of the 2006 International Symposium on World of Wireless, Mobile and Multimedia Networks. IEEE Computer Society, 2006.

Xu, Z., Y. Wang and J. Zhu, 2010. A reliable multicast routing protocol for high-speed mobile ad hoc networks: R-ODMRP. J. Softw., 5(1): 20-27.

Zhang, X.F. and L. Jacob, 2004. MZRP: An extension of the zone routing protocol for multicasting in MANETs. J. Inf. Sci. Eng., 20: 535-551.