**Available Online at www.ijcsmc.com**

**International Journal of Computer Science and Mobile Computing**

**A Monthly Journal of Computer Science and Information Technology**

**ISSN 2320–088X**

***IJCSMC, Vol. 4, Issue. 6, June 2015, pg.750 – 757***

**RESEARCH ARTICLE**

# Scalable Routing in Mobile Ad Hoc Networks

**Khalid Khanfar**

Zarqa University / Jordan

## Abstract

*Mobile ad hoc Networks (MANETs) are formed dynamically by a set of nodes that are connected by wireless communication links. Since the nodes in a network of this kind can serve as router sand hosts, they can forward packets on be-half of other nodes and run user applications. MANETs is getting larger and large. Therefore, routing is one of the challenges issues in MANETs. An efficient Scalable Routing in Mobile Ad Hoc Networks will be described in this paper.*

## 1. Introduction:

Mobile ad hoc networks (MANETs) consist of a set of wireless mobile nodes in order to exchange information without depending on a fixed base station. Wireless networks [1] consist of a number of nodes which communicate with each other over a wireless channel which have various types of networks: sensor network, ad hoc mobile networks, cellular networks and satellite networks. In Latin, Ad hoc means "for this purpose". So, Ad hoc networks are created for special purpose with no access points as an infrastructure included in them. An efficient routing approach in mobile ad hoc networks will be described in this paper. Mobile ad hoc networks (MANETs) [2] " represent complex distributed systems that comprise wireless mobile nodes that can freely and dynamically self-organize into arbitrary and temporary, ‘ad-hoc’ network topologies, allowing people and devices to seamlessly internetwork in areas with no pre-existing communication infrastructure, e.g., disaster recovery environments" . Ad hoc networks are handy when there is a need to transfer data among different devices in an environment and there is no network infrastructure is setup in this environment. Ad hoc networks do not have fixed infrastructure such as wired networks. As a result, they do not have base stations, or switching centers. The nodes in the ad hoc network communicate directly with those nodes that they are within their radio range. Mobile nodes that are within each other’s radio range communicate directly via wireless links, while those that are far apart rely on other nodes to relay messages as routers [3]. Each node in mobile ad hoc network acting as both a host and a router moves arbitrarily and communicate with others via multiple wireless links [4]. Many researches on multicast routing protocols in MANETs have been done. In [5], the authors classify multicast routing protocols into tree-based, mesh-based, stateless, hybrid-based and flooding protocols. The mobile ad hoc network has the following typical features [6]:

- Unreliability of wireless links between nodes.
- Continuous change in the topologies.
- Lack of security because of the different network setup.

An efficient scalable routing approach in mobile ad hoc networks will be described in this paper.

The rest of the paper is organized as follows: The related work is described in section 2. The proposed scalable routing protocol is presented in section 3. Conclusion is described in section 4.

## 2. Related Work

Routing protocols in mobile ad hoc networks are categorized into two categories:

- Proactive protocols in which each node maintains the information of each other node in the network by using tables (eg. OLSR). When there is a change, all nodes update their tables [9]. Update messages are periodically or whenever there is a change of the topology of the network [10, 11, 12]. Other examples on proactive protocols are: DSDV [13], DBF [14], WRP [15].

- Reactive protocols (on demand) in which the maintenance of the routes does not exist (eg. AODV). Instead, routes are created when they are needed [16, 17]. Other examples on reactive protocols are: DSR [18], TORA [19].

### 2.1 AODV (AD HOC ON DEMAND DISTANCE VECTOR) ROUTING PROTOCOL.

It is variation of DSDV. It is designed for use in ad hoc mobile networks. It is an on-demand routing protocol. It creates the routes only when they are needed. It uses traditional tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops [7, 8]. One of the important features of the AODV is the maintenance of the time-based states of the routes. It maintains the time-based states in each node: a routing-entry not recently used is expired. In case of a route is broken the neighbor scan be notified. Another important feature of the AODV is the combination of all broadcasting communication methods. AODV can provide unicast, multicast, and broadcast all together.

## 2.2 DSDV (DESTINATION SEQUENCED DISTANCE VECTOR) PROTOCOL

It is well known table driven protocol, based on Bellman-Ford routing mechanism. The major points in it are:-Freedom from loops in routing table. Some other characteristics are more dynamic and less convergence time. Each node maintains a routing table which contains a list of all possible destination nodes within the network along with the no. of hops required to reach to particular node. Each entry of the table marked with a sequence number assigned by the destination node which identifies stale routes, thus avoids formation of loops. Every node keeps a route table <Destination-address, Metric, Sequence-no.> for every possible destination. It is non-scalable [20].

## 2.3 DSR (DYNAMIC SOURCE ROUTING) PROTOCOL

It is based on the theory of source-based routing. It is source initiated rather than hop-by-hop. This protocol is divided into two essential parts:-

1. Route Discovery.

2. Route Maintenance.

In this, every node possess route cache to store recently discovered path. When a node desires to start transmission of packets, it first checks its entry in the cache. If it is present there, then it uses that path to transmit and also its source address is attached to packet. If it is not there or entry is expired, then the source broadcasts route request packet to all its neighbors asking for a path to destination [1] [3] [6]. Suppose in e.g. Node S wants to send a packet to node D, but does not know route to D. So, node S initiates a route discovery. It floods RREQ to its neighbors. Each node appends its own identifier (address) when forwarding RREQ. As the route request packet arrives to any of the node, they checks from their neighbors or their caches about asked destination. If route information is known, they sent back RREP packet to source otherwise they broadcasts RREQ packet to its neighbors. On discovery of route, the data packets are sent from source to destination. Also an entry in the cache is made for future use. Destination d on receiving the first RREP sends route reply. RREP is sent on the route obtained by reversing the RREQ [20].

## 2.4 TORA (TEMPORALLY ORDERED ROUTING ALGORITHM)

The theory behind this is that it decouples the generation of potentially far-reaching control message propagation from the rate of topology changes.

The basic steps of this protocol are:-
1. Creating Routes.
2. Maintaining Routes.
3. Erasing Routes.

All the links in a network is represented as the nodes of undirected graph. Each node maintains a “Metric”. This metric assigns the direction to links with each neighbor. Routes can be created in Reactive or Proactive mode. The route maintenance is performed only for routers that have a non-null height. Reaction to link failure is initiated only when the node loses its last downstream link. In this protocol, the no. of nodes participating in failure action is minimum [20].

### 2.5 Rout Discovery

When a node needs to send a packet to a destination to which it does not have a routing entry, it broadcasts a route request (RREQ) packet. To prevent unnecessary broadcasts of RREQs the source node uses an expanding ring search. In an expanding ring search, the source node initially uses a time-to-live (TTL)-Start in the RREQ packet IP header and sets a timeout for receiving a reply (RREP). Upon timeout the source retransmits a RREQ with TTL incremented by TTL-increment. This continues until TTL reaches a specified maximum. The source will retransmit the RREQ with the highest TTL if it does not receive any reply within the timeout period. A node receiving a RREQ establishes a reverse path to the RREQ source in its routing table, and either replies to the RREQ if it already has an entry for the destination or forwards the RREQ. Eventually the RREQ reaches the destination and it sends a reply (RREP). Nodes receiving a RREP set up a path to the destination and, in this way, desirable routes are discovered [21].

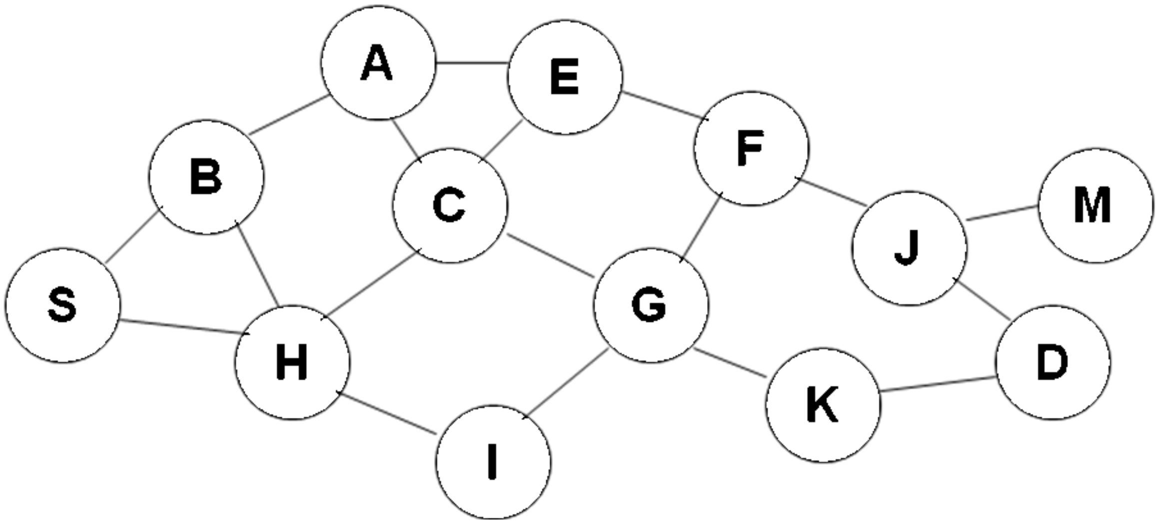
### 2.6 Rout Maintenance

An existing routing entry may be invalidated if it is unused within a specified time interval, or if the next hop node is no longer reachable. In these cases, an invalidation notice is propagated to neighbors that have used this node as the next hop. Each time a route is used to forward a data packet, its route expiry time is updated. When a node detects that a route to a neighbor is no longer valid, it removes the invalid entry and sends a route error message to the neighbors that are using the route. The nodes receiving route error messages repeat this procedure. Finally, the source requests a new route if a route is still needed to that destination [21].

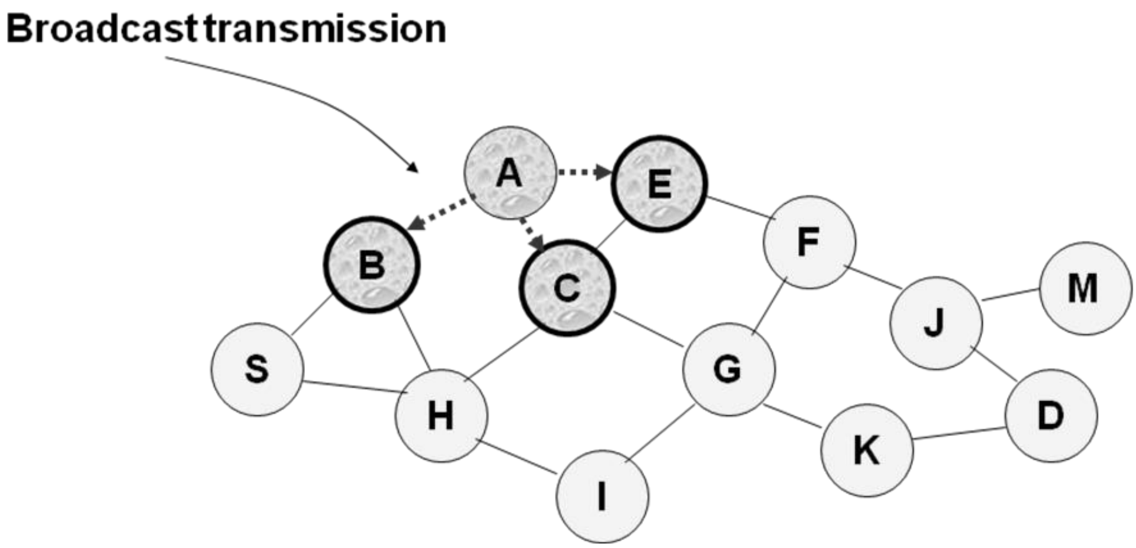
## 3. The Proposed Routing Protocol

**A Doubly Linked List** is used to maintain the rout between the source and the destination. All intermediate nodes can be source and destination at any specific time. Building the doubly linked list goes through four steps. First: a route request is initiated (RREQ); second: Broadcast the transmission of the RREQ; third: reverse path setup; fourth: a doubly linked list is setup. The following figures show these steps.

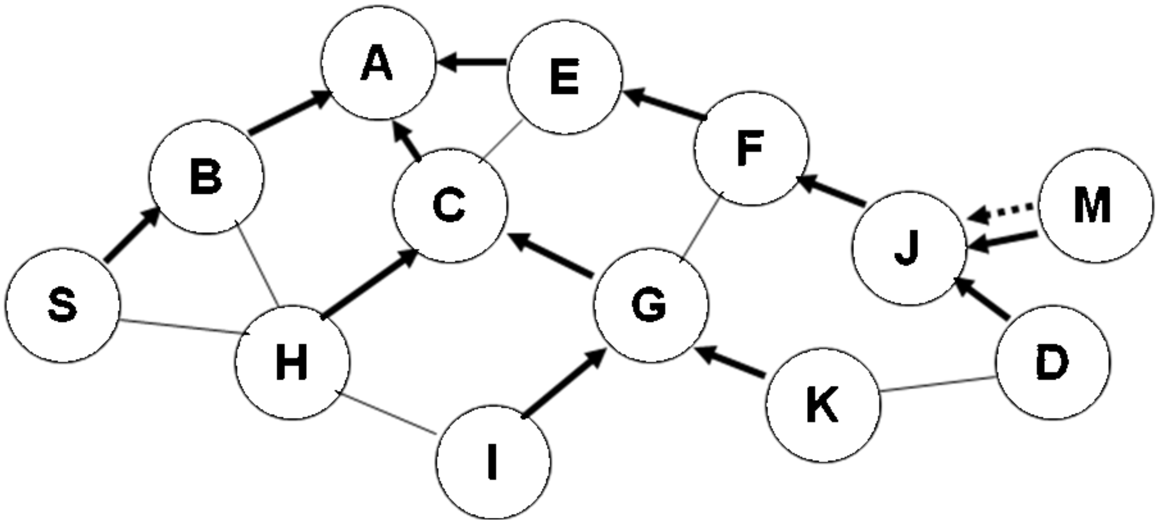



Step 1: Figure 1: RREQ for D from A

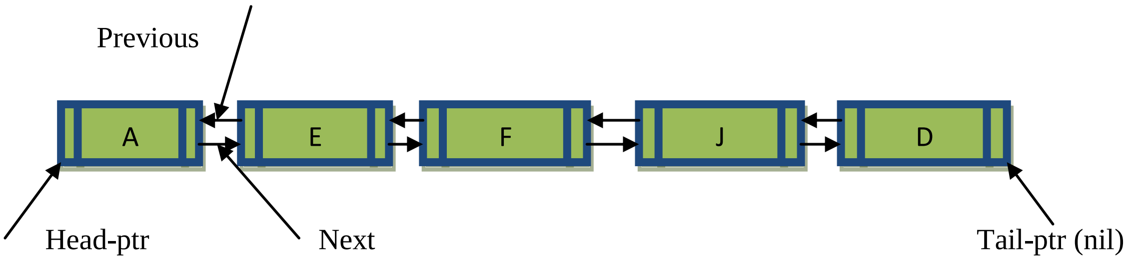



Step 2: Figure 2: Broadcast the transmission




Step 3: Figure 3: Reverse path setup




Step 4: Figure 4: Building the doubly linked list

Each node maintains a pair of pointers. One pointer (next) points to the successor node in the path, and the other pointer (previous) points to the predecessor node in the path except for the source and the destination. The previous of the source points to the source and the next of the destination points to nil. By doing this; first: in case of any failure, it will be very easy to rebuild the path; second: there is no need to maintain the entire path at each node. Each node will only maintain the previous and the next nodes. This makes the search and the update faster especially in paths with large number of nodes which leads to an enhancement in the performance.

## 4. CONCLUSION

In this paper we introduced a new Efficient Scalable Routing Algorithm in Mobile Ad Hoc Networks by using a doubly linked list to keep the information about the nodes that are in the rout. No long time is required when there is a need for updating the path due to a node failure. Also, by using a doubly linked list, a node only maintains its successor and predecessor nodes. This will reduce the search time and will lead to performance enhancement.

## References


1. R. Shiva Kumaran, Rama Shankar Yadav, Karan Singh ”Multihop wireless LAN ” HIT haldia, March 2007.

2. Imrich Chlamtac a, Marco Conti b,*, Jennifer J.-N. Liu Mobile ad hoc networking: imperatives and challenges, TX, USAb Istituto IIT, Consiglio Nazionale delle Ricerche, Pisa, Italy Department of Computer Science, University of Texas at Dallas, Dallas, TX, USA, 1 (2003) 13–64.

3. Mehdi Bahrami, Mohammad Bahrami, " A multi routing algorithm for Ad-Hoc networks ", Journal of Theoretical and Applied Information Technology, Vol. 32 No. 1, October 2011.

4. YuHua Yuan, HuiMin Chen, and Min Jia, "An Optimized Ad-hoc On-demand Multipath Distance Vector (AOMDV) Routing Protocol", 2005 Asia-Pacific Conference on Communications, Perth, Western Australia, October 2005.

5. O. Tariq, F. Greg, W. Murray, On the effect of traffic model to the performance evaluation of multicast protocols in MANET, Canadian Conference on Electrical and Computer Engineering (2005) 404–407.

6. Amitabh Mishra and Ketan M. Nadkarni, Security in Wireless Ad Hoc Networks, in Book *The Handbook of Ad Hoc Wireless Networks (Chapter 30)*, CRC Press LLC, 2003.

7. Georgy Sklyarenko, “AODV Routing Protocol”, Seminar Technische Informatik, Freie Universit¨at Berlin, Germany, 2006.

8. Prashant Kumar Maurya , Gaurav Sharma, Vaishali Sahu, Ashish Roberts, Mahendra Srivastava, " An Overview of AODV Routing Protocol", International Journal of Modern Engineering Research (IJMER), Vol. 2, No. 3, 2012 pp-728-732

9. L.M. Feeney, “A Taxonomy for Routing Protocols in Mobile Ad-Hoc Networks”, SICS Tech. Report T99-07, www.sics.se/~lmFeeney/huc.pdf, October 1999.

10. Nidhi S. Kulkarni,Balusubramanian Raman And Indra Gupta,”On Demand Routing Protocols For Mobile Ad Hoc Networks-A Review” 2009 IEEE International Advance Computing Conference (IACC 2009) Patiala,India, 6-7 March,2009.

11. Dr.Shuchita Upadhayaya and charu Gandhi “Quality Of Service Routing In MANETs Using Location And Energy Parameters” International Journal of Wireless and Mobile Networks (IJWMN) , Vol 1, No.2, November 2009.

12. Arun Kumar B.R., Lokanatha C.Reddy,Prakash S. Hiremath, ”Performance Comparison Of Wireless Mobile ad Hoc Network Routing Protocols ”IJCSNS International Journal of Computer Science And Network Security Vol. 8,No.6., June 2008.

13. C.E. Perkins & P. Bhagwat, “Highly Dynamic Destination Sequence-Vector Routing (DSDV) for Mobile Computers”, Computer Communication Review, 24(4), 1994, 234-244.

14. D. Bertsekas and Gallager, Data Network, pages 404-410, second ed. Prentice Hall, Inc., 1992.

15. S. Murthy and J.J Garcia-Luna-Aceves, “An efficient routing protocol for wireless networks”, ACM Mobile Networks and Application Journal, Special issue on Routing in Mobile Communication Networks,1996.

16. Royer E.M. Perkins C.E. Ad-hoc on-demand distance vector routing. Proceedings of the 2ndIEEE Workshop on Mobile Computing Systems and Applications, p.90, 1999.

17. Das S. Perkins C.E., Belding-Royer E.M. Ad-hocon-demand distance vector (AODV) routing. RFC3561, IETF Network Working Group, 2003.

18. David B. Johnson and David A. Maltz. "Dynamic source routing in ad hoc wireless networks", Mobile Computing, Kluwer Academic Publishers, edited by Tomasz Imielinski and Hank Korth, chapter 5, pages 153–181, 1996.

19. V.D. Park and M.S. Corson, "Temporally-Ordered routing algorithm (TORA) version 1 functional specification (Internet-Draft):, August 1998.

20. Tanu Preet Singh, Dr. R.K Singh, and Jayant Vats, "Routing Protocols in Ad Hoc Networks: A Review", "International Journal of Computer Applications (0975 – 8887), Volume 25– No.4, July 2011.

21. Mehdi Bahrami, Mohammad Bahrami, "A Multi Routing Algorithm for Ad-Hoc Networks", Journal of Theoretical and Applied Information Technology, 15th October 2011. Vol. 32 No.1

*This research is funded by the Deanship of Research at Zarqa University / Jordan