Impact of Packet Size and Number of Nodes on DSR and AODV Routing Protocols in MANET

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Abstract- Ad hoc networks are characterized by multi-hop wireless connectivity, regularly changing network topology and the need for efficient dynamic routing protocols. The wireless mobile nodes in Ad-hoc networks communicate with each other without any centralized control or established infrastructure. Since there are more chances of errors in the wireless links and due to mobility of nodes these links can go down frequently, therefore, routing in MANET is a significant task due to their highly dynamic nature. In recent years, several routing protocols have been proposed for mobile ad hoc networks and some well-known among them are DSR (Dynamic Source Routing) and AODV (Ad hoc On Demand Distance Vector). This paper presents, a comparison of the performance of these two on-demand routing protocols by presenting their functionality. Various scenarios have been generated to study the functionality of these two protocols using NS2.34 as network simulator.

***Keywords-* Ad hoc Networks, DSR, AODV, Routing, Performance evaluation.**

1. Introduction

The wireless network can be divided into two types: Infrastructure less or Infrastructured. In Infrastructured wireless networks, the mobile nodes are connected with each other without physical links creating a fixed network structure and mobile nodes can move during communication. In these types of networks the base stations are fixed and when the mobile node goes out of the range of a base station, it comes into the range of another base station. In Ad Hoc wireless network or Infrastructure less, the mobile nodes can also move during communication, but there are no fixed base stations and all the nodes in the network act as routers. The mobile nodes in the Ad Hoc network dynamically set up routing among themselves to form their own network 'on the fly'. A Mobile Ad Hoc Network consists of wireless mobile nodes forming an impermanent/short-lived network without any fixed infrastructure where all nodes are free to move about randomly and where all the nodes organize themselves. In this network, each node acts both as a host and as a router & even the topology of network may also change quickly.

1.1 Characteristics of MANET

One of the main characteristic of MANET node is the neighbor discovery. The discovery enables the data reception and transmission using discovered node. The node also has data routing abilities that is data can be routed from a source node to a neighboring node. MANETs has flexible architecture. In the case of limited wireless connectivity range and resource constraints there are variable routing paths to provide communication. Following are the various characteristics of MANETs.

Flexibility: There is a fast establishment of network in MANETs. For the establishment of the new network the only requirement is to provide a new set of nodes having limited wireless communication range. In this type of network a node have limited capacity that is it can connect only to the nodes which are nearby. Therefore it consumes less power.

Direct Communication Through Nearby Node and Neighbor Discovery: The nodes in MANET are able to discover neighboring node and service. Using a service discovery protocol a node discovers the service of nearby node. In this way it communicates with remote node.

Peer to Peer Connectivity: Nodes of the MANET have peer-to-peer connectivity among themselves.

Computations decentralization: Each MANET node has independent switching (or routing), computational and communication capabilities.

Limited wireless connectivity range: The wireless connectivity range in MANETs include only nearest node connectivity.

Weak connectivity and remote server latency: There are unpredictable links to base station or gateway. Due to the failure of intermediate node there will be greater latency in communicating with the remote server.

Resource constraints: In MANETs there is a limited bandwidth available between two intermediate nodes which becomes a constraint for MANET. The node may have limited power and thus need energy efficient computations.

No access-point requirement: There is a requirement of access point in MANET. Only selected access points are provided for connection to other networks or other MANETs.

Requirement to solve exposed or hidden terminal problem: To solve exposed or hidden terminal problem there is a requirement of some mechanism.

Diversity: The nodes of the MANET can be the iPods, handheld computers, Smart phones, PCs, Smart labels, smart sensors and automobile-embedded system.

Protocol diversity: Different protocols can be used by nodes of the MANET, for example 802.11, GSM, and TCP/IP.

Data caching, saving and aggregation: The nodes of the MANET can perform Data caching, saving and aggregation.

Limited physical security: There is limited physical security in MANETs**.**

Multi-hop radio relaying- When a source node and destination node for a message is out of the radio range, the MANETs are capable of multi-hop routing.

Dynamic nature: The nodes can join or leave the network anytime, which makes the network topology dynamic.

Identical features: All nodes have identical features with similar responsibilities and capabilities and hence it forms a completely symmetric environment.

1.2 Advantages of MANETs

- The following are the advantages of MANETs:
- They provide access to information and services irrespective of physical position.
- These networks can be set up at any place and time.
- These networks work without any pre-existing infrastructure.
- They do not require any centralized system.
- They are flexible in nature because they enables fast establishment of network. When a new network is to be established the only requirement is to provide a new set of nodes with limited wireless connectivity range.
- MANETs do not have the requirement of access points. Some selected access points are used to provide connectivity with other network or other MANET.

1.3 Disadvantages of MANET

Wireless communication is rapidly growing in our day to day life because it is easy to deploy and is more flexible. In particular, the mobile ad-hoc network (MANETs) is one of the latest innovations in the field of wireless communication. MANETs can be used in various fields of our day to day life but they have various disadvantages due to its dynamic nature.

Some of the disadvantages of MANETs are:

- Limited resources. Limited physical security.
- Intrinsic mutual trust susceptible to attacks. Lack of authorization facilities.
- Unpredictable network topology makes it hard to detect malicious nodes.
- Security protocols for wired networks cannot work for ad hoc networks.
- Limited wireless connectivity range. MANET nodes include only neighboring node connectivity.
- Open Medium - Overhearing is easier than in wired network.
- Lack of Centralized Monitoring –Due to the Absence of any centralized infrastructure prohibits any monitoring agent in the system.
- Dynamically Changing Network Topology – In MANETs Mobile Nodes comes and goes from the network randomly, thereby allowing any malicious node to join the network without being detected.

2. Routing Protocols

A routing protocol is required whenever a packet needs to be transmitted to a destination via number of nodes and various routing protocols have been proposed for such kind of ad hoc networks. These protocols find a route from source to destination for packet delivery and deliver the packet to the correct destination. The studies on various features of routing protocols have been an active area of research for many years. Many protocols have been recommended keeping applications and type of network in view. Basically, routing protocols can be generally divided into two types as: On-Demand Protocols or Reactive Protocols and Table Driven Protocols or Proactive Protocols. In Proactive routing protocols each node preserve one or more tables holding routing information to every other node in the network. All nodes keep on updating these tables to maintain latest view of the network. Some of the well-known table-driven protocols are DSDV [5, 10], DBF [6], GSR [12], WRP [11] and ZRP [15, 9]. In Reactive routing protocols, routes are created as on demand. It invokes the route discovery procedure, when a communication occurs from source to destination. The route remains valid till destination is achieved or until the route is no longer needed. Some of the well-known on demand routing protocols are: DSR [7, 8], AODV [3, 4] and TORA [13, 14].In this research paper we concentrate on the performance analysis of two well-known on-demand routing Protocols i.e. AODV and DSR.

2.1. Dynamic State Routing (DSR) [7, 8]

DSR is a type of Ad Hoc routing protocol which is based on the theory of source-based routing. This protocol is source-initiated rather than hop by-hop. This is mainly designed for use in multi hop wireless ad hoc networks of mobile nodes. This Protocol is made up of two essential parts first is route discovery and second is route maintenance. Every node maintains a cache to store newly discovered paths. When a node desires to send a packet to some node, it 1st checks its entry within the cache. If it's gift within the cache, then it uses that path to transmit the packet and additionally attach its source address on the packet. If it's not there within the cache or the entry in cache is expired (because of long term idle), the sender transmits a route request packet to any or all of its neighbors requesting a path to the destination. The sender is waiting until the route is discovered. Throughout waiting time, the sender will perform alternative tasks like sending/forwarding alternative packets. Because the route request packet arrives to any of the nodes, they check from their neighbor or from their caches whether or not or not the destination asked is known or unknown. If route info is known, they remit a route reply packet to the destination otherwise they broadcast a similar route request packet. When the route is discovered, the required packets will be transmitted by the sender on the discovered route. Also an entry in the cache will be added for the future use. To know whether the cache is fresh or not the node will also keep the age information of the entry. When a knowledge packet is received by any intermediate node, it initial checks whether or not the packet is supposed for itself or not. If it's meant for itself (i.e. the intermediate node is that the destination), the packet is received otherwise the same will be forwarded using the path attached on the data packet. Since in Ad-hoc network, any link may fail anytime. Therefore, route maintenance method can unceasingly monitor and can additionally report the nodes if there is any failure within the path. As a result, the nodes can amendment the entries of their route cache.

2.1.1 Characteristics

The benefits of DSR protocol are:

a) DSR do not use periodic routing messages, thereby reducing network bandwidth overhead, conserving battery power, and avoiding the dissemination of potentially large routing updates throughout the ad hoc network.
b) It is able to adjust rapidly to changes such as host movement.
c) To route a given data packet there is no need to keep routing table because the entire route is contained in the packet header.
d) The routes are maintained solely between nodes that require to speak.
e) Route caching will more cut back route discovery overhead. One route discovery might yield several routes to the destination, owing to intermediate nodes replying from native caches
f) The DSR protocol guarantees loop-free routing and very speedy recovery once routes inside the network change.
g) Additionally, DSR has been designed to calculate correct routes within the presence of uneven (unidirectional) links.

The limitations of this protocol can be summarized as:

a) The DSR protocol is generally efficient for mobile ad hoc networks with less than two hundred nodes. This is not suitable for large networks.
b) DSR needs considerably a lot of process resources than most different protocols.
c) The Route Maintenance protocol doesn't locally repair a broken link. The broken link is barely communicated with the initiator.
d) Flood of route requests may potentially reach all nodes in the network.

e) Care must be taken to avoid collisions between route requests propagated by neighboring nodes.
f) The conflict is increased if too several route replies come back due to nodes replying using their local cache. The Route Reply Storm drawback is there.
g) An intermediate node could send Route Reply employing a stale cached route, therefore polluting different caches. This drawback may be alleviated if some mechanism to purge (potentially) invalid cached routes is incorporated.

2.2 Ad Hoc on Demand Distance Vector Routing (ADOV)[3, 4]

AODV is a variation of Destination-Sequenced Distance-Vector (DSDV) routing protocol which is collectively based on DSDV and DSR. It aims to minimize the requirement of system-wide broadcasts to its extreme. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed & are maintained only as long as they are required. The key steps of algorithm used by AODV for establishment of unicast routes are explained below.

2.2.1 Route Discovery

When a node desires to send a data packet to a destination node, the entries in route table are tested to make sure whether or not there's a current route to the destination node or not. If it's found in the entries of the routing table then, the data packet is forwarded to the suitable next hop toward the destination. If it's not found in the entries of the routing table then, the route discovery method is initiated. AODV initiates a route discovery method using Route Request (RREQ) and Route Reply (RREP). The source node will produce a RREQ packet containing its current sequence number, the destination's IP address, its IP address, broadcast ID and the destination's last sequence number. When the source node initiates RREQ, the broadcast ID is incremented anytime.

Basically, the sequence numbers are used to verify the timeliness of every data packet and therefore the IP address & broadcast ID along type a unique symbol for RREQ therefore on unambiguously determine each request. The requests are sent using RREQ message and therefore the information in reference to creation of a route is sent back in RREP message. The source node transmits the RREQ packet to its neighbors so sets a timer to wait for a reply. The node sets up a reverse route entry for the source node in its routing table for the processing of the RREQ. This helps to understand a way to forward a RREP to the source. Primarily a lifespan is related to the reverse route entry and if this entry isn't used inside this lifespan, the route information is deleted. The source node is allowed to broadcast once more using route discovery mechanism, if the RREQ is lost throughout transmission.

2.2.2 Characteristics

The benefits of AODV protocol are as follows:

a) The routes are established on demand or according to need and destination sequence numbers are wont to notice the most recent route to the destination. In ADODV connection setup delay is lower.
b) It favors the smallest amount congested route rather than the shortest route and it additionally supports each unicast and multicast packet transmissions even for nodes in constant movement.
c) It additionally responds terribly quickly to the topological changes that affects the active routes.
d) It doesn't place any extra overheads on data packets because it doesn't create use of source Routing.
e) It provides loop free routes.

The limitations of AODV protocol are summarized below:

a) The intermediate nodes can lead to unpredictable routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, there by having stale entries.
b) The periodic beaconing results in unneeded bandwidth consumption.
c) It expects/requires that the nodes in the transmission medium can detect each other's transmissions.
d) The various performance metrics begin decreasing due to the growth of network size.
e) It's susceptible to various types of attacks

3. Performance Metrics

There are varieties of qualitative and quantitative metrics that may be wont to compare reactive routing protocols. Most of the present routing protocols make sure the qualitative metrics. Therefore, we used the packet delivery ratio as quantitative metrics for analyzing the performance of aforesaid routing protocols. The packet delivery ratio is outlined as fraction of successfully received packets that survive while finding their destination. This performance metric determines the completeness and correctness of the routing protocol.

Table 1 Simulation Model

Simulation Parameters	**Parameter Value**
Simulator	NS-2.32
Simulation Area	1000m X 1000m
Mobile Nodes	25, 35, 50
Pause Time	200
Speed	10 m/s
Packet Size	256, 512, 1024 bytes
Routing Protocols	AODV & DSR
Traffic Sources	CBR(UDP)
Simulation Time	500 Sec.
Performance Metrics	PDR ,Throughput, End to End Delay Ratio and Routing Load

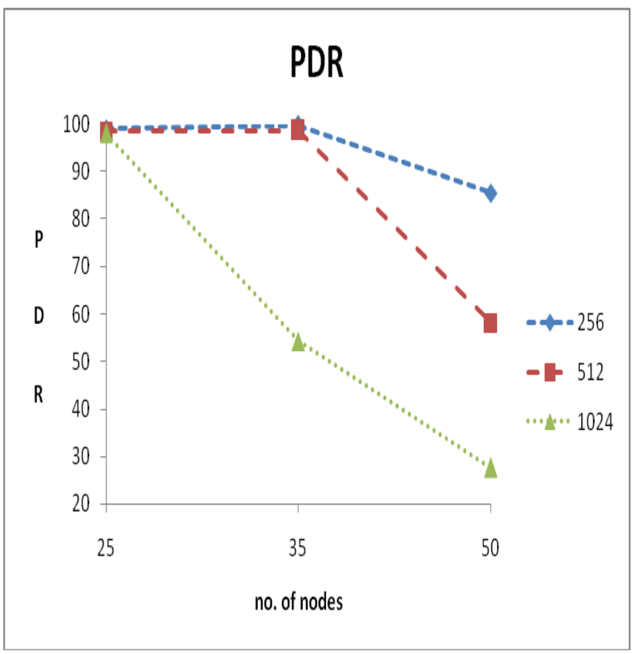

Figure 1: Packet delivery ratio using various packet sizes

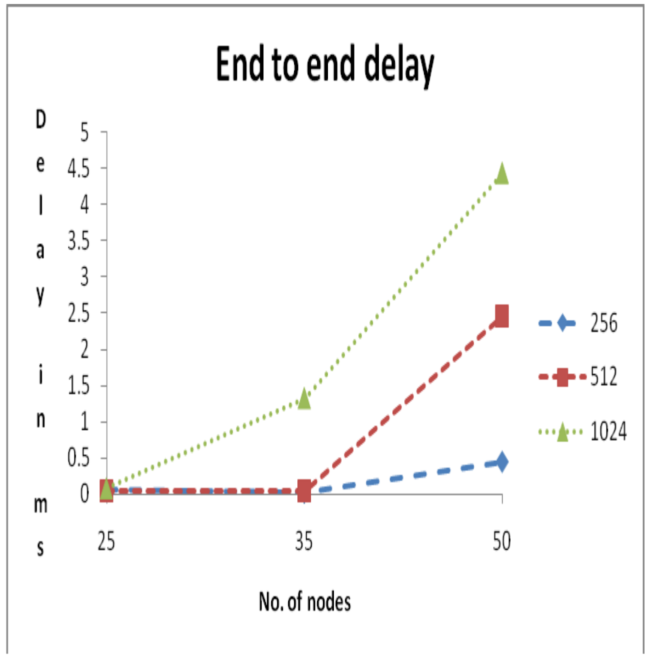

Figure 2: End to End Delay Ratio with Varying Packet Sizes

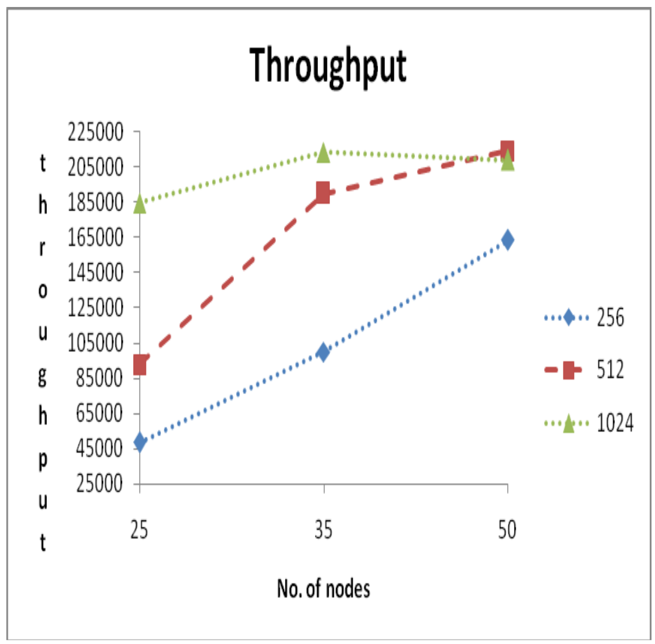

Figure 3: Throughput with varying packet size

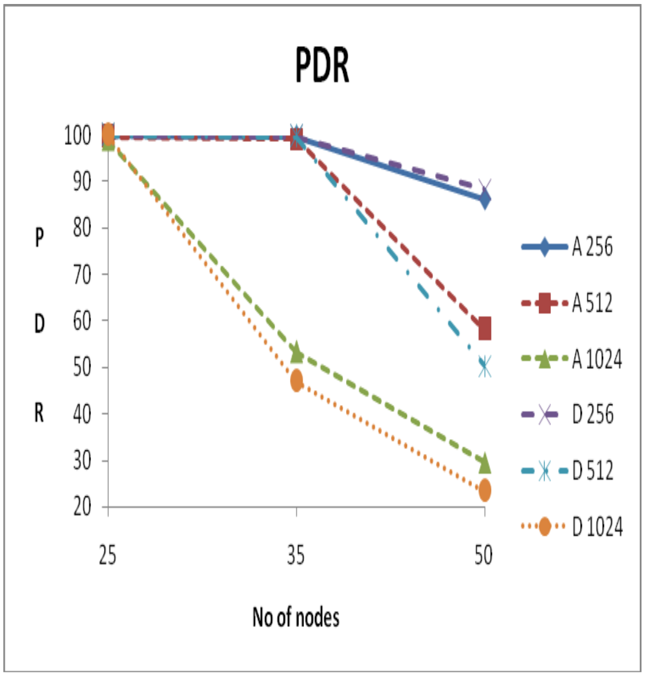

Figure 4: PDR with AODV and DSR V/s varying sizes

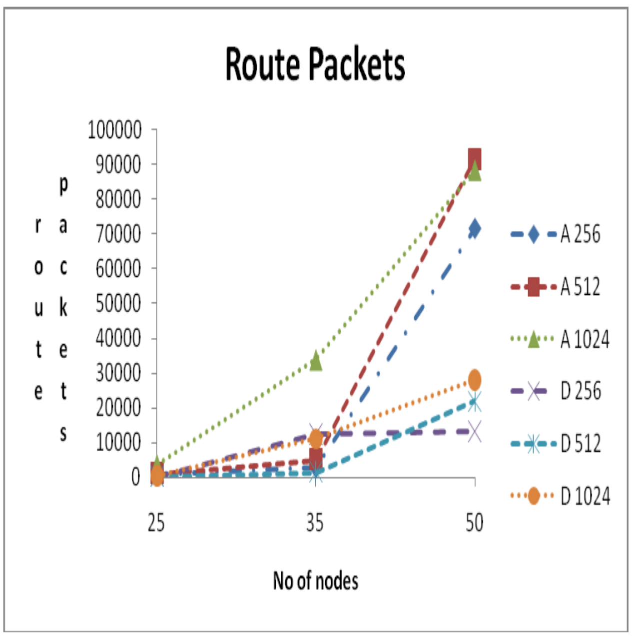

Figure 5: Routing Packets with AODV and DSR V/s varying sizes

4. Simulation Results & Observations

(a) Packet Delivery Ratio

Figure 1 show PDR in AODV routing protocol with varying the packet size i.e. 256,512 and 1024 bytes. This graph proves that if the size of packet high then PDR is low and if size of the packet is small PDR is high. In this graph that is also clear if the number of nodes less and packet size is less PDR is High i.e. 97% to 100% up to the size of packet is 512 and number of nodes up to 35. After that PDR steep fall with packet size 1024 and the number of nodes 50.

(b) Average End To End Delay

Figure 2shows the end to end delay ratio in routing protocol AODV with packet size 256, 512 and 1024 bytes and the number of nodes is 25, 35 and 50. In this graph we can observe that end to end delay ratio will be increased with number of nodes and packet size. The analysis shows that till size of packet is 512 and the number of nodes 35 end to end delay ratio is between 0to0.041.

(c) Throughput

Figure 3 shows throughput in the routing protocol AODV, with different packet size and number of nodes i.e. 256, 512 and 1024 bytes and 25, 35 and 50 nodes. It is clear from the graph that throughput will be increase as the size of packet and number of nodes is increased.

(d) Packet Delivery Ratio

Figure 4shows the PDR of two routing protocols DSR and AODV which achieve almost 100% with small size of packet and the less number of nodes. But when the packet size is 1024 bytes the PDR is very less in the comparison of AODV. So in this graph the performance of AODV is better in the comparison of DSR.

(e) Routing Load

Figure 5shows that DSR almost always has a lower routing load than AODV. This can be attributed to the caching strategy used by DSR. By virtue of aggressive caching, DSR is more likely to find a route in the cache, and hence resorts to route discovery less frequently than AODV.

5. Conclusion

The study has been carried out using the same scenario for both schemes to make it biasfree. Same metrics have been used and results are compared. It has been observed that AODV in the simulation experiment shows overall best performance. It has an improvement of DSR and DSDV and has advantages of both of them. Future work will concentrate on using more metrics and also using different networks for making the study more effective and conclusive. Efforts are on to study the network for more denser and sparse medium as well.

References

[1]. Kush A., Chauhan R., 2005. Optimization of routing techniques, *CSI India Journal*, Vol. 35, No. 2, pp 68-74.

[2]. Kush A., Chauhan R., Hwang C. and Gupta P., 2008. Stable and Energy Efficient Routing for Mobile AdhocNetworks, *Proceedings of the Fifth International Conference on Information Technology: New Generations*,

[3]. ISBN:978-0-76953099-4 available at ACM Digital Portal, pp. 1028-1033.

[4]. Vijay Kumar and Rakesh Sharma, May 2011. "Behavioral Study of Dynamic Routing Protocols For MANET"International Journal of Computing and Business Research ISSN (Online) : 2229-6166 Volume 2 Issue 2 May 2011

[5]. Vijay Kumar and Ashwani Kush, 2012. "A New Scheme for Secured on Demand Routing", Network and Complex Systems www.iiste.orgISSN 2224-610X (Paper) ISSN 2225-0603 (Online).

[6]. Vol 2, No.2, 2012

[7]. Johnson D. B., Maltz D. A., Hu Y.C., 2003. The Dynamic Source Routing Protocol for Mobile Ad HocNetworks (DSR), *http://www.ietf.org/internetdrafts/draft-ietf-manet-dsr-09.txt,* IETF Draft.

[8]. Bertsekas D. and Gallager R., 2002. *Data Networks*, Prentice Hall Publ., New Jersey.

[9]. Anwar F., Azad M.S., Rahman M.A. and Uddin M.M., Performance Analysis of Ad hoc Routing Protocols inMobile WiMAX Environment, *IAENG International Journal of Computer Science,* Vol.35, No.3, pp-13.

[10]. Reddy P.C. and Reddy P.C., 2010. Performance Analysis of Adhoc Network Routing Protocols, *InternationalJournal of Computing and Business Research (IJCBR)* Vol. 1, No. 1.

[11]. Murthy S. and Garcia-Luna-Aceves J. J., 1996. An Efficient Routing Protocol for Wireless Networks, *ACMMobile Networks and App. Journal, Special Issue on Routing in Mobile Communication Networks*, pp. 183-97.

[12]. Taneja S., Kush A., 2010. Performance evaluation of DSR and AODV over UDP and TCP connections,*International Journal of Computing and Business Research (IJCBR*), Vol. 1, No. 1.

[13]. Chen T.W. and Gerla M., 1998. Global State Routing: A New Routing Scheme for Ad-hoc WirelessNetworks, *Proceedings of International Computing Conference IEEE ICC*.

[14]. Park V.D. and Corson M. S., 1997. A Highly Adaptive Distributed Routing Algorithm for Mobile WirelessNetworks, *Proceedings of the IEEE International Conference on Computer Communications (INFOCOM),*Kobe, Japan, pp. 1405-1413.

[15]. Park V. and Corson S., 1998. Temporally Ordered Routing Algorithm (TORA), *Functional specificationIETF Internet draft, http://www.ietf.org/internet-drafts/draft-ietf-manet-tora-spec-01.txt.*