

Performance Comparison of Broadcasting methods in Mobile Ad Hoc Network

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Abstract

A Mobile Ad hoc Network (MANET) is an autonomous system of mobile nodes with routing capabilities connected by wireless links, the union of which forms a communication network modeled in the form of an arbitrary graph. The vision of Mobile Ad Hoc Network (MANET) is wireless internet, where users can move anywhere anytime and still remaining connected with the rest of the world. The main challenges in MANET are reliability, bandwidth and battery power. The network has unpredictable characteristics such as its topology, signal strengths fluctuates with environment and time, communication routes breaks and new ones are formed dynamically. In this context, communication algorithms and protocols should have very light in computational and storage needs in order to conserve energy and bandwidth. Broadcasting is the process in which a source node sends a message to all other nodes in MANET. Network wide broadcasting in Mobile Ad Hoc Network provides important control and route establishment functionality for a number of unicast and multicast protocols. Broadcasting in MANET poses more challenges than in wired networks due to node mobility and scarce system resources. Broadcasting a packet to the entire network is a basic operation and has extensive applications in mobile ad hoc networks (MANETs). This paper presents an overview of the broadcasting techniques in mobile ad hoc networks, and simulating the simple Flooding algorithm and Probability based flooding algorithm using NS2 simulation.

Keywords: MANET, Network wide Broadcast, Flooding, Probability based Flooding

1. Introduction

Recent research in network layer protocols for MANETs has involved unicast, multicast and broadcast communications. Unicast protocols allow one mobile node to communicate with another mobile node across the network. Researchers have also studied the use of geographic information, obtained via a system such as Global Positioning System, in unicast routing. Multicast communication involves one source node sending data to a number of destination nodes. Network wide broadcasting, simply referred to as “broadcasting”, is the process in which one node sends a packet to all other nodes in the network. Broadcasting may be used to disseminate data to all other nodes in the network or may be used by MANET

unicast or multicast routing protocols to disseminate control information. For example, many unicast routing protocols such as Dynamic Source Routing (DSR) [1], Ad Hoc On Demand Distance Vector (AODV) [2], Zone Routing Protocol (ZRP) [3] and Location Aided Routing (LAR) [4] use broadcasting to establish routes. Currently, these protocols all rely on a simplistic form of broadcasting called Flooding, in which each node (or all nodes in a localized area) retransmits each received unique packet exactly one time. The main problems with Flooding are that it typically causes unproductive and often harmful bandwidth congestion, as well as inefficient use of node resources. In MANET, broadcasting is used in the route discovery process in several routing protocols, when advising an error message to erase invalid routes from the routing table, or as an efficient mechanism for reliable multicast in a fast moving MANET. In MANETs with the promiscuous receiving node, the traditional blind flooding incurs significant redundancy, collision, and contention, which is known as the broadcast storm problem [5]. Efficient broadcasting in a MANET focuses on selecting a small forward node set while ensuring broadcast coverage. Ad hoc wireless networks are dynamic in nature. Due to this dynamic nature, global information/infrastructure such as minimal spanning tree is no longer suitable to support broadcasting in ad hoc networks.

2. Broadcasting in MANET

Broadcasting means one node sends a packet to all other nodes in a network. Efficient broadcasting in a mobile ad hoc network focuses on selecting a small forward node set while ensuring broadcast coverage. The objective is to determine a small set of forward nodes to ensure full coverage. A formal framework is used to model inaccurate local views in MANETs, where full coverage is guaranteed if three sufficient conditions connectivity, link availability, and consistency are met. A MANET consists of a set of mobile hosts that may communicate with one another from time to time. No base stations are supported. Each host is equipped with a CSMA/CA (carrier sense multiple access with collision avoidance) transceiver. In such environment, a host may communicate with another directly or indirectly. In the latter case, a multi hop scenario occurs, where the packets originated from the source host are relayed by several intermediate hosts before reaching the destination. The broadcast problem refers to the sending of a message to other hosts in the network. The problem considered here has the following characteristics. In a broadcast process, each node decides its forwarding status based on given neighborhood information and the corresponding broadcast protocol. Most existing broadcast schemes assume either the underlying network topology is static during the broadcast process such that the neighborhood information can be updated in a timely manner. The results in show that existing static network broadcast schemes perform poorly in terms of delivery ratio when nodes are mobile. There are two sources that cause the failure of message delivery.

Collision: The message intended for a destination collides with another message.

Mobility nodes: A former neighbor moves out of the transmission range of the current node (i.e., it is no longer a neighbor).

Random delay time

Many of the broadcasting protocols require a node to keep track of redundant packets received over a short time interval in order to determine whether to rebroadcast. That time interval, which we have arbitrarily termed "Random Delay Time" (RDT), is randomly chosen from a uniform distribution between 0 and T_{max} seconds, where T_{max} is the highest possible

delay interval. This delay in transmission accomplishes two things. First it allows nodes sufficient time to receive redundant packets and assess whether to rebroadcast. Second, the randomized scheduling prevents the collisions. An important design consideration is the implementation of the random delay time. One approach is to send broadcast packets to the MAC layer after a short random time similar to the jitter. In this case, packets remain in the interface queue (IFQ) until the channel becomes clear for broadcast. While the packet is in the IFQ, redundant packets may be received, allowing the network layer to determine if rebroadcasting is still required. If the network layer protocol decides the packet should not be rebroadcast, it informs the MAC layer to discard the packet. A second approach is to implement the random delay time as a longer time period and keep the packet at the network layer until the RDT expires. Retransmission assessment is done considering all redundant packets during the RDT. After RDT expiration, the packet is either sent to the MAC layer or dropped. No attempts are made by the network layer to remove the packet after sending it to the MAC layer.

3. Broadcasting methods

Broadcasting methods have been categorized into four families utilizing the IEEE 802.11 MAC specifications [6]. Note that for the comparisons of these categories the reader is referred to [7].

Simple flooding [8,9]: requires each node in a MANET to rebroadcast all packets.

Probability based [10] : assigns probabilities to each node to rebroadcast depending on the topology of the network.

Area based [10] :common transmission distance is assumed and a node will rebroadcast if there is sufficient coverage area.

Neighborhood based [11–15] : State on the neighborhood is maintained by neighborhood method, and the information obtained from the neighboring nodes is used for rebroadcast.

3.1 Simple flooding method

In this method, a source node of a MANET disseminates a message to all its neighbors, each of these neighbors will check if they have seen this message before, if yes the message will be dropped, if not the message will be disseminated at once to all their neighbors. The process goes on until all nodes have the message. Although this method is very reliable for a MANET with low density nodes and high mobility but it is very harmful and unproductive as it causes severe network congestion and quickly exhaust the battery power. Blind flooding ensures the coverage; the broadcast packet is guaranteed to be received by every node in the network, providing there is no packet loss caused by collision in the MAC layer and there is no high-speed movement of nodes during the broadcast process. However, due to the broadcast nature of wireless communication media, redundant transmissions in blind flooding may cause the broadcast storm problem [16], in which redundant packets cause contention and collision.

3.2 Probability based approach

3.2.1. Probabilistic scheme: The Probabilistic scheme from [10] is similar to Flooding, except that nodes only rebroadcast with a predetermined probability. In dense networks multiple nodes share similar transmission coverage. Thus, randomly having some nodes not

rebroadcast saves node and network resources without harming delivery effectiveness. In sparse networks, there is much less shared coverage; thus, nodes won't receive all the broadcast packets with the Probabilistic scheme unless the probability parameter is high. When the probability is 100%, this scheme is identical to Flooding.

3.2.2. Counter-Based scheme: Ni et al [10] show an inverse relationship between the number of times a packet is received at a node and the probability of that node being able to reach additional area on a rebroadcast. This result is the basis of their Counter-Based scheme. Upon reception of a previously unseen packet, the node initiates a counter with a value of one and sets a RDT (which is randomly chosen between 0 and T_{max} seconds). During the RDT, the counter is incremented by one for each redundant packet received. If the counter is less than a threshold value when the RDT expires, the packet is rebroadcast. Otherwise, it is simply dropped. From [10], threshold values above six relate to little additional coverage area being reached.

3.3 Area based methods

Suppose a node receives a packet from a sender that is located only one meter away. If the receiving node rebroadcasts, the additional area covered by the retransmission is quite low. On the other extreme, if a node is located at the boundary of the sender node's transmission distance, then a rebroadcast would reach significant additional area, 61% to be precise [10]. A node using an Area Based Method can evaluate additional coverage area based on all received redundant transmissions. We note that area based methods only consider the coverage area of a transmission; they don't consider whether nodes exist within that area.

3.3.1. Distance-Based scheme: A node using the Distance-Based Scheme compares the distance between itself and each neighbor node that has previously rebroadcast a given packet. Upon reception of a previously unseen packet, a RDT is initiated and redundant packets are cached. When the RDT expires, all source node locations are examined to see if any node is closer than a threshold distance value. If true, the node doesn't rebroadcast.

3.3.2. Location-Based scheme: The Location-Based scheme [10] uses a more precise estimation of expected additional coverage area in the decision to rebroadcast. In this method, each node must have the means to determine its own location, e.g., a Global Positioning System (GPS). Whenever a node originates or rebroadcasts a packet it adds its own location to the header of the packet. When a node initially receives a packet, it notes the location of the sender and calculates the additional coverage area obtainable were it to rebroadcast. If the additional area is less than a threshold value, the node will not rebroadcast, and all future receptions of the same packet will be ignored. Otherwise, the node assigns a RDT before delivery. If the node receives a redundant packet during the RDT, it recalculates the additional coverage area and compares that value to the threshold. The area calculation and threshold comparison occur with all redundant broadcasts received until the packet reaches either its scheduled send time or is dropped.

3.4. Neighbor Knowledge method

3.4.1. Self pruning: Self Pruning is an effective method in reducing broadcast redundancy. Each node in this approach is required to have knowledge of its neighbors, this

knowledge can be achieved by periodic "Hello" messages. The receiving node will first compare its neighbor lists to that of sender's list, the receiving node will rebroadcast if the additional nodes could be reached, otherwise the receiving node will drop the message. This is the simplest approach in the neighbor knowledge method. In Figure 1, after receiving a message from node 2 node 1 will rebroadcast the message to node 4 and node 3 as it's only additional nodes. Note that node 5 also will rebroadcast the same message to node 4 as it's only additional node. In this situation still the message redundancy takes place.

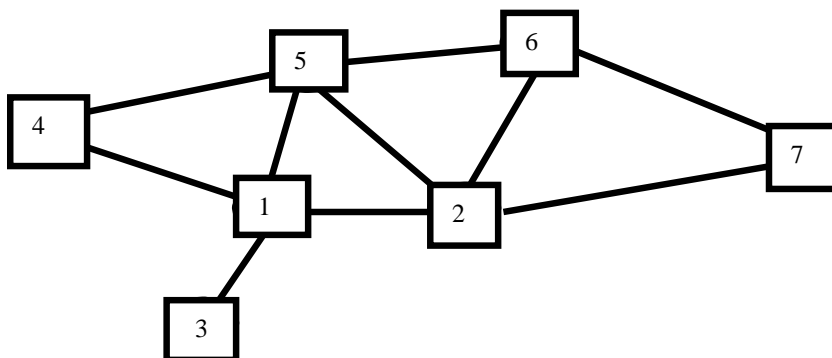


Figure 1. Self Pruning approach

3.4.2. Ad Hoc Broadcasting approach: In this approach, only nodes selected as gateway nodes and a broadcast message header are allowed to rebroadcast the message. The approach is described as follows:

Locate all two hop neighbors that can only be reached by a one hop neighbor. Select these one hop neighbors as gateways.

Calculate the cover set that will receive the message from the current gateway set for the neighbors not yet in the gateway set, find the one that would cover the most two hop neighbors not in the cover set. Set this one hop neighbor as a gateway.

Repeat process 2 and 3 until all two hop neighbors are covered.

When a node receives a message and is a gateway, this node determines which of its neighbors already received the message in the same transmission.

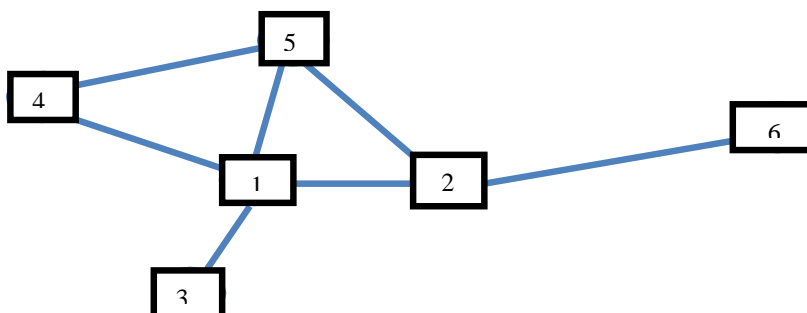


Figure 2. Ad hoc broadcasting approach

In Figure 2 Ad hoc broadcasting approach, node 2 has 1, 5 and 6 nodes as one hop neighbors, 3 and 4 nodes has two hop neighbors. Node 3 can be reached through node 1 as a one hop neighbor of node 2. Node 4 can be reached through node 1 or node 5 as one hop neighbors of node 2. Node 3 selects node 1 as a gateway to rebroadcast the message to nodes 3 and 4. Upon receiving the message node 5 will not rebroadcast the message as it is not a gateway.

3.5. Cluster Based methods

The clustering approach has been used to address traffic coordination schemes [15], routing problems [16] and fault tolerance issues [17]. Note that cluster approach proposed in [15] was adopted to reduce the complexity of the storm broadcasting problem. Each node in a MANET periodically sends "Hello" messages to advertise its presence. Each node has a unique ID. A cluster is a set of nodes formed as follows. A node with a local minimal ID will elect itself as a cluster head. All surrounding nodes of a head are members of the cluster identified by the heads ID. Within a cluster, a member that can communicate with a node in another cluster is a gateway. To take mobility [19] into account, when two heads meet, the one with a larger ID gives up its head role. This cluster formation is depicted in Figure 3.

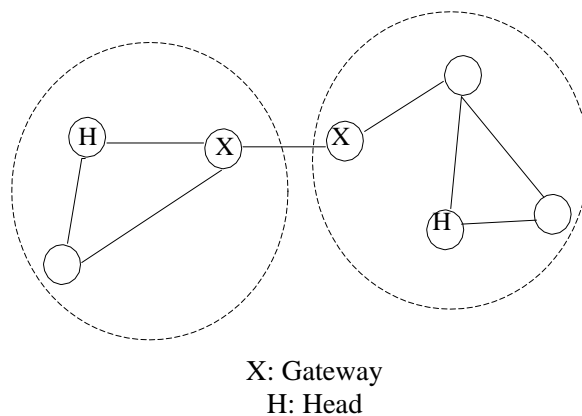


Figure 3. Clustering in MANET

Ni et al [10] assumed that the cluster formed in a MANET will be maintained regularly by the underlying cluster formation algorithm. In a cluster, the heads rebroadcast can cover all other nodes in its cluster. To rebroadcast message to nodes in other clusters, gateway nodes are used, hence there is no need for a non-gateway nodes to rebroadcast the message. As different clusters may still have many gateway nodes, these gateways will still use any of the broadcasting approaches to determine whether to rebroadcast or not. Ni et al [10] showed that the performance of the cluster based method where the location based approach was incorporated compared favorably to the original location based scheme. The method saved much more rebroadcasts and leads to shorter average broadcast latencies. Unfortunately, the reachability was unacceptable in low density MANETs.

3.6. Shortcoming of existing broadcasting methods

The shortcomings are deduced from detailed comparative studies in [7]. All methods apart from neighbor based methods require more rebroadcasts, with respect to the number

of retransmitting nodes [10]. Methods that make use of RAD suffer in high density MANETs unless a mechanism to adapt a nodes RAD to its local environmental behavior are developed. Because it does not use local information to decide whether to rebroadcast or not, the ad hoc broadcasting approach have difficulties in a very high mobile MANET.

Base on the comparative studies by [7], none of the existing broadcasting protocols are satisfactory for wide ranging MANET environments. Because of its adaptive nature, scalable broadcast approach has significant improvements over the non adaptive approaches. Due to these shortcomings there is a need to develop new efficient broadcasting approaches with the common goal of conserving the available scarce resource in MANETs.

4. The Broadcasting Algorithms under Evaluation

4.1. Simple flooding algorithm - Algorithm I

The simple flooding algorithm with respect to normalized routing load is implemented in Algorithm I using NS2 Simulation. The steps are as follows:

The algorithm for simple flooding starts with a source node broadcasting a packet to all neighbors.

Each of those neighbors in turn rebroadcast the packet exactly one time and

This continues until all reachable network nodes have received the packet.

4.2. Probability based flooding algorithm - Algorithm II

The probability based flooding algorithm with respect to normalized routing load is implemented in Algorithm-II using NS2 Simulation. The Probabilistic scheme is similar to Flooding, except that nodes only rebroadcast with a predetermined probability. The algorithm for Simple Flooding starts with a source node broadcasting a packet to all neighbors. Each of those neighbors in turn may rebroadcast the packet exactly one time with respect to some random condition. And this continues until all reachable network nodes have received the packet. When the probability is 100%, this scheme is identical to Flooding.

5. Simulation Results and Analysis

NS-2[18] is a discrete event network simulator that has begun in 1989 as a variant of the REAL network simulator. Initially intended for wired networks, the Monarch Group at CMU have extended NS-2 to support wireless networking such as MANET and wireless LANs as well. Most MANET routing protocols are available for NS-2, as well as an 802.11 MAC layer implementation. NS-2's code source is split between C++ for its core engine and OTcl, an object oriented version of TCL for configuration and simulation scripts. The combination of the two languages offers an interesting compromise between performance and ease of use. Implementation and simulation under NS-2 consists of the following steps:

Implementing the protocol by adding a combination of C++ and OTcl code to NS-2's source base;

Describing the simulation in an OTcl script;

Running the simulation and

Analyzing the generated trace files.

Implementing a new protocol in NS-2 typically requires adding C++ code for the protocol's functionality, as well as updating key NS-2 OTcl configuration files in order

for NS -2 to recognize the new protocol and its default parameters. The C++ code also describes which parameters and methods are to be made available for OTcl scripting. The NS-2 architecture follows closely the OSI model. We have adapted the implementation of flooding provided in NS-2 in the context of diffusion in sensor networks.

Simulation Parameters: The following list shows some of the important simulation parameters

Bandwidth	1Mb
Routing Protocol	DSDV
MESSAGE_PORT	42
BROADCAST_ADDR	-1
Nam Animation Speed	250u (in Micro Seconds)
Node Velocity	20,40,60 80,100,120 meters per sec
Transmission Probability	50; # 1 to 100
Broadcast Probability	50; # 1 to 100
Broadcast Delay	0.01
Hello Reply Delay	0.01
NAM Animation Speed	250u ;#in Micro Seconds
Message Size	100 ;# in bytes Max 1500
Interface queue type	Queue/DropTail / PriQueue
Antenna model	Antenna/Omni Antenna
Max packet in IFQ	50

The Table.1 shows the normalized routing load of the two algorithms with respect to different velocity of the nodes. Here the total Number of Mobile Node is 24.

Table 1. Normalized Routing Load

Node Speed M/s	Routing Load	
	Algorithm 1	Algorithm 2
20	0.09310	0.08378
40	0.10043	0.09499
60	0.11919	0.09608
80	0.12082	0.10032
100	0.12280	0.10598
120	0.12558	0.11089

5.1. Normalized Routing Load Chart for Simple Flooding Algorithm-Algorithm I

Routing load: The ratio of the number of routing messages propagated by every node in the network and the number of data packets successfully delivered to all destination nodes. In other words, the routing load means the average number of routing messages generated to each data packet successfully delivered to the destination.

The following line charts (Figure.4) shows the normalized routing load chart of the Simple Flooding Algorithm - Algorithm I with respect to different velocity of the nodes.

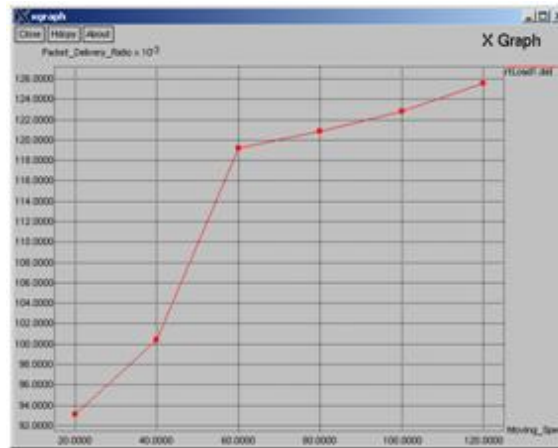


Figure 4. Normalized Routing Load Chart – Algorithm I

5.2 Normalized Routing Load Chart for Probability Based Flooding Algorithm - Algorithm II

The following line charts (Figure.5) shows the normalized routing load chart of the Probability Based Flooding Algorithm - Algorithm II with respect to different velocity of the Nodes.

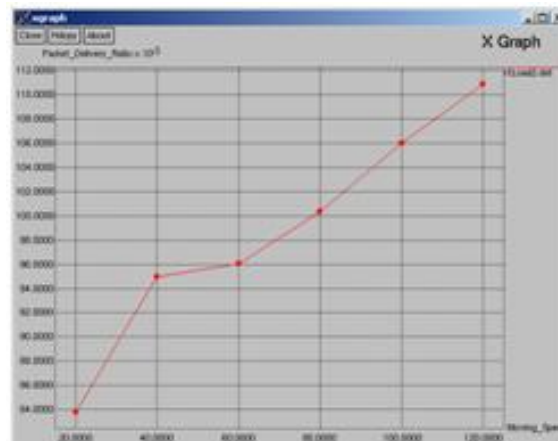


Figure 5. Normalized Routing Load Chart – Algorithm II

The following line charts (Figure.6) shows the normalized routing load of the both Simple Flooding Technique in Algorithm I and Probability Based Flooding Technique in Algorithm II with respect to different velocity of the nodes in a combined graph.

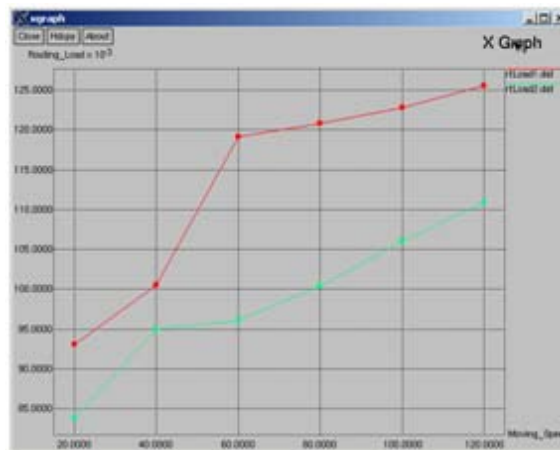


Figure 6. Normalized Routing Load Chart – Algorithm I and Algorithm II

6. Conclusions and Future work

We have evaluated the performance of a single source broadcasting techniques such as simple flooding algorithm and probability based flooding algorithm using simulation. In addition to that we have done the comparative study on existing broadcasting techniques in MANET. It concludes that simple flooding requires each node to rebroadcast all packets. Probability based methods use some basic understanding of the network topology to assign a probability to a node to rebroadcast. Area based methods assume nodes have common transmission distances: a node will rebroadcast only if the rebroadcast will reach sufficient additional coverage area. Neighbor knowledge methods maintain state on their neighborhood via “Hello” packets, which are used in the decision to rebroadcast. Broadcasting is an essential building block of any MANET, so it is imperative to utilize the most efficient broadcast methods possible to ensure a reliable network. This paper has offered an overview on all major broadcasting methods in the literature focusing on their functionalities and shortcomings and, moreover, suggesting improvements for some of them, as appropriate. Due to dynamic change of MANET topology and its scarce resource availability, however, there are no single optimal algorithms available for all relevant scenarios.

Our future work is to evaluate and implement the cluster based broadcasting algorithms and comparative analysis between the single source broadcasting techniques such as simple flooding, probability based and cluster based broadcasting algorithms with respect to metrics of normalized routing load and packet delivery ratio using NS2 simulation. The cluster broadcasting algorithm for mobile ad hoc networks guarantees to deliver the messages from a source node to all the nodes of the network. The nodes are mobile and can move from one place to another. The algorithm adapts itself dynamically to the topology and always gives the least finish time for any particular broadcast. The algorithm focuses on reliable broadcasting. It guarantees to deliver the messages within a bounded time.

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References

- [1] D. Johnson, D. Maltz and Y. Hu. The Dynamic Source Routing Protocol for Mobile Ad hoc Networks. Internet Draft: draft-ietf-manet-dsr-09.txt, 2003.
- [2] C. Perkins, E. Beldig-Royer and S. Das. Ad hoc on Demand Distance Vector (AODV) Routing. Request for Comments 3561, July 2003.
- [3] Z. Haas and M. Pearlman. The Performance of Query Control Schemes for the Zone Routing Protocol. *IEEE/ACM Transactions on Networking*, 9(4):427–438, 2001.
- [4] Y. Ko and N. Vaidya. Location-aided Routing (LAR) in Mobile Ad hoc Networks. Proceedings of the ACM/IEEE International Conference on Mobile Computing and Networking (MOBICOM),66-75, 1998.
- [5] Y.-C. Tseng, S.-Y. Ni, and E.-Y. Shih, “Adaptive Approaches to Relieving Broadcast Storms in a Wireless Multihop Mobile Ad Hoc Network,” *IEEE Trans. Computers*, vol. 52, no. 5, pp. 545-557, May2003.
- [6] I.S.Committee.Wireless LAN Medium ACCESS CONTROL (MAC) and Physical Layer Specifications. IEEE 802.11 Standards. IEEE, New York, ISBN 1559379359, 1997.
- [7] B. Williams and T. Camp. Comparison of Broadcasting Techniques for Mobile Ad hoc Networks. In Proceedings of the ACM Symposium on Mobile Ad Hoc Networking and Computing (MOBIHOC), 194–205, 2002.
- [8] C. Ho, K. Obraczka, G. Tsudik and K. Viswanath. Flooding for Reliable Multicast in Multi-hop Ad hoc Networks. International Workshop in Discrete Algorithms and Methods for Mobile Computing and Communication, 64–71, 1999.
- [9] J. Jetcheva, Y. Hu, D. Maltz and D. Johnson. A Simple Protocol for Multicast and Broadcast in Mobile Ad hoc Networks. Internet Draft, draft-ietf-manet-simple-mbcast-01.txt, 2001.
- [10] S. Ni, Y. Tseng, Y. Chen and J. Sheu. The Broadcast Storm Problem in a Mobile Ad hoc Network. International Workshop on Mobile Computing and Networks, 151–162, 1999.
- [11] H. Lim and C. Kim. Multicast Tree Construction and Flooding in Wireless Ad hoc Networks. In Proceedings of the ACM International Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWIM), 2000.
- [12] W. Peng and X. Lu. Efficient Broadcast in Mobile Ad hoc Networks using Connected Dominating Sets. *Journal of Software*, 1999.
- [13] W. Peng and X. Lu. On the Reduction of Broadcast Redundancy in Mobile Ad hoc Networks. In Proceedings of MOBIHOC, 2000.
- [14] W. Peng and X. Lu. AHBP: An Efficient Broadcast Protocol for Mobile Ad hoc Networks. *Journal of Science and Technology*, 2002.
- [15] J. Sucec and I. Marsic. An Efficient Distributed Network-wide Broadcast Algorithm for Mobile Ad hoc Networks. CAIP Technical Report 248 - Rutgers University, September 2000.
- [16] M. Gerla and J. T. Tsai. Multicluster, Mobile, Multimedia Radio Network. *ACM-Baltzer Journal of Wireless Networks*, 1(3):255–265, 1995.
- [17] S. Alagar, S. Venkatesan, and J. Cleveland. Reliable Broadcast in Mobile Wireless Networks. In Military Communications Conference, MILCOM Conference Record, 1:236-240, 1995.
- [18] Marc Greis.NS2 Tutorial presentation in the website, www.isi.edu/nsnam/ns/tutorial/nsindex.html
- [19] R.Purtoosi, H.Taheri, A.Mohammadi and F.Foroozan, “Effect of Connectivity and Mobility on the Performance of Stability-Based Clustering Algorithm for Ad Hoc Wireless Networks”, The IFIP and IEEE International Conference on Wireless and Optical Communications Networks (WOCN), Dubai, UAE, March 2005.

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