EFFECTIVE APPROACH FOR REDUCING THE FLOODING IN ROUTING MECHANISM FOR MULTIHOP MOBILE AD HOC NETWORKS

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***Abstract*— MANET is infrastructure less network and the routing protocol in MANET is not designed specifically with dynamic, self-starting behaviour required for wireless networks. Each and every node in MANET acts as a forward and receiver node. Performance of most of the protocols is not encouraging in a highly dynamic interconnection topology. In this paper, a reliable broadcast approach for MANET is proposed, which improves the transmission rate. The MANET is considered with asymmetric characteristics, where the source and forwarding nodes have different properties. In addition, there exists a non-forwarding node, which is a downstream node and never forwards a packet. The status of each node is dynamically changes and thus the topology of the network also dynamic. In this work, the number of redundant transmission is minimized by creating less number of forwarding nodes. The forwarded packet is considered as acknowledgements and the non-forwarding nodes explicitly send the acknowledgements to the source. The performance of the proposed approach is evaluated in NS2 environment. Since the proposed approach reduces the flooding, we have considered functionality of the proposed approach with AODV variants. The effect of network density on the overhead and collision rate is considered for performance evaluation. The performance is compared with the AODV variants found that the proposed approach outperforms all the variants.**

Keyword- MANET, Broadcasting, Flooding, Routing protocols, collision rate.

I. INTRODUCTION

Mobile Ad Hoc Network (MANET) is an infrastructure less network provides multi hop based communication services, where the nodes are connected via wireless medium. Wireless networks can be broadly divided into single-hop and ad-hoc multi-hop networks. In single-hop network, the communication between nodes accomplished based on a fixed structure. The second type is the Mobile Ad-hoc Network, where the communication between nodes is accomplished via other nodes, which are called intermediate or forwarded nodes. It is well-known that one of the inherent characteristics of the multi hop MANET is that large interference area, where the mobile nodes overlap with each other. Each node in a MANET acts as a router to receive and forward packets for seamless communications between people and devices. The MANETs are used in various application domains such as battlefield communications, emergency services, disaster recovery, environmental monitoring, personal entertainment and mobile conferencing [1] and [2]. Suitable routing protocol mechanism is used for routing the packet and there are varieties mechanisms proposed by the researchers. In a MANET, nodes moves randomly, leave the network, or the power is switched off and new nodes may join the network unexpectedly. Due to this fact and characteristics, MANET is considered as an unstable network, where links between nodes may break frequently. Therefore, all the nodes in a MANET generates control message periodically and distribute it to update their connection states. However, due to the limited bandwidth constraint of the wireless medium, the protocols which use the medium should try to minimize the unnecessary traffic. Thus, it is imperative that an effective message distributing mechanism is essential for transmitting packets throughout the network.

Broadcasting has been used widely in wired and wireless networks to understand the data and topology information. There are various routing protocols in MANETs such as On-demand Distance Vector (AODV) [3], Dynamic Source Routing (DSR) [4] and Optimized Link State Routing protocol (OLSR) [5]. Rely on a flooding mechanism to broadcast data and control packets over the entire network for establishing routes between source-destination pair [6]. The simplest way of broadcasting a packet to all nodes in the network is basic flooding or blind flooding [7] which allows each node to retransmit a packet to its neighbours, in case it has not received broadcast packet during earlier transmission. The rebroadcasting process continues until all nodes in the network have received a copy of the packet. Since, topology packets pass through every possible path in parallel, it is assured that the flooding can always find the shortest path between various source and destination combinations. However, the basic nature and characteristics flooding mechanism causes a large number of packets propagation in MANETs. This will eventually overload the network and traffic is congested, which is depicted in Figure 1.

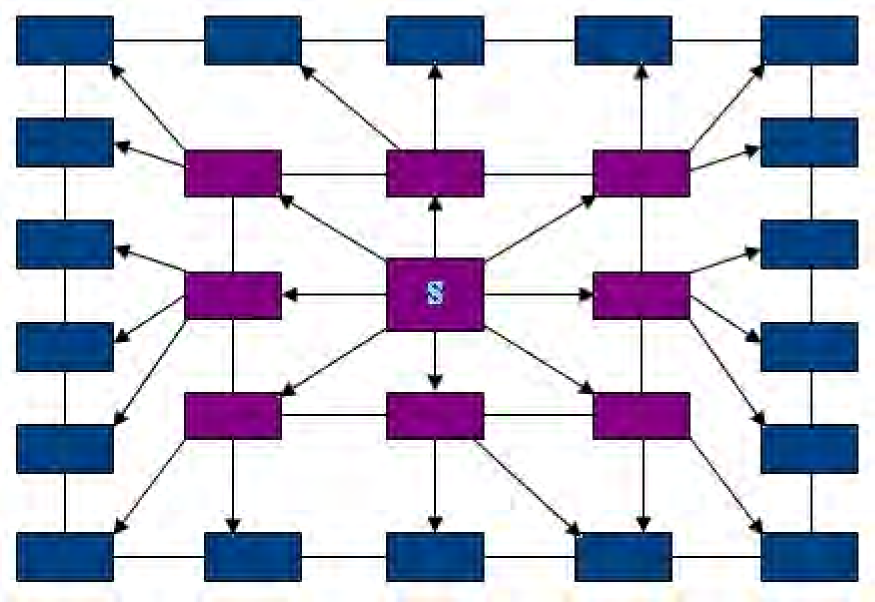


Figure 1. Sample Flooding Scenario

In Fig. 1, the centre node is the source node, nodes in the first inner circle are one-hop neighbours and the nodes in the outer circle are two-hop neighbours. While S, transmit out the packet, all the one-hop neighbours broadcast copies of the packet to all its two-hop neighbours of S at the same time. As a result, there is a heavy redundant rebroadcasting, which means same packet is being received more than once by some nodes, contention and collision that are referred to as the broadcast storm problem [8]. There are various methods have been proposed for achieving efficient broadcasting to solve the broadcast storm problem [9] and [10]. In general, these broadcast protocols can be categorized into three classes such as probability-based methods, area-based methods and neighbour knowledge methods. The probability-based methods are similar to basic flooding, except that each node rebroadcasts packets with a predetermined probability. This mechanism is found to be suitable in dense networks while multiple nodes with similar neighbour coverage. However, the effect of this approach is encouraging only in the sparse network. In area-based methods, the rebroadcast process depends on the distance between itself and the source node. While the distance between them is longer than a predefined threshold, the packet is rebroadcasted, so that a larger additional area can be reached. However, area-based methods do not consider whether some nodes actually exist within that additional area that leads to inefficient broadcasting. The neighbour knowledge methods are further classified as neighbour-designated methods and self-pruning methods. While a node in the neighbour-designated methods transmits packet with a specification to denote, which one of its one-hop neighbours should forward the packet and in self-pruning methods, the receiving node will decide whether the or not to transmit the packet by itself.

In general, all the routing protocol in MANETs relies on a broadcast scheme to disseminate routing information. This is an important task and using an efficient broadcast scheme is critical. There has been large number of approaches proposed in recent times and the Multi-Points Relay (MPR) is considered as one of the distributed broadcast schemes. Most of the distributed schemes have used the basic concept of MRP, which generally focus on different performance issues. During data transmission, there is higher possibility of occurrence of collusion and retransmission. The collusion is avoided by reserving the channel based on Request-To-Send (RTS), Clear-To-Send (CTS), data transmission and Acknowledgement (ACK). This sequence of channel reservation mechanism for data transfer is followed only in unicast and however not used for multicast. One of the issues channel reservation mechanism used in multicast is that for each neighbouring node, the channel has to be reserved and a lot of computation is involved. In fact, the time consumed for transferring data to a node with plurality nodes is N*T(RTS-CTS-data-ACK), where N is the number of nodes. Since, the channel reservation mechanism is not used for broadcasting in MANET, there is chance of data collision in the air. Also, the frequency of collusion is higher and thus the reliable data transmission will be affected. This issue has been addressed by adapting ACK based mechanism and however the ACKs are received by all neighbouring nodes and thus for receiving the ACKs alone the time consumed is N *T(ACK). Below, in Figure 2, the general MANET environment with wireless medium is depicted.

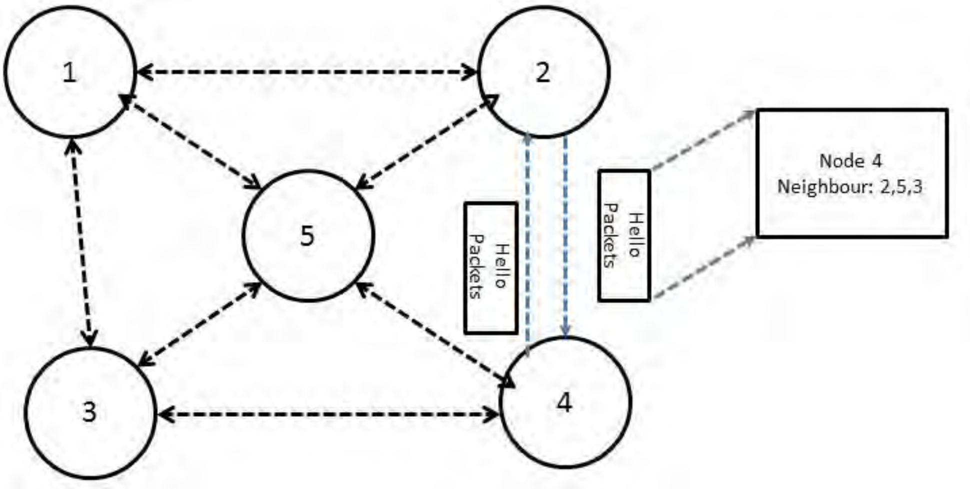


Figure 2. General MANET structure and environment.

In MANET, nodes are free to move and change their location and causes changes in the topology of the network as well as states of the neighbouring nodes. Since, the states of the neighbouring nodes are important for the data transmission in MANET, the topology of the network is periodically updated using Hello packets. Essentially, the Hello packet consists of information about its own Internet Protocol (IP) and the identified neighbouring nodes. In addition, during broadcast process in the MANET in a conventional environment, the source node transmits the broadcast signal to all the nodes in the network using flooding approach. The flooding packet is transmitted to all the nodes in the network through intermediate neighbouring nodes and thus the neighbouring nodes are being used as relay station. Based on the node topology depicted in Fig. 2, this situation can be analysed by extracting the adjacency lists and is given Fig. 3.

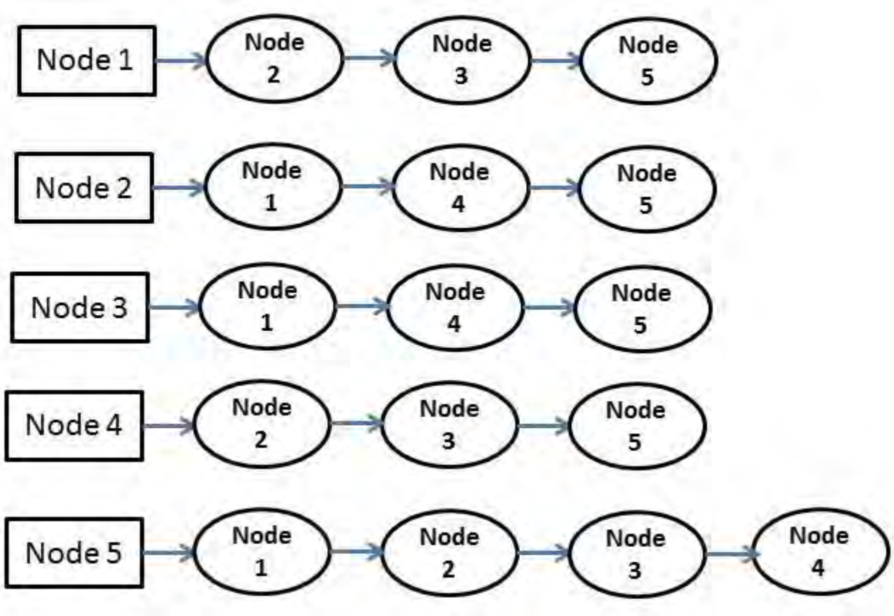


Figure 3. Adjacency node list extracted from Fig. 2

Considering the above Figure, say for example, Node 1 is interested in sending the broadcasting message, message is sent to Node 2, Node 3 and Node 5. Following the same convention and sequence, the same message is relayed by Node 2 to its neighbour as Node 2 to Node1, Node 2 to Node 4 and Node 2 to Node 5. In this way, all the nodes in the network receive the same packet transmitted by Node 1. It is observed from above Fig. that Node 1 is the neighbouring node for Node 2, Node 3 and Node 5. Similarly, Node 2 is neighbouring node for Node 1 and Node 4, etc. Thus, it is imperative that any node in MANET structure can overlap with the transmission and reception area of other nodes. In most of the cases, the MANET nodes are using omnidirectional antenna, which covers the area in a circular fashion, the overlapping of nodes in the transmission and reception area is unavoidable. This situation is a difficult situation and increases the chance of collusion during the broadcasting. Thus, a specific timing mechanism is required for continuously transmitting the broadcast data in MANET.

In this paper, we propose a reliable broadcast approach for MANET, for improving the retransmission rate. We have considered MANET with asymmetric structure, where the upstream node that has initiated the broadcast packet transmission is considered as the source node. A downstream node designated by the current node for forwarding the broadcast packet is considered as forwarding node. A non-forwarding node is a downstream node, which is not designated to forward the packet. Essentially, the status of the node changes for each transmission of packet and a forwarding node in the current view may be non-forwarding node. A view is considered as a specific snapshot of network topology and the broadcast process with respect to a particular broadcast process. This paper tries to minimize the number of redundant transmission in the MANET by minimizing the number of forwarding nodes. A forward node list is generated such that all the nodes in the list transmit the packet in the downstream and this is being treated as ACKs. Further, non-forward 1-hop neighbours explicitly send the ACK and sender acknowledges the same. It is observed that the number retransmission has reduced considerably. The rest of the paper is organized as follows. The recent literature is received in the next section. In section 3, the proposed work is explained. The experimental result is presented in section 4 and we conclude the paper in the last section.

II. LITERATURE REVIEW

Flooding technique is considered as a simple and direct approach to broadcast a message from one node to another node in the MANET. Most of the well-known ad hoc routing protocols of MANET use flooding to ensure that all nodes receive the source message and it is assumed that the reachability of this approach is approximately up to 100% [11] and [12]. However, the flooding mechanism increases the number of packet and is unsuitable for MANETs [13] and [14]. Route discovery in wireless mobile ad hoc networks with adjusted probabilistic flooding [15], A new A New Probabilistic Broadcasting Scheme for Mobile Ad hoc On-Demand Distance Vector (AODV) Routed Networks[16], Performance evaluation of an efficient counter-based scheme for mobile ad hoc networks based on realistic mobility model [17] and the broadcast storm problem in a Mobile Ad hoc Networks [18] debated that the broadcasting operation without using flooding technique can minimize the BSP and improve the MANETs performance in terms of low collision, overhead and end-to-end delay. Among various schemes, a fixed probabilistic scheme is the first probabilistic approach and is considered as the base for all later dynamic probabilistic schemes. Every node receives a broadcast message for the first time and rebroadcasts it to all the nodes in the network with a certain value of probability, regardless of the density level of current node. The paper [13] have derived best probability value (0.07%) for high reach ability and saved rebroadcast. However, the degree of density is not considered and the paper [16] has demonstrated that while the probabilistic scheme considers the degree of nodes density, it will outperform the fixed probabilistic scheme. A probabilistic broadcasting algorithm has been developed, which divides the MANET into four levels of density such as sparse, medium sparse, dense and high dense. A specific forward value is assigned for each level. The density information is collected by broadcasting HELLO packets every second for 1-hop to construct a neighbour list at each node. Then, the node can decides the current level by comparing its neighbour list with average network neighbours. This scheme opens up a promising approach towards optimal probabilistic broadcasting. However, manipulating the levels for comparing neighbour consumes more energy.

In the counter-based mechanism, a counter variable is maintained to calculate and store the number of received messages. The node will rebroadcast the message while the value of the counter is less than a predefined threshold within a period of Random Assessment Delay (RAD) time. However, this scheme is not suitable for the applications that have a very high speed movement like Vehicular Ad hoc Networks VANETs. Recently, the merits of the probabilistic model and counter approach has been proposed, which solves the BSP in MANETs based on realistic mobility model and Performance evaluation of an efficient counter-based scheme for mobile ad hoc networks based on realistic mobility model [17]. In the distance-based scheme, the distance between two hosts is always calculated and compared with a threshold. If the distance is very small, i.e. less than a threshold, the broadcast message will not be rebroadcasted. This is due to the fact that the additional coverage will be very small. In case, if the distance exceeds certain threshold, the packet is rebroadcasted because the additional coverage will be significant. In contrast, in the locations-based scheme, a host receives a broadcast message for the first time. The additional coverage provided by the host will be initialized and compared with a predefined coverage threshold for deciding the broadcast operation. However, this scheme requires additional hardware, say, GPS (Global Positions System) to find the location of the hosts. In addition, the power consumption along the cost for using GPS are considered a critical issue in wireless network [13] and [17].

The paper [19] has considered the issue of efficient broadcasting in mobile ad hoc networks using network coding and directional antennas. It has focused on reducing the number of transmissions in each forwarding node. This study has focused on the multiple sources and message broadcast application. In each forwarding node, some of the received messages are combined for transmission. This coding approach has reduced the total number of transmissions considerably compared to broadcasting using the same forwarding nodes without coding. The directional antennas have been deployed and exploited for further reducing the energy consumption. A node equipped with directional antennas can divide the omni-directional transmission range into several sectors and turn some of them on for transmission. In their approach, locally identified forwarding nodes only transmit the broadcast message to the restricted regions. The paper [20] has proposed a geographical routing algorithm called Location-Aware Routing for Delay-tolerant networks (LAROD). This approach has been enhanced with a location service, Location Dissemination Service (LoDiS), which together are shown to suit an intermittently connected MANET (IC-MANET). It is observed that the location dissemination consumes time, LAROD routes packet with partial knowledge of geographic position. A beaconless strategy has been used with a position-based resolution of bids during packet forwarding procedure. LoDiS maintains a local database of node locations, which is updated using broadcast gossip combined with routing overhearing. The authors have evaluated the algorithms in real time application, i.e., unmanned aerial vehicles deployed in a reconnaissance scenario.

In paper [21] a distributed algorithm for mobile nodes in a MANET has been proposed to construct a CDS to facilitate the route finding or the broadcasting task. It is argued that the algorithm is simple as well as efficient and the simulation results show that it has good performance compared to other heuristic algorithms.

The paper [22] has proposed a distributed Medium Access Control (MAC) layer protocol called Ad hoc Multichannel Negotiation Protocol (AMNP) for multichannel transmissions in the multi-hop MANET. This has been proposed with an intention to handle the issue related to single transceiver in parallel multichannel access. In addition, the multichannel hidden terminal problem and the multichannel broadcast transmission problem are caused by single transceiver operations in the multichannel environment. An enhanced AMNP with channel scheduling scheme has been introduced for effective channel utilization [23]. An adaptive topology control protocol has been proposed for mobile nodes. The protocol is designed in such a way that it allows each node to decide whether to support energy-efficient routing or conserve its own energy. Also, the broadcasting power of beacon messages for mobile nodes dynamically adjusted. They have proved that any reconstruction and change of broadcasting radius converge in four and five beacon intervals.

Based on the above discussion, it is noticed that most of the above mentioned protocols is applicable in multi-point MANET and all of them tries to minimize the number of messages. However, to achieve this it is observed that lot of energy is consumed or special hardware is required. Thus, it is imperative that a protocol is required to reduce the number of messages during broadcasting to avoid flooding. In this paper, we propose a novel approval, which uses subset nodes for forwarding the broadcast messages so that the flooding is reduced considerly. The performance of the approach is ported with variants of AODV and found that the performance is encouraging.

III. PROPOSED WORK

A. Concepts and notations

The proposed retransmission control mechanism is designed for asymmetric MANET and it is modelled as a directed graph $G = (V, E)$. The V is the set of vertices and E is set of time varying edges. Each node v_i€V has its transmission range (tr) with tr_{min} as minimum and tr_{max} as maximum range. The notational convention used in the directed graph holds in the MANET also such that a directed edge (v_i,v_j) is in E and if $d(v_i,v_j) \leq tr_i$. Similarly, for an edge is considered as bidirectional, if both (v_i,v_j) and (v_j,v_i) are in E , which is $d(v_i,v_j) \leq \min(tr_i,tr_j)$. It is well known that the radiation pattern of omni-directional antenna is disk centered and with the radius equal to the transmission range. Since most of the nodes in the MANET have omni-directional antennas, the above statement holds true and communication range of the node in the network can be typically modelled as disk centred at the node with radius equal to the transmission range of the radio. Below, a simple asymmetric model of MANET is presented in Figure 4 for better understanding of the proposed work.

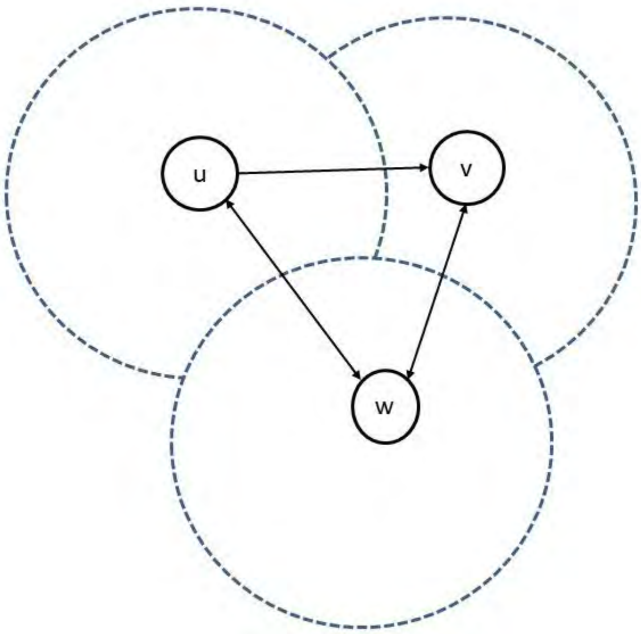


Figure 4. The nodes with symmetric and asymmetric paths.

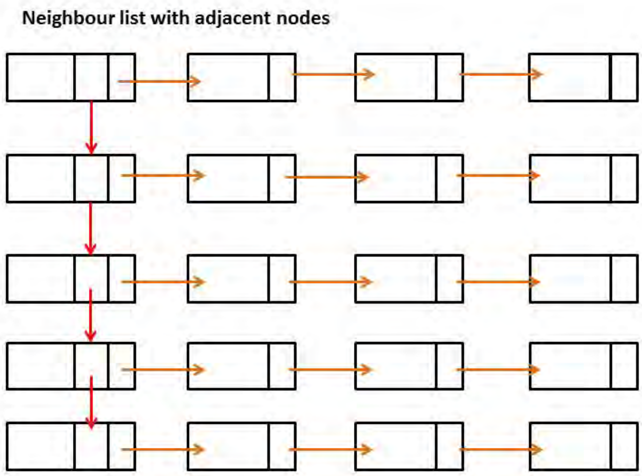
In above Figure, u,v and w are set of nodes in a MANET with corresponding directions and the transmission ranges of u,v and w are different. While the link (u,v) is asymmetric, and (u,w) as well as (w,v) are considered as symmetric. The node v understand the asymmetric link (u,v) while it receives the HELLO message from u with the first hop neighbour list of u. It is observed that the node itself is not in the first hop neighbour list and v initiate a local broadcast Route Request (REQ) to identify u. The intermediate node, which is w attaches the ID and forwards the REQ. While the REQ packet reaches u, the asymmetric link (u,v) is recognised and the feedback path is built as (v,w,u) and this path is informed. As a result, any node can build the feedback path with one intermediate node, which is consists of one hop neighbour with only one intermediate node. While a source node is intended to broadcast a message, a subset of its neighbours are identified and all of them are considered as forwarding nodes. The broadcast message is attached to all these forwarding nodes. Each node in the network receives the broadcast message and delivered to the application layer. The receiver node verifies the stamping for its entry as forwarding node. The forward node computes the next hop forwarding nodes from the current node and the message is broadcasted. These selected nodes covers all the nodes of the 2-hop neighbours with respect to the sender and finally the message is despatched all the nodes effectively. In the proposed approach, a virtual backbone is formed with a set of forwarding nodes. The forwarding nodes are selected in such a way that the delivery of broadcast packets throughout the network is balanced effectively for avoiding broadcast storm and ACK implosion problem. This is due to the fact that the proposed approach allows the only the forwarding nodes to transmit the packet. The retransmission of the forwarding nodes are considered as ACK and no additional ACK is sent in the network. In case of failure due to overhearing forwarding nodes, the sender retransmits the packet so that the packet loss is recovered in a local region. In addition, the proposed approach handles the issue of receiver-initiated approach, which consumes more time to detect the missed packets.

B. Data Structures used in Each Node

In each node, there are two data structures used and they are named as broadcast table and two-hop neighbour table. The information about the recently received broadcast messages is entered into the broadcast table and the duplicate entries are identified as well as removed. The fields of the table are the source address of a broadcast message, the sequence number and the time stamp. The view of the data structure is presented below.

Source Address	Sequence Number	Timestamp

(a)

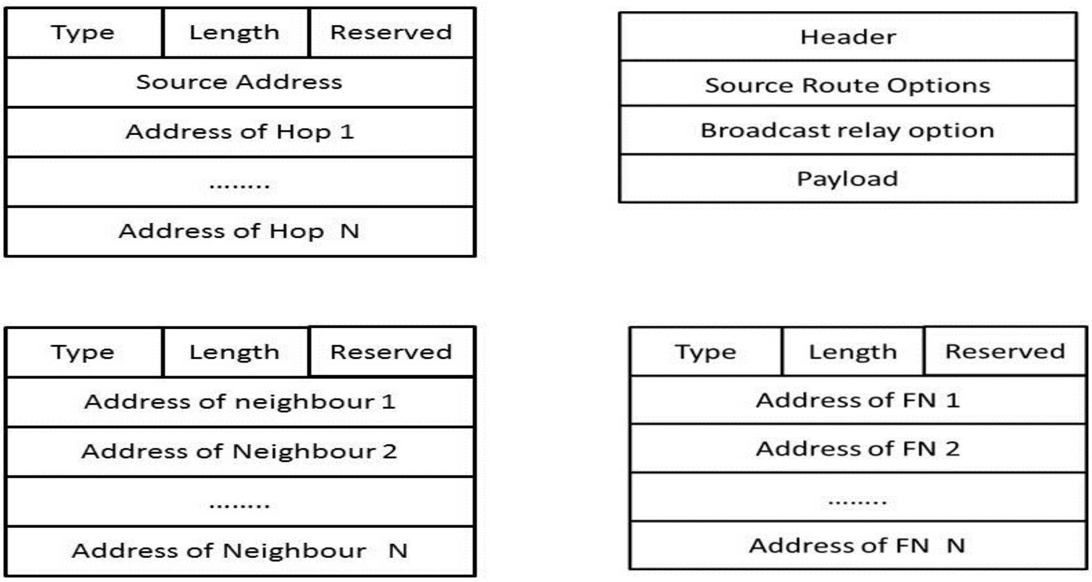


(b)

Figure 5. Proposed data structures to be deployed in each node (a) Table entry to hold broadcast information (b) adjacency neighbour (two-hop) table.

In Fig. 5, the proposed data structure is depicted. In Fig. 5(a), table data structure is presented, where the broadcast information is stored. The structure of neighbouring nodes alone with their respective neighbouring nodes is presented in Fig. 5(b). The link state is sensed from the two-hop neighbour table. In addition, the knowledge of the network topology

is also understood, where all the nodes that are at most two hops away is maintained. The topology information is effectively used for identifying the forwarding node list. The node is relived from the task of querying a route to a destination, which is one-hop or two-hop away. The adjacency list can also be used for diagnosing the working principle of a routing protocol. The broadcast message sent by the source or by a forwarding node contains the broadcast message, the information previously listed for HELLO messages and a list of forwarding neighbours. The format of a broadcast message is illustrated in Fig. 6



(a) (b)

Figure 6. Message Structure (a) Structure of HELLO Message (b) Structure of Broadcast Message

In Fig. 6(a) the list of neighbours and route structure is presented for the HELLO message and is used for source route option. Similarly, required header extension and forward node list for broadcast relay option is shown in Fig. 6(b).

C. Proposed Algorithm

The proposed algorithm tries to reduce the number of duplicate re-transmission while forwarding the broadcast packets. The objective is to consider a subset of neighbouring nodes for forwarding the broadcast packet instead of considering all the nodes and thus the flooding is avoided. The number of nodes selected for the purpose of forwarding is kept as minimum and also the entire network region is covered. Each node v exchanges its 1-hop neighbour list information $N_1(v)$ with each other and thus the two-hop information $N_2(v)$ also available. The forward node selection process is executed at the source node and in each forwarding node, determines its own forwarding node list. Thus, each node (u) in N1(v) may be a forwarding node or a non-forwarding node, which is adjacent to the forwarding node. The algorithm to determine the forwarding nodes 1-hop list to cover 2-hop is presented below.

Algorithm Find-Forward-Node (All the nodes, s)

Step 1: Let $NL(\varphi, s) = \varphi$, $HS(s) = N_1(s) - s$ and $UCL(\varphi, s) = N_2(s) - N_1(s)$

(Nodes which are two hope away from the source (s).

Step 2: Source node s selects those 1-hop neighbour nodes in H(s) and forward nodes which are the only neighbour of nodes in $UCL(\varphi, s)$, adds these 1-hop neighbour nodes to $NL(\varphi, s)$ and removes from H(s) and also removes 2-hop neighbours which are covered by the above 1-hop neighbours from $UCL(\varphi, s)$

Step 3: Find w in H(s) with maximum effective neighbour degree using $\deg(w) = \left|N_1(w) \cap UCL(\varphi, s)\right|$. If more number of one hop neighbours cover the same number of uncovered two hop neighbours of s then node with less ID is selected as forward node.

Step4: $NL(\varphi, s) = NL(\varphi, s) \cup \{w\}, UCL(\varphi, s) = UCL(\varphi, s) - N_1(w) \, and \; H(s) = H(s) - \{w\}$

Step 5: Repeat step 3 and 4 until $UCL(\varphi, s)$ become empty

IV. Experimental Results

To evaluate the performance of the proposed approach, we used NS2 as the simulation platform designed by researchers at Berkeley University. NS2 provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless networks. Since most of the routing protocol uses broadcasting for understanding the topology and thus there is a chance of flooding. The proposed approach reduces the flooding and thus we have combined functions of the approach with well-known AODV variants.

The performance is evaluated using two different settings and conditions over a wide range of different ad hoc networks parameters. Initially, the impact of network density is assessed by deploying a different number of mobile nodes over a topology of 1000m x 1000m. Later, the effects of an offered load on the performance of the broadcast schemes have been investigated for number flow for each simulation experiment. Both the nodes density and traffic load are varied from low to high for ensuring that the proposed approach is applicable for network having different network densities and traffic loads. The performance of the proposed approach is compared with Fixed Probability (FP-AODV), Blind Flooding (BF-AODV), Smart Probabilistic Broadcasting (SPB-AODV) [16] and (ABS-AODV) [24]. For simulation, we have collected average of 30 different randomly generated mobility models and the confidence interval is 95%. This is due to the fact that considering more number of random network topology provides more precise simulation result compared to lower valued topologies. The main parameters used in the simulations are summarized in Table 1 and presented below as used in [24].

Table1. Various parameters used in the simulation experiments

S.No.	Parameter	Value
1	Transmitter range	Transmitter range
2	Bandwidth	2Mbit
3	Interface queue	length 50 messages
4	Simulation time	900 sec
5	Pause time	0 sec
6	Packet size	512 bytes
7	Topology size	1000×1000 m2
8	Nodes speed	4 m/sec
9	Number of node	25,50,75,100 nodes
10	Traffic load	5,10,20,30
11	Data traffic	CBR
12	Mobility model	Random Way-Point
13	Number of trials	30 trials

The broadcast schemes are evaluated using well-known evaluation parameter such as routing overhead, collisions rate and end-to-end delay. The routing overhead is the total number of RREQ packets generated and transmitted during the total simulation time. The collisions rate is the total number of RREQ packets dropped by the MAC layer due to collisions between RREQ packets during route discovery operation (per simulation time unit). The end-to-end delay is the average delay of a data packet to reach from source to destination and includes all possible delays. While evaluating the performance, we have considered the network density and is changed from low to high by varying the number of nodes placed in a 1000m x 1000m area of each simulation scenario. The nodes move based on random way point mobility model with a speed between 1 and 4m/sec, which mimic the human speed. For each simulation, the number of random source and destination connections is chosen as 10 and generates 4 data packets/second. Figure 7 shows that the over head by the competitive protocols increase with the number of nodes. The proposed protocol handles the scalability and applicability issues even the number of nodes are increased. This is due to the fact that the number transmitting nodes are drastically reduced by having one-hop neighbour participating in transmission. As a result a number of large duplicated and dropped packets are reduced.

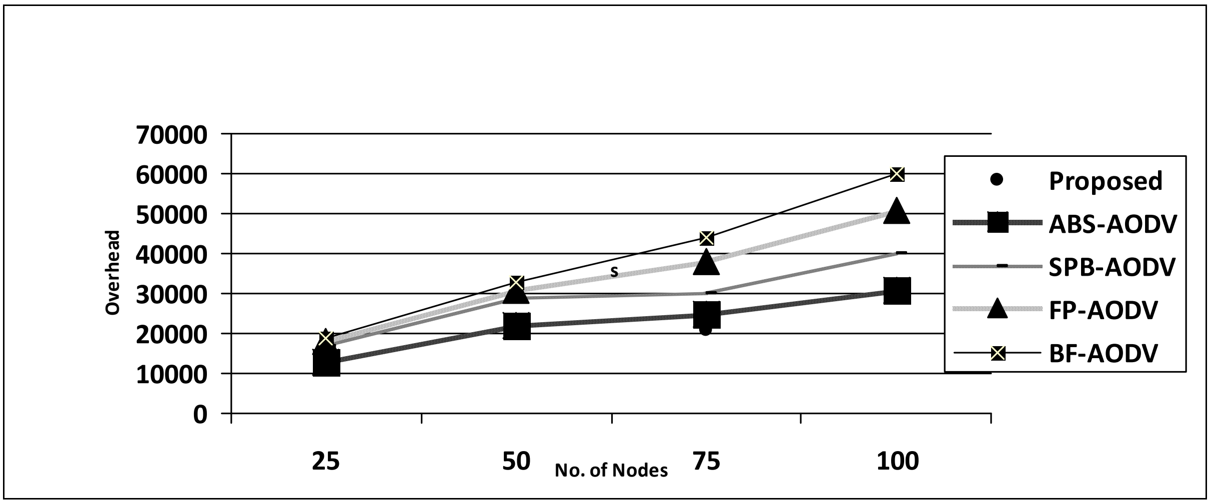


Figure 7. The effect of the network density on the overhead.

In Figure 8, we present the collision rate of the proposed approach and is compared with some of the similar approaches as in Fig. 7. The collusion rate is reduced considerable compared all other approaches.

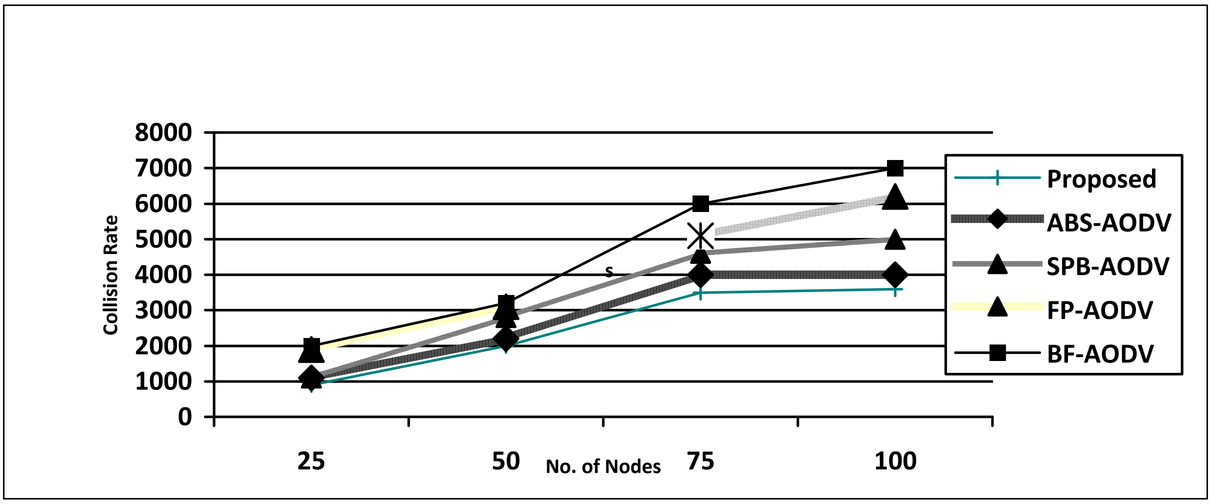


Figure 8. The effect of the network density on the Collision rate

In Fig. 9, we investigate the effect of traffic load for 5, 10, 20, 30 and 40 packets per second and measure the collision rate. From the figure, it is noticed that the number of collisions is increased with offered load and this is due to the fact that the number of RREQ generated increase with the load and disseminated packets also increases. Due to self-contention between the same shared transmission channel, most of the RREQ packets collide with each in the network. It is observed from the result that for an injection rate point, the proposed approach outperforms all the contemporary methods.

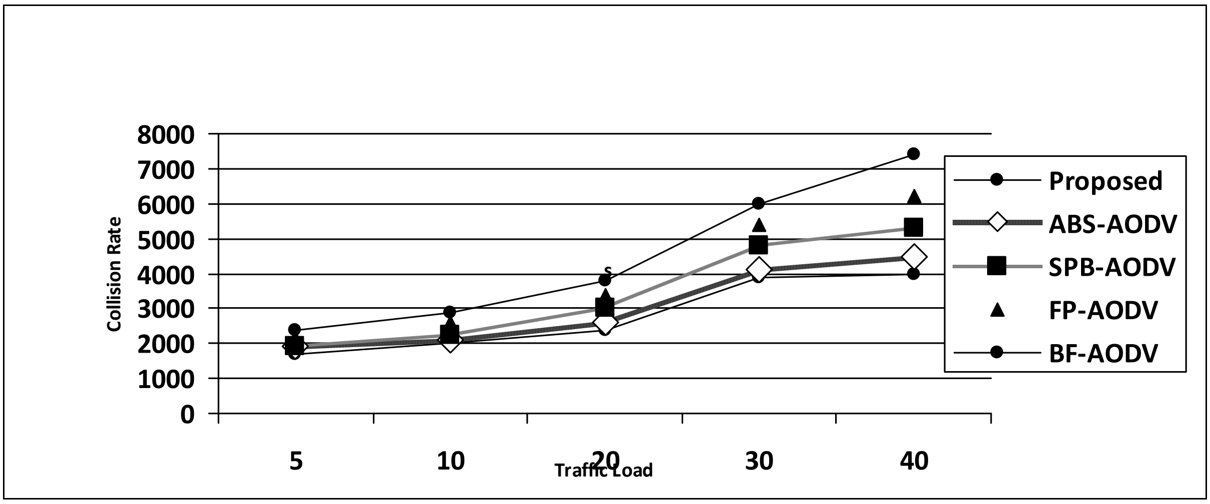


Figure 9. The effect of traffic load on the collision rate.

V .Conclusion

In this paper, we have proposed a broadcast approach for minimizing flooding and can be used for routing. The number of broadcast packet is minimized and reduces memory requirements by avoiding needless duplications. The proposed approach is scalable to large populations of nodes. The route to a destination may be returned by any intermediate node. In addition, the link breakages are reported immediately and routes are quickly re-established. The flooding overhead is reduced and the retransmission rate is improved. The distributed dynamic routing is simplified. The performance of the proposed approach is measured in terms of collision rate and overhead. The proposed approach performs well compared to the recently proposed counterpart approaches.

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