Integrated Selective and Optimize Broadcasting Method (ISOBM) for Mobile Ad-hoc Network

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***Abstract*– For the mobile ad-hoc network, flooding is mechanism of broadcasting messages between the nodes due to absence of pre-setup infrastructure. Flooding define as a method to broadcast control messages that assists routing protocols. In the flooding method, nodes that receive flooded message first time are responsible for rebroadcasted the message to others. Flooding occurs redundancy of packets in the network means each node receives multiple copy of same packet from the broadcasting node. This property of flooding leads broadcast storm problem that results redundancy in message retransmission, collisions, wastage of resources such as bandwidth, battery power etc.**

To control flooding, number of methods suggested that concentrate on different criteria and concerns. In this paper, a study has done on 1-hop neighbor knowledge based flooding methods. Also, a method is proposed based on 1-hop neighbor knowledge that named as Integrated Selective and Optimize Broadcasting Method (ISOBM). Proposed methods is experimental simulated in network simulator tool i.e. NS-2 considering several simulation parameters and evaluated by various parameters like routing efficiency, routing overhead, remaining battery power and good-put.

***Keywords:* Mobile Ad-hoc Network, Flooding, Methods of Flooding, 1-Hop Neighbor Knowledge Based Flooding Methods, ISOBM.**

I. INTRODUCTION

In the absence of pre-setup infrastructure, flooding is a fundamental method for broadcasting of the messages in the MANET. Flooding works on control packets to provide help for the routing protocols. Flooding method offer a node to receive flooded control packet Cp for the first time and rebroadcasted it once [1]. The working of flooding is illustrating in figure 1.

In figure 1, a network is considered of six nodes from A to G. Node A initiates broad cast of control packet Cp to node B and C. Node B receives packet from both node A and C, accept first received packet i.e. node A and discard later receiving for the same packet i. e. Node C. Similar process is follows for all the nodes of network to leads flooding operation. Discarded packet is indicated by red coloured arrow in the figure. Three black coloured dots indicate continuity of network or more nodes may exist in the network.

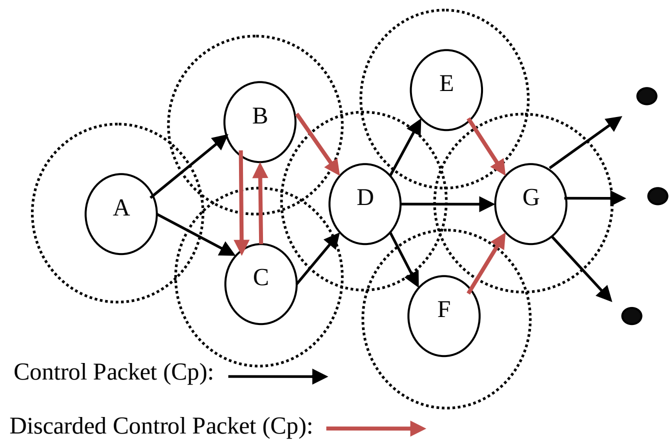

Figure 1: Flooding Method in MANET

Mobile ad-hoc network device have limited resource constraints such as bandwidth, battery power and transmission range. Flooding occurs redundancy of packets in the network means each node receives multiple copy of same packet from the broadcasting node. This property of flooding leads many issues in the network. These issues elaborated below.

- Unnecessary consumptions of battery power of nodes.
- Lead high routing overhead and cost as well as low performance of routing protocol.
- Lead less lifetime of networks.

II. 1-HOP NEIGHBOR KNOWLEDGE BASED FLOODING METHODS

1-hop neighbor knowledge method offers local connectivity knowledge of each node in the network. Means, every node contains records of its single hop i.e. 1-hop neighbor information. Each node collects the information of its 1-hop neighbor through transmitting receiving HELLO packet at the MAC layer using MAC layer protocols [2].   A major issue in the schemes that use 1-hop or 2-hop information is the selection of a subset of neighbors for forwarding the flooding message. There are two strategies for choosing forwarding nodes:

- **Sender-based-** In this strategy, each sender nominates a subset of its neighbors to be the next hop forwarding nodes. The schemes proposed in [3] [4] [5] are sender-based
- **Receiver-based-** Unlike sender based, in this each receiver of a flooding message makes its own decision on whether it should forward the message or not. The schemes proposed in [6] are receiver-based. Forwarding nodes choosing strategies shown in figure 2.

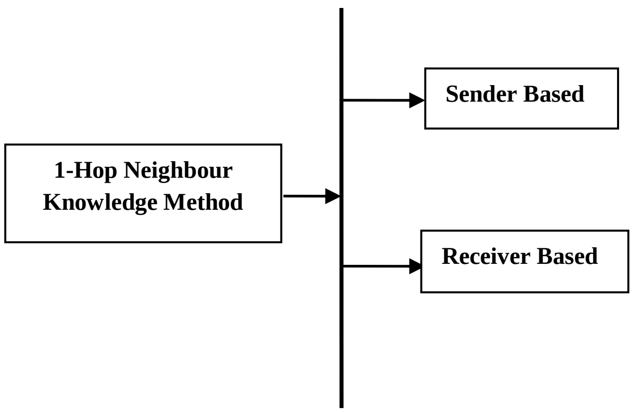

Figure 2: Types of 1-hop Neighbour Knowledge Method

Flooding with self pruning (FSP) [7] were the first receiver based method in which sender forwards flooding message with enclosed list of its entire 1-hop neighbour to the message. A receiving node match its own 1-hop neighbour with node list in the message, if all its 1-hop neighbour included in list then it was not forward the message otherwise it forward the message as a sender.

At other site, a flooding method was proposed that named vertex forwarding [3] which also tries to minimize the flooding traffic by leveraging location information of 1-hop neighbor nodes. It is a sender-based algorithm which assumes a hexagonal grid in the network field to guide the flooding procedure. When a node has a message to flood out, it assumes that it is located at a vertex of the virtual hexagonal grid, and the neighbors located at the adjacent vertices will be selected to forward the message. If there is no node located at these vertices, the nodes that are nearest to the vertices in terms of hops will be selected to forward the message once.

Another flooding method was proposed that known as efficient flooding (EF1) based on 1-hop neighbour information [8]. In this method forwarding node selection strategy was sender based. It was also referred as light weight in context of overhead. This method worked in three phase named as forwarding node selection, forwarding node optimization and mobility handling.

III. NOTEWORTHY CONTRIBUTIONS

Previous section described about 1-hop neighbour knowledge based flooding and its conventional methods. Apart from the conventional methods for efficient flooding based on the 1-hop neighbour knowledge, many efforts have been put by researchers to enhance the efficiency and effectiveness of these. This section presents some efforts that have putted in this direction.

Selective rebroadcasting method is extended by a method named as Mistral [9] that balance between message overhead and reliability through compensating for messages that are not rebroadcast. This compensation is based on a technique borrowed from forward error correction. Every incoming data packet is either rebroadcast or added to a compensation packet. The compensation packet is broadcast at regular intervals and allows the receivers to recover one missing data packet.

An efficient and reliable method was presented that named as ASTRAL [10]. This method use two recovery method is Forward Packet Recovery and Backward Packet Recovery. There were some assumptions defined about topography of nodes, transmission range, velocity and medium access control protocol. In this node are placed at 2D plane and uniform transmission range of nodes was considered.

A new one-hop broadcasting algorithm, know as an Efficient Reliable one-hop Broadcasting (EROB) [11] was presented that guarantees the completion of one-hop broadcasting, i.e., all nodes in the source's transmission range will receive the broadcast message. In this method, two type of packet were used that control packets and data packets. Data packets contain the data to be one-hop broadcast, and control packets are used to enhance the efficiency of the data packet transmission. Although control packets may not be essential, the network throughput is usually higher with them due to their control over packet collisions.

An adaptive scheme for information broadcasting [12] was proposed which allows nodes to select an appropriate action, either to rebroadcast or to discard receiving messages. The decision is based on the amount and timestamps of received messages. The proposed scheme is based on results from recent studies stating that there is no benefit to rebroadcast the same message after hearing it k times when k>4, because the expected additional coverage area is below 5%. In this scheme, information received by neighbors is used to inhibit some nodes from rebroadcasting by selecting the appropriate action (i.e., rebroadcast, discard). The principle of this scheme is described as follows. Unlike other proposed schemes from literature that select between two actions, the proposed scheme adds another action, named wait, in addition to discard and rebroadcast actions. In other words, when a node receives a broadcasted message, it uses neighbors' knowledge to determine an appropriate action by adding another one (the wait action). Selecting this action gives each node the chance to select a successful decision of whether to rebroadcast the message or discard.

A novel method was proposed [13] named as Global Queue Pruning method, which limits the overhead of the transmission and provides assurance of the delivery of the messages to every node in the network. The developed algorithm creates the logical topology that consists of lower number of forwarders in comparison to the previous methods, the paths are shorter. In this method, at the initial phase every node sends to the known, control node the list of its 1hop neighbours. The global queue of potential forwarders is created, arranged by the weight. At the beginning every node is a potential forwarder as it can be considered as the forwarder.

In the 2017, a method is proposed that know as Selective Epidemic Broadcast Algorithm [14] to suppress the Broadcast Storm Problem and to improve the Emergency Safety message dissemination rate through a new BSSA based on Selective Epidemic Broadcast Algorithm (SEB). This is suppress the broadcast storm by spreading the message only to selective vehicles which later rebroadcast the messages, resulting in lesser messages being sent. The vehicles are selected based on the Passive Acknowledgment from the neighbors, which are reply messages from the neighbor list named as Emergency Broadcast Neighbors (EBN) located within the transmission range of the source vehicle.

IV. PROPOSED METHODOLOGY

To control broadcast storm problem and make efficient broadcasting, here a method is advice that refer as Integrated Selective and Optimize Broadcast Method (ISOBM) based on 1-hop neighbour knowledge. Reason behind the named of this method is it uses both sender and receiver based concepts to choose suitable neighbours for message forwarding. Earlier methods concentrate only one sender site or receiver site. Each method has some features and consequences. In advised method, efforts putted to gather feature of both type of methods. This method is applicable to adaptive nature and limited resource constrained of the network.

ISOBM method works in two phases to accomplish selective broadcasting and optimize 1-hop neighbour forwarding list.

In the first phase, sender nodes of network choose some 1-hop neighbours for message forwarding. To choose neighbours, sender use available battery power and velocity of nodes. Those nodes that have enough battery power and less velocity with compare to other neighbours, includes in list of forwarding nodes. Here, sender nodes broadcast forwarding list also with the message to further optimization. This procedure applies to all the sender of network.

During the second phase, receiving nodes of broadcasted messages decides to further message forwarding to which or which not neighbours. The decision makes via optimization of forwarding neighbour list received by sender. To optimize the list, receiving nodes match the neighbour list of message with its own neighbours. Common neighbours are deleting from the list and forward message to rest neighbours of the list.

ISOBM use additional field information such as battery power status, velocity and neighbour list which added as separate field in the original HELLO message. After the addition of these fields HELLO message show in figure 3.

Source Node ID	Hello_Int	Ref_Int	VLT	Seq No	Neighbor 1 ID	BP	Vel	Neighbor List	Options

Figure 3: Updated HELLO Message Format

Proposed method use information gather during the exchange of updated HELLO message by the nodes of network. Each node forwards HELLO message to all its 1-hop neighbours with available battery power, current velocity and neighbours list. Therefore, every receiving neighbour keeps information from received HELLO messages to take further decision for broadcasting of messages.

A. Algorithm

An algorithm is designed for the proposed method i.e. ISOBM works in two phase apart from the neighbors discovery via Hello Message. Several nomenclatures are used in the algorithm.

```
Algo ISOBM (N[ ], id)

{

DECLARE i, j, BP[ ], Vel[ ], Neigb_id[ ], Neigb_List[ ], Sender;

// Neighbor discovery process initiated through exchange of Hello Message

Repeat i=1 to n

    {

        Send (hello, Node[i], Node [i+1]);

          Node [i+1]= Neigb_List[i];

        /*Keep information about battery power, velocity and neighbor list of node i from hello message received at node i+1 */

        BP[i]=Receive (hello, Node[i+1], Node[i])

       Vel[i]=Receive (hello, Node[i+1], Node[i])

        Neigb_id[i][j]=Receive (hello, Node[i+1], Node[i])

/*Now, phases of method is work based on the node is sender or receiver of broadcasting message*/

      If (Node[i]==Sender)
```

```
{
  If (BP[i+1]>BP[i+2] && Vel[i+1]>Vel[i+2]….)
  {
    Node [i+1] chooses as forwarder neighbor
  }
 Else
  Node [i+1, i+2,..] chooses as forwarder neighbors
 }
Else
 {
  // For each neighbor of node i repeat upto m
  Repeat j=1 to m            // Here m represents number of neighbors of node i
 {
  If (Neigb_id[i][j]==Neigb_id[i+1][j])
   //Neighbor j of node i deleted from the neighbor list
   Neigb_List[j].delete();

Else
  Neigb_List[j];
}
/* Check if neighbor list is not empty then follow first phase to choose forwarder nodes among multiple neighbors*/
  If (Neigb_List[]!=NULL && BP[j]>BP[j+1] && Vel[j]>Vel[j+1]….)
   {
    Node [j] chooses as forwarder neighbor
   }
  Else
  Node [j, j+1, ...] chooses as forwarder neighbors
 }
}
}
```

V. SIMULATION AND RESULT ANALYSIS

ISOBM is experimental accomplished in network simulation tool named as NS-2. This is simulates to consider different parameters of the network such as type of antenna, propagation model, connection type, number of mobile devices as nodes, traffic type, mobility model, energy model etc.

A. Simulation Scenario

Proposed method simulated considering mobile ad-hoc network with consists of 100 numbers of nodes. In the simulation, nodes play role of sender, receiver and relay or forwarder. The different scenarios occurred during the simulation of methods results in below figures.

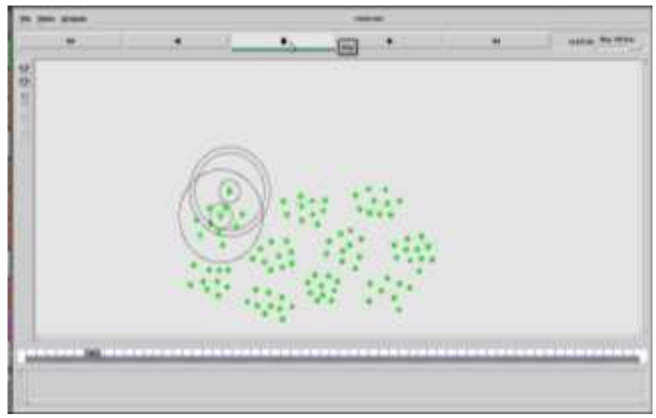

Figure 4: Simulation Scenario of ISOBM Method

B. Result Analysis

Simulated method results in various aspects which are presents in this section. Proposed method is evaluates in different evaluation metric of network like routing efficiency, routing overhead, good-put, remaining battery power of nodes.

Routing Efficiency- Efficiency of routing protocol is determined by number of data packets transmitted upon the total number of packets includes data and routing both packets. Figure 5 shows routing efficiency of the ISOBM that compare with pure flooding method.

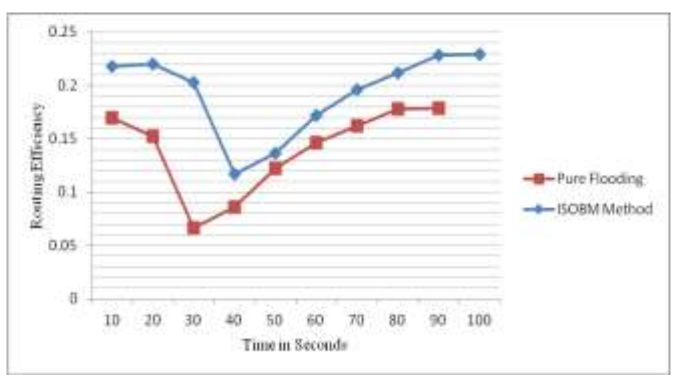

Figure 5: Routing Efficiency Graph

Routing Overhead- Number of routing packets used to route discovery and maintenance refers as routing overhead. Figure

6 show routing overheads of ISOBM compare with pure flooding method.

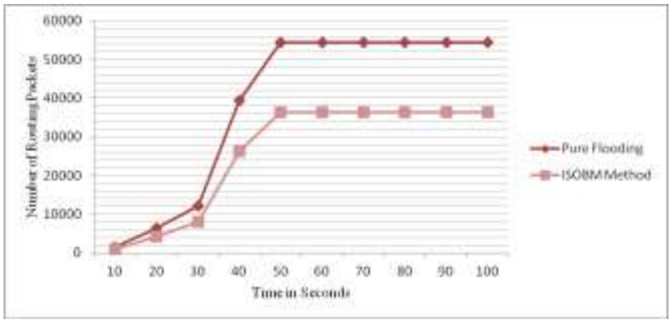

Figure 6: Routing Overhead Graph

Remaining Battery Power- Each node has battery power as a resource to participants in the network communication. After the completion of communications rest power of each node refer as remaining battery power of nodes. Figure 7 shows remaining battery power of nodes where ISOBM used that compare with pure flooding method.

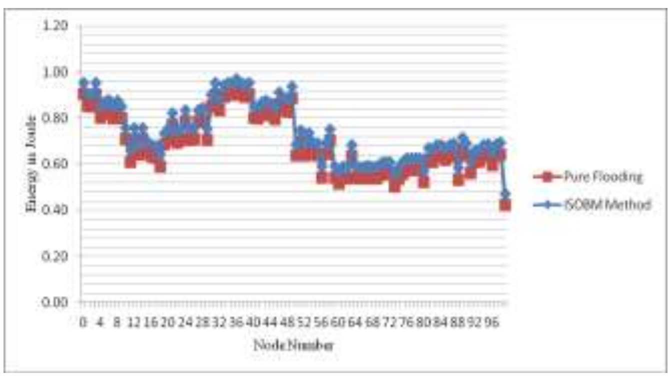

Figure 7: Remaining battery power graph of nodes

Good-put- Good-put is the network performance evaluation parameter which is determined through number of received data packets out of the total packets i.e. control and data packets at the receiver. Figure 8 shows good-put of the ISOBM that compare with pure flooding method.

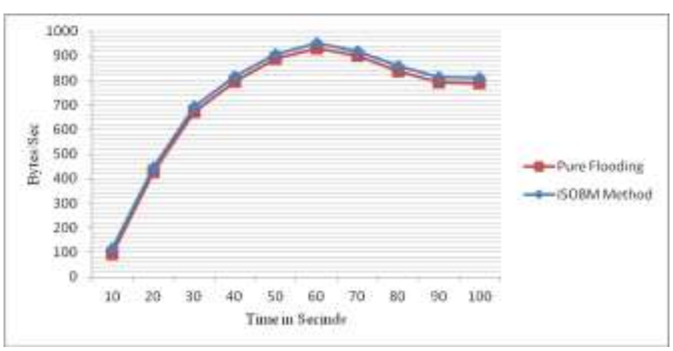

Figure 8: Good-put Graph

VI. CONCLUSION

Flooding method plays vital role in broadcasting of messages between the nodes in mobile ad-hoc network. It also offers routing procedure that uses by number of routing protocol. Inversely, flooding methods occurs redundancy of packets in the network means each node receives multiple copy of same packet from the broadcasting node, collisions and wastage of resources such as bandwidth, battery power etc.

Proposed method tried to control traditional flooding impact by the use of 1-hop neighbor knowledge. Proposed method results good routing efficiency, less routing overhead and considerable good-put.

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