Environs Aware Broadcast Mechanism for Community Radio Service on an Ad hoc Device-to-Device Mobile Network

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Abstract – Each device in a MANET (Mobile Ad Hoc Network) is free to move independently in any direction. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Audio message send from one device to the entire network devices. Using static and dynamic topology. When the mobility is high using SBA (Scalable Broadcast Algorithm) and the mobility is low using MaBA (Memory aided Broadcast Algorithm) Using the above algorithm drawbacks are overhead and latency and packet loss .And this drawbacks are overcome using EABA (Environs Aware Broadcast Algorithm) Using this technique the node only decide to use either SBA or MaBA depending on network condition. The performance metrics are reachability and packet delivery ratio to be analyzed in EABA algorithm.

Index Terms – MANET, Scalable Broadcast Algorithm, Memory aided broadcast Algorithm, Environs Aware Broadcast Algorithm.

1. INTRODUCTION

Mobile ad hoc networks (MANETs) consist of wireless enabled mobile nodes that not only communicate with each other but also act as intermediaries for nodes that are out of direct range from one another [11]. A message from a source node might travel through multiple nodes before reaching the destination node.

The mobile phones are to create local telephony without require any phone tower or other expensive supporting infrastructure. Community Radio service can use this feature. Using device-to-device (peer-to-peer) model the user is creating and broadcast the content to the entire network device (node). This is called decentralized model and it also ensures that the content consumers and that content consumers are content creators and content providers. Using MAC layer to send data packet done the broadcast occur some random delay that is equal to jitter. And clear the broadcast using Interface Queue. While using interface queue the redundant packet will be broadcast. Simulation using probabilistic scheme that is similar to flooding and nodes only rebroadcast in the predetermine probability.

2. RELATED WORK

The dominant pruning algorithm [3] find the forwarding nodes using greedy algorithm and it maintains only the one hop knowledge only. The selector forwarder node does not need to rebroadcast the message between 2 hops [3].

Local deterministic broadcasting algorithm aim to form connected dominating set. Therefore the minimum number of required broadcast is less than that means does not exceed the size of connected DS [10].

- The Existing deterministic broadcasting protocols.

2.1 The Existing deterministic broadcasting protocols

These existing broadcast schemes can be classified into four broad categories that are (i) Flooding (ii) Position based method (iii) Neighbor knowledge schemes. And the flooding is too inefficient and position based methods need special topology like GPS enabled devices. And this neighbor knowledge algorithm using SBA and it is one of the best options for broadcasting in a mobile ad hoc network.

The work of SBA protocol is SBA works well in a dynamic topology is because each node maintains up-to-date 2 hop knowledge about its neighborhood via hello messages [10]. A rebroadcast after a small delay is called RAD (Random Assessment Delay).RAD is essential for SBA's function. Using SBA the overheads are increased. To avoid this overhead using MaBA. In SBA broadcast algorithm [10] consist two parts that is Local Neighborhood discovery and Data broadcasting. And Local Neighborhood Discovery consists two parts: 1. Neighbor discovery. 2. Topology Management [10]. Neighbor discovery is performed when the node has no clue about the structure of its immediate surroundings. In particular, the node is unable to perform any useful task. When the node performs topology maintenance, it can perform topology maintenance together with these neighbors in order to consume less energy [10].

The redundant transmissions may cause a serious problem, referred as the broadcast storm problem in which redundant packets cause communication congestion and contention. Total dominant pruning and partial dominant pruning [3] used the broadcast algorithm.

In SBA the data broadcasting consists the steps are:

- For source node s, it just broadcasts messages to all its neighbors and ignores duplicate messages received later.
- For any other node , say u, when it receives a broadcast message m from node r ,it performs the following operations:

(a) If N (u) ≤ N(r) U {r}, then no rebroadcast need be performed and the duplication received later will be dropped.
(b) Or else, if the message is received firstly, then let C (u, m) = N(r) U{r}, and schedule a rebroadcast by delaying the rebroadcast operation for a random period. In this period, any successive duplicates will be discarded, and at the mean time the information of the nodes covered by the transmissions will be recorded in the broadcast cover set. That is, if m is a duplicate, then let C (u, m) = C (u, m) U N(r) U {r}, and discard m.
(c) After the delay period is expired, if N (u) ≤ C (u, m), then cancel the rebroadcast; or else, rebroadcast the message m. The duplicate messages received later will be ignored.

When the node send the hello message to each other and that two nodes are discover to each other and that two nodes are communicate and do not know about another node.

Suppose A0 node receives a broadcast message 'alpha' node A1 then node A0 can find out all the neighbors of node A0 and that the 'alpha' message should be scheduled for rebroadcast after a small delay is called RAD (Random Assessment Delay) also some nodes are received the duplicate message. Also the node A0 again determine if any new node receive that the rebroadcast message. Suppose the neighbor node of A0 does not have the rebroadcast message means at the end of RAD the message is rebroadcast. Ad hoc broadcast protocol also uses two hop neighborhood knowledge. Simple flooding is highly in dense networks. The protocol is well suited for highly mobile node in sparse network. And introduced CGnet swara net all the peoples are communicated.

Neighbor knowledge schemes used the community radio service: (1) the rural ad hoc network many nodes are in semi-static or static and dynamic. SBA done in the dynamic network also semi-static and static network does not need to change the topology constantly. Because SBA work well in the dynamic topology because each node maintains always two nodes knowledge about its neighborhood via hello messages. And there hello messages create the overhead on the network. When the network is semi-static or static that time automatically reduce the overhead.

(2)High latency is also reducing the quality of audio stream. Here the SBA is also introduced the RAD component. So the SBA knows to use the significant amount of latency. Also the RAD is very important for SBA functioning. And the algorithm does not use RAD component means could achieve the lowering of latency and jitter of the packets in the broadcast.

(3)The node sends to the stream of message means that time the node must know the nodes past behavior and nodes past behavior consist whether the node in static or dynamic network. These all are same in the memory aided broadcast algorithm.

When the network mobility is changed that is static and dynamic. The SBA is unsuitable as the broadcasting algorithm for a community radio service. Using some algorithm in lesser overheads can be as or more effective than SBA. And this new algorithm is called Memory aided Broadcast Algorithm (MaBA). Using this algorithm the node remembers its past behavior and it's to decide whether the node is rebroadcast the message or not. Using MaBA some advantages are occurring. (1)Lesser network congestion due to lesser number of hello messages.(2)Lower latency and jitter because of not using the RAD component.(3)Increased efficiency because of exploiting a node's memory past behavior.

To calculate the Uncovered Neighbor set U(ni) of node ni using

$$U(ni)=N(ni)-[N(ni)]\cap N(s)]-s \qquad 2.1$$

Where N(s) and N(ni) are the neighbors sets of node s and ni. And s is the node which sends on RREQ packet in node ni.
Before that calculate the rebroadcast delay Td(ni) of node ni.

$$Tp(ni)=1-\{(|N(s)\cap N(ni)|)/(|N(s)|)\}$$
$$Td(ni)=MaxDelay * Tp(ni) \qquad 2.2$$

Where Tp(ni) is the delay ratio of node ni and MaxDelay is the small constant Delay.
And calculate the additional coverage ratio (Ra(ni)) [1] of node ni.

$$Ra(ni)=\{(|U(ni)|)/(|N(ni)|)\} \qquad 2.3$$

Where U(ni) is the uncovered neighbor set of node ni and N(ni) is the neighbor set of nodes ni.

3. PORPOSED MODELLING

The protocols of Ad-hoc-On-demand Distance vector Routing (AODV) [13] and Dynamic Source Routing Protocol (DSR) all are proposed in MANETs. And the above two protocols

are in the demand routing protocol [1],[3] and those are improve the scalability of MANETs and its decrease the overhead.

The proposed mechanism called Environs Aware Broadcasting Algorithm(EABA) each node is independently decides to use either SBA or MaBA broadcasting algorithm and depending on the network condition and the position of the current data packet. The nodes past behavior using the position of the current data packet. Every new source of node to discover a new set of routes using a neighbor knowledge scheme like SBA and the data packets are stored and using the MaBA approach.

SBA variant is called SBA-mob. The EABA to achieve a better performance. Using EABA to reduce the significant savings in node-to-node packet latency and significant reduction in jitter. Both latency and jitter are the metrics for audio application. EABA perform in the congested network. And the EABA performance does not affect the packet delivery ratio and the reachability of the broadcast of audio application.

3.1. Protocol implementation and performance evaluation

In our proposed method Environs Aware Broadcasting Algorithm (EABA). And this EABA consist two modes in which a node can broadcast that is SBA and MaBA. Depending on the mobility in the network and the position of the packet in the broadcast stream our EABA to choose the SBA or MaBA algorithm.

At each node deployed four strategies in EABA that is (1)Mobility detection (2)Adapting the frequency of hello messages(hello message interval) (3)Maintaining and using the nodes recent history of broadcasting behavior and (4)Decide the mode that is which node to use SBA or MaBA.

3.1.1 Mobility Detection

A node has to modify its behavior depending on the degree of mobility in the network and that each node maintains some measurement is called the mobility factor called mobf which is its local network or dynamic network. Every node to calculate the mobility factor by keeping track of changes to its neighbor table. To create the neighbor table of a node indicates a rapidly changing network topology and in the high degree of mobility. And stable network table indicates that the network is static or the node is very least mobility in the network. And the relative stability means that a bunch of nodes are more directly in the same direction at the same speed. A node does not need to rediscover its neighborhood and the node's same rebroadcast paths and all the nodes are discovered earlier and it can be reused and this is the primary assumption in MaBA.

The architecture diagram for Environs Aware Broadcast Algorithm is shown below.

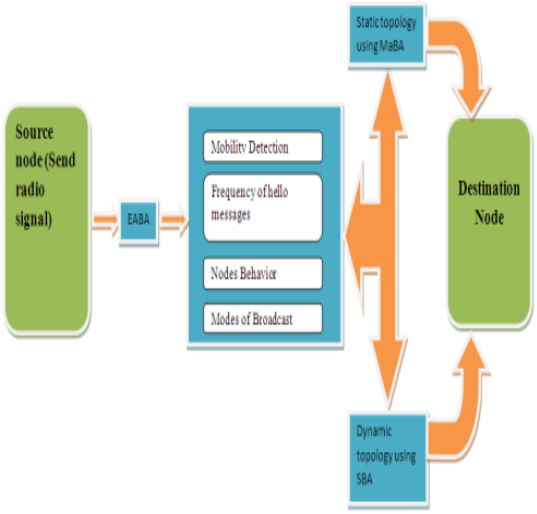

Fig 3.1: Architecture

Both static and dynamic the current neighbor table is compared in the relative mobility in the network. And each node to calculate the mobility factor. The node in SBA protocol each node periodically broadcast the hello messages to all its neighbors in the network. Using the hello message each node to build the neighbor table. And the mobility factor of each node is calculated every T seconds and its comparing the current neighbor table and also that was recorded every T seconds. If mobf=0 for a particular node and that node denotes is in the stable network and then the mobility factor is calculated from its neighbor table information. Also unknown nodes are also receiving the hello message. For each node in the neighbor table the time of the latest hello message that was received from the neighbor and it also recorded. And the neighbor table is refreshed every R seconds. And all the nodes information's are stored also stored the nodes current and last time from the neighbor node is greater than the refresh interval.

The calculation of the mobility factor is

$$mobf(Node1,t+T)=(Neighbors(Node1,t+T)U\ Neighbors(Node1,t)-(Neighbors(Node1,t+T)\cap Neighbors(Node1,t)) \quad 3.1$$

Where

mobf (n , t)=mobility factor of node n at time t.

Neighbors (n , t)=set of neighbors in the neighbors in the neighbor table of node n at time t.

Before that calculate the mobility factor find out the connectivity factor that is

$$Fc(ni)=\{Nc/(|N(ni)|)\} \quad 3.2$$

Where Fc(ni) is the connectivity factor, Nc is equal to 5.1774 log n and n is the number of nodes in the network. And when |N(ni)| is less than Nc and Fc(ni) is greater than 1.

The refresh interval R should be set the value is at least twice or thrice the value of the hello message interval. And that past node history is deleted every refresh interval that means the node deleted for at least two or three hello cycles. Means the node deleted for at least two or three hello cycles. And to minimizes false deletion from the neighbor table and done the packet drops due to the congestion in the network. And that refresh interval R is combined with the hello message interval f and at the initial stage R is combined and then changed and these are all done in the EABA.

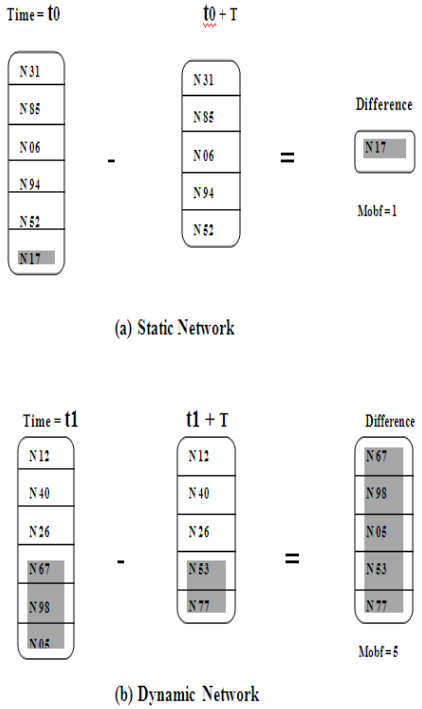

Fig 3.2: Calculation of mobility factor

3.1.2 Frequency of hello messages

The SBA needs periodically the hello messages that only possible the nodes in the local network. And the node however to create a significant overhead based on the network mobility. When the nodes are in the static or semi-static network that times the nodes does not make continuously change the neighbor table. Based on the calculation of mobility factor periodically decrease the frequency of hello message for the mobility factor is > M and where the M is a threshold value. To satisfy this condition means every one second the hello message is sent. And at the another case the mobility factor decrease means the hello message interval is increased using the formula is

If mobf ≥ M then hello message interval = 1 second
Else hello message interval = M − mobf 3.3

Where M is the threshold mobility factor.

For example, assume M=5 and mobf=0 for node n in the static network hello messages are created every 5 seconds. When the mobility factor value is 5 that time the frequency of hello message is increased to one second. The last two hello cycles are not deleted. Suppose the nodes hello message is missing from the neighbor table others does not deleted. The hello message interval is refreshed every D seconds.

The calculation of R
If mobf ≥ M then R=M
Else R= 2M – mobf 3.4

Hello message interval is refreshed every twice and increase the network steadily.

3.1.3 Nodes Behavior

Each node maintains a recent history of its broadcasting behavior. And take the current broadcasting decision using MaBA algorithm. In SBA each node maintains two node knowledge of its neighbor node. In the EABA each node maintains the neighbor table. And the list of broadcasting decisions said where 0 denotes 'not broadcasting' and 1 denotes 'broadcasting' from the recorded history of nodes.

Each node maintain the broadcast history. Here sent the message to everyone and save the broadcast history. Neighbor table B looks like this means when node A have 0 means that time collision is occurred at the case of two that is D have all are 1's that means the connection is fully qualified.

Neighbors	History
A	10010
D	11111
F	01100

Fig 3.3 – Calculation of Neighbor table

At first A have 5 bits the first bit is broadcast then second not broadcast that means A is out of direct range from B. Also D has complete connection in 5 bits. F node loss the connection at the first attempt that is first bit. The above table defines the node B rebroadcast twice time and dropped the packet three times. Similarly the broadcasting history is maintained for each at every R seconds. When the node receives the data packet at first time immediately the node to decide whether the node to use the SBA or MaBA broadcast algorithm.

Using the algorithm to decide whether the node to broadcasts or not. The recorded history using the notation is N (i) where N is the source node and the data packet is received from node and i denotes the recorded history and I ranges from 1 to x.

If N (x) =1 or sum (N(1)…… N(x-1))>x/2
Then broadcast packet , else drop packet. 3.5

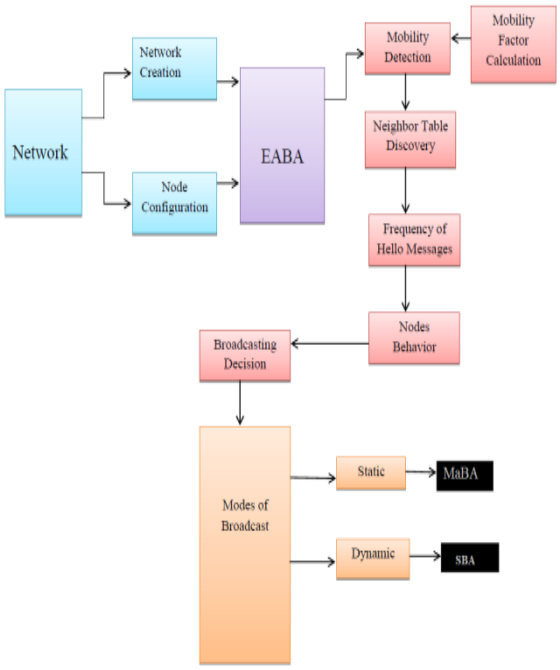

Fig 3.4: Detailed Design of broadcasting

Using the nodes recorded history the nodes past behavior consume the node is broadcast or not. Using SBA achieve more reachability. The nodes recent history is stored using the sufficient bits 5 that means the value of x=5 in our simulations. The nodes last five actions is 00000 means the node in the network will continuously drop the data packet. And that time the node might switch the algorithm from MaBA to SBA and then might transmit the data packets. Also SBA does not rely on past behavior.

3.1.4 Deciding the node: SBA or MaBA:

Finally the node to decide between SBA or MaBA as the broadcasting algorithm. The node in dynamic network the node is used SBA algorithm. And the MaBA algorithm is used when the node is static or semi-static network. In the static or semi-static network the same path can be reused to send the same data packet. When a new source node start to send the new data packet and that node does not have the past memory behavior and node to choose a new set of routes from a new source to every node in the network. Nodes have the history means that node is already used that means node is not a new source node. And all the nodes to discover the new set of routes. Even if the network is static means a node should use SBA for the first some messages in the data packet and then use MaBA for the rest of sending data packets.

The nodes mobility factor is greater than 0 or at the data packets beginning stage using SBA algorithm else some other case using MaBA algorithm.

4. RESULTS AND DISCUSSIONS

In our simulations all the mobile devices are assumed a uniform range for communication and increase the sufficient amount of throughput.

Position Of Message In Audio stream		Nodes to be discover the route	Nodes routes are not constantly updated
	At Beginning	Algorithm: SBA	Algorithm: SBA
	Non Beginning	Nodes all are in Stable network Algorithm: MaBA	Nodes routes are constantly updated. Algorithm: SBA
		Very low	Medium or High

Fig: Degree of network Mobility

Fig 4.1: Node behavior

4.1 Modeling a rural village

In the village area have the population is very high. More than 200000 villages have a population under 500 persons and more than 4000 villages have a population is greater than 10000 persons. In our application the traditional communication infrastructure is not exist. In our simulation typically tend to the village. In our simulation assume 100 mobile phone users and assume that are in 400 kilometers. The typical mobility pattern in a village can be divided into four phases of an ad hoc network. (1)A highly dynamic place but the short area in the morning when almost the peoples are communicating to their place of work. (2)A static network but the long area for more the seven days when they are working. (3)And a short area but very highly dynamic when most of the peoples getting back to the home and (4) Very stable or static at night time in the same area.

And the village population can be divided into four major types that is (1) Some peoples who live in or near the center of the village and that peoples live near in the main street of shops and joining with the residence. (2)Some people are live in near working place (3)Some people live in the village (4)Some people maintain the account for the village shops.

In the existing only consider the sable network. In the proposed consider the dynamic network mobility hence our

simulation have created our own mobility model to capture the dynamics of village level movements.

The mobility of node is divided into two modes that is static and dynamic and in the proposed if EABA algorithm is able to distinguish between a static and dynamic network and also adapted with it.

In the dynamic network place 30% of nodes are placed randomly with in the central square of size 750m * 750m and each node move to randomly choose the location within that central square place. Above mentioned the category a and b each 30% of node choose the route randomly. Another 30% nodes are start of from the central square but move towards the randomly choose the route.

The remaining 10% of nodes are randomly placed anywhere in the network and nodes move randomly choose location in the network area. This is done in the category d.Once all the nodes to reach the destinations and its stay their static network place and then during the next dynamic network place all nodes return to their original position.

4.2 Performance analysis

In our simulation using Ad hoc On-Demand Distance vector (AODV) routing protocol is used our proposed broadcast algorithm in EABA use the network layer used MAC and physical layer. Also the network layer use UDP and RTP of audio signal. IEEE 802.11 is implemented at the MAC layer and this is the default network layer used for voice is to send audio frames every 20ms and also check latency every time. The data packets are translate 50 packets per second and the packet size is 20 bytes in RTP, UDP and EABA required addition of 32 bytes.

From source node 12000 packets are transmitted and randomly a new node to choose every source node at the entire simulation network. Our simulation assume a threshold mobility factor is 5 and also the hello message interval ranges from 1 second to 5 seconds it's depending on the current mobility factor of the node. To avoid the packet loss using the maximum jitter is 250ms is applied the hello message interval. The neighbor table refresh interval ranges from 5 seconds to 10 seconds depending on the hello message interval. The value of mobility detection interval T is refreshed every 10 seconds. And the MaBA uses a small jitter for simultaneously broadcasting a message. The SBA not need to introduced jitter because the SBA using the RAD component.

4.3 Design of simulation and metrics for evaluation

Our simulation consist for distinct set, the first set have our proposed mobility detection scheme. The second set have our proposed broadcast algorithm that is Environs Aware Broadcast Algorithm and compare the performance to other broadcast algorithm. The third set consist various changes of parameters on the broadcast algorithm and the fourth set consist the variations of the mobility model and compare the performance of EABA.

Table: Simulation parameters

Network Size	1000m * 1000m
Number of Nodes	100
Data Payload	52 Kb
Range	400m
Average speed of nodes	1.43 m/s
Simulation time	150 seconds
Packet Rate	50 packets per seconds
Hello message interval	1 second – 5 second
Threshold Mobility factor (M)	5
Neighbor table refresh interval	5 seconds – 10 seconds
Mobility detection interval (EABA)	10 seconds

4.3.1 Simulation Set 1

EABA works well a node correctly detect the mobility in the network EABA evaluate how the broadcast algorithm done the mobility detection. In the static network nodes are mobile for 500 seconds. The node to detect the mobility between 500 seconds.

Whether using the EABA can detect the mobility changing. EABA achieve two metrics for simulation that is (i) Mobility factor described the different categories based on the area of node mobility. (ii)At the simulation the number of nodes using SBA or MaBA.

4.3.2 Simulation Set 2

Environs Aware Broadcast Algorithm its performance are comparing with other broadcasting algorithm of SBA, SBA-mob and flood. SBA-mob is the variant of SBA and where the local mobility network hello message interval is adapted. SBA-mob is similar to EABA while the hello message interval is same as that two approach. SBA-mob is exactly same as SBA that is two approaches maintains the history of two node neighbor knowledge. Based on that knowledge the node to decide whether the data packet is forward or not. Also the SBA –mob does not have neighbor history that time MaBA done the work. While the SBA-mob helps to

differentiate EABA and reduce the hello message interval. Every node to rebroadcast the every message and flood is so inefficient.

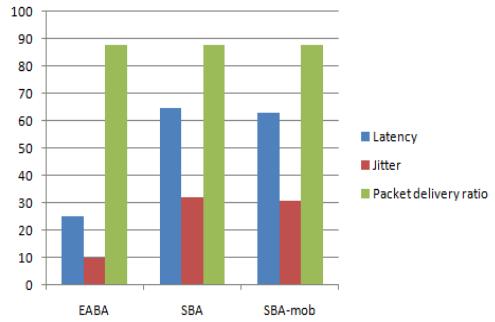

Fig 4.2: performance of audio application related metrics

Using the SBA and MaBA algorithm consist some metrics that contain two major groups that is (1) Broadcast related metrics and (2) Audio application related metrics. Then efficiency, reachability, bandwidth overhead are the broadcast related metrics. And latency, jitter and packet delivery ratio are the audio application related metrics.

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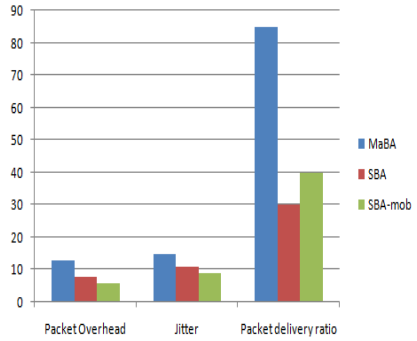

Fig 4.3: Performance of broadcast related metrics

Broadcast related metrics:
Efficiency:

The node to rebroadcast the message. Efficiency means lesser rebroadcast the message while node using the algorithm.

Reachability:

All the nodes in the network are received the message. The node packet loss is less than 100% is a better reachability.
Bandwidth overhead:

Some of the broadcast mechanism create the additional message that is all the node create the hello message. The size of hello message is similar to the number of neighbor node in the each node.

Audio application related metrics:
Latency:

In between the two timestamp the packet transmit delay is calculated. Suppose simulation have high latency means its affect the quality of audio stream.

Jitter:
Jitter is the variation of packet transmit delay. The jitter level is high means the network collision is occurred.

Packet delivery Ratio:
The percentage of data packet is receive the receiver that packet delivery ratio is greater than 95% means the simulation cause lower level of packet loss.

4.3.3 Simulation set 3

This simulation explained the various set of protocol based on the node in the network condition. Due to the power problem the community radio service done in the morning and evening two hours. And other common energy savings techniques in MANETs is (i)Put some percentage of nodes in the sleeping mode and (ii)Decrease the range of transmission that means set the small range of network. That two cases less energy is required for an individual node. In our simulation using the option 2 that is decrease the range of data packet transmission in the network.

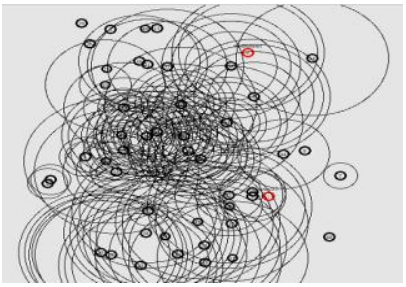

Fig 4.4: find mobility

Fig 4.5: select SBA or MaBA

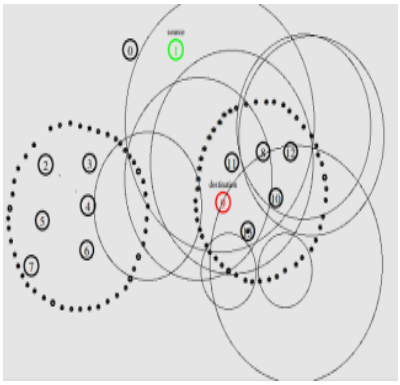

Fig 4.6: broadcast history

Fig 4.4 is only find the mobility. In this figure all the nodes are send the hello message to everyone and then the nodes are very efficient to send the data and act. All the nodes are send the hello message before data transfer. When considering the shortest path the nodes intermediate node will change. And then calculate the frequency of hello message that information are stored in the hellomsg.txt file. When the data transfer stop the hello message history will save.

Fig 4.5 is the calculation of mobility factor. And some nodes are affect the CBR traffic. Some of the node to send and share the message. Compare the mobility factor and the factor range is equal to one means its node will in mobile. Then mobility factor is zero the node is static. If the mobility factor is equal to one means then its follow MaBA. And otherwise its follow the SBA. If the node follow MaBA check the range and bright nodes are having mobility factor one and dull nodes are having the mobility factor is zero.

Fig 4.6 all the nodes are maintain the data transfer details also maintain the data transfer range. If ranges change the path of data transfer will lose. All the nodes are randomly send the hello message to other node and data as well.

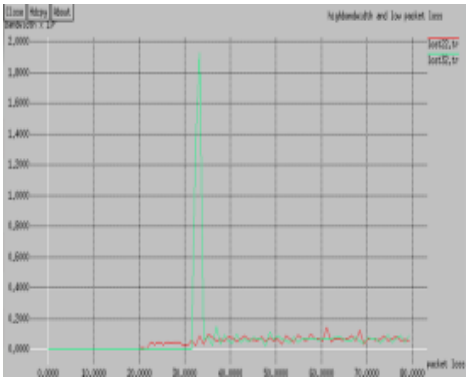

Fig 4.7: Comparison of SBA and MaBA graph

In this graph explain the performance of packet loss and packet delivery ratio and SBA contain high packet loss and low packet delivery ratio then MaBA contain low packet loss and high packet delivery ratio because the MaBA done the work in only static network place so the packet delivery ratio is increased.

4.3.4 Simulation set 4

The fourth simulation set described the village level mobility model based on the behavior of EABA mobility model using to test the broadcast algorithm. In the model some nodes are static and others are dynamic. In this simulation test the node movement.

Using EABA the mobility factor is low even during the dynamic phase and the mobility factor is high even during the static or semi-static phase. In EABA approach the mobility detection only decide to switch the SBA and MaBA. The threshold value of mobf>0 is to switch the static network and the threshold value of mobf>1 is to switch the dynamic network.

Whether EABA switch SBA or MaBA based on the value of mobility factor (mobf) and the position of data packet in the stream of node. SBA-mob performs better than SBA as the reduction of hello messages. And EABA does not use RAD and the performance between two hops.

5. CONCLUSION

In the village area traditional communication infrastructure is used to communicate the radio signal due to the economic reasons and the poor regions. In our simulation propose the Environs Aware Broadcast Algorithm (EABA) stored the broadcast behavior. Each node to calculate the local network mobility and stored in the each node knowledge stored in the neighbor table. When the network is dynamic a node uses SBA (but in the existing algorithm using SBA but occur high overheads) but the local neighborhood static or semi-static node switches the MaBA.

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