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EANKBB: Neighbour Designating Method for Broadcasting in Mobile Ad Hoc Network

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Abstract: An efficient broadcasting is required in wireless ad hoc network such that the hubs broadcasting the message form a connected dominating set to confirm the coverage. A small node set generated for broadcasting information without excessive overhead is said to be an efficient broadcast operation. In this study, an Environs Aware Neighbour-Knowledge Based Broadcasting (EANKBB) method is applied to network such that the underlying local information is collected by exchanging "hai" message and the broadcast history information. By allocating priority slot, EANKBB schedules the neighbours to send information by that network reachability is attained with minimum broadcast delay. The efficiency of broadcasting operation is attained by ranking the priority slots assigned to each node. The performance of this algorithm is analyzed based on the metrics such as delay, hop count, reachability, delivery ratio.

Key words: Broadcast, priority slot, sparse network, dense network, wireless, ad hoc network

INTRODUCTION

The MANET is the foundation less remote system (Zhang *et al*., 2013). It has remote versatile hubs that can speak with each other and furthermore, also go about as switches for hubs to course the movement frame one hub to other. A message from a source hub should go through number of hubs before achieving the goal hub. The gadget to gadget organizes that are without any brought together basic leadership substance is called as a MANET.

Every gadget in a MANET could see as a hub that can generously move toward any path severally and would thus be able to change its connects to elective hubs in many cases. Every hub ought to forward message inconsequential to its own utilize. In framework based remote system, every gadgets could communicate the message with each other or could speak with a wired system through get to point. In mobile ad hoc networks, a source node that transmits message to every node is known as broadcast. The network nodes are inadequate in energy in their wireless medium and the efficiency of broadcast operation is determined by the number of rebroadcast and network reachability. For improving the performance of the network, a new approach called environs aware neighbour-knowledge based broadcasting approach is introduced.

Initially, the density of network is calculated by the normal number of neighbours in the network. The node location is determined based on the transmitting node. The broadcast node may be interior or at the border. The border nodes are the node at the end of the coverage area of the transmitting node. The border nodes are given more priority than the interior nodes as it has more chances for transmitting the information to the uncovered nodes. The priority slot is assigned to all nodes and EANKBB schedules nodes on the network. Environs Aware Neighbour-Knowledge Based Broadcasting (EANKBB) method depending on the network density the network is considered as dense and the sparse network. Then the location of the node is identified by comparing its current location with the threshold value fixed. Then the priority slots are assigned to each node on the network. EANKBB method, checks its neighbours by sending simple hello messages to ensure the coverage of network. The nodes are then self-scheduled depending on identifying whether interior or border node.

Literature review: Various existing examinations in remote systems concentrated on communicating data. In the writing survey the disservices of broadcasting instrument in MANET were talked about. The impediments of unadulterated flooding plans are the communicate confusion and the communicate storm issue

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(Tseng *et al*., 2002). The telecom of bundles in MANET has been ordered through four general classes: simple flooding, probabilistic based plans, location based techniques and neighbour information based plans. In these four classes the neighbour information communicate plot is best for dynamic topology organize. Flooding and probabilistic techniques are awfully not productive and location or area based flooding strategy ought to have the area based data which may require uncommon gadgets like Global Positioning System (GPS). In simple flooding (Tseng *et al*., 2002): when the source hub communicates a bundle to all neighbours, each neighbour gets the parcel and thus rebroadcast the bundle precisely one time and this proceeds till all reachable system hubs have gotten the bundle. This plan accomplishes dependable communicate and multicast in exceptionally powerful system.

Probabilistic based flooding (Zhang and Agrawal, 2005; Sasson *et al*., 2003): This is like flooding yet in light of foreordained likelihood esteem the hubs just rebroadcast. Counter based flooding: the hub working under this plan with a counter can have an underlying quality one and sets a RAD (Random Assessment Delay) which is haphazardly picked, subsequent to accepting before hand concealed bundle. By utilizing the RAD, the counter is augmented by one for each repetitive message got and when the RAD lapses and the counter esteem is not as much as a limit esteem at that point the bundle is to be rebroadcast, else it is dropped.

Components: Simplicity and versatility to neighbourhood topology.

Zone based flooding (Suradkar and Surve, 2014): A hub can assess an extra scope territory (Zhang *et al*., 2013) in light of all got excess transmissions. This plan considers just the scope territory of transmission and not whether the hubs exist inside that range.

Separation based flooding (Tseng *et al*., 2002): The separation is ascertained and looks at between the hub and its neighbour hub that has already rebroadcast a given bundle. By accepting the data about beforehand concealed bundle, a RAD is started and repetitive parcels are stored. At the point when the RAD terminates the whole source hub areas are analyzed to check whether any hub is nearer than an edge remove esteem. In the event that exist the hub doesn't rebroadcast.

Area based flooding: Whenever a hub starts the transmission or rebroadcasts a bundle it adds its own area data to the header of the parcel. At the point when a hub at first gets a bundle, it should mindful of the area of the sender and computes the extra scope region. In the event that it is not as much as a limit esteem, the hub won't rebroadcast. Something else, the hub allots a RAD before conveyance (Zhang *et al*., 2013). On the off chance that the hub gets an excess bundle amid the RAD, it re-ascertains the extra scope zone and looks at that incentive to the limit. This happen until the point when the parcel comes to either it's booked send time or is dropped. Chatter based ad hoc routing (Haas *et al*., 2002) depicts where every hub communicates something specific with some plausibility to diminish the overhead of the directing conventions. Tattling shows double mode conduct in adequately vast systems in a few executions, the talk rapidly bites the dust and just barely any hub gets the message in the left finished executions.

Adaptable Broadcast Algorithm (SBA) (Ranganathan, 2011; Robinson and Rajaram, 2016): It is a two-jump neighbour learning based convention utilizing RAD. Every hub keeps up an incomplete system guide of all hubs inside a two-bounce span of itself. This can be accomplished by conveying intermittent "hi messages".

In order to develop an adaptive and efficient broadcast schemes to reduce the rebroadcasting the Environs Aware Neighbour-Knowledge Based Broadcasting (EANKBB) method is proposed based on the study of existing algorithms. Some of the algorithms are considered only dynamic network. EANKBB is suitable for both the dense and sparse network. To analyze the network, it is considered as sparse and dense area based on the no of neighbouring nodes and the node density. In order to apply this method need to have the instantaneous knowledge of network configuration (particularly, the number of mobile nodes present within the transmission range, network density, node location, number of neighbours) is required.

MATERIALS AND METHODS

Proposed work: The network model is designed with number of equal-sized nodes with unique identifiers, distributed randomly. The density of the network is calculating by determining the average number of neighbours of each node in the network. Depending on the network density the sparse network is categorized into sparse, medium sparse network, dense and highly dense network. Then the location of the node is identified by comparing its current location with the threshold value fixed. The nodes are assigned with priority slots such that no two nodes communicate the messages amid same need opening. A hub is secured if that hub has been as of now recovered the communicate message. The start node of a broadcast session is always covered. The uncovered node is a node which has not yet retrieved the broadcast message. The broadcasting node covers the maximum uncovered nodes on each transmission. Hence, each transmission deletes the maximum number of covered nodes with minimum transmission by that network reachability is attained.

An efficient broadcast algorithm should possess the features like nodes reachability, number of rebroadcasts, latency and neighbourhood knowledge. The existing approaches discussed in related research do not satisfy all the above features. The message should be transmitted only once so that the number of rebroadcasts is reduced considerably with low latency which was not achievable using broadcast storm problem. The gossiping approach do not satisfy the important criteria, i.e., node reachability. The features for an efficient broadcasting mechanism are satisfied by EANKBB algorithm. EANKBB's methodology prevents algorithmic limitations that affects broadcast scheme.

System model: In light of the quantity of neighbour of the hubs in the system, the system thickness is figured. This is utilized to decide the normal measure of neighbour of every hub in the system and furthermore, figure the base and the greatest number of the neighbour of the hubs in the system. In view of the recipe given underneath is utilized to decide the normal number of neighbours n-avg at a hub in the system at that need purpose of time is characterized by the connection (Bano and Singhai, 2012; Zhang *et al*., 2013) in Eq. 1:

$$\bar{n}_{avg} = \frac{\sum_{i=1}^{N} N_i}{N} \quad (1)$$

Where:

N = The aggregate number of hubs in the system

N_i = The measure of neighbours at a hub xi at a specific day and age

Let, Nx1, Nx2, ..., Nxk, be the quantity of neighbours at hubs x1, x2, ..., xk, separately with the end goal that N_i>(n)¯_avg where i is a positive whole number to such an extent that $i \leq k$, at that point decide the normal most extreme number of neighbours is characterized as (Bano and Singhai, 2012) in Eq. 2:

$$\bar{n}_{max} = \frac{\sum_{i=1}^{k} N_i}{k} \quad (2)$$

Then consider N_{y1}, N_{y2}..., N_{yr} are the number of neighbours at nodes y_1, y_2,..., y_r, respectively such that $N_i < \bar{n}_{avg}$ where i is a positive integer such that $i \leq r$, then calculate the expected minimum number of neighbours is defined (Bano and Singhai, 2012) in Eq. 3:

$$\bar{n}_{min} = \frac{\sum_{i=1}^{r} N_i}{r} \quad (3)$$

From the expected minimum, average and maximum number of neighbours of a node in a given topology scenario can enumerate the relationship (Bano and Singhai, 2012; Abdulai *et al*., 2009) as $\bar{n}_{min} < \bar{n}_{avg} < \bar{n}_{max}$ in Eq. 4:

$$\text{Density}\,\alpha = \begin{cases} \text{Low sparse if } N_x < \bar{n}_{min} \\ \text{Medium sparse if } \bar{n}_{min} < N_x < \bar{n}_{avg} \\ \text{Dense if } \bar{n}_{avg} < N_x \leq \bar{n}_{max} \\ \text{Highly dense if } N_x > \bar{n}_{max} \end{cases} \quad (4)$$

The node location is determined based on the transmitting node. When the source node is transmitting the neighbours of the source node is divided into two category, they are the interior nodes and the border nodes. The border nodes are the node at the end of the coverage area of the transmitting node. The border nodes are given more priority than the interior nodes as it has more chances for transmitting the information to the uncovered nodes. Let, L_x be the location of the present system and D^{thres} is the remoteness threshold (constant value). The node location β is computed by the following relation (Bano and Singhai, 2012):

$$\beta = \begin{cases} \text{Interior if } L_x < D_{thres} \\ \text{Border if } L_x > D_{thres} \end{cases} \quad (5)$$

The residual coverage computation is done by sending the CReq and the CRep message. It provides the uncovered number of the neighbours in the system. The nodes with more number of neighbours are given more priority in the broadcasting.

The hub's booking is done in light of the RC estimation of a hub in the system. This is finished by a straight forward neighbour discovery convention where scope rebroadcast ask for (CRReq) and a scope rebroadcast answer (CRRep) messages are traded between neighbouring hubs. The steps for RC computation are given as:

- Step 1: Covered node sends CRReq to its neighbours
- Step 2: Neighbour node responds with
  - CRRep if it is not covered
  - If covered it does not response to the request

In the context of network, consider more importance to as parse network is a network with very minimum number of nodes than the maximum possible number of nodes within the same network. The sparse nodes are deployed randomly in the network topology and also it provides the unique ID to the deployed nodes. The dense network also taken into account to analyse the performance of the EANKBB method. The priority slot is assigned to each node in the network with the help of vector set construction (Nikolov and Haas, 2015) algorithm. Initially the broadcast node ranks and orders the transmission priority among its neighbours according to its priority slot assigned.

The neighbour nodes are selected depending on the coverage area of the node. The distance measure used for the neighbour creation is Euclidean distance measure as mentioned in Eq. 6. Two nodes are referred to as one-hop neighbours and can communicate directly if the Euclidean distance between them is <r (m). Where N_x, N_y and N_a, N_b are the two point in the planes with coordinates:

$$\text{dist}\left(\left[N_x, N_y\right], \left[N_a, N_b\right]\right) = \sqrt{\left(N_x - N_a\right) + \left(N_y - N_b\right)^2} \quad (6)$$

Next the broadcast node transmits the broadcast message to its neighbours and marks them as covered. The neighbours that are not yet received the message are said to be uncovered. Those nodes schedule themselves again and reassign its priority slot. The same process is followed until all nodes are covered. The system model is described in Fig 1 and 2. In this priority sequence broadcasting scheme, first step is the construction of the vector set which is done by every node during the broadcast session (Nikolov and Haas, 2015).

Algorithm 1; the vector set construction:

1. Initialize the priority slot with upper, lower and middle values
2. Under the condition middle value >1, compare the middle value with lower value
3. If both are equal, decrement lower value by 1. Otherwise decrement middle value by 1
4. Determine next priority slot values depending upon the previous values

This algorithm generates some series of priority slot at which the broadcasting of any particular node should take place. The priority-slot is defined to have repeated priority slot units reordered for each epochs or levels. Then each node calculates the residual coverage for that node. The entire node then runs the self-scheduling algorithm to determine the priority of transmission of that particular node. After the transmission of any node in the priority-slot every other node should calculate the residual coverage again and then run the self-scheduling algorithm to determine their transmitting priority-slot.

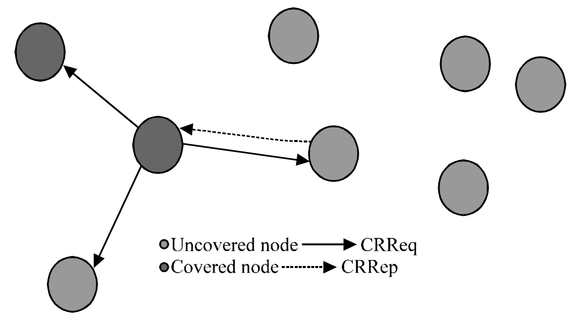

Fig. 1: Computation of residual coverage value

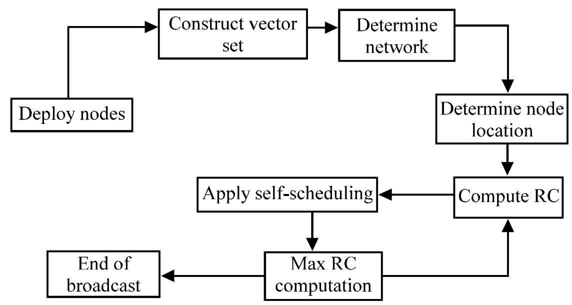

Fig. 2: Architecture of EANKBB

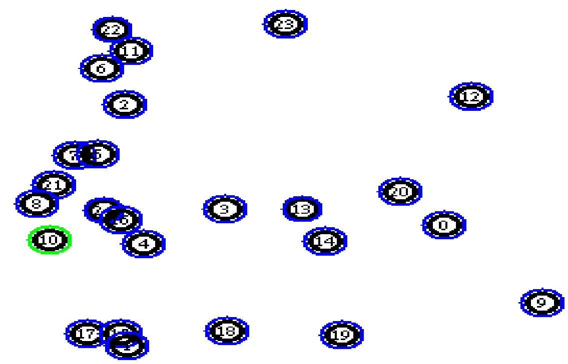

Fig. 3: Sparse network

Algorithm 2; the node self scheduling (Nikolov and Haas, 2015):

1. Associate the vectors constructed from algorithm 1 to form current priority slot
2. If residual coverage of a node is greater than the current middle value, the node will transmit the message in the next allotted priority slot
3. Otherwise if the residual coverage is greater than lower then the particular node will hold the current value
4. If the residual coverage is even less than lower then the particular node will hold the later level depending on its value

The above modules are implemented in both sparse and dense network. A comparison is made between those networks to evaluate the performance. The sparse network is deployed and broadcast process is done as shown in Fig. 3.

In sparse network the number of retransmission can be considerably reduced even though latency is little high when compared to dense network. But the entire network would be covered without any loss of information. Cluster based priority sequence scheme (NKBB) broadcasting nodes ranks in a disseminated path by need premise, so that all in all the quantity of re-communicates in the system is lessened in thick systems.

RESULTS AND DISCUSSION

The performance evaluation is done between sparse and dense network based on the metrics such as number of retransmission, reachability, latency and hop count and delivery ratio. The process of node deployment is considered for simulation and the simulation studies are carried out based on the parameters described in the Table 1.

The network range is defined to be 100-1000 and number of nodes chosen as 25 to form a network. The coverage area is defined as 250 and Node 10 is chosen as broadcast node. The Packet Delivery Ratio (PDR) depends on the got and created packets as recorded in the follow document. All in all, PDR is alluded as the ratio between the got packets by the goal and the produced packets by the source and is delineated in the Fig. 4.

The analysis of node retransmission is made for sparse and dense networks is shown in Fig. 5. The number of retransmission is considerably reduced in sparse network when compared to dense network.

The analysis of sparse and dense network for reachability is shown in Fig. 6. Reachability can be calculated as the number of nodes covered in every iteration. In sparse network the fraction of nodes covered takes the probability approximately 1.0 to reach the network. The number of nodes considered for broadcast is between 100 and 500.

The analysis of sparse and dense network for delay calculation is shown in Fig. 7. The delay factor is high in sparse network of about 7 m sec even though the number of nodes is less when compared with dense network.

Performance evaluation: The EANKBB broadcasting algorithm is compared with the probabilistic based approach called gossip based ad hoc routing. During analysis it is found that the packet delivery is high with EANKBB based approach than gossip based approach. Figure 8 shows thecompared results of both approaches for packet delivery ratio.

While comparing the delay factor with gossip based approach and EANKBB approach, the priority taken to broadcast is high for gossip based approach to reach the

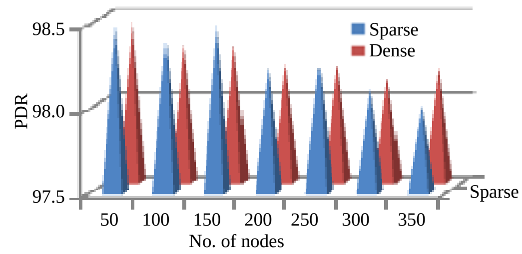

Fig. 4: PDR (Packet Delivery Ratio)

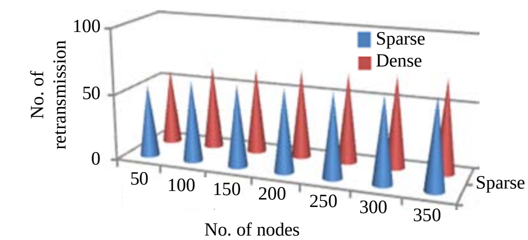

Fig. 5: Number of retransmission

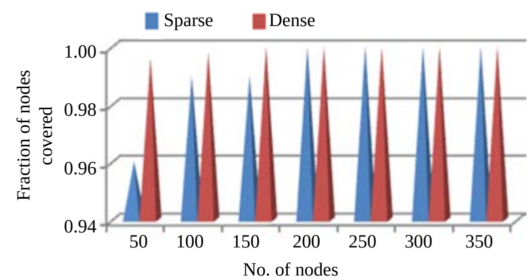

Fig. 6: Reachability

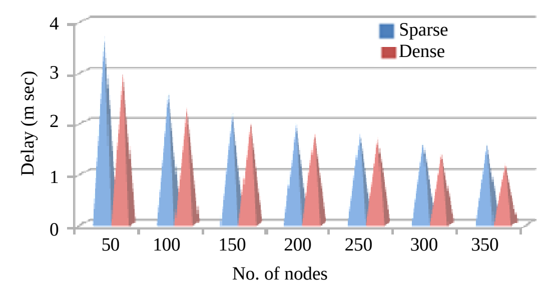

Fig. 7: Delay calculation for sparse and dense network

Table 1: Simulation parameters

Parameters	Values
Simulator	NS2
MAC layer	IEEE 802.11b
Packet size	64-1000 bytes
No. of nodes	[100-1000]
Priority-slot duration EANKBB	50 (m sec)
Network size	1000×1000 m
Nodes velocity	0-10 m sec
Node distribution	Uniform/clustered
Transmission or broadcast range	300 m

Table 2: Metrics comparison

	Sparse network				Dense network			
No. of nodes	PDR (%)	No. of Re-txn	Delay (m sec)	Reachability (%)	PDR (%)	No. of Re-txn	Delay (m sec)	Reachability (%)
50	98.50	55	3.7	0.96	98.450	58	3.0	0.996
100	98.40	62	2.6	0.99	98.320	64	2.3	0.998
150	98.50	62	2.2	0.99	98.320	65	2.0	1.000
200	98.25	63	2.0	1.00	98.210	67	1.8	1.000
250	98.26	64	1.8	1.00	98.205	68	1.7	1.000
300	98.12	65	1.6	1.00	98.125	70	1.4	1.000
350	98.02	68	1.6	1.00	98.180	71	1.2	1.000

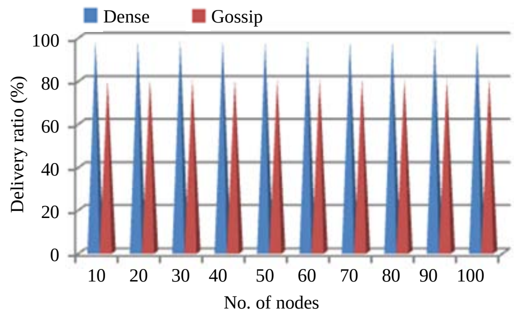

Fig. 8: PDR (Packet Delivery Ratio) for gossip and EANKBB in dense network

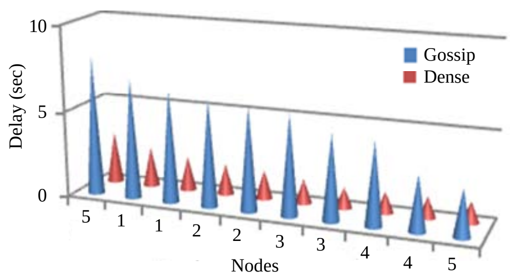

Fig. 9: Delay for gossip and EANKBB in dense network

entire network and is shown in Fig. 9. The comparison is made on both sparse and dense network is described in Table 2. The number of nodes considered ranges from 50-350 is shown in Table 2. It is observed that the metrics like delay and number of rebroadcasts are reduced considerably with dense network.

The node reachability in dense network is attained higher than sparse network since the nodes are grouped into different clusters. From the performance analysis the packet delivery ratio in dense network is also high compared to sparse network.

EANKBB based approach has number of reward over other advances referred in the literature. First, number of retransmissions is reduced considerably by covering entire nodes since, the network is divided into zones and grouped as clusters. Second, broadcast message is transmitted with low latency and network reachability is high.

CONCLUSION

In this study, a new scheme is introduced called EANKBB for broadcasting in sparse and dense networks based on ranking and arranging the priority slots fixed for the nodes in a network. The performance of broadcasting schemes on sparse and dense network is compared by analyzing the metrics like transmission complexity, delivery ratio and the delay. While comparing with other broadcasting schemes the performance is achieved with low delay and minimum number of retransmissions for the EANKBB algorithm. Further, one among the soft computing techniques called genetic algorithm and fuzzy classification techniques are used to optimize the network parameters performance.

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