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A New Adaptive Broadcast Scheduling Algorithm in MANETs Using Good Neighbor Node Detection Approach

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Abstract: MANET is a collection of wireless mobile sensor networks that randomly discover nodes in distributed manner. The unique properties of MANET are self-configuring and fast deployment and without central controller network which makes them them suitable for communication. Energy efficiency is the most important issue in adhoc networks due to power constraints. In MANET, node may be infrastructure or infrastructure less network, so each device can move independently and act as a host as well as router, while most of the wireless network design is concentrated only on routing protocol and its security issues. In general, MANET discussed the major impacts of bad neighbor nodes and observed routing problem, affecting performance of adhoc routing. Our proposed work, describes vulnerability of both internal and external attacks using two on-demand adaptive broadcast scheduling strategies using GNDA, identifying good neighbor nodes, in addition to adding extra parameters i.e signal strength, flow capacity and relative position of the node. In this proposed work we optimize the routing issues of AODV,GNDA,DSDV,DSR compared with their pause time, different number of connecting nodes and its available path. ns-2 simulator used in this proposed work shows that GNDA is better than other routing protocol.

Keywords: Ad Hoc Routing in MANET, Flow capacity, signal strength, ns2-simulation.

1 Introduction

Mobile computing is used for creating and managing the information platform, which is different from free constraints of spatial and temporal networks, so that user can access their information anywhere in the space. A Mobile ad-hoc is a group of nodes that cooperate and forward packets to their neighbor nodes. Broadcasting has been major problem for both industry and research community.

Broadcasting is usually required to disseminating message to all nodes of the network. This operation is highly required in MANET to distribute necessary information to ensure efficient control and co-ordination over the network nodes. A wireless network has limited bandwidth along with few other media in mobile communications and vulnerability of both internal and external attacks [1,2].

During transmission two nodes are not connected within the specific range, other host can forward the messages effectively among the deployed node. Proposed approach used to analyzed by using AODV [3,4] routing protocol are classified by being either reactive or proactive. In a reactive protocol route discovery process are initiated only on demand, i.e. packets is available for transmission when no route is available. In a reactive protocol, the route discovery process is initiated only on demand. In a proactive protocol, routing is available whenever a packet is available for transmission. This work is usually done under the table-driven approach.

In this paper a new adaptive broadcast scheduling in MANETs using GNDA is organized as follows: Section 2 discusses about the background of AODV, DSR and DSDV. Section 3 discusses neighbor node detection system. Section 4 suggests proposed system of GNDA

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design. Section 5 illustrates simulation evaluation of performance metrics. Section 6 depicts conclusion.

2 Background

MANET routing protocols are categorized into two different methods as: table-driven or proactive and demand-driven or reactive. In the following section discusses about the overview of these protocols.

2.1 Adhoc on-demand distance Vector routing (AODV)

AODV establishes the routes "On demand" by flooding a query in Adhoc On-Demand Distance Vector (AODV) [5, 6] algorithm that belongs to the group of reactive and proactive protocols. AODV initiates the route discovery process only on demand and maintains the alive route list while they are in use. AODV flooding is to discover a route. Each route sends a broadcast request (RREQ) to the network. Thus the broadcasting introduces route discovery and maintenance process. Packet-requesting node leads to broadcast storm problem. In this issue, AODV creating a symmetric links in reactive routing protocol for minimizing the broadcast and links route reply follows same reverse path of the requesting packet using hello message so route can easily identifies its neighbor nodes and also ensure the links. But more number of broadcasting request may lead to considerable amount of collision.

In general due to high node mobility link breakage, frequent path failures are major issue in MANETs. This problem which could be reducing the packet delivery ratio increases routing overhead and end-end delay. The proposed system suggest neighbor node detection technique, while Umang Singh and Reddy [1,7] briefly discussed AODV routing technique.

2.2 Dynamic Source Routing(DSR)

In a reactive method, Dynamic Source Routing (DSR) protocol is based on source routing protocol. Mobile nodes are maintaining a cache route list that contain the source aware list and also update the source list entry continuously. There are two major categories, i.e route discovery and route maintenance. When a node discovers the routing process, it consults the route cache and also checks its node status. Sender sends flooding (RREQ) to all other neighbor nodes. And neighbors identify the requesting information through ID RREQ, and RREP. Each node maintains routing table lists which contains unique number and the details about the destination. To limit the number of route request propagate on out links. Destination node can only send the route reply until the route request reaches. By the limited time duration packet reaches the destination either source or intermediate node, then route record yielding the hop sequence should be taken.

2.3 Destination-Sequenced Distance-Vector (DSDV)

In a proactive routing, the best path selection instead of choosing the multipath network is destination-sequenced distance vector routing protocol based on table-driven method. Every requesting node maintains its own routing tables which contain all possible destination details within a network. In a route request numbers of hops are marked with sequence number and periodically update their routing status throughout the transmission. DSDV discovers the route in two ways of packets which is fully dumped and smaller incremental packets each are fit into standard size of network protocol unit. For this reason traffic decreased but mobile nodes can maintain additional table to store these packets. If a new broadcast route is initiated they contain address of the destination and number of loops to reach the destination. Normally the route labeled with recent sequence number supposes two updates having same sequence number then the route considered only small metrics(shortest path).

3 Adaptive broadcast scheduling using neighbor node detection system

AODV discovers the route only on demand. It does not maintain the route list, but routes are maintained as long as being necessary. AODV routing protocol [8,9] has suggested usually that nodes are monotonically increasing the sequence number and time; the node can notice and change its topology. AODV routing table uses either multicast or unicast router. Routing table stores destination address, destination sequence number, and next hop address. Every time routing table life time status is updated. Suppose router lifetime is not within a range, it expires. The routing table is automatically updated the link failure status and send the error notification to their neighbor nodes. The source node receives the error message and retransmits the route. Distributed intrusion detection system [10] has suggested an effective approach to the neighbor attack but it has some limitations which can't detect impersonate attack when mobility is high, so that accuracy is decreased automatically.

Once the condition is satisfied then route discovers unicast route request to destination, otherwise maintain the transmission range and sequence number for broadcast route request. Neighbor node checks the transmission range of the router, if it is maximum transmission range; node can prepare route reply sent to the original node. Similarly the original node also maintains transmission range that would be forwarded to transmit data on active route. Finally data received from source. The proposed approaches identify the problem using flow capacity and signal strength is verifying the level of each node. Based on the parameters node decided whether requesting nodes are good/bad neighbors. This process can significantly reduce the retransmission and gradually reduces the routing overhead. It has suggested a method to decide to number of necessary nodes by considering size and transmission range of a network. Moreover, other works have proposed that probability of a network connectivity goes to zero if $r(|V|) \leq \sqrt{(1-\varepsilon)A\log|V|/\Pi|V|}$, for any $\varepsilon > 0$. Otherwise if $r(|V|) \geq \sqrt{A(\log|V| + \gamma|V|)/\Pi|V|}$, is connected with probability converging to one. It has been analyzed that frequent interrupting of neighbor nodes can produce transmission delay and low quality in terms of data transfer.

4 Adaptive broadcast scheduling using GNDA design

Proposed Adaptive Broadcast scheduling using GNDA (Good neighbor node Detection in MANET) describes a node list which all maintain their own transmission range. Node collects its neighbor list that can be compared to network transmission range (NTr) with total transmission of the network (TTrN).

AODV-based routing already maintains the trustworthiness of the neighbor node. In this approach we suggest some parameter to detect good neighbor in MANET. This method increases the size of the routing table the same as in AODV but these parameters individually detect the attack in every stage. Critical power of asymptotic connectivity [8] has described its transmitter power level need to be high or low enough to reach their intended receiver. It has some limitation which can't detect impersonate when mobility is high, so that accuracy is decreased automatically. Periodically check the energy level when it reaches below 2000 Jules then node goes to sleeping state. The number of necessary nodes in ad-hoc [9] has proposed the energy calculation based on the adequate number of nodes to form communication in the network area. The proposed approaches identify the problem using some parameters to verify the level of each node. New adaptive broadcast scheduling using GNDA approaches as some of the following parameters are as follows:

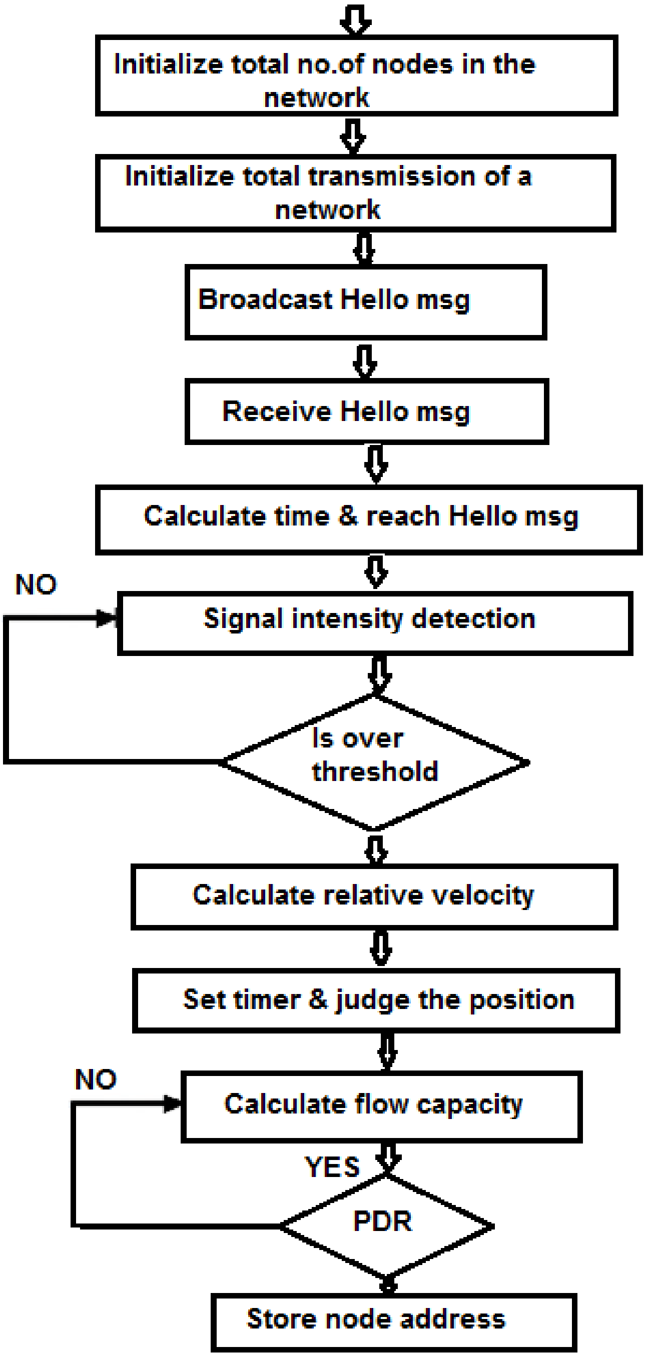

Fig. 1: Process flow of proposed GNDA

4.1 Signal strength

Each node can have its own transmission range, if Network transmission range is compared with overall network ($NTr > TTrN$) then the node value is adjusted to exact range otherwise calculate signal strength. In the system, the signal stress is calculated by using Eq. (1),

$$\text{Transmitter signal strength} = \begin{cases} S_H - \left\{ \frac{S_H - S_{\text{Threshold}}}{e} \right\}, & \text{if } T > e \\ S_H, & \text{closer } T < e \\ S_{\text{Threshold}}, & \text{otherwise.} \end{cases} \quad (1)$$

Signal strength equation (1) represents, S_H is signal strength of hello message, T is time period and e is link connectivity between i and j.

4.2 Flow capacity

Graph G consists of (V,E). The capacity is denoted by C_{ij} and s for source and d for destination in directed edges. Flow graph G is assumed as F where E is edge between (i, j).

$$\text{Flow capacity} = \sum_{j:(s,j)\in E} F_{sj} - \sum_{i:(i,s)\in E} F_{is} \quad (2)$$

Flow capacity equation (2) represent the counter amount of bytes F_{is} and F_{sj} that can be followed by the link (i, j) upto time t in packets.

4.3 Complexity computation of GNDA

The following parameters are to be considered for complexity computation in good neighbor node detection algorithm.

4.3.1 Traffic

Good neighbor detection algorithm is proposed to maximize the network lifetime and minimize the power consumption during the route establishment. Initially total traffic level is zero in source node. During a route discovery, intermediate node level may change accordingly.

4.3.2 Network size

By adding new parameters such as flow capacity, signal strength and residual power into the routing table increases the size of routing table. Thus storage complexity is the same as AODV i.e. $O(N)$, where N is the total number of nodes present in the network. It slightly increases overhead by using hello messages but it provides good communication between source and destination when compared to AODV. Performance of each node is evaluated and analyzed individually. Evaluation is done by increasing number of nodes and network size in the networks.

Table 1: Comparison between AODV and GNDA

Protocol	AODV	GNDA
Routing Type	Reactive protocol	Reactive protocol
Packet forwarding	Hop-by-Hop forwarding	Same as AODV
Route Maintenance	Only Active Route	Secure route
Process request relations	High	High
Packet their own transmission range with salvage	Less	Less

4.3.3 Selection criteria

Route requesting packet is broadcasted by the source. Every routing packet maintains a header that includes Source ID, Type of data to be transfered, destination, node iD and total traffic level. Similarly destination nodes wait for threshold time after route request arrives within time slot, then the traffic is computed. Target node is storing all routing information for an allotted time. Suppose node time limit expires, target node which may select minimum total traffic level in AODV-based routing table and send the data route reply via the same path.

4.4 Adaptive Broadcast Scheduling Algorithm using GNDA

[Node energy calculation unit per time]
If
$E_i < 2000$ then set the E_i value is sleep (few sec)
Sleep node = $\{Ns_1, Ns_2, \ldots, Ns_n\}$
else
$E_i > 2500$ then set the E_i is awake/active node.

$$\text{Active node} = \{Na_1, Na_2, \ldots, Na_n\} \quad (3)$$

also calculate

$$\text{Energy awake} = \{Ea_1, Ea_2, \ldots, Ea_n\} \quad (4)$$

From Eq. (3) and Eq. (4).
GNDA select its neighbor as energy efficient node for consuming less energy and less time of adhoc network. Finally selecting our target node GNDA uses three factors which are,

$$\text{Stability factor } (S) = C_i + F_i/N_i \quad (5)$$

New connection (C_i) is added to number of link failures (F_i) that is divided by node surrounding that node (N_i).

$$\text{Utility factor } (U) = N_i - Na_i/N_i \quad (6)$$

where,
N_i = node surrounding that node

Table 2: Simulation parameters

Simulation	Node values
Node	3–7
Simulation time	100 sec
MAC layer	IEEE 802.11
Packet size	512
Initial energy	3000 J
Transmission Range	250 m
Transmission threshold power	0.281838
Tx power and Rx power	0.173, 0.05
Number of CBR connections	10, 12, 14, ..., 20
Packet rate	4 packets/sec
Bandwidth	2 Mbps
Topology size	1000 m × 1000 m
min-max speed	1 m/s–5 m/s

Na_i = Number of additional node among the neighbors.

$$\text{Energy factor } (E) = Eo_i - Et_i/Eo_i \quad (7)$$

where,
Eo_i = initial node energy
Et_i = amount of energy of a node at time t.
By adding equations (5), (6) and (7), node get original target node. The above calculation is used to find the short distance from source to target node.

5 Simulation Evaluation

The GNDA model is compared with other routing protocols like AODV, DSR, and DSDV evaluated in terms of signal strength, flow capacity, and relative position of the node by using NS-2 simulation. The radio channel model follows a bit rate of 2 Mbps and the transmission range is 250 meters. Every source sends four CBR packets whose size is 512 bytes per second to the destination. Each node moves to a randomly selected destination with a random speed from a uniform distribution. After the node reaches its destination, it stops for a pause time interval and chooses a new destination and speed. To reflect the network mobility, set the max-speed to 5 m/s and set the pause time to 0. The simulation time for each scenario is set to 300 seconds. In the results, each data point represents the average of 30 trials of experiments [13,14]. The detailed simulation parameters are shown in Table 2.

The simulation results are shown and compared with other methods with the tested algorithm like delay, dropping rate, packet delivery, and throughput with different parameters which are shown in Tables 3 to 5.

5.1 End-to-End Delay

Table 3 shows the delay analysis of protocols in all number of nodes. The proposed method minimizing the delay, therefore overall network delay is reduced. Compared to AODV with an adaptive broadcast scheduling scheme, GNDA with Adaptive broadcast Scheduling algorithm, Modified aware broadcast scheduling algorithm in networking (MABSAN) has reduced the delay.

Table 3: Comparison of delay analysis

Number of nodes	Delay		
	AODV	GNDA	MABSAN
500	0.87334	0.70342	0.6934
750	0.76384	0.7484	0.6845
1000	0.73768	0.7893	0.65098
1250	0.65472	0.6937	0.59983

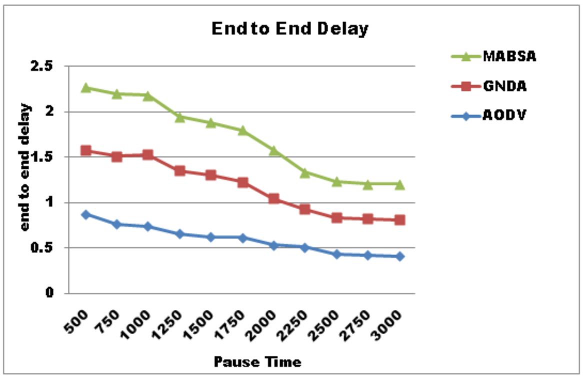

Fig. 2: End-to-end delay analysis versus pause time for AODV, GNDA, and MABSA (number of node = 50, topology size = 1000 m × 1000 m)

The average time can be taken by a data packet is reach to their destination node. This process a route discovery, and queue in the transmission of the data packet the delay can occur. The successfully delivered data packets are only counted. The end-to-end delay is calculated by the arrival time– sending time divided by the number of connections. If the protocol has a lower delay, then it performs better communication between the nodes. Fig. 2 shows the simulation result of average end-to-end delay of the proposed and existing protocols. From the above result, a delay is reduced by the adaptive broadcast scheduling algorithm. This proposed system has a low end to end delay compared to the existing methods.

5.1.1 Dropping Ratio

Table 4 shows the dropping ratio analysis of protocols in all number of nodes. From the dropping ratio, the proposed method of consuming low energy, therefore the packet dropping rate is reduced. Compared to the AODV,

Table 4: Comparison of dropping ratio analysis

Number of Nodes	Dropping ratio (ms)		
	AODV	GNDA	MABSA
500	35.45	34.05	33.21
750	35.23	33.98	33.12
1000	34.72	33.87	32.134
1250	33.45	33.13	32.034

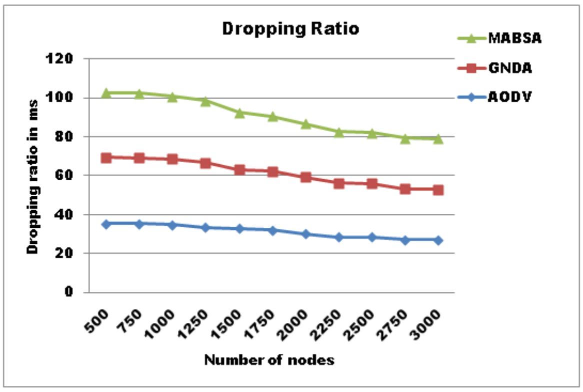

Fig. 3: Dropping ratio (number of node = 50, topology size = 1000 m × 1000 m)

Table 5: Comparison of PDR analysis

Number of Nodes	Packet delivery ratio		
	AODV	GNDA	MABSA
500	80.56	82.56	84.76
750	81.76	83.67	85.78
1000	83.67	83.98	86.98
1250	83.76	84.02	87.23

GNDA, and the proposed Adaptive broadcast scheduling algorithm has a lower dropping ratio.

Fig. 3 shows the dropping ratio of the proposed protocol and existing protocols. From this dropping ratio of all protocols compared with the proposed method has the low energy consumption and packet dropping rate than the other existing protocols; therefore proposed method can give better performance than the other protocols.

5.1.2 Packet Delivery Ratio

The packet delivery ratio is evaluated in Table 5. From the table, the proposed scheme can take less time to transfer the packets in MANET. In this analysis, the proposed method has a high packet delivery rate and provides a better quality of service.

Fig. 4 shows the packet delivery ratio of proposed and existing protocols. The proposed method has a higher delivery rate compared to the existing AODV and GNDA protocols, so it can send the packets with less time, therefore network lifetime can be increased and also reduce the link failure over the radius link using the adaptive scheduling algorithm.

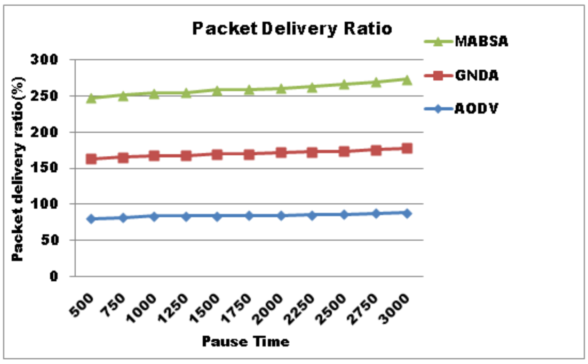

Fig. 4: Packet delivery ratio versus pause time for AODV, GNDA, and MABSA (number of node = 50, topology size = 1000 m × 1000 m)

Table 6: Comparison of throughput analysis

Number of nodes	Throughput		
	AODV	GNDA	MABSA
500	7.044	9.987	11.65
750	7.345	10.154	12.15
1000	7.513	10.398	12.29
1250	7.756	11.676	12.47

5.1.3 Throughput

The throughput of protocols is evaluated in From Table 6; the proposed scheme can take less time to transfer the packets in MANET. In this analysis, the proposed method has a high throughput and Quality of service. In the network, the throughput is generally defined as the amount of success data transmission.

Fig. 5 shows the throughput analysis of proposed and existing protocols. The proposed method has a high throughput compared to the existing AODV, GNDA protocols, so it can send the packets with less time, therefore network lifetime can be increased and also reduce the link failure over the radius link using the adaptive broadcast scheduling algorithm.

This work covers the design of a broadcast methodology using node neighbor failure detection. The investigation is done on existing methods like rebroadcast probability based on neighbor knowledge, neighbor knowledge, and velocity-based broadcast. The proposed used to monitoring adaptive broadcast scheduling algorithm using GNDA approaches are implemented. The

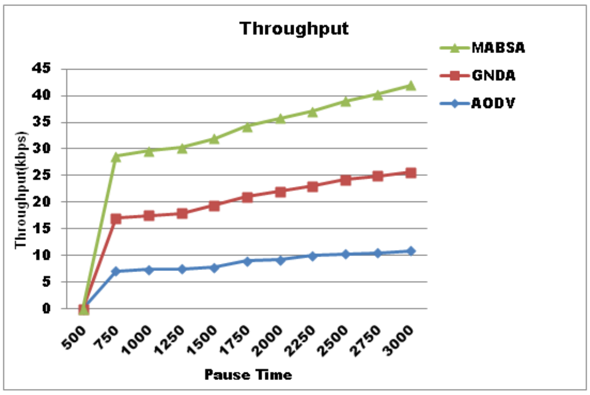

Fig. 5: Throughput versus pause time for AODV, GNDA, and MABSA (number of node = 50, topology size = 1000 m × 1000 m)

performance of the proposed method with AODV and GNDA is compared. The performance comparison is done using the parameters like delay, packet delivery ratio, throughput and dropping ratio.

6 Perspective

Proposed solution describes all information that is related to good neighbors. A new adaptive broadcast scheduling algorithm using GNDA-based routing protocol maintains a trustworthy neighbor list which increases the routing performance. Maintaining the energy level and network life is voluminous concern in MANET. For that efficient routing protocol is required to discover the route which facilitates the secure and reliable communication. It is infeasible to compare the routing with one another because protocols are dependent on network parameters or each protocol has a different goal with different postulation. The network parameter affects the overall performances of the protocols in the network, as well as, each modifying routing protocol perform independently in case of energy cognate issue. Due to this reason results cannot be compared with all other routing protocol. Our proposed solution improves maximum throughput and increases the network performance. All analytical results focus only to improve fixed and dynamic transmission range in the overall networks.

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