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AODV Based Improved Method for Detecting Good Neighbour Nodes with Energy Efficiency

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Abstract

A major issue with ad hoc networks is energy consumption since nodes are usually mobile and battery operated. A recent trend in ad hoc network routing is the reactive on-demand philosophy where routes are established only when required. This paper proposes a new scheme called GNDA to improve existing on-demand routing protocols by introducing the power efficient algorithm in whole Mobile Ad hoc Network (MANET). This scheme is one of its types in adhoc networks which can provide different routes for different type of data transfer and ultimately increases the network lifetime. All information related with good neighbors are stored in routing table which improves performance of routing protocol in terms of good communication and stable route. Analytical results of proposed solution shows that it improve overall performance of the network and improve network life with in fixed and dynamic transmission range.

Keywords: TTr, NTr ,GNDA.

1. INTRODUCTION

In wireless network whenever source node want to find the route, they calculate shortest distance and create route accordingly. But a malicious nodes present in the route as well as neighbor node doesn't have that much capacity to transfer data at required speed. To solve this problem and to increase the performance of network rapidly, good nodes should be considered. Classifications of good neighbor node and bad neighbor nodes depend upon signal strength, flow capacity of each nodes which are present in network. Also, classification can done using how fast each node can receive the complete information and pass it to next neighbor node. Proposed approach is analyzed by using AODV routing protocol.

A. AODV (Ad-hoc On Demand Distance Vector Routing Protocol) Routing Protocol

AODV discovers routes as and when they required. It does not maintain routes from every node to every other node. Routes are maintained just as long as necessary. Every node maintains its monotonically increasing sequence number and it increases every time the node notices change in the neighbor node topology.
AODV utilizes routing tables to store routing information
1. A Routing table for multicast routes.
2. A Routing table for unicast routes.
The route table stores: destination address, next-hop address, destination sequence number life time for each destination, a node maintains a list of precursor nodes to route through them precursor nodes help in route maintenance more later. Life-time is updated every time the route is used. If route is not used within its life time, it expires. A neighbor node or source node moves then, a new route discovery process is initiated. If intermediate nodes or the destination move then the next hop links break resulting in link failures. Routing tables are updated for the link failures. All active neighbors are informed by RERR message. When a source node receives an RRER it can reinitiate the route discovery process. In that case the performance of network steadily decreases in certain following cases:
1. If transmissions range of node is larger than transmission range of network.
2. If neighbor node is flooding unnecessary RREQ messages to other nodes.
3. The hello messages take more time to reach one node to its neighbor nodes.
4. If transmission range of node is less, then packet dropping ratio of a neighbor node is high. All above four cases responsible for decreases performance of on demand routing protocol broken link.

B. Characteristics of AODV

- On-demand route establishment with small delay.
- Only keeps track of next hop for a route instead of the entire route.
- Use of Sequence numbers to track accuracy of information.
- All routes are loop-free through use of sequence numbers
- Link breakages in active routes efficiently repaired.
- Multicast trees connecting group members maintained for lifetime of multicast group.

- Unicast, Broadcast, and Multicast communication.

_C._ Limitations/ Disadvantages of AODV

- Overhead on the bandwidth: Overhead on bandwidth will be occurred compared to other protocols, when an RREQ travels from node to node in the process of discovering the route info on demand. It sets up the reverse path in itself with the addresses of all the nodes through which it is passing and it carries all this info all its way.
- High route discovery latency: AODV is a reactive routing protocol. This means that AODV does not discover a route until a flow is initiated. This route discovery latency result can be high in large-scale mesh networks
- No reuse of routing I nfo: AODV lacks an efficient route maintenance technique. The routing info is always obtained on demand, including for common case traffic.
- It is vulnerable to misuse: The messages can be misused for insider attacks including route disruption, route invasion, node isolation, and resource consumption.
- AODV lacks support for high throughput routing metrics: AODV is designed to support the shortest hop count metric. This metric favors long, low bandwidth links over short, high bandwidth links.
- Requirement on broadcast medium: The algorithm expects/ requires that the nodes in the broadcast medium can detect each other's broadcasts [1].

The paper is organized as follows: Section II discusses related work, Section III discusses system model. Section IV suggests procedures for proposed Mechanism. Section V illustrates the Performance evaluation. Section VI concludes the paper.

2. RELATED WORK

Rajesh Sharma, SeemaSabharwal have proposed that, the Dynamic Source Routing protocol (DSR) is specifically for use in multi hop wireless ad hoc networks of mobile nodes [2]-[3]. The protocol adapts quickly to routing changes when node movement is frequent, yet requires little or no overhead during periods in which nodes move less frequently. The protocol is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network.

Bhavyesh Divecha, Ajith Abraham, CrinaGrosan and Sugata Sanyal have proposed Destination-Sequenced Distance-Vector is a proactive table driven routing protocol In DSDV protocol each node maintains routing information for all known destinations[3]. The routing information is updated periodically. Each node maintains a table, which contains information for all available destinations, the next node to reach the destination, number of hops to reach the destination and sequence number.

Prashant Kumar Maurya, Gaurav Sharma, Vaishali Sahu, Ashish Roberts and Mahendra Srivastava have proposed the Ad-hoc On-Demand Distance Vector (AODV) routing protocol is designed for use in ad-hoc mobile networks [4]. AODV is a reactive protocol: the routes are created only when they are needed. It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops.

Umang Singh, Prof. B. V. R. Reddy and Prof M. N. Hoda [5]-[6] have proposed (GNDA) for identifying good neighbor nodes in the network. Categorization of nodes is based on performance metrics such as transmission range and power of node, signal strength, capacity of node for high packet forwarding and relative position of node. Neighbor routing table maintains address of node for maintaining record of the entire nodes. These stored nodes are used for data transmission and forwarding. This approach minimizes energy consumption of node and increases its battery life.

Piyush Gupta, and P. R. Kumar [7] have proposed WIRELESS networks consist of a number of nodes which communicate with each other over a wireless channel. Some wireless networks have a wired backbone with only the last hop being wireless. Examples are cellular voice and data networks and mobile IP. In others, all links are wireless. One example of such networks is multihop radio networks or ad hoc networks.

S. Sridhar and R. Baskaran [8] have proposed, in Mobile Ad hoc Networks each node has limited wireless transmission range, so the routing in MANETs depends on the cooperation of intermediate nodes. Two types of routing protocols have been defined for ad hoc networks: Table-driven protocol and On-demand routing protocol. Table driven protocols are proactive in nature and consume excessive network bandwidth.

3. SYSTEM MODEL

In this approach Initially all nodes maintain their own transmission range .Assume the transmission range of the network is 250 meter compare transmission range (NTr) of each node present in the network with the total transmission of network (TTrN) of the node Determination of transmission power is required to send a message between node n and its neighbor n1. It can be measured by calculating the received power of hello message. This approach is enhanced by adding parameters in the neighbor table such as flow capacity, signal strength. Reaching time of hello messages between node and its Neighbor, Address of node If (NTr>TTrN), then adjust energy of this node accordingly, otherwise calculate signal strength by using equation (1). If threshold value is maximum then evaluate position of node and also set timer for the same. Further work is preceded by calculating the flow capacity of a node as mentioned in equation (2). If flow capacity of a node is good then store address of a node otherwise remove address of the node from routing table.

After this calculation we are identifying the shortest path among the selected good neighbor nodes. After receiving the first RREQ packet the destination wait for a random amount of time to receive multiple RREQ packets. After the time out destination processes the RREQ packet and identifies the path with maximum power and send back the RREP packet to the corresponding source node. Then the source node can transmit the data packets through the energy efficient path which satisfies the maximum delivery rate. If sufficient battery power is not present then sends a negative Acknowledgement [1]-[5]-[6].

In the system signal strength of node is calculated by using equation (1),

Signal Strength

$$Transmitter_{signal\ strength} = \begin{cases} S_H - \left\{ \frac{S_H - S_{threshold} * T}{e} \right\} & \text{if farther } (T>e) \\ S_H & \text{closer } (T<e) \\ S_{thresh} & \text{Otherwise} \end{cases} \quad (1)$$

Where
SH: Signal strength of Hello Message.
T: Time Period between two Successive Hello Message.
e: Link connectivity between i and j.

Flow Capacity

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

Where
E-Edge of node (i,j)
Fis, Fsj -Amount of bytes that flowed on link(i,j)

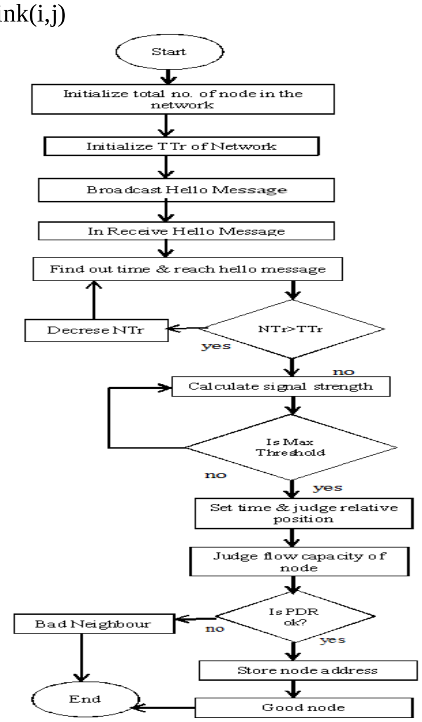

Figure 1.Process Flow of GNDA

4. METHODOLOGY

A.Sleep and awake mechanism

In this approach sleep and awake mechanism for consumption of energy and time. Initially check how many no. of nodes comes under the main node network. Set the same energy to all the nodes. Select the destination node for sending the data in the form of packets. For sending the data we select the coordinator node we need to find the three factors i.e. stability, utility, energy factors. In our project, we use the sleep and awake mechanism for consumption of energy and consumption of time. Initially the source node i.e. server node(initially before transmission of packet) form its own network then search for neighbour nodes those are inside the network and then sub- nodes do same . Then the network is formed based on the traffic on its network. If the no. of nodes is less than 5 (low traffic on the network) on the network then the bus, ring and star topology is formed for sending the data. If the no. of nodes are greater than 5 (high traffic on the network) then the mesh topology is formed for sending the data. That's why our system is on demand i.e. dynamic changes on the network. For less consumption of energy and time we use the sleep and awake mechanism. Suppose there are more no of nodes on the network , the source node and destination node are set and path is fixed for few seconds for sending the data and there are no of nodes which are on the network and but not on the path of sending the data from source to destination. In this case the nodes which are on the path of sending the data, these nodes are kept as(set status) awake nodes i.e. these nodes are active nodes and which are participating in the path of sending of data . And the nodes which are on the network but in idle state i.e. they does not do anything or do not perform anything, these nodes are kept as (or set status) sleep nodes. By keeping the nodes sleep which are not used, system will consume the less energy and less time of our network [9].

B.Mathematical model

Set of Nodes = {N0, N1, N2…..Nn}
Suppose Energy = 3000J

Select destination node = {Ni}
First find the main node i.e.co-coordinator node
For finding the main node we use three factors stability, utility and energy factors

Stability factor(S) = $\frac{Ci+fi}{Ni}$ (3)
Where, Ci = new connection established
Fi = number of link failures
Ni = nodes surrounding that node

Utility Factor (U) = $\frac{Ni-Nai}{Ni}$ (4)

Where, Ni = Nodes surrounding that node
Nai = number of additional nodes among these neighbours

Energy Factor (E) = $\frac{Eoi-Eti}{Eoi}$ (5)

Where, Eoi = initial node's energy
Eti = Amount of energy of a node at time t

By adding eq1, eq2, eq3 we get the main node,
Main node (Source node) = S+U+E
T = {T1, T2, T3, T4...}
T = Set of topology T1= 1st topology
:
:
So on

Finding the Shortest distance from source to destination by using the DBET with AODV routing protocol we calculate the shortest path:
Suppose set of Energy = {E1, E2...En}

Shortest path (unique path) =E1 (src) +...+Ei (dest.).

Find the energy of nodes per unit of time

Ei< 2500, then set the status of Ei is sleep i.e. sleep this node for few secs.

Set of sleep nodes is = {Ns1, Ns2….Nsn}

Ei> 2500, then set the status of Ei is awake i.e. awake (active) nodes.

Set of awake nodes is = {Na1, Na2….Nan}

From Existing System,

Set of nodes = {N1,N2,…..Nn}

And Energy of nodes per unit time = {E1,E2,….En}

Calculate the Total Energy of all nodes,
Total Energy (Existing system) = E1+E2+…..+En.

From Proposed System,
Set of awake nodes ={Na1,Na2,…..Nan}

Set of Energy of awake nodes = {Ea1, Ea2…Ean}

Calculate the Total Energy of only awake nodes,
Total Energy (Proposed system) = Ea1+Ea2+…..+Ean.

Compare the Total Energy (existing system) and Total Energy (Proposed system)
By Comparing,
Total Energy of Proposed system is less than the Total Energy Existing system.

Algorithm 1.1

1. Identify Nodes in the Network: Discovering the nodes which are available in the network
2. Get Ip addresses : Get the all connected nodes ip address
3. Calculate the Ntr: Calculate the random ntr of nodes with respect to Ttr
4. Form Topology: Form the network topology based on the Network Transmission Range of each node.
5. Send Control Packets: send RREQ packet and find the best path in the topology from source to destination
6. Calculate all possible routes to destination
7. Send data packet: After finding all paths choose one best path to destination and send the data through it.

Algorithm 1.2

1. Assign Energy: Assign the static network energy i.e. 3000 Jules to each node at initiation time when Nodes are discovered in the network.
2. Decrease Static Energy:Decrease energy of each node by 10 Jules per 10seconds when nodes join the network and until it goes into the sleep state
3. Use Energy Efficient Nodes: Choose nodes in the network for communication which will consumes less energy.
4. Check Sleeping Nodes: Periodically check the nodes in the network and put them into the sleeping state if node reaches the 2000jules
5. Awakening sleeping nodes: If sleeping nodes gets charged then take them back into the awake state.

5. PERFORMANCE EVALUATION

Proposed approach for neighbor node detection in mobile adhoc networks is identified and compares its result with existing routing protocol AODV. Initially it has been assumed that all nodes have their own transmission range with dynamic movement. Mobility scenario is generated by using random way point model with 3-7 nodes in an area of 250m by 250m
The simulation parameters are mention below.

Table 1: Simulation Parameter

Simulation Parameters	Values
Nodes	3-7
Simulation time	100 sec
MAC Layer	IEEE 802.11
Packet size	512
Initial energy	3000J
Transmission Range	250m

Table 2: Comparison of routing protocol

Routing Protocol			
	No of node	**AODV**	**GNDA**
Packet Delivery ratio	7	91	97
Packet Loss ratio	7	64.36	51.89
Communication time	7	64.36	51.89
End to end delay	7	13	9
Energy saving	7	0	240
Throughput	7	69	77

The performance of suggested approach is evaluated by using following metrics:

i. **Packet delivery ratio**: the ratio of number of delivered packet to the destination. Number of packet received / Number of packet send. The greater value of packet delivery ratio means the better performance of the protocol. From figure 2 it is observed that Packet delivery ratio of AODV delivers lesser percentage of the original data (91%) than GNDA(97%)

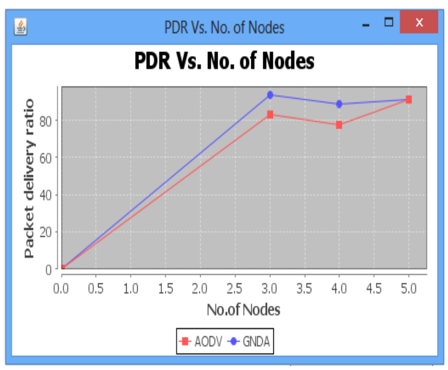

Figure 2: Packet Delivery ratio

ii. **Packet loss ratio**: the ratio of number of packet send and receive from source to destination Total packet send-Total packet receives. From figure 3 it is observed that Packet loss ratio of GNDA delivers lesser percentage than AODV

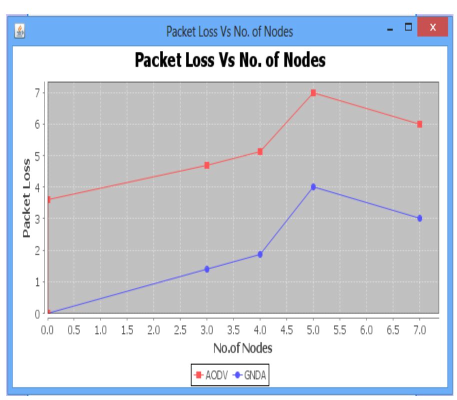

Figure 3 : Packet Loss ratio

iii. **Communication time**: From figure 4 it is observed that communication time is reduced by about 14 percent compared with AODV.

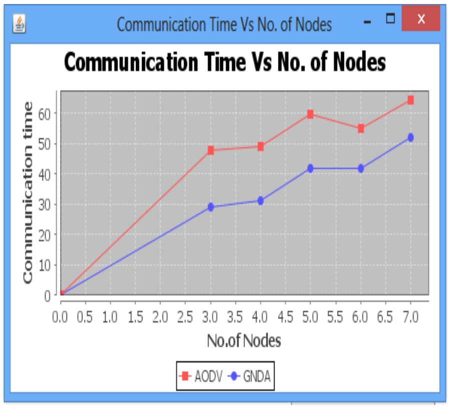

Figure 4 : Communication Time

iv. **Average end-to-end delay**: the average time taken by a data packet to arrive in the destination. (arrivetime−sendtime)/Number of connectionThe performance of the protocol is inversely proportional to end-to-end delay.From figure 5 Average end to end delay is reduced by about 14 percent compared with AODV.

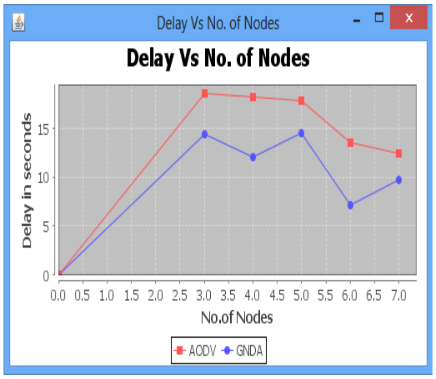

Figure 5 : End to end Delay

v. **Energy Saving**: As per study about project, it is clear that energy consumption by using sleep and awake mechanism is more than the AODV protocol. For sending the data from source to destination the sleep and awake mechanism is used. From Figure 6 it is observed that no energy is saved in AODV compared with GNDA.

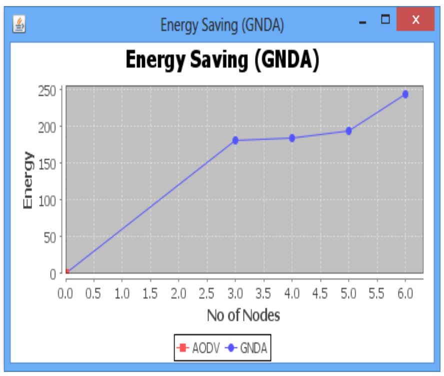

Figure 6 : Energy Saving(GNDA)

vi. **Throughput**: Percentage of packets received by the destination to the number of packets sent by the source is affected by available of selfish nodes in MANET.

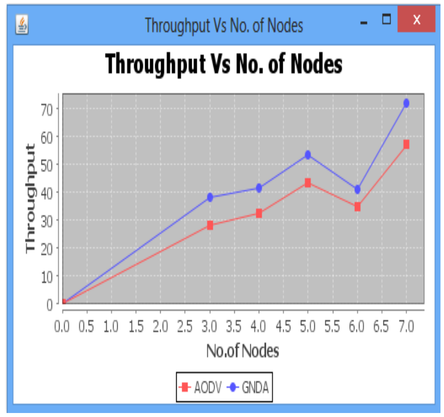

Figure 7 : Throughput

6. CONCLUSION

In this paper, we proposed good neighbor node detection based on signal strength and flow capacity. This approach calculates the energy,flow capacity and signal strength for each node in the network. Simulation results shows that the proposed method increases packet delivery ratio and end to end delay with less overhead, reduce communication time.Energy consumption by using sleep and awake mechanism is more than the AODV protocol. Analytical results of proposed solution shows that it improves overall performance of the network with in fixed and dynamic transmission range.

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