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Optimized Route Technique for DSR Routing Protocol in MANET

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***Abstract*- Mobile ad hoc network (MANET) is a collection of portable devices which communicate with each other without the help of any fixed base station or access point. Each node in MANET experiences the dynamic topology, limited transmission range, bandwidth and battery power which affects routing. The critical issue of routing in MANET is to select an optimal and stable route. Link failure causes due to high mobility, congestion and limited battery power which affects the performance of the routing protocol. Such problems make a routing protocol ineffective and unreliable. To make a routing protocol effective and reliable, this paper proposes a Optimized Routing Technique(ORT) using Modified Combined Weight Function (MCWF) mechanism by calculating signal strength, energy level, load and distance between nodes. Then based on the MCWF, the routes are arranged such that routes with minimum length, traffic load, maximum energy level and signal strength are listed first in the route table. The path is established with route which has maximum MCWF. The benefit of this mechanism is to select the stable and optimal path to reach the destination. It is implemented using NS-2 which minimizes the end-to-end delay, overhead and energy consumption and maximizes the packet delivery ratio.**

Keywords: DSR, MANET, Modified Combined Weight Function, stable route, link failure.

I. INTRODUCTION

Mobile ad hoc network is a collection of wireless portable nodes forming a temporary/short-lived network, without any fixed infrastructure, where all nodes are liberated to move randomly and configure themselves. In MANET, each node will act as both router and as well as host. The premise of forming a MANET is to provide wireless communication between various devices, anytime - anywhere- any device-any (A4). MANET is suitable for the application which needs quick setup and implementation such as Military and disaster areas.

Due to nodal mobility, the network topology may change rapidly and unpredictably over time which affects the propagation of packets from one node to another. So MANET requires a stable and efficient routing method which should have a long life to transmit the data.Thus Routing is a major problem in a decentralized environment. Fundamentally two types of routings are used in Ad hoc network they are Proactive and Reactive. Proactive routing protocols maintain consistent, up-to-date routing information between source and destination nodes in the network by propagating the routing information in a periodical manner. These protocols are sometimes referred to as table driven routing protocol because each and every node in the network maintains the routing information in the table and updates its information periodically.

In On-demand routing protocol, when a source node wants to send data to the destination, first it checks its route table whether it has an existing route. If no route exists, then it performs a route discovery procedure to find the path to the destination. Hence route discovery becomes on-demand. A Stable route is route which assists for a long time transmission without link breakage.

II. RELATED WORK

A mobile ad hoc network is an emerging technology. Due to its dynamic topology it has to face many challenges and issues like link failure[9][10]. To overcome this problem it has to select the stable route for the data transmission between source and destination. Various methods have been proposed to achieve the stable route .

Nitin Manjhi & Nilesh Patel[3] has proposed a method SSAODV(Signal Strength Adhoc On Demand Routing Vector), in which signal strength is measured between nodes and compare with the RSSI threshold value. If the signal strength is greater than the threshold value then it is accepted for further transmission else it is discarded. This scheme is used for selecting the stable route between source and destination. It maximizes packet delivery ratio, throughput and minimizes end-to-end delay and routing overhead.

B.R Sujatha, & M V Satyanarayana[4] proposed a PDSR (Preemptive Dynamic Source Routing) which improve the data connectivity in the network by selecting an alternate path as soon as signal strength reduces below the threshold value and also considering the age of the path which exceeds the predefined threshold. The performance depends on the preemptive ratio and it is considerably improved.

Deepti Bansal & Megha Vij[5] enhanced the existing AODV routing protocol by adding the header part in the RREQ to find out the destination. The best path is found out by using its signal strength. Source node first checks the visibility of the adjacent nodes and those nodes further checks for the visibility of their adjacent nodes. Subsequent to that the source node finds out the average path. The path with the maximum average value is selected as the final path. Second hypothesis is based on the hop count similar to that of the AODV protocol. The path with minimum hop count is considered as the final path. Third assumption is based upon the sequence number. This helps to improve the performance of the enhanced AODV.

P.Srinivasan & K.Kamalakkannan[6] proposed a novel SEA-DSR (Signal strength and Energy Aware Routing DSR) protocol consider the signal strength and residual battery capacity of nodes for the route selection through the cross layer approach. In this approach intermediate nodes update the reliability count in the RREQ field based on the strength of the signal and energy. Reliability factor is calculated for the received path. The path with highest reliability count is selected and the RREP is send in that path for data transmission to take place. This minimizes the energy consumption in a great manner.

Priyadsrini, T.M. Navamani and Venkatesh Mahadevan[7] proposes algorithms to estimate the stability of the path by considering the energy drain and rate of mobility of the node. This algorithm is implemented in the AODV and this was evaluated against the original AODV. The proposed work improves the network performance and minimizes the computation overhead by avoiding route discovery process by selecting stable path with long life. So it maximizes packet delivery ratio and reduced routing overhead.

III. PROPOSED WORK

Ad hoc networks require highly adaptive routing protocols to deal with the frequent changes in topology. DSR is a dynamic routing protocol, discovers the path only when it requires. Due to its mobility characteristic the link between source and destination node is broken quickly which makes protocol as inefficient. The efficiency of the DSR routing protocol is upgraded by selecting the stable route for data transmission in order to avoid the link failure. The ORT selects the routes which have more stability. The stability of the route is measured by calculating the modified combined weight function using the following characteristics

- Signal Strength-specifies the received signal strength
- Energy-Specifies the residual battery energy for the route
- Length- distance between nodes and
- Traffic load-specifies the traffic load across the route

First the received signal strength is calculated in order to determine whether the node is within the transmission range or not. There are three main radio propagation models. They are free space modal, two-ray ground reflection model and shadowing model. The ORT adopted the two-ray ground reflection model [2] which gives more accurate prediction over a long distance than a free space model

$$P_r(d) = \frac{P_t G_t G_r h_t^2 h_r^2}{d^4 L} \quad \text{- (1)}$$

Where P_t is the transmitted signal power.

G_t and G_r are the antenna gains of the transmitter and the receiver correspondingly

L is the system loss,

d is the distance between transmitter and receiver.

h_t and h_r are the heights of the transmit and receive antennas respectively.

The length of the route between two nodes $S(x_m, y_m)$ and $D(x_n, y_n)$ is calculated using the Euclidean distance [8] among the nodes is

$$Len_i = \sqrt{(x_n^2 - x_m^2)(x_n^2 - y_m^2)} \quad \text{-- (2)}$$

Determine the multiple paths between the nodes and choose the path which has minimum distance between them. If the distance is less than the transmission range then they are consider as neighbors.

$$Energy_i = \frac{Energy_{res}(i)}{N_i \times Energy_{initial}} \quad \text{----- (3)}$$

Where N_i is the number of nodes in the route,

$Energy_{initial}$ is the energy assigned to the node in the beginning of simulation (which is set to the same value for all nodes)

$Energy_{res}\,(i)$ is the sum of the remaining energy in the nodes of route i .

The traffic load also plays a vital role in the link failure. A route with a minimum traffic has a higher priority in the routing process than route with maximum traffic. Traffic of each node is related to the number of routes through it. *TLi* which indicates total traffic of route *i* is:

$$TL_i = \frac{\sum_{n=1}^{N_i} R1_n + \sum_{k=1}^{NH_n} R2_n^k}{NH_i \times C_{max}} \quad \text{---- (4)}$$

Where $R1_n$ is the number of routes through node n and N_i is the number of nodes in route i. Packet delay is not only caused due to traffic load at the current node, but can also be caused by the traffic load at neighboring nodes. NH_n is the number of neighbors for node n, $R2_n^k$ is the number of routes through k^{th} neighbor of node n., NH_i is the number of neighbors of nodes in route i which has N_n nodes (repetitive neighbor is also taken into account once), C_{max} is the maximum connection which a node can establish in a network (which is set to the same value for all nodes)

Finally the Modified Combined Weight Function is calculated using the formula (1), (2), (3) and (4)

$$MCWF = \frac{(Energy_i + P_R)}{(Len_i + TL_i)} \quad \text{----- (5)}$$

STEPS INVOLVED IN THE ORT ALGORITHM ARE SUMMARIZED BELOW:

If Source node A wants to transmit data to destination node B
Using Route Discovery phase all possible routes for a path are discovered
Add all routes R_i in route table Where i=1…n
For each route R_i in the route table
Calculate signal strength, residual energy, load and distance between nodes
Calculate Modified combined weight function for each route
End for
Set Fixed threshold value
Routes R_i in the route table are arranged in the descending order based on MCWF
Route R_i with maximum MCWF is selected
If signal strength of R_i >= fixed threshold value
Establish a route through R_i and data transmitted through R_i
Else
Drop/Discard the route from the route table
Select the alternate path from the route table and transmit the data through that path
End if
At time period T
Route table is refreshed by invoking routing algorithm
If New routes found, it can be added in to table based on its MCWF value
Checks each route in the route table by recalculating MCWF
If MCWF < minimum threshold value
Drop/Discard the route from the route table
End if
End if

NS2 is used for simulation in which the channel capacity of mobile hosts is set to the value of 2 Mbps.

DCF of IEEE 802.11 for wireless LANs as the MAC layer protocol. It has the functionality to report the network layer about the link breakage. In this simulation, mobile nodes of size 10, 20, 30, 40 and 50 moves in a rectangular region of 1500 meter x 300 meter moves randomly with the minimal speed of 5 m /s to the maximal speed of 20 m /s. It uses Random Way Point mobility model with the packet size of 512 bytes. Initially, each node is initialized with the energy of 5.1 joules. The time taken for the simulation is 100 seconds. All nodes have the same transmission range of 250 meters. The simulated traffic used is Constant Bit Rate (CBR). The node transmits the data at a constant rate. Simulation settings and parameters are given below:

A. Simulation Parameters

No. of Nodes	10,20,30,40 and 50
Area Size	1500 X 300
Mac	802.11
Radio Range	250m
Simulation Time	100 sec
Traffic Source	CBR
Packet Size	512
Mobility Model	Random Way Point
Rxpower	0.395
Txpower	0.660
idlepower	0.035
Initial energy	5.1 Joules
Speed	5m/s to 20m/s
Pause time	10, 20, 30, 40 and 50

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B. Performance Metrics

The ORT is compared with the RECM. The performance of ORT is evaluated using the following metrics by varying the number of nodes and pause time.

Control overhead: The control overhead is defined as the total number of routing control packets normalized by the total number of received data packets.

Average end-to-end delay: The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

Average Packet Delivery Ratio: Packet delivery ratio is measured by dividing the number of packets received by the destination to the total number of packets originated by the source..

Average Energy: It is the average energy consumption of all the nodes involved in sending, receiving and forwarding operations.

C. Results

(i) Based on Nodes

The performance of the work is evaluated by varying the number of nodes

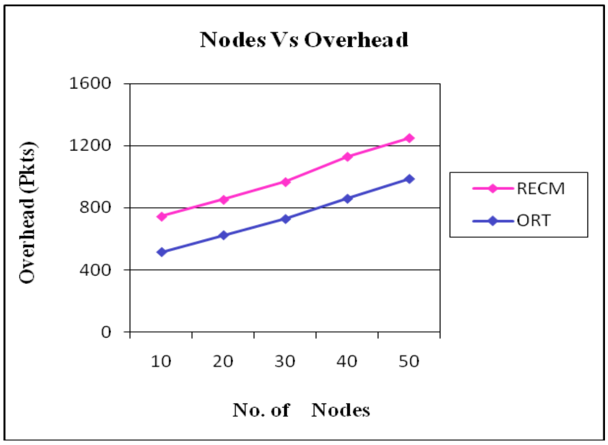

Fig 1: Node Vs Overhead

Fig 1 shows the performance over the control overhead of the protocols. Control overhead of the ORT is minimized by selecting the stable routes which in turn avoids flooding of route request packet.

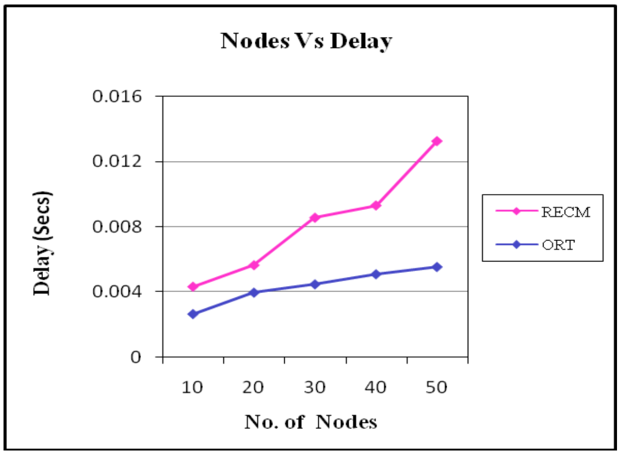

Fig 2: Node Vs Delay

Fig 2. Shows that the average end to end delay for the ORT is minimized when compared to the RECM Protocol by selecting the stable route between source and destination

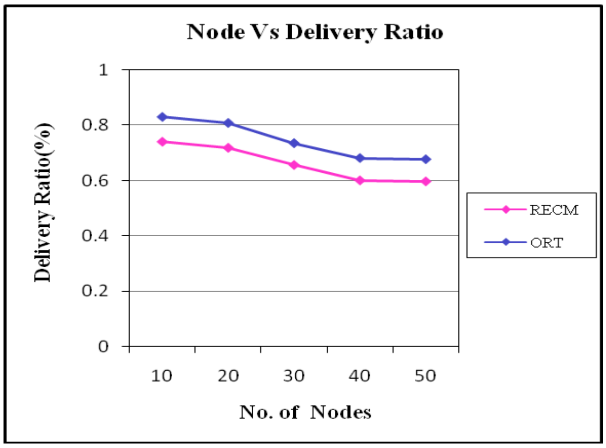

Fig 3: Node Vs Delivery Ratio

Fig 3. Shows the result for packet delivery ratio. From the result, packet delivery ratio is increased when compared with the RECM algorithm since it utilizes the robust links.

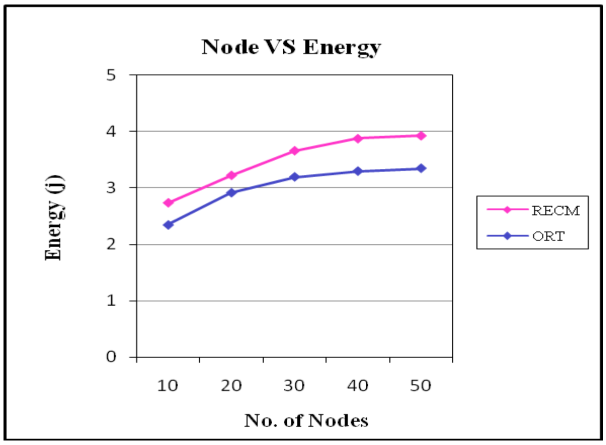

Fig 4: Node Vs Energy

From Fig 4. We can see that the energy consumption for the proposed work increases when compared with RECM

(ii) Based on Pause Time

The performance of the ORT is evaluated for 50 nodes by varying the pause time as 10, 20, 30, 40 and 50.

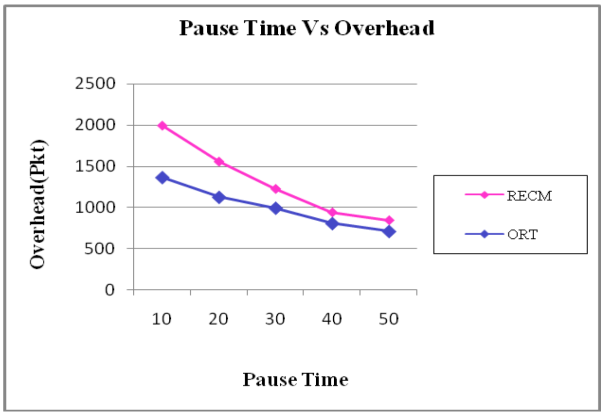

Fig 5: Pause Time Vs Overhead

Fig 5 shows that the overhead for ORT is minimized when compared with RECM because the frequent route discovery is avoided in this technique.

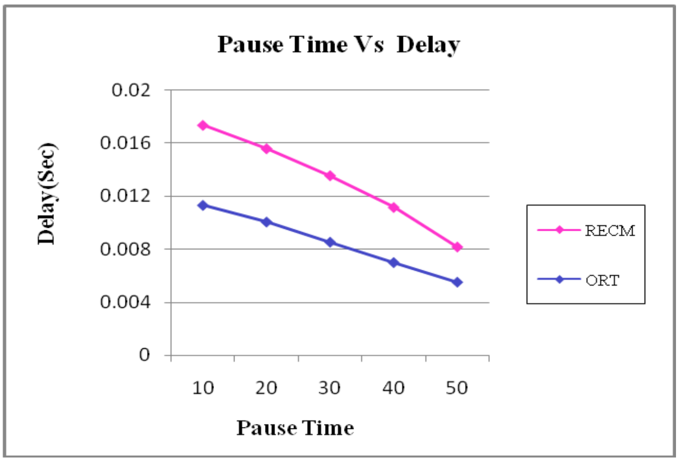

Fig 6: Pause Time Vs Delay

Fig 6 shows that the end-to-end delay is reduced when compared with RECM

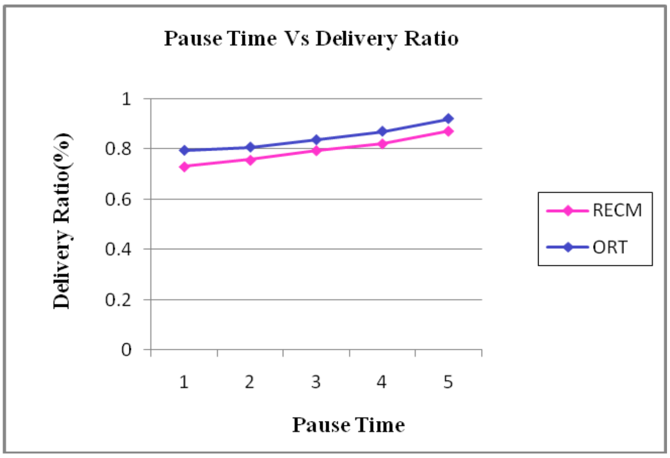

Fig 7: Pause Time Vs Delivery Ratio

Fig 7 shows delivery ratio for ORT is maximized when compared with the RECM

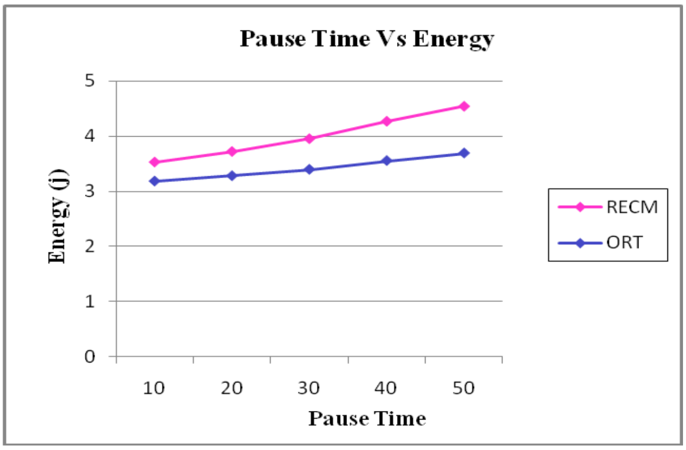

Fig 8: Pause Time Vs Delivery Ratio

Fig 8 shows the energy consumption for ORT is reduced when compare with the RECM

V. CONCLUSION

In this paper, we have developed a technique which is used to select the stable route for data transfer. In this technique a modified combined weight is calculated for each route in the route cache. The route with maximum modified combined weight is selected for data transmission in order to avoid the link breakage. So that the ORT maximizes packet delivery ratio and minimizes the delay, energy consumption and overhead.

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