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A Novel Energy Based Routing Algorithm to Reduce Link Break in Mobile Ad Hoc Networks

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Abstract*— Mobile ad hoc networks is a self organizing wireless networks for mobile devices. It does not require any fixed infrastructure due to no wired backbone. It is suitable to use in environment that have a need of on the fly set-up. Every host is a router and packet forwarder. Each node may be mobile, and topology changes frequently and unpredictably due to the arbitrary mobility of mobile nodes. This aspect leads to frequent path failure and route rebuilding. Routing protocol development depends on mobility management, efficient bandwidth and power usage which are critical in ad hoc networks. In this paper, first one is a novel energy based routing algorithm to reduce the link breaks in mobile ad hoc networks and second analysis of network performance under different traffic conditions. This present approach reduces packet loss and finds optimized route by taking into consideration of bandwidth, delay which results by improvement of quality of service. The performance analysis and simulation are carried out to evaluate network performance using network simulator NS-2 based on the quantitative basic parameters like throughput, delay and Packet Delivery Ration(PDR) in term of number of nodes and various mobility rates. A simulation result was during the comparison of AODV protocol with Modified- Reduce Link Break Algorithm Ad hoc On-demand Distance Vector protocol (RLBAAODV) the probability of link break has been decreases in RLBAAODV considering when various pause times and increases number of nodes.

***Keywords*-AODV, RLBAAODV, RSSA, PDR.**

I. INTRODUCTION

Mobile ad hoc networks is a self organizing wireless networks for mobile device which is composed by a group of mobile terminals with wireless transceiver when the communication facility damaged between the mutual connections of sub elements[1]. Conflict in the accident of natural disaster such as non center distributed controlled network may provide the temporary communication support compared with other communications networks, ad hoc networks has the following characteristics. Network is a self-regulating topology which is dynamic, bandwidth is restricted, and the capacity of network is changeable. MANET is mobility where all the nodes are allowed to move in different dimensions which results in dynamic topology, since nodes are moving so they can go out of range network or come in range of network at any time, any node which part of network (n1) time (t_j) can be part of an other network (n2) at time (t_j) MANET are also used for meetings or other conventions in which people can quickly share information and data acquisition operations in hospitable terrain.

The terminal energy is limited and the networks are controlled through distributing it and so on. The routing protocol in ad hoc network is critical in achieving good performance of networks.

The challenge of designing network protocols for MANET comes from link until they break which caused network performance degradation .The route reconstruction of link takes major challenge of routing protocols task doing rebuilding packets can be lost making QoS of connections depending on the state of networks. In various approach had been proposed to make routing protocol becomes efficient and correct. There are Three types of routing in MANETs viz., float routing versus non-flat or hierarchical routing which benefits proactive routing protocols (e.g. DSDV,OLSR), reactive (e.g. AODV,DSR), and hybrid(e.g. ZRP,CBRP) mechanism for routing[2]. This paper discus to design a new modified AODV technique to reduce the link break, which consider all the above mentioned problems together, and to maintain a balance between mobility and energy constraints in MANET[1][2][3]. As compare to other routing protocols, AODV is more popular and easy to modify.

The first one is Reduce the Link Break Algorithm to be implemented in Ad hoc On demand Distance Vector (RLBAAODV) protocol is considered as the extension to the well known AODV, to find out route for all traffic that reduce link break, have been proposed. The purpose of the proposed algorithm is to discover and exploit routes with efficient route optimization method. This algorithm finds out optimized route by prediction of link break which is predicted according to Received Signal Strength (RSS) and Link Expired Time (LET) of every node in the network. The proposed solutions minimize packet loss and reduce the link break by considering bandwidth, throughput and packet delivery ratio which results in improvement of QoS and second one is the performance of CBR and TCP traffic models was evaluated using AODV and RLBAAODV.

The rest of the paper is organized as follows: Section II explains about the methods and materials. Section III gives our proposed method. Detailed description of proposed algorithm to reduce the link break (RLBAAODV) in Section IV. Section V presents the Results and discussion. Implementation and graphs are given in Section VI, Conclusion in Section VII.

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II. METHODS AND MATERIALS

A. RELATED WORK

More amount of work has been done earlier on QoS in MANET, Wu et al. [3], which considers several route optimization schemes for the routing protocols. Park and voorst [4] present an algorithm, called "Anticipated route maintenance (ARM)" which predicts whether a link between two nodes will be broken with in a predefined time interval, using GPS [5], which is an extension to the AODV protocol algorithm gives weight function using several parameters. This paper reduces network overhead also gives heuristic paths with a higher saturate bandwidth than original AODV protocol. Sjaugi et al.[6] appeals to location information for nodes (as provided by GPS) in order to detect unsafe links that is, links whose geometric length exceeds a certain threshold distance. This is a path expanding routine; similar to what was proposed in Park and Voorst [4]. Paper [7] also improve QoS in MANET, by reducing end-to-end delay and increasing packet delivery ratio under conditions of high load and moderate to high mobility, though the routing load of AODV is slightly less than that of the proposed protocol.

This paper focuses only on bandwidth and delay to improve the QoS in MANET. Our proposed scheme uses this concept to Reduce Link Break in MANET. M.Veerayya and Abhay karndikar [8] gives a novel energy-aware stability based routing protocol for enhancing QoS in Wireless Ad-hoc networks. It proposes a "make-before-break" mechanism for finding an alternate route for the session. This approach is based on cross layer architecture. In this approach they had not mentioned anything about bandwidth and delay. F.Jiang and J.Hao [9] discussed about optimized AODV algorithm for Ad-hoc network. This proposed algorithm improved Hello Mechanism, Enhanced Route repair process and performs single route improvement by providing back-up path in case of link broken. But this paper focuses on bandwidth, signal strength and delay [3] [8]. Routing and QoS support for MANETS [10], a new reduce the link break algorithm is called RLBAAODV which is an extension to the AODV protocol. The fundamental idea in this approach is separating nodes and links in the network that can be used in a QoS routing [8] [9]. This approach can reduce route breaking meanwhile improving Throughput, packet delivery ratio and delay. This approach considers received signal strength of node and remaining battery life for selecting proper node sets that can take part in the routing procedure.

B. AD HOC ON-DEMAND DISTANCE VECTOR (AODV)

The AODV routing protocol [10] is the extensive application by people in reactive routing protocols. When the AODV needs to establish routing, the source node broadcasts a route to ask for the RREQ grouping at first, which includes the destination node address, the destination node serial number, the broadcast serial number, source node address, the source node serial number, previous hop address and hop number. When the intermediate nodes received RREQ, at first it should build up this RREQ, and according to the information provided by this RREQ, it then look for the routing table of its own as soon as effective routing to the destination node is discovered. Response RREP packet is sent by reverse routing the RREP packet including the source node address, the destination node address, the serial number of destination node, hop number and service time.

If there is no effective routing to the destination node is found, then RREQ is broadcasted to the neighbor nodes until the RREQ arrives at the destination node, which then generates the RREP packet, and passes the RREP to the source node along the established reverse routing. When identical RREQ has been identified in many different RREP then the source node will choose the routing which has the highest destination sequence number, or choose the routing with smallest hop count when destination node has the same serial number. Thus the routing is established and it can be used in its term of strength. When the source node and the destination node transmit data along the established routing and if the routing has abruption, the upstream node at the place of the abruption will launch the source repair or local repair according to the relative position to the destination node.

C. TRAFFIC MODELS

The ad hoc routing protocols have been considered analytically using TCP, CBR, VBR traffic models [11]. Analysis has carried out that TCP traffic models perform weakly by misconception of packet loss, link failure, and delayed acknowledgement as a sign of the network congestion since mobile ad hoc wireless networks using TCP traffic models are congested due to the frequent topology changes. (TCP was designed for fixed node networks).Which routing protocol from all categories is the best to response to link failure and packet loss before the TCPs response is also indefinite. The mobility and traffic are unpredictability and also congestion is the main factor that affects the performance of TCP traffic models in MANET. In recent years most researches use CBR traffic models due to the assumption and analysis the TCPs failing in MANET.

III. PROPOSED METHOD

The prospect in related work has been proposed many distinct path breaks finding algorithm to improve QoS either by using end-to-end delay, throughput and Packet Delivery Ratio(PDR) . In this paper, we have implemented the proposed reliable on-demand algorithm based on the, which will minimize packet loss by predicting reduction in link break. Our proposed RLBAAODV algorithm, finds out the link break by predicting signal strength and link expired time of the neighboring node in the network, delay, throughput and Packet Delivery Ratio (PDR) which results in improvement of QoS. Second one is the fact that considerable simulation work has been done, the performance of the traffic and mobility models and comparison between them using routing protocols. While Evaluates the performance of TCP and CBR traffic model using AODV and RLBAAODV routing protocols. In this paper, the performance of CBR and TCP traffic models was evaluated using AODV and RLBAAODV.

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IV. REDUCE LINK BREAK USING PREDICTION OF RSS

In this approach can reduce the link break using prediction of received signal strength and link expired time to reduce number of packet loss and hence improve QoS in MANET. The proposed an algorithm in which every node in route discovery phase before broadcasting route request (RREQ) packet to its intermediate node, checks QoS parameters based on conditions that are discussed below. The RREQ packet of AODV is extended in this protocol. Two new fields Link Stability Announcement Timer (LSAT), Total Power Cost (TPC), minimum bandwidth of node and maximum delay of node are added to the RREQ Packet. RREP packet is modified to include the reliability information during route reply from the destination node to the source node. If any node satisfies all these conditions then only it will forward RREQ to its intermediate node else it will drop the packet. If there is no single node which satisfies all these conditions, then it will restart route discovery phase until it finds route which satisfies all these conditions. Once route discovery is done by prediction of link break, route reply (RREP) packet is sent from destination node to source node in reverse path. If the signal strength is between minimum and maximum, then link status is calculated based on the Received signal strength (RSS). Then, Power cost for the link is calculated using the Cost function equation(4).

A. Received Signal Strength Algorithm (RSSA)

There exists several ways to predict the link break [12] [13] [14][15][16]. This approach to prediction of link break is based on the Received Signal Strength Algorithm and Link Expired Time (LET) which is used to find out received signal strength of node. As nodes move, the distance between them varies and therefore we consider RSSA Pr values.

For each node, compute RSS using the radio propagation model at distance "d" is predicted by:

$$\Pr(d) = \frac{P_t G_t G_r h_t h_r}{d^4 L} \qquad (1)$$

Where,

P_r = Received Signal Strength.

P_t = default Transmission power.

G_t = Antenna gain of transmitter.

G_r = Antenna gain of receiver

ht , hr = Heights of antenna.

L = System loss.

In addition, wireless ad hoc simulation, an omni-directional antenna is used. Thus, assume the ground is flat and hr and ht are known. After simplify equation (1) under the condition of ad hoc wireless network simulation.

$$P_r(d) = C\,\frac{P_t}{d^4 L} \qquad (2)$$

Where $C=Gt*Gr*(ht^2*hr^2)$ is Constant.

The signal strength of received packet to predicts the link break time when two nodes are moving out of the radio range in the network [15][16] Here, we assume that the signal strength Pr less than threshold value for a wireless network interface is fixed, the prediction time is stable if two nodes keep moving in the same direction and mobility rate during the prediction period [16][17][18][21].

Since, Fig 1, mobile node B receives a signal from node A at time T_1, suppose the distance"d" between them is d_0, then,

$$P_{r1}=C\,\frac{P_t}{d_0^4} \qquad (3)$$

If the mobile node B computes the relative mobility, speed and direction according to node A using the equation (3) then the current distance and prediction of link break time can be known [16][21]. If the link break time is not known then in order to take these constraints, more examples are needed. At time T2 and T3, the mobile node B receives the second signal from node A. Let $t_2=T_2-T_1$ and $t_3=T_3-T_1$, At the time T the Received Signal Strength power(RSS) at node B will be equal or closed to the threshold power Pr.

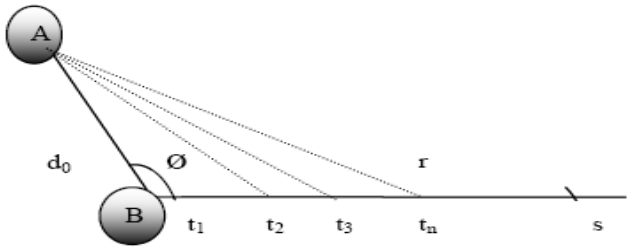

Fig.1. Mobility speed of two mobile nodes

$$P_{r2}=C\,\frac{P_t}{a^2-2ab+b^2} \qquad (4)$$

Where

a= d_0^2

b= $(st)^2$

2ab= $(d_0 st\cos\theta)$

Based on the equation (4) and using the two received packet signal power strength [17][21]. We can compute the link break time between two mobile nodes. When the received power at the time of receiving data packets is less than the threshold and has reduced as compared with the previous received power. In general, the distribution of Pr is of logarithmic nature, and majority of broadcast packets are received with Pr close to minimum value of observed Pr values[20][21]. Therefore, in many situations, the value of Threshold minimum shall be closed to minimum Pr. This value represents the case when receiving node is on the boundary of the communication range of the transmitter node.

B. Reduce The Link Break Algorithm Using Rssa (RLBA)

Algorithm 1: Implemented in Intermediate nodes.

Begin

…

Set Threshold = minimum, maximum, AT, LSAT, TEC, P;

…..

If (P is RREQ Packet) then

{

At times, after each time interval "t" computes new value of RSS. P=min-max Update Link Configuration table with new RSS

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(i.e) LSAT=0.
Assuming that link break time "T=0" wants to send from source "S" to destination "D".
Source node "S" will find out the valid neighbor nodes by checking the following conditions

```
}
If (Power of Receive Data Packet >Threshold) then
{
        Drop the Data Packet;
        return
        end if
}
If (Admit Control message =fails) then
        {
         Drop the Data Packet;
         Return;
         End if;
         }
If(Receiving Data Packet has AT=1) then
 {
          If (Power of Receive Data Packet <Threshold)
          then
          AT=1;
          Else
          LSAT=LSAT*AT
          Update the RREQ LSAT,TPC;
          Else
          {
          Node will broadcast the packet further;
          Repeat for every node until it reaches to the
          destination;
          }
          Drop the packet
          Return
          End if
          End if
}
}
End
```

V. SIMULATION RESULTS AND DISCUSSION

A. PERFORMANCE ANALYSIS

The performance analysis was carried out using network simulator NS-2.34 version running windows XP operating system in a topology area of 1000 X 1000 meters with simulation time 100 seconds. Sending rate 8 packets/seconds and transmission range of 250 meters.

B. SIMULATION ENVIRONMENT

In this section, the experimental results of the proposed on –demand reliable routing algorithm as evaluated with the NS2 version 2.34 by making modification in the existing AODV protocol. We have added extra two parameter Link Stability Announcement Timer (LSAT)[21][22][23], Total Power Cost(TPC),in routing table and Link Expired Time (LET), this value is used to find the state of node for propagating packets. During route discovery phase, If found out to Reduce Link Break (RLB) using parameters like RSS. A lower hop count path with strongest link is to be selected from all these routes which are recorded in the routing table and used whenever a link break occurs.

Table1. Simulation Parameter

Simulator	NS-2.34
Terrain Area	1000X1000 m
Number of Nodes	50,100
Simulation Time	100 Seconds
Movement speed	0-20 meter per second
Mobility model	Random way point
Traffic Type	CBR ,TCP
Radio Propagation	Propagation/TwoRayGround
Pause time	10,20,30,40and50 seconds
Antenna type	Omni Antenna
MAC Protocol	IEEE 802.11
Ad hoc Routing	AODV, RLBAAODV

The simulation was carried out for network topology with 50 and 100 nodes. Comparison between RLBAAODV and standard AODV is carried out. The performance analysis is done for End-to-End Delay, Throughput and Packet Delivery Ratio (PDR).

C. Performance Metrics

1. Packet Delivery Ratio

The mathematical representation of packet delivery ratio is developed by how successfully the packets are delivered from source to destination and it can be written as

$$p = ((p_r / p_s) * 100) \quad (5)$$

Where p is packet delivery ratio, p_r is the total number of packet received and p_s is the total number of packet sent.

2. End-to-End Delay

The mathematical model for average End to End Delay refers to the time taken for a packet to be transmitted from source to destination and is expressed as

$$AE = (p_{st} - p_{rt}) / p_r \quad (6)$$

Where AE the average End to End Delay is, P_{st} is the packet sending time and P_{rt} is the packet received time.

3. Throughput

It refers to number of packets delivered successfully from source to destination.

VI. IMPLEMENTATION

The obtained simulation results are compared and evaluated based on the performance of AODV and RLBAAODV routing protocols.

The Simulation was carried out at various pause times of 20,30,40,50 seconds, different packet sizes were sent with various traffic models. We are using 50 nodes, pause time and mobility speed starting from 20 change and since it has been observed that the increasing end-to-end delay in AODV. In RLBAAODV the delay is slightly decreased compared by original AODV.

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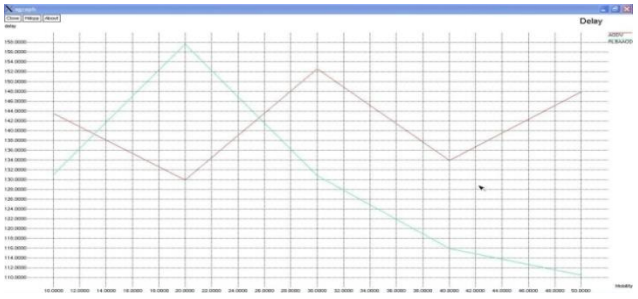

Fig.1.End-to-End Delay versus Pause Time (m/s) for 50 nodes

The Fig.1and Fig.2 Observed that the delay RLBAAODV is high with compared with AODV in the presence of mobility. It is reason to the admit process carried on RLBAAODV. At the low mobility speed while the delay was decrease. The delay of RLBAAODV is low for various mobility speeds and increasing the nodes 50 and 100 nodes also. It is observed that the delay varies as number of nodes and time for AODV and RLBAAODV varies. The proposed algorithm gives better result in the presence of mobility. Due to the selection of reliable route based on the link stability and power metrics.

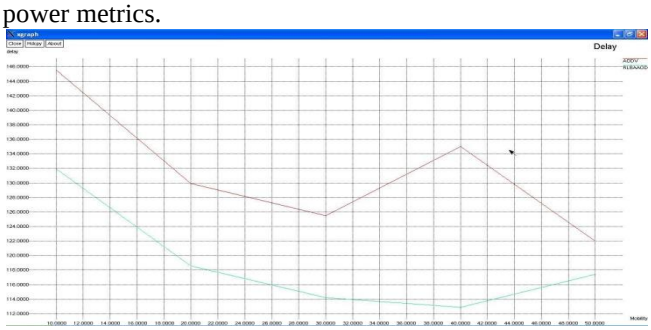

Fig.2.End-to-End Delay versus Pause(m/s) Time for 100 nodes

Fig.3 and Fig.4 shows, Mobility Speed versus Throughput for number of nodes 50 and 100.

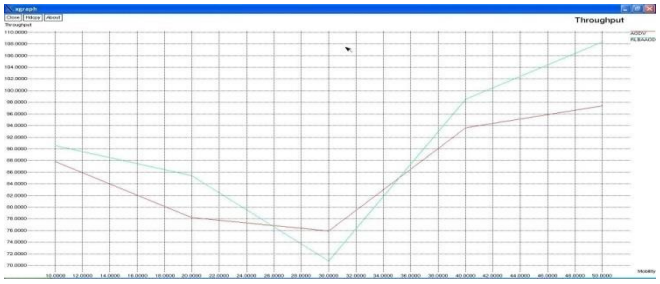

Fig.3.Throuthput versus Pause Time (m/s) for 50 nodes

In AODV and proposed protocol RLBAAODV, as the random mobility speed and number of nodes modify throughput it varied the speed of nodes 20.2 ms, 40.1 ms and 48 ms of proposed protocol RLBAAODV, which results in the improvement of QoS.

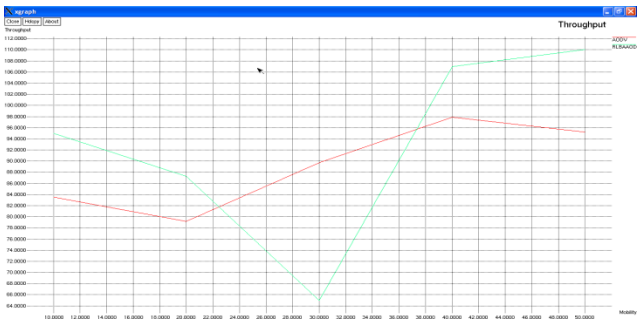

Fig.4.Throughput versus Pause Time (m/s) for 100 nodes

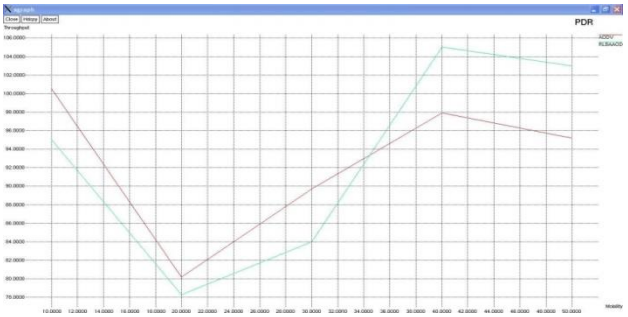

Fig.5.PDR versus Pause Time(m/s) for 100 nodes

Fig.5 observed that the Packet Delivery Ratio (PDR) decreases as the mobility speed was increases in the two protocols. While the reason for decreases the PDR when increasing the mobility speed and route discovery process is slow. The Packet Delivery Ratio (PDR) of RLBAAODV are 97.22% and 105.00% respectively in case high mobility speed. The energy and reliable of the route selection based on the RLBAAODV in reducing the number of link break compare with AODV protocol.

VII. CONCLUSION AND FUTURE WORK

Routing protocol is a very important mechanism for QoS guaranteed in MANET. It uses the route until a link break is found. A repeated disconnection of mobile node can cause some packet losses and delays. In this paper, an algorithm is proposed reliable on demand algorithm and implemented based on prediction of signal strength and route stability by route discovery process. Since we have considered the factor of on prediction of signal strength, it results show that compare with AODV protocol and RLBAAODV protocol slightly changes in minimization of packet loss. The low mobility, the proposed algorithm has slightly high delay compared with AODV. It is also observed that the difference in energy. The implementation result shows that, the present algorithm RLBAAODV in term of minimizes packet loss, improved throughput, Delay and PDR, which results in improvement of QoS as a future work, we can analysis their performance of the protocol under different traffic models.

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