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Dynamic Stability Factor Based AODV Routing Protocol

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Abstract—The mobility of nodes is the important factor responsible for the performance of mobile adhoc networks. Since the development of wireless sensors, stability of each node has been an important region of concern to ensure the quality of network. In this paper link stability factor is calculated dynamically in order to use the remaining energy present in the nodes. The modified routing scheme is evaluated by simulation and results show that an improved throughput and reduced end to end delay can be obtained.

Keywords— Wireless Sensor Networks, Sensor Nodes, Link Stability Factor, MANET, AODV Routing Protocol

I. Introduction

From last few years wireless technology has become important in today's modern world. Two persons can communicate and share their views with one another sitting at two different ends of the world. Wireless sensor network has gain importance in almost every field like in industry, transportation, battle fields, security, etc. MANET's [1] are self established networks in a way that for nodes to communicate with each other, there is no need to gaining knowledge about different parameters of network to establish a network. It is a kind of a mesh network which has no structured network. There are three types of MANET's routing protocols namely as:

1. Proactive routing protocols
2. Reactive routing Protocols and
3. Hybrid Routing Protocols.

In **Proactive routing protocol**, each node participated in the network has its own routing table .E.g.- Optimized link stable routing protocol(OLSR),Destination sequence distance vector protocol(DSDV).

In **Reactive Routing protocol**, the principle of on-demand is applied .this works when there is a need to forward the data from source to destination. There is less number of routing tables and are updated only when there is need to update them. E.g. - Adhoc on demand distance vector (AODV) and Dynamic source routing (DSR).

In **Hybrid Routing Protocol**, both distance vector and link state protocols worked together for desired results. This protocol finds out best route to deliver the packet to destination end.

In reference [2], a new algorithm named link stability based AODV (LSB) is implemented and selection of path for sending data to destination is by selecting the stable path for transmission and the range of a node is divided into two zones namely stable zone and caution zone. This newly developed protocol can reduce link breaks and also improved the performance of packet delivery ratio. In reference [3], Improved AODV protocol is proposed with the help of which the consumption of energy is reduced during route discovery process and it also improved packet delivery by calculating stability factor of each node participating in the network. In reference [4], the stability is based on the link stability by increasing the node lifetime by finding the discard limit of each node in the network. The algorithm used saved the energy of each node of topology while simulating AODV. Results show that under a variety of applicable network loads and settings, our protocol achieves better packet delivery ratio and less routing overhead. In reference [5], the authors proposed Prediction based link stability scheme (PLSS) to balance between stability of path, link, and neighbor node to extend the network lifetime. In reference [6], the objective of the proposed work is to develop an energy efficient AODV routing algorithm in a way that an optimal route from source to destination can be selected by keeping energy consumption factor as an important parameter. In reference [7], the energy factor based AODV (EFAODV) is implemented and the energy at every node is used in the process of route establishment. This EE-AODV works well in highly mobile nodes. In reference [8], the main focus is on the mobility of the source node and the intermediate node which cause link failure. So main goal is to update the new path so that link failure can be reduced and with this the end to end delay is reduced and throughput is increased.

The goal of this paper is to utilize the remaining energy that is left in the nodes when certain (threshold) limit of node energy is reached. To fulfill the goal, the distance between two neighboring nodes is to be calculated for defining the link and path stability factor and the distance is calculated by using the Log distance path loss model. As the main concern of AODV routing protocol is to find out the best stable path for data transmission which is calculated using the link stability factor of each link in the network.

The paper is arranged as follows: Section II shows the detailed information about the link stability factor and path stability factor. Section III shows all the implementation of our dynamic stability factor based AODV protocol by proposed algorithm. In Section IV, various simulation parameters details and the results are discussed and in last Section V conclusion of the paper.

II. Link stability and path stability

A. LINK STABILITY

Link stability points to the way that how stable the link is between two neighboring nodes to send the data from source to destination. The algorithms are there which only selects the path of a link that will work longer in the network.

As it is mentioned in [2], that T-R (transmitter-receiver) separation is as follows:

$$\overline{PL}(dB) = \overline{PL}(do) + 10\, n \log\left(\frac{d}{do}\right) \quad (1)$$

Where n stands for the rate at which path loss increases with the distance. do is the close in distance to the transmitter and d is the separation distance of both transmitter and receiver.

$$\overline{PL(do)} = 10\, log\frac{Pt}{Pr} = -10\log\left[\frac{Gt\, Gr\, \lambda^2}{(4\pi^2)d^2}\right] \quad (2)$$

Where Pt is the power of a transmitter and the Pr is the power of a receiver and

Gt is the gain of a transmitter antenna and Gr is the gain of the receiver antenna

As Lucent WaveLAN cards have a transmission range of 250mm in open environment and reception power threshold is $3.65X10^{-7}$ mW. So,

$$10log\frac{Pt}{3.65X10^{-7}} = \overline{PL}(do) + 10n\log\left(\frac{250}{do}\right) \quad (3)$$

$$10\, log\frac{Pt}{Pr} = \overline{PL}(do) + 10n\log\left(\frac{d}{do}\right) \quad (4)$$

Hence, from equations (3) and (4),

$$d = \frac{250}{\sqrt{\frac{Pr}{3.65X10^{-7}}}} \quad (5)$$

In the end the Link stability factor (LSF) is defined as follows:

$$L.S.F = \frac{R-D}{R} = 1 - \frac{d}{r} \quad (6)$$

Where R is the transmission range of a node.

From equation (5) and (6),

$$L.S.f = 1 - \sqrt{\frac{3.65X10^{-7}}{Pr}}$$

B. PATH STABILITY

The path stability is correlated with the link stability as the stability of a particular path depends on the stability of a links come along with a given path. The path stability factor is calculated mathematically as follows:

$$P.S.F = \prod_{i=1}^{n} LSF$$

(7)

III. Proposed Algorithm

1. **Set up the scenario:** Firstly set up the scenario in EXATA. Take 100 nodes in 1500 X 1500 simulation area.
2. **Selecting the Protocol:** After creating a simulation scenario selects the AODV protocol and take readings.
3. **LSF_AODV:** As in [1] the link stability factor (LSF) is used to select a stable path while minimizing the number of hops. By using the following formulas calculate the link stability factor.

   The Link stability factor (LSF) is defined as follows:

   $$L.S.F = \frac{R-D}{R} = 1 - \frac{d}{r}$$

   After calculating, take the reading by setting up the same simulation parameters.

4. **Modified_AODV:** After calculating link stability factor using the above said formulas, there reaches a point in the network when the nodes that are participated in the transmission are left with no energy in them. But actually some of the energy is present in these nodes.

So in our proposed algorithm, we dynamically calculate the link stability of each node for again using that wasted energy for further transmission. The following formula is used:

$$\sum_{i=1}^{n} \text{Pi}$$

N

Where, Pi is power of non-participating nodes and
N is the number of nodes

5. With the help of above formula we can calculate the power of non-participating nodes and the nodes which are inactive. By calculating the remaining power in the nodes, make the inactive nodes as active nodes and then again use them in the network for further transmission.

IV. Simulation Parameters and Results

A. Simulation Scenario settings

EXATA simulator is used to perform different simulations. After performing the simulations the obtained results are compared with the default AODV.

TABLE 1 Simulation Values

Parameter	Value
Environment Size	1500 X 1500
No. of nodes	100
Simulation time	3 hours
seed	1
Packet size	512 bytes
Protocol	AODV
Traffic Type	CBR
Battery model	Linear model
Battery capacity	400
Battery charge monitoring interval	1 second
Interval	1 second
Start time	1 second
End time	0 second

B. Performance Metrics

Our Proposed algorithm uses the following metrics to compare the performance of both default AODV and Dynamic stability factor based AODV Protocol.

1. **Packet Delivery Ratio:-**It is defined as the ratio of number of packets that are received at the destination end to the number of total packet sent. If the value of packet delivery ratio is high that means that the more stable is the protocol.

2. **Average end-to-end –delay:-**It is defined as the time a packet takes to reach at the destination.

3. **Throughput: -** In a particular time period amount of data that can be transferred from a given source to a destination.

4. **Average Jitter:-**It is defined as the variation in a time period of sending the data packet from source and receiving the data packet at their destination**.**

C. Simulation Results

The performance of the modified M_AODV is compared with default AODV and with LSF_AODV.

1. Throughput

AODV	LSF_AODV	M_aodv
7467	8218	8413

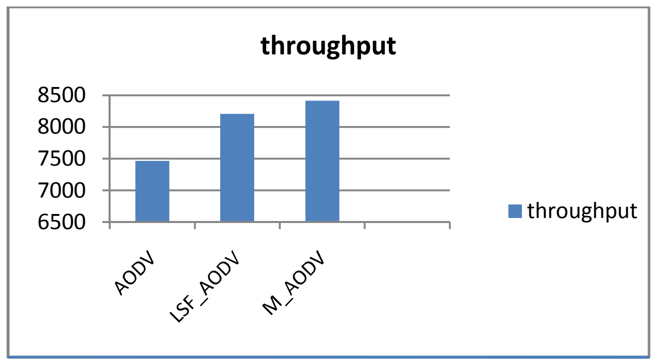

Figure 1: Throughput

Figure 1 show how the throughput varies against time. The throughput of modified AODV is better than the simple AODV and LSF_AODV.

2. Jitter

AODV	LSF_AODV	M_AODV
0.00232942	0.0232945	0.0232941

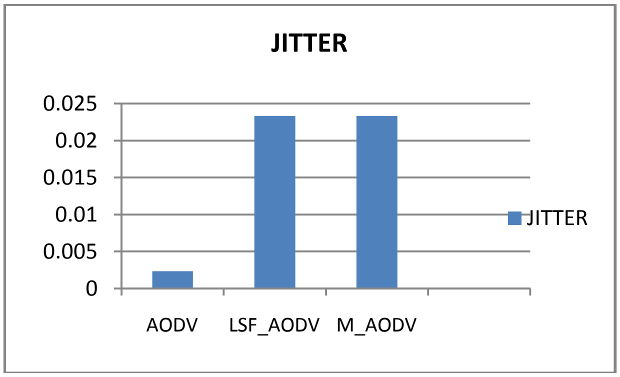

Figure 2: Jitter

Figure 2 shows that the jitter of modified M_AODV is lesser than the LSF_AODV but it is greater than simple AODV

3. End Delay

AODV	LSF_AODV	M_AODV
0.022861	0.022851	0.022849

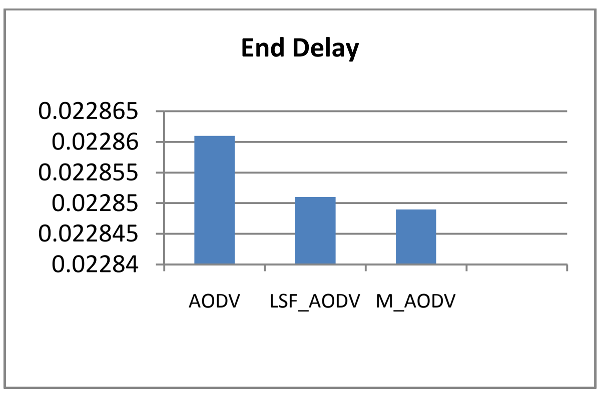

Figure 3: End delay

Figure 3 shows that the end to end delay of the modified AODV is better as the performance of a protocol is best if the end delay is lowest.

V. Conclusion and future work

This research work proposes an improvement of LSF_AODV and compares the performance of modified M_AODV with the simple AODV and LSF_AODV. By making the inactive node as a active node for further transmission the modified M_AODV is better than the LSF_AODV by increased throughput and decreases end delay.

The more work has to be done in the future in this area .As we can calculate the link stability factor by considering only one parameter as battery .In future by considering more parameters for e.g. Traffic and the security the performance can be improved to a large extent.

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