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Fuzzy based Drug Target Interfacing in Wireless Ad hoc Molecular Network using Reliable Multicast Routing

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Abstract: ***Wireless Ad hoc Molecular network consists of atoms in terms of nodes in the absence of administrative point. In this connection, there is a need to adopt molecular analogy to define the architecture. Prediction of Drug Target Interaction (DTI) is a major impact in molecular ad hoc network. Efforts were made to combine such information with data to define DTI and to construct biological space. The concept of Conditional Random Field (CRF) is used in our proposed Fuzzy based Multicast Reliable Routing Protocol (FLRMRP) to integrate genomic, chemical and functional data to predict DTI. Reliability of links was also maintained to predict the drug target issues. From the analytical results, proposed reliable multicast routing has achieved better improvement in terms of packet forwarding ratio and throughput.***
Keywords: Drug target interaction, multicast, reliability, fuzzy routing, link breakages.

I. INTRODUCTION

In recent years, Wireless Ad hoc Molecular network is one of most advancement and familiar network in ad hoc network. It contains number of atoms that is represented as nodes. Atoms play the major role in packet forwarding during channel assignment period. If channel contention is more, it is difficult to reorder the packet priority. It may cause more congestion. In this section, the concept of Code division multiple access with scheduling scheme is deployed to avoid packet loss rate. Multicast routing provides additional advantage for efficient packet forwarding. In drug target landscape model [1], authors reviewed the path which lead to the development of a knowledge to convey the overall meaning of an integrated set of data including disease association, druggability, competitor intelligence, genomics and text mining. The therapeutic precedence line creates clearly distinct 'zones' of pharmaceutical opportunity, ranging from small-molecule repurposing to biotherapeutic prospects and gene family exploitation. It is difficult to identify the link failures, node failures and broken paths in ad hoc molecular network because of high drug target issues. Hence there is need of obtaining the link reliability before route maintenance phase. Mobility of atoms is a major issue in molecular network [2, 3]. In high mobile environment, link failure may occur which degrades the reliability of network performance. If high number of nodes or atoms is deployed in the network, throughput will be reduced to zero [4]. In high density network, the transmission capacity may be influenced by throughput. Moreover congestion takes places which consumes excessive number of control packets and leads to heavy packet dropping. Including this, the congestion of wireless network also needs to be taken into account in ad hoc It is critical to set all mobile atoms with constant reliability value due to limited capacity. In the proposed research, drug target prediction can be achieved by introducing the concept of reliable multicast routing with fuzzy decision model. Based on fuzzy interference system, network performance can be easily improved by overcoming the issues of drug target. The research work is categorized into four chapters. In first chapter, introduction about ad hoc molecular network and prediction of drug target was discussed. In second chapter, survey of routing in wireless ad hoc molecular network was discussed. Chapter three introduces the proposed protocol. Chapter four conveys performance results of proposed and existing schemes. Last chapter concludes the work and future work.

II. RELATED WORK

In [5], fuzzy cost based Multi Constrained Quality of Service routing was proposed for optimal path selection with network parameters. To achieve the best transmission, maximum path lifetime and least fuzzy cost were estimated. There was no stability of link present in this work. Reliability based performance metrics were not focused in this work. In [6], a tree based multicast routing was discovered with the concept of fuzzy controller and spanning tree algorithm. There are three parameters considered i.e. bandwidth, delay and throughput of links. In our scheme, we construct the multicast backbone based on node reliability and link

reliability after evaluating its stability rate. A secure level adaptive multicast routing [7] was established to discover the secure multicast route. Only secure routes were focused. There is need to focus on stability with reliable multicast route. Saber Ghasempour et.al [8] proposed a priority scheduler with fuzzy decision mechanism to compute packet priority. In congested network environment, packet scheduling algorithm was also analyzed to increase network performance. Here scheduling algorithm was introduced without the need of link stability environment. It needs to be considered. Location management and future cluster head prediction method [9] was determined based in adaptive fuzzy system to ensure less overhead for route maintenance. Sometimes the location of mobile nodes may be out of the range and it is difficult to predict clustering in future. Reliable multicast on-demand routing protocol [10] was introduced for cluster environment. It was integrated with mesh topology which leads to heavy flooding and overhead. In [11], authors presented Artificial Fish Swarm (AFS) algorithm based on fuzzy mathematics principle. This algorithm computed reliability degree and Quality of Service (QoS) degree. In [12], authors had proposed Bandwidth Delay Product (BDP) to increase network throughput with mesh based backbone routing. Based on BDP requirements, the paths from source to destination were created with reliability pairs. In order to diminish the issues of internal attackers, a novel secure multicast routing [13] was created to ensure data delivery and to avoid adversarial links using reliability metric calculation. In [14], authors introduced the model called Probabilistic Soft Logic (PSL) for drug target interaction prediction. A blocking method was also proposed to show how PSL enables rich, large-scale analysis of drug-target networks, combining similarities and collective inference to produce state-of-the-art prediction accuracy using an interpretable model.

In this research work, drug target interaction is predicted with reliable multicast routing to attain balance between drug target issues and link reliability.

III.PREDICTION OF DRUG TARGET INTERACTION BASED RELIABLE MULTICAST ROUTING PROTOCOL

The main aim of the proposed protocol is to focus on drug target interaction with reliable multicast routing protocol. Fuzzy introduces the reliability of model with link performance. Fuzzy based Reliable Multicast Routing Protocol (FLRMRP) consists of two steps.

A. Construction of Conditional Random Field Model

In this model, two nodes are connected to indicate relational dependency with high similarity. If the similarity of two nodes is above threshold, the edges will be connected in a strong manner. Various threshold values are used to tune the inter- connected edges in the graph. The concept of edge node with degree based scheme is also deployed to ensure the degree of each node in the graph to stop the isolated nodes. Each node should have the top degree with highest similarity scores i.e. K. The two approaches are investigated i.e. Target based and Drug based approaches. Let S_d be the prediction score using drug based and S_τ be the prediction score using target based scheme. The final score for the query target pair is given as,

$$S = \beta S_d + (1-\beta) S_\tau \qquad (1)$$

Where β is the tuning parameter and it is kept as 0.5.

B. Prediction Of Drug Target Interaction Using Fuzzy Based Reliable Protocol

In MANET, reliability is the measure of successfully received the packets at the destination from the source node with more stability of links and nodes.

C. Determination of Link Reliability

The main goal of the proposed routing in resource constrained and dynamic MANET is link reliability. Both mobility and stability are included to determine reliability. Random Way Mobility model is deployed in the proposed routing scheme. If the nodes are moving randomly inside the network with high mobility, it is critical to improve the network performance y attaining network reliability. If the links are broken often, there are some reasons we need to sketch i.e. more overhead, wastage of network resources, more delay and packet transmission failure etc. Compared to other optimization techniques, the conclusion is minimum link utilization and more path stability. Stability is a major concern in ad hoc molecular network where the calculation of distance between two atoms is compulsory. In free space model, distance between two atoms can be obtained based on their geographical location. Based on link communication, source atom can keep track of neighbor node location information.

If source or destination atom is not receiving any information from neighbors, link breakage may be assumed. For the case of link $L_{m,n}$ at time *t*, the link stability rate is assumed to be $DSL_{m,n}(t)$. For two atom threshold values, the distance between source and destination atoms $DSL_{m,n}(t)$ needs to be defined. Initial threshold value between two mobile atoms will be $T_{dm\max}$.

If $DSL_{m,n}(t) \geq T_{dm\max}$ means, the information packets from source mobile atom to destination mobile will not be reached due to prediction of drug target interaction. Final threshold value $T_{dm\min}$ is the minimum distance between source and destination mobile atoms.

If $DSL_{m,n}(t) \leq T_{dm\min}$ means, the information packets will be reached through more stable paths. From the distance between source and destination mobile atoms, the stability can be estimated. If any atom found drug target issues, the message will be kept loss. It is recorded in the routing table and packet forwarding table.
The following steps shown below to ensure the link stability

.Step 1: If the message is reached through stable link with minimum drug target, $DSL_{m,n}(t) = \eta$.

Step 2: If the message is lost through the unstable link with maximum drug target, $DSL_{m,n}(t) = 0$.

Step 3: If drug target issues are minimum, the link is considered as more stable, otherwise less stable.

Step 4: Reliability of links can be ensured based on static nodes and network states The network states can be represented as χ_q , q =1,…..|K|, where K is the set of all possible network configurations. The link existence is given as,

$$\alpha = \frac{v}{(e-1)}, \qquad (2)$$

where *v* is the average number of nodes and *e* is the number of participating atoms during packet transmission.

Step 5: The link existence can be expressed as,

$$P(\lambda_k = 1) = \alpha^{\varepsilon_i}(1-\alpha)^{\varepsilon_j} \qquad (3)$$

where $\varepsilon_i, \varepsilon_j$ be the numbers of connected and disconnected paths.

D. Reliability Determination Using Fuzzy Logic

The concept of fuzzy logic is used in the proposed multicast routing protocol to provide decision model whether it is true or not. Uncertainty of atoms and packet transmission can be easily identified using this model. It is a rule based system to adjust and limit the uncertainties effects from the output of the system. This system is equipped with a rule base model to find online decision to adjust the system behaviour to ensure optimal in all cases. In the proposed fuzzy interference system, the inputs are given as link reliability and drug target ratio. The output from the defuzzification will be the more prediction of links with high reliability. If either drug target ratio or link reliability is low or medium, the corresponding network reliability value from defuzzification is either low or medium. Once high reliability has begun, the network achieves more packet delivery rate which leads to more network lifetime and less overhead. Having stability and mobility of node as well as link, a network lifetime can be improved from the nominal value. Here, the fuzzy logic provides whether the system performance is good or not. The fuzzy set parameters we have considered are packet loss rate, packet delay, throughput, mobility, stability rate. If good network performance means, QoS requirements can be easily satisfied.

IV. PERFORMANCE EVALUATION

We have used the network simulation tool to evaluate the performance of the proposed protocol. Simulation tool used is Network Simulator (NS 2.34). It is a simple tool but updation is more. IT is user friendly and easy to fabricate our own protocol. Tool Command Language (TCL) is a string-based command language which works as front end in NS2. Mobility scenario is generated by using random walk model with 100 nodes in an area of 1000 m × 1000 m. The simulation settings and parameters are summarized in table 1.

Table 1. FLRMRP simulation settings

No. of Nodes (Atoms)	150
Area Size	1000 x 1000 m^2
Mac	802.15.4
Radio Range	100 m
Simulation Time	100 sec
Traffic Source	Poisson traffic
Packet Size	80 bytes
Mobility Model	Random Walk
Initial energy	80 Joules
Transmitted power	0.7894 watts
Received Power	0.0678 watts

It defines the number of packets received at the destination per seconds.

A. Results

The results are examined based on the performance metrics namely packet loss rate, network stability rate, node reliability rate, link reliability rate, end-to-end delay, packet delivery ratio, and control overhead. Fig.1 shows the result of number of atoms Vs Packet Forwarding Ratio (PFR). From the results, our proposed scheme achieves high PFR than the existing schemes because of stability deployed in the reliable multicast routing. Packet arrived at the destination node is high. Reliable multicast backbone ensures that packets are travelled through reliable links. Link between the nodes are well connected together to avoid congestion.

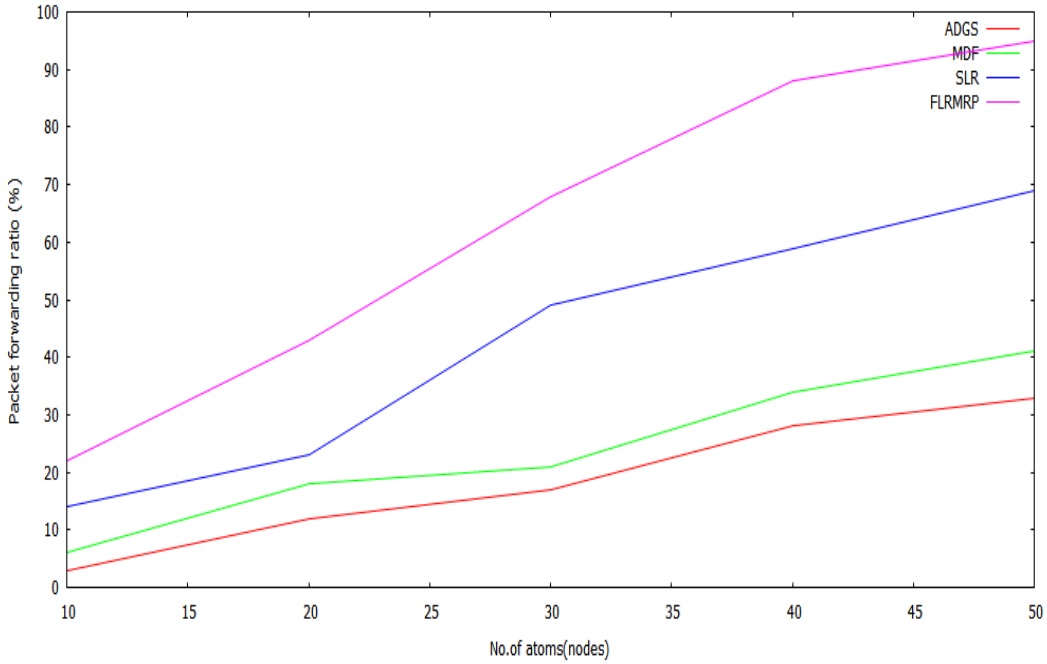

Fig.1: Packet forwarding ratio Vs Atoms

In Fig.2, number of links is varied as 10, 20….50. When we increase the links, the throughput is also getting increasing. Compared to existing schemes, proposed protocol FLRMRP achieves high throughput than existing schemes.

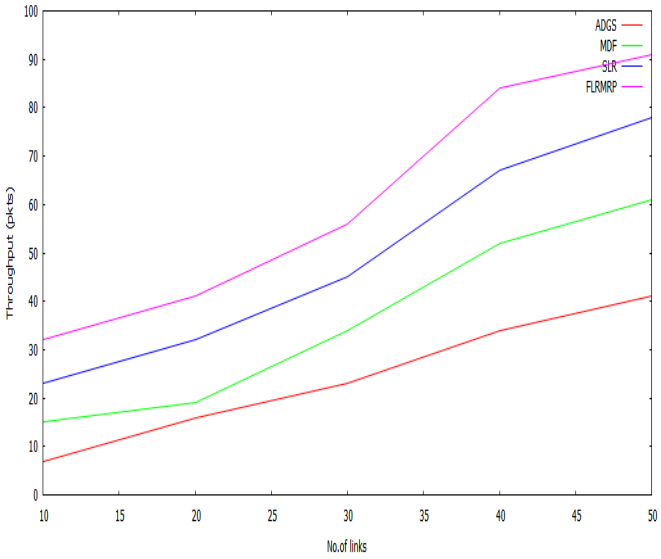

Fig. 2: Throughput Vs No. of Links

V. CONCLUSION

In this research work, the Fuzzy based reliable multicast routing protocol is proposed to predict drug target interaction while handling link reliability among atoms. The proposed scheme is based on similarity threshold value to maintain the reliable multicast routing which enhances target interaction. Fuzzy based reliable routing is determined to ensure conditional based reliability. Drug target issues are predicted using madman fuzzy decision system. Reliable multicast backbone routing is determined towards high packet delivery rate. Based on the simulation results, the performance of the proposed protocol is better previous work in presence of uncertainty cases. The proposed work can be a suggestive approach for real time applications such as military and disaster management.

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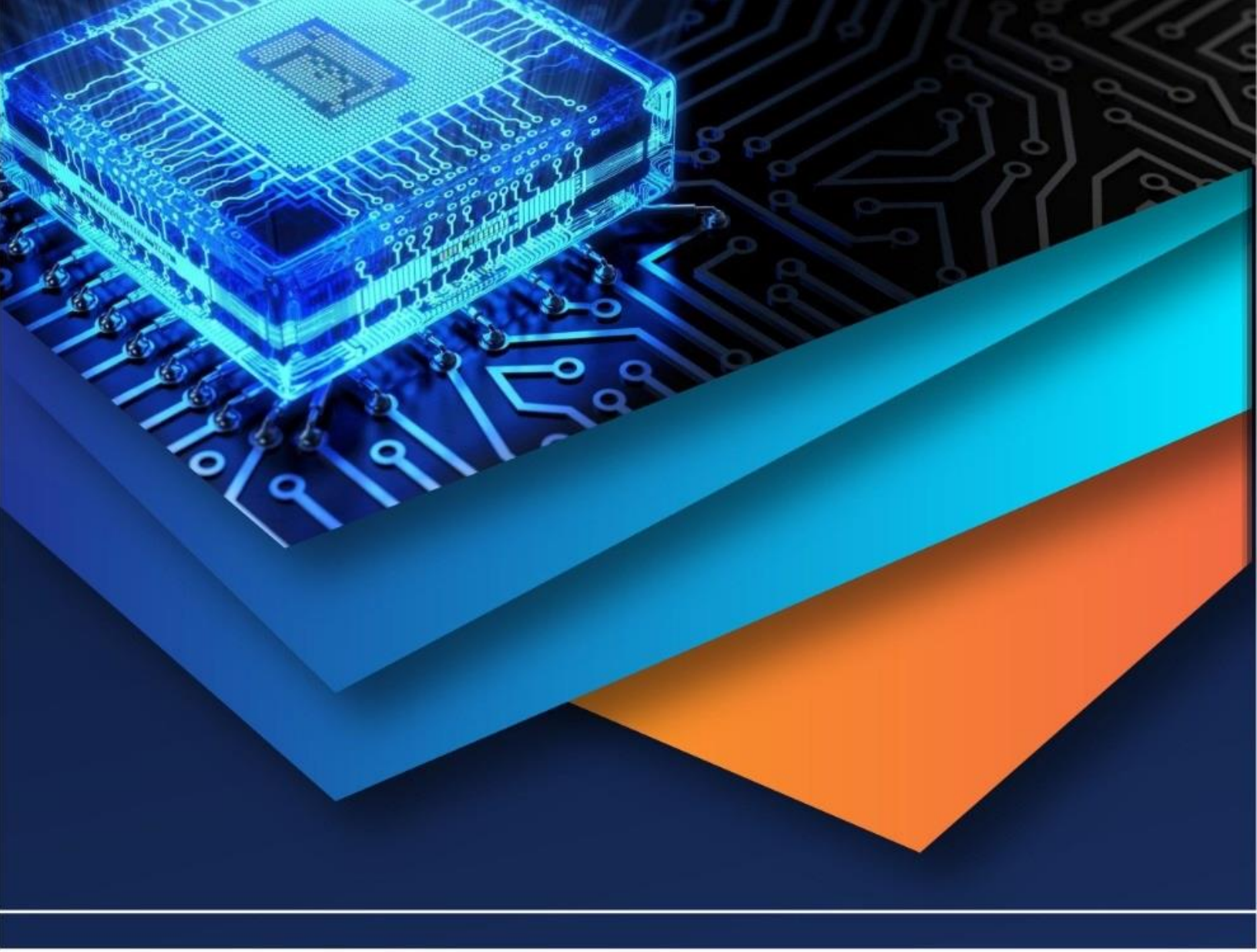

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