Design of Dynamic Source Routing With the Aid of Fuzzy Logic for Cross Layered Mobile Ad Hoc Networks

Saravanan T, Nithya N S

Abstract: The conventional dynamic source routing (DSR) standard chooses the path in need of minimal hop counts for communicating the information from the source to the target. Therefore due to node displacements in autonomous self – regulatory ad hoc networks, the path comprising a minimal number of probably increased extent hops do not works well always. Moreover, the presently employed path might split due to the node displacements and the path related data acquired from the path identification might become illogical. For avoiding the probably imprecise nature of the route-related data a fuzzy logic supported scheme is initiated into the routing scheme for evading the control of rough routing related data. Extensively the fuzzy logic supported schemes are probable of operating various inputs which therefore are used for both the anticipated path lifespan and the hop counts as their input thus permitting to combine the physical layer and the network layer into a mutually modeled routing standard. The lifetime of the path is usually minimized based on the increased node displacements. The precise path with increased path constancy is lastly chosen for communicating the data and based on the lifetime of the path the path cache termination time is altered erratically. The illustration is performed for the designed fuzzy based DSR scheme which outdoes the traditional DSR in terms of reasonable network outcomes rather with minimal network governance load. Lastly measuring the influence of the physical layer is performed over the possible behavior of the network layer for various physical layer schemes using NS 2 simulator.

Keywords: Layer, Network Layer, Route Identification, Route Preservation and DSR.

I. INTRODUCTION

Attempting to preserve immense network output is crucial but accomplishing their goals without any anticipations directly because it is dependence over diverse features comprising quality of wireless medium, the displacement position and energy for communication over the physical layer, the medium access and administering queues over the medium access control (MAC) the forwarding schemes used within the network layer the traffic governance and management of transport layer and the flow governance over the application layer [1] [2].

* Correspondence Author
Saravanan T*, PhD Scholar Anna University,Chennai, India
Nithya N S, Associate Professor, Dept of CSE, K.S.R College of Engineering , Tiruchengode, Namakkal, India

Based on them the displacement of node holds crucial control since the radio association might become intricate since the ability portraying the path is not valid. Hence the class of rotting scheme in terms of node displacement position grabs crucial attention for analysis for the purpose of enhancing the outcomes of the network. For instance the design of statistical formulas for symbolizing the lifetime of a path for the accessibility of an association taking into account the corresponding location, displacement and magnitude of the nodes [3]. Therefore the formulas designed based on the consideration of precise space-based node broadcasting which is suitable for the termed arbitrary direction displacement framework [4]. The use of the corresponding degree in the direction of the nodes is chosen for the preceding broadcast node. The imitated four associated lifespan relay for four diverse displacement prototypes and designed four association strength assessment patterns. Therefore the association lifespan scattering is based on the node displacements [4]. Therefore during the modifications of surroundings, the relaying has to be recreated. The corresponding displacements, the degree of direction and location of the in-between node and the target node needs to select the feasible broadcast node rather employing the flooding schemes [6] [7]. Though the displacement assisted routing standard considers that the source nodes have all the needed data, the displacement and degree of direction for the target these data are normally anonymous. The dynamic source routing (DSR) is charmingly effective routing protocol precisely planned for multi-hop wireless ad hoc networks [8]. Usually, the network standards eternally alter the based on the node displacements, therefore, the presently employed path might become disconnected due to the routing related data stored within the path cache that might be decayed particularly during increased displacements experienced as in vehicular ad hoc networks. Therefore the routing related data gathered might become imprecise during the task of path identification. The fuzzy logic based schemes are broadly employed for both artificial intelligence and the governance analysis commune [9] [10] due to their ability in addressing intricate decision in terms of probably imperfect data and several inputs. The improvement of association traffic issues within the network based on the choice of size of the traffic window employing fuzzy logic based organizer where the input is a signal to noise proportion and the standard information unit drop proportion of the MAC layer [11].

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The utilization of fuzzy logic based system for randomly regulating the inflection and coding mode the communication energy and the number of re-forwarding based on the node displacement within the physical layer along with the average packet delays and packet success ratio over the MAC layer [12]. The usage of fuzzy routing organizer based on the count of hops to be wrapped and the nodes remaining energy for selecting the path with utmost path quality in terms of a precise intent function [13]. A fuzzy logic based organizer aggregates the remaining node power the tele-congestion forwarded using the node portrayed in bits/seconds and the average acquired signal power ramp is employed for increasing the lifespan of the network with their limited energy resources. The usage of fuzzy logic supported system in terms of quality of associations the prevailing node power and the number of hops to be judged in order to select whether to cache the freshly identified path in terms of restricted path abilities of cache regarded [14] [15]. The prevailing queue extent of the nodes was also introduced as fuzzy based regulator input for erratically setting the time revisions of the path cache. These involvement attempts to generate effective cross layered design by aggregating the data prevailing from diverse OSI layers.

The focus is for connection lifespan forecast framework designed based on the displacement position of the node comprising the location, displacement and moving direction of the node joined based on fuzzy logic supported for hitting a crucial swapping among the hop counts and lifespan of the path in terms of node displacements. The results of the fuzzy logic supported regulator are effective path constancy parameter which is employed as load depicting the interest of a precise path. The increased path constancy that the path is dependable and in particular based on the route lifespan the break of the path verified within the path is altered erratically. It is illustrated that the fuzzy logic based standardly adaptable for several displacement frameworks and symbolizes the accomplishable metric of the designed fuzzy based DSR as evaluated against conventional DSR for three diverse physical layer conditions.

II. RELATED WORKS

The packet communication over the mobile ad hoc networks (MANETs) is not safe because the data packets are broken due to feeble associations among the nodes prevailing within the network environment. The connection initiation is crucial for relaying information between the sender to the destination nodes where the radio range commences connections and the feeble radio range creates an imprecise connection. The congestion for transmission is accomplished during forwarding routes because it comprises voluminous data related to the data distribution so the comprehensive communication experiences delay. The design of constancy rapid and safe forwarding acquires accurate association among the senders to the target node as it offers constantly rapid and safe routing. The technique is aimed at choosing the path with authorized choice scheme verifying each and every node associations to the adjacent node over the forwarding routes. In case the values of credit are huge the feasible connection else acquires most terrible among the autonomous nodes over the forwarding route. The connection preservation minimizes the network overheads as it enhances the rate of association and reduces the ratio of network overheads.

The goal is to design a fuzzy logic based multicast scheme for the choice of two evaluating constant paths by estimating autonomous path lifespan over the mobile ad hoc networks (MANETs). The fuzzy logic based loads with multi – conditions are employed to autonomously estimate the lively path lifespan for deciding the suitable paths. Diverse routes for forwarding are initiated to offer multicast communication and to improve vigorous communication against irregular and restricted bandwidth of the wireless associations. Because of regular node displacements, the standards of the mobile ad hoc networks alters erratically. The assessment of autonomous path lifespan is quite intricate over the wireless networks. The fuzzy based load multi-condition are based on the minimal utilization of energy of the nodes over the path, hop counts and the governed packets. The designed scheme termed as dependable multicast scheme used the fuzzy logic based system for enhancing the QoS over MANETs. The scheme is assessed over a wide range of experiments using NS 2 where the outcomes reveal that the scheme outdoes other prevailing schemes in terms of delivery ratio, end – to – end delays and lifespan.

III. PROPOSED METHODOLOGY

The lifespan of Connection and Assessment Framework:

For mobile ad hoc a straightforward outcome of node stability is the topology of the network which is time alternative and at time of failing node transmission to the target the path becomes worthless. Hence for assessing the remaining time of association prevailing among the nodes, it is probable to assess the constancy of the association. The lifespan of the association assessment framework is designed based on the position of node displacement comprising the present location the present displacement along with its direction of forwarding of a node imitating the anticipated displacement of the node for nearest possibilities. Based on the corresponding displacement of nodes position among two nodes along with the accountable lifespan of the node is also estimated.

It is presumed that there are N_n nodes within the network at time instance 'i' where the location of the lth node N_{na} is $(l_{a_x,i}, l_{a_y,i})$ along with its displacement $d_{a,i}$ and its direction $\theta_{a,i}$. Based on the usual selection the direction of the parallel vertices is presumed to be linked with the degree of 0.

Likewise, the location of node N_{nb} is $(l_{b_x,i}, l_{b_y,i})$ along with its displacement $d_{b,i}$ and its direction $\theta_{b,i}$. The distance prevailing among the nodes N_{na} and N_{nb} is $d_{a,b,i}$. Soon after the time intervene of Δi the location of node N_{na} happens to be $(l_{a_x,i} + \Delta i, l_{a_y,i} + \Delta i)$ where the displacement is $d_{a,i} + \Delta i$ along with its direction $\theta_{a,i} + \Delta i$. Likewise, for node N_{nb} the forthcoming location happens to be $(l_{b_x,i} + \Delta i, l_{b_y,i} + \Delta i)$ where the displacement is $d_{b,i} + \Delta i$ along with its direction $\theta_{b,i} + \Delta i$. For assessing a precise lifespan of the connection the easiest framework is to regard the displacement and the direction of the most prevailing hop though the forthcoming analysis makes use of increased order displacement assessment as portrayed in facet assessments.

Hence the aim is to entail the displacement and magnitude of N_{na} and N_{nb} at time period 'i' based on the elementary initial order framework as d_a, d_b, θ_a and θ_b.

$$l_{a_x,i} + \Delta i = l_{a_x,i} + d_a \cos(\theta_a)\, \Delta i \ (1)$$

$$l_{a_y,i} + \Delta i = l_{a_y,i} + d_a \cos(\theta_a)\, \Delta i \ (2)$$

$$l_{b_x,i} + \Delta i = l_{b_x,i} + d_b \cos(\theta_b)\, \Delta i \ (3)$$

$$l_{b_y,i} + \Delta i = l_{b_y,i} + d_b \cos(\theta_b)\, \Delta i \ (4)$$

The prevailing distance between N_{na} and N_{nb} for the time period $(i + \Delta i)$ is estimated using,

$$[(d_b \sin(\theta_b) - d_a \sin(\theta_x))^2 + (d_b \cos(\theta_b) - d_x \cos(\theta_x))^2](\Delta i)^2 + 2[(l_{b_y,i} + \Delta i - l_{a_y,i} + \Delta i)(d_b \sin(\theta_b) -$$
$$d_x \sin(\theta_x) + (l_{b_x,i} + \Delta i - l_{a_x,i} + \Delta i)(d_b \cos(\theta_b) - d_a \cos(\theta_a))]\Delta i + [(l_{b_y,i} + \Delta i - l_{a_y,i} + \Delta i)^2 + (l_{b_x,i} + \Delta i$$
$$- l_{a_x,i} + \Delta i)^2] + v_{\max}^2 \le 0$$

(7)

It is evident that eqn. 7 is a quadratic polynomial of the type $Ax^2 + Bx + C \le 0$ and here,

$$A = (d_b \sin(\theta_b) - d_a \sin(\theta_a))^2 + (d_b \cos(\theta_b) - d_a \cos(\theta_a))^2$$

$$B = |\, 2[(l_{b_y,i} + \Delta i - l_{a_y,i} + \Delta i)(d_b \sin(\theta_b) - d_a \sin(\theta_a)) + (l_{b_x,i} +$$

$$C = [(l_{b_y,i} + \Delta i - l_{a_y,i} + \Delta i)^2 + (l_{b_x,i} + \Delta i - l_{a_x,i} + \Delta i)^2] - v_{\max}^2$$

$$x = \Delta i \ (8)$$

Based on the features of quadratic polynomials the least real root symbolizes the utmost connection independent lifespan selected by the nodes restricted range of communication. From eqn. (8) $A \ge 0$ and $C \le 0$. If $A = 0$ representing that two nodes are regarded to hold the identical node displacement position then the distance prevailing among them would never alter unless one of them modifies their displacement position. Therefore the lifespan of the association between them is invalid. In contrast during the presence $A \ne 0$ and it is appropriate practical condition then eqn. 7 might hold one and only real root fulfilling $B^2 - 4AC \ge 0$. Based on the

$$x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

equation of here $A > 0$ allowing to choose utmost connection lifespan.

Fuzzy Based DSR:

It is initiated from the fuzzy set assumptions designed with merits of addressing the choice predicaments even during the design of imprecise data based on diverse inputs. A fundamental fuzzy logic governance tasks comprise three segments as fuzzified, suggestion and defuzzified. Fig. 1 represents the model of the fundamental fuzzy logic based system. The fundamental phases in modeling the fuzzy-based system are to select the appropriate experiences the bias function of the input and outcomes along with the fuzzy suggestion strategies and defuzzified schemes. identical communication energy there the identical range of communication which is written

$$v_{ab,i+\Delta i}^2 = (l_{b_x,i} + \Delta i - l_{a_x,i} + \Delta i)^2 + (l_{b_y,i} + \Delta i - l_{a_y,i} + \Delta i)$$

(4)

During the increase in distance between two nodes than their dependable range of communication the association among them will vanish and the corresponding session will terminate. It is regarded that each and every node comprises

$$v_{ab,i}^2 + \Delta i \le v_{\max}^2 \ (6)$$

Here $v_{\max}$ is the range of communication and hence based on joining eqn. 5 and 6,
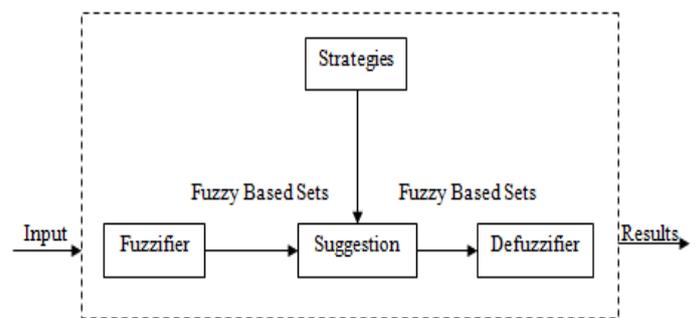
as,

Fig. 1: Fuzzy Logic Based System Model

The DSR is a reactive routing standard which is initiated only during the need to communicate information. Soon after the task of path identification diverse paths are located and hoarded within the path cache of the source node. The parameter used for selecting the needed path for forwarding the source information is to reduce the hop count. Moreover, the path re-identification is initiated during a precise association between the employed path breakdowns due to node displacements and no duplicate path or path mending is offered. Therefore for mobile ad hoc networks, the usage of minimal hop counts states that conventionally there prevails a prolonged distance among the unique node which is probably to be linked with minimal acquired energy an increased bit fault rate and probably minimal path lifespan. Moreover for the choice of locating all the paths during one and only preliminary path identification task without any repeated revisions which might deliver the path cache data condition particularly during autonomous displacements. During a node displacing out from the range of transmission of the remaining nodes, it might be possible that not only that particular connection is taken care of but all the other paths comprising the connection within the path cache still remains illogical at the same time. Hence the traditional DSR standard might not accomplish better for the autonomous environment.

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A swapping among choosing a small number of hops holding minimal path lifetime and diverse hops with increased path lifespan shall be located. For hitting an eye-catching swapping the design of fuzzy based DSR is performed which in combination takes into account of hop counts along with the lifespan of the path as their input focusing for locating the accurate equalization among them. The shortest path lifespan imitates the position of path constancy to some extents. The escalated path lifespan the increased will be path constancy. Meanwhile the paths with

minimal hops it is very less probable the path breakdowns and therefore the path of constancy becomes increased. It is regarded that there are 'h' hops over the path and the lifespan of the connection among the node Nna and Nnb are portrayed as $p_{ab}, 0 \le a,b \le (h-1)$ which is based on the estimation based on the assessment of connection lifespan framework. Usually, the connection holding minimal lifespan represents blockage of the path which hence is the minimal connection lifespan that may be inferred as the lifespan of the path as,

$$r_l = \min(p_{ab}), 0 \le a,b \le h-1 \quad (9)$$

Here rl represents the lifetime of the path.

In terms of their attractive easiness and esteem, the designed triangle based bias function is selected to match the precise value of the input into the fuzzy sets and vice versa. The outcomes of the fuzzy-based system are the path constancy. The choice of three fuzzy sets entailed by the movable terms 'small', 'average' and 'prolonged' for both the number of hops and for the lifetime of the path. For path constancy the usage of methodologies 'small', 'average' and 'prolonged'. The easiest triangle based bias function of the hop counts and route lifespan are portrayed in fig. 2. The bias function of the path constancy holds the identical shape as that of hop count but it is not depicted in terms of a graph. Therefore the global hop counts and the path constancy is standardized to the extent [0, 1] where the lifetime of the path is [0, 300s] since the path cache termination break is 300s. For the triangle based bias function of the path lifetime, dmax represents the utmost displacement of all the nodes.
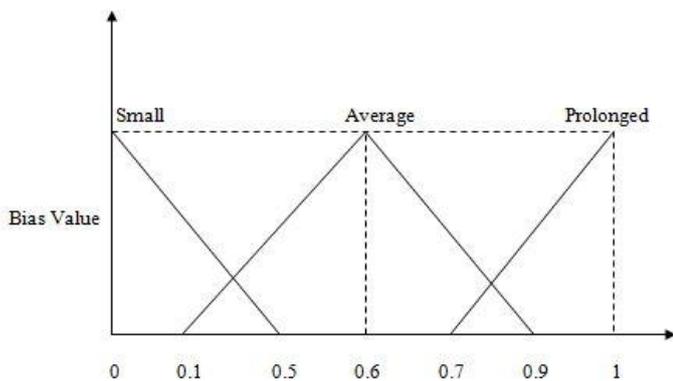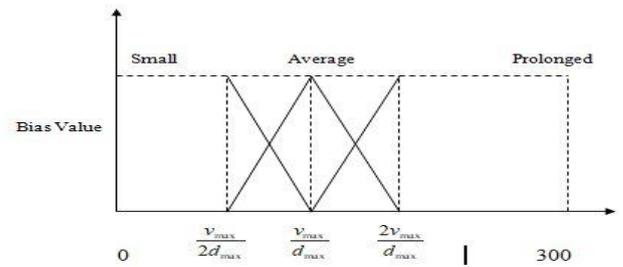

Fig. 2a: Standard Hop Counts

Fig. 2b: Path Lifespan
Fig. 2: Bias Function of Antecedents

The conventional IF – THEN strategy is selected as suggestion strategy for matching from the fuzzy input sets to the fuzzy-based resulting sets. For instance, P is a fuzzy set entailed over U and Q is the fuzzy-based set portrayed over V where the suggestion strategy is entailed as IF U THEN V which is identical to the stated fuzzy based association as,

$$L = (U \times V) \cup (\bar{U} \times V) \quad (10)$$

It is presumed that there are fresh ancestor U' over U then,

$$V' = U' \circ L \quad (11)$$

Here V' symbolizes the fresh significance of V and $\circ$ symbolizes the task of aggregation. Eqn. 11 represents the combination of fuzzy based associations which changes the max-min schemes therefore IF U' THEN V' as in eqn. 11. The suggestion strategy of the fuzzy-based system is portrayed in table 1. For instance, the representation of IF hop counts are small AND lifespan of the path is small THEN path constancy is average. The load-based medium scheme is chosen based on the defuzzified scheme.

The designed fuzzy based scheme is introduced in each and every node. The fuzzy based DSR is split into two classes as path identification and path preservation.

Table 1: Suggestion Strategies of Fuzzy Logic based System

Count	Hop Counts	Path Lifespan	Path Constancy
1	Small	Small	Average
2	Small	Average	Prolonged
3	Average	Prolonged	Prolonged
4	Average	Small	Small
5	Average	Average	Average
6	Prolonged	Prolonged	Prolonged
7	Prolonged	Small	Small
8	Prolonged	Average	Average

Path Identification

During a path demand (RREQ) packet arrives at the node where it witnesses the present displacement position (location, direction and displacement) where it estimates the connection lifetime among the hop and sudden earlier hop based on their corresponding displacement position.

Soon after the RREQ arriving at the target, the anticipated path lifespan is estimated as in eqn. 9 and is replaced into path acknowledgment packet which carries out the anticipated path lifespan and the identified path locator back to the source node. Based on a precise path identification process diverse feasible path might be located. Based on the fuzzy-based system the path displaying increased path constancy communicates the information from source to the target.

Path Preservation

The source path packet is communicated from the source node to the target node which transmits the selected path and locator. During the source node packet reaching at the node during the task of communication, it witnesses the present displacement of the node and revises the anticipated association lifespan of each and every pair offered that there are modifications in displacement position. During any connection of the chosen path breakdowns and no repeated path prevails a path fault is created by the present node of this connection to inform all the nodes which hoards this connection to eradicate this connection for their cache. Usually, at this phase, a fresh path identification task is triggered. For the presence of repeated path, it will be triggered for recovering the packet and eventually the session. Therefore it is unknown whether the repeated path is illogical but additionally due to the node displacements it might create information communication faults. Therefore based on the remaining path lifetime, the termination time of the path within the path cache is altered erratically for revising the path related data within the path cache.

IV. PERFORMANCE ANALYSIS

Here evaluation of the feasible performance of the designed fuzzy based DSR and conventional DSR for three various physical layer schemes in terms of ideal medium, uncoded QPSK and for TTCM – 8PSK is performed.

Initially, NS 2 is employed for generating simulation for estimating the BER behavior of the uncoded QPSK and TTCM – 8PSK where two nodes are regarded located within 500 x 500 m2 square-shaped region. The distance prevailing among them is 100 m. Based on suitably altering the acquired SNR the witness of BER vs SNR associations is performed. The BER of the uncoded QPSK was estimated from the hypothetical Q function based on the equations while for TTCM – 8PSK are employed for pre-assessing visit table for the Additive White Gaussian Node (AWGN) medium for creating the BER based on both the SNR and over the extent of turbo – interleaved frame. The generator polynomial employed by the TTCM element code is in octal symbolization. Four increments were cited in the TTCM decoder. The size of the interleaved frame over the physical layer differed from 100 bits to 6500 bits. The assessment outcomes recommend that for SNR of about 7.5 dB the BER of TTCM – 8PSK holds nearly 5dB improvements estimated to uncoded QPSK at BER of 10-5 though usually the profit is acquired at an increased assessment difficulty.

Followed by which increased difficult assessment with 20 nodes were regularly positioned within 500 x 500 m2 square-shaped region where 5 node at each of the row and four nodes in each and every column. The source node was constant at location (500, 500) and the target node is position at location (0,0). The constant bit rate traffic was created within the application layer employing a packet length of 512 bytes and packet creation regularity of 5 packets per second.

The transport layer makes use of UDP but the MAC layer alters the IEEE 802.11b standard. For the purpose of omitting the packet drop incidents are due to the overflowing buffer where the length of the queue within MAC layer is fixed unlimited. Over the physical layer, an independent space route loss framework of 20 dB / decade is presumed and AWGN medium was employed. The energy for performing communication is fixed to 1mW the sensitivity of the receiver is 90 dBm where the signal to suggestion plus noise ratio and the fixed value is presumed to be 5 dB which needs increased and effective minimized rate of FEC coding than the aforementioned TTCM – 8PSK methods. The bit rate over the medium was 2 Mb/s and it is considered that no suggestion prevails among the nodes and both the control packets along with the physical layer header were acquired without faults. Excluding for the source node and target node all the other node observes the voluminous displacement framework where the displacement and magnitude of each and every node was selected erratically. Evaluation of the designed fuzzy based DSR and traditional DSR during the thermal noise tn was 92 dBm and regularly scattered arbitrary autonomous displacement was 0 – 12 m/s based on the below stated performance parameters as,

Standardized Count of Path Break Incidents

Each and every time when the information was not effectively transmitted to the subsequent hop the connection among two nodes was presumed to be wrecked and the count of path breakage incidents was escalated by one. The standardized count of path breakdown incidents by the average hop counts.

Network Outcomes

The number of information bits acquired at the target per second within the network layer.

Inverse Network Governance Load

The count of information bits effectively disseminated to the target per number of governance bits communicated might be perceived as the inverse of the count of governance bits linked with the dissemination of information bit. The governance bit comprises the bits of all the forwarding packets and the header bits within the information packets. Each and every hop based communication of the governance bits was calculated.

From fig. 3, 4 and 5 it is monitored that based on escalating the mobile displacement both the fuzzy-based DSR and the traditional DSR depending on three diverse physical layer mechanism displays identical tendencies in terms of a number of path breakdowns, network outcomes and network governance loads. From fig. 3 the number of path breakage of the uncoded QPSK initially reduces then escalates since due to the node displacements which might permit the node to avert unoccupied in a bottomless fade which is more evidently perceptible for the fuzzy-based DSR condition which has a minimal number of path breakages and increasingly comprehensive network outcomes. As the network governance load features from fig. 5 it is evident that the mobile displacement is minimal which is likely 0 m/s the fuzzy-based DSR has the earlier displacement positions based on RREQ, RREP and source demand packets which escalates the number of governance bits.

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In contrast during the mobile displacement increased than 1 m/s the negative influence of the added governance bits within the governance packets and the information packets are lessened by the increasing node displacement and due to which the network governance load of the fuzzy-based DSR becomes minimal than the traditional DSR. The motivation for this occurrence is that the fuzzy-based DSR always selects a precise path with increased path constancy which is freely portrayed as the path with increased flexibility against any modifications within the topology of the network. In case the number of path breakages minimizes then normally the count of information packets disseminated to the target gets escalated where the possibility of stimulating fresh path dissemination tasks minimizes, therefore, the count of governance packets communicated also minimizes. Usually, the TTCM – 8PSK accomplishes bad than the precise medium because it needs an SNR of 8 dB for preserving a BER of 10-5, therefore, the information packet might experience bit faults. The uncoded QPSK accomplishes more feebly because of their demand of SNR of 12 dB for preserving a BER of 10-5 where virtually no information was disseminated to the target node effectively for the condition. The number of path breakages is increased and the network outcomes are nearly zero and therefore the inverse of the network governance load is also nearly zero. Hence the TTCM – 8PSK outdoes the uncoded QPSK in terms of their network layer behaviors which highlights an appropriate customization of the physical layer which is crucially significant for accomplishing probable network layer behavior.
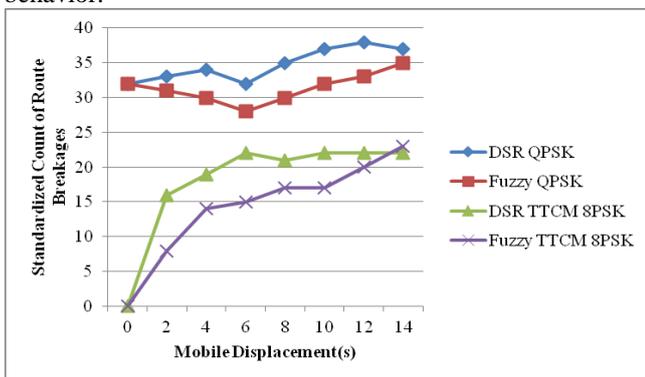

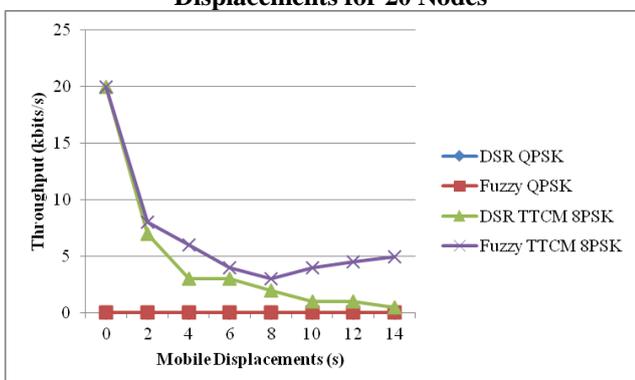**Fig. 3: Normalized Count of Breakages vs Node Displacements for 20 Nodes**

Fig. 4: Accomplishable Throughput of Various Physical Layer Customizations for 20 Nodes
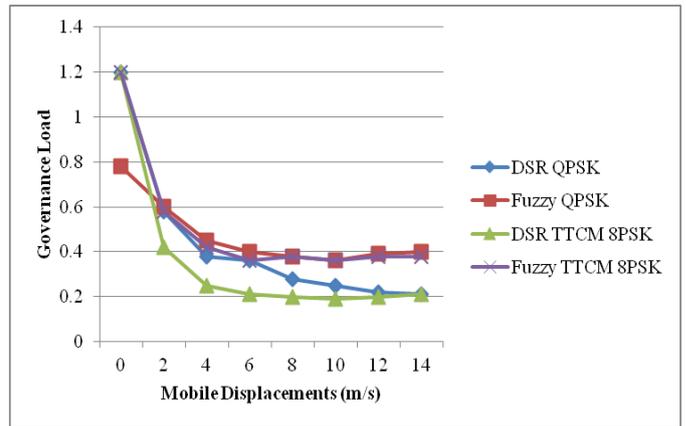

Fig. 5: Evaluating Inverse of Governance Load

V. CONCLUSION

The intention is to design a fresh fuzzy based DSR standard to work on diverse inputs probably offering rough data which mutually regards the hop counts and the path lifespan by selecting the path with increased path constancy. The outcomes of the assessments verify that the fuzzy-based DSR outdoes the traditional DSR because it minimizes the count breakages enhancing the network outcomes by minimizing the network governance load. Meanwhile, the influence of various physical layer mechanism on the possible behavior was effective for precise medium along with uncoded QPSK and TTCM – 8PSK representing the fault dependant coding and modulation significantly enhances the behavior of the network layer.

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AUTHORS PROFILE

T.Saravanan graduated from Selvam College of Technology, Anna University, Chennai with a B.E degree in Computer Science and Engineering. He has an M.E degree in Network Engineering from Anna University Regional Center, Coimbatore, India. He is pursuing a doctoral degree in the department of Information and Communication Engineering at Anna University, Chennai, India. His research interests include Computer Networks and Wireless Sensor Networks.

Dr. N.S.Nithya is an Associate professor in the department of **Computer** Science and Engineering at K.S.R. College of Engineering, Anna University, Chennai, India. She obtained her Ph.D. degree in Information and communication engineering from Anna University in 2015.She has published more than 10 papers. Her research interests include Data Mining, Wireless Networks, Fuzzy logic, Mobile Ad-hoc Networks.