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Research paper

Path Span in VANETs Using Position Based Routing Protocol

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Abstract

Vanets (Vehicular Ad-hoc Networks) are the minor-class systems of Manets (Mobile Ad-Hoc Networks) or it can be created using Manets. In which there is no access point Vanets are subclass systems of Manets in this no access point to say every node those are in high mobility collect and accept the incoming data in the network. The network density is infrequent in MANET while in VANETs it is dense and frequent. VANETS plays an important role in context of safety of moving vehicles that includes Infringement Warning, Fall back direction information, Electronic constraint warning, Collision monitory, etc. Change in network topology due to Mobility of vehicle affects throughput and efficiency, that results the failure of link on the route between source and destination. The span of track is rely on the designing of routing rules of conduct.. The evaluation of the track span is count on the knowledge of the entire network topology that changes frequently due to huge motility of the automobiles. Therefore, the estimation of the Path span in the VANETs can reduce the communication and the route maintenance overhead. In this, benefaction is a probabilistic and mathematical perusal of Path span in VANET, based on position-based routing concept. We will attain the probability distribution as expected Route from source to destination in VANET, using position-based routing protocol We will presume that vehicles have not reaches the speed limit, and not stopped. We will analyze result for the estimation of Path span between source and destination in VANETs with the help of Proposed Mathematical Model.

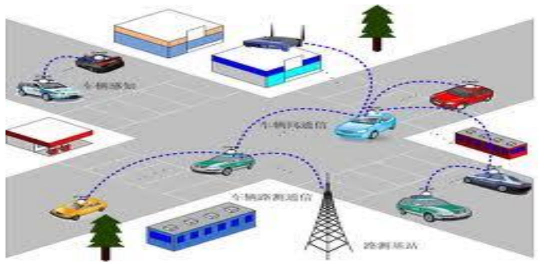
Keywords: *VANETS,Position-Based Routing , Probability distribution, MANETS, Path-Span.*

1. Introduction

The interest of the mobile technology is on peak. As the appeal is increasing, research on the mobile technology is also rise that works on individual-coordinate network and can assemble at distant site on the outside advance knowledge of infrastructure. A route that contains group of movable nodes, which have the capacity of self-organization in a decentralized fashion without fixed infrastructure is called Mobile Ad Hoc Networks [5]. It is particular of the utmost turn up area for scientist & corporation. Mobility of bud in network changes the topology as a result in which several parameters gets effected cause in loss of throughput & efficiency of VANETS. Failure chances in path link between source and destination is high due to high velocity of terminals. We all know that the road mis-happenings occurs worldwide costs human life and to control these mis-happenings, many research work is going on. Many research communities come forward and produce some very good and useful research projects. Some of these projects are Car Talk, Traffic Information System, Drive-In, Fleet Net-Internet on the road, SeVeCom (Secure Vehicular Communication) etc. These projects adds some amazing features in the vehicles, in the form of safety measures, security, driving assistant and allow communicate a vehicle to other vehicles on the road. VANETs also attract the inter-vehicle networks. Worldwide automobile manufacturing brands like BMW, Fiat, Audi, Mercedes, Volkswagen and Daimler Chrysler united together and form an organization, that Consortium (C2CCC). The C2CCC focuses on riskless vehicle for any circumstances. In simple words, it makes the smart vehicle. These riskless vehicles are lash with life rescuing features, which make travelling safe ,secure and comfortable for user. Users may be drivers, passengers or pedestrians. In VANETs, researchers have no need to worry about the resource limitation like data storage and battery power, as nodes are vehicle and battery power of vehicle could be use easily. So the road security in VANETs is high by having communication in between the buds i.e. automobile and concerned system in episodic way[15]. Thus VANETs offer various applications as follows [9][10] :

Table 1: Applications of A2R[15] & A2A:

Automobile-to-Roadside (A2R) Applications	Automobile-to-Automobile (A2A)Applications
Speed &Traffic Violation Monitory	Lane Change Monitory
Location Data	Electronic Brake Monitory
Route Data	Collision Monitory
Route Block	Inline Traffic Monitory



VANETs Communication Scenario Comparison between MANETs & VANETs-

MANETs	VANETs
Low speed	High Speed
Assured Mobility of nodes	Uncertain Mobility of nodes
Issue of Power Management	No issue of Power Management
Density of nodes is static	Density of nodes is variable

Significance of Path Span in VANETs- The movability of the buds is the major concern in VANETs. This changes the accordance graph and makes the topology dynamic in nature, which in turns infulence the completion of the network. Matrix is used to predict the behavior are called link span and path span. The time measurement of a bud to active its nearest neighbor is known as link duration (nodes which are within the communication of each other)[12]. If one bud wishes to deliver large data to its neighbor node, the link between these nodes is active till the data transfers completely. If neighbor node moves away before data transfers completely, a untimely disconnection will happens and complete data will not received by the node . In the multi-hop routes, the routing protocol finds the route reaches to destination from the source with the help of the intermediate buds. The routing protocol maybe table driven or on demand for VANETs. These two routing algorithm is used to find the path instead of checking how long the way will be active. The time duration that,path is active is called track span. The path becomes invalid after some time due to mobility of the nodes and affects the on-going communication between two nodes. If routes fails it raise the overhead of the routing protocol and it will strike the efficiency of network. In this case a new path is configure by routing protocol for communication. Path span is actually the minimum link duration along the path (since path contains multi-hop that contains different individual links). TTL (time to live) for routing protocol also assign by path span. To minimize the failure, prior evaluation of Path span needed otherwise failure degrade the performance of network. It is very difficult task to find the correct estimation of route due to different factors . There are different inter-related factors and some independent factors, which affects the route. Bud density[8], transmission area[7], count of hops[4], node velocity and routing protocols are some factors that affect the route. Global Positioning System (GPS) installed in vehicles provide a great help in the estimation of Path span in the VANETs [13].

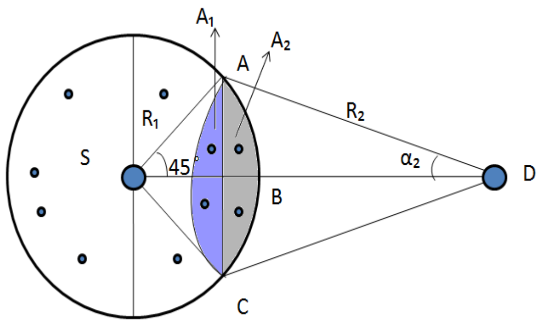
The method of finding route and communication between source and destination is done with the help of path span But the calculation of path span is most challenging issue due to node velocity and movement of node. Movement of node change the topology of network. Links between two nodes breaks frequently if nodes moves out from communication range. Due to this a new route has to find again by routing protocol. This will affects the efficiency of the VANETs.

2. Problem Formulation

In many past years number of research has been done for efficient Vehicular ad hoc Network. Movement of the nodes, frequently change the path span, roadway layout, traffic scenarios are the feature of VANETs. This is the challenging task for the researchers to works in this network. The network route is mainly depends on the routing protocols algorithms. The movement of the nodes is gear by the algorithm of the routing protocols. The path Span estimation is mainly depends on network topology that changes gradually due to the movement of vehicles which causes the mobility of nodes, this will reduce the transmission efficiency, communication, and route maintenance overhead. The study of the Path span from the basis of work presented in the paper. We have reviewed the different research work proposed in the field of VANETs for the calculation of the Path span.

2.1. Mathematical Model-

In this section we will derive the mathematical model for calculating the path span. The aim of this mathematical model to find an expression for finding route from source to destination. This can be done with the help of average number of hops and link duration. Classic principle of traffic flow is used to describe the vehicular surroundings that will be more precise for our track span estimation. Autumobile are pretended to have Poisson distributed arrivals to obtain the probability distribution function.
In our propose model, some assumptions are made, which are given as follows: Every bud is armed with GPS receiver, sensors and digital map. Only fixed infrastructure is used there is no other way of communication. Every node has same transmission area. Link duration of every node moving away from the source node is considered only. Given below is the Algorithm for the proposed model and later is explained with working of the model like how these parameters are calculated with the help of certain equations.



Algorithm:
Find Area of Border Region for Finding the Next-hop bud

$A_s = R_1^2\left[\frac{\pi-2}{4}\right] + R_2^2\left[\alpha_1 - \frac{sin(2\alpha_2)}{2}\right]$

2. Find the Probability of Finding buds in the Selected Area.
In border region the possibility of having at least one node is
P = 1- P(X=0)

$= 1- e^{\frac{-\omega}{2}\{R_1{}^2\left[\frac{\pi-2}{4}\right]+R_2{}^2\left[\alpha_2-\frac{sin(2\alpha_2)}{2}\right]\}}$

3. Find the moderate count of Hops between Source and Destination Node
The *k*-hop can be defined as

$P(k) = [e^{-(k-1)^2\pi\omega R_1^2} - e^{-k^2\pi\omega R_1^2}]$ x $[1- e^{\frac{-w.A_S}{2}}]^{k-1}$

The expected count of hops can be calculated as, E_H between source and destination as follows:$E_n = \sum_{H=2}^{k} HP(H)$ = P(1) + 2 P(2) + 3 P(3) + ….+ k P(k)

$= \sum_{H=1}^{k} H\left[e^{-(H-1)2\pi\omega T2} - e^{-H2\pi\omega T2}\right]$ x $[1- e^{\frac{-w}{2}}\{R_1^2\left[\frac{\pi-2}{2}\right] + R_2^2\left[\alpha_2 - \frac{sin2\pi_2}{2}\right]\}]^{H-1}$

4. Velocity of Nodes
Relative Velocity can be calculated as

$V_R = V.\sqrt{\frac{1 - Cos\theta}{2}}$,where V1=V2

The pdf of V_R ,$f_{VR}(V_R)$ can be shown as

$f_{V_R}(V_R) = 1/\sqrt{(1 - sin^2\theta/2)}.\frac{1}{\pi}$

$= \sqrt{\frac{4V^2-V_r}{V}}.\frac{1}{\pi}$

5. Link Duration
$T= E_z/ V_R = nR_1/ V_R (n+1)$

The probability distribution function of T, f_T (T) is given by,

$f_T(T) = \int_0^V V_R \cdot f_{dvr}(V_R T, V)dv = \int_0^V [E_Z] \cdot [2/\sqrt{4V^2 - V_R^2} \cdot \frac{1}{\pi}] dV_r$

6. Path Span

T_{path} = MIN (T_1, T_2, T_3…….T_{EH})

The probability density function (pdf) of T_{path} is

$f(T_{path}) = E_H \cdot E_Z \cdot C_T^{E_{n-1}}$

Therefore, the average Path span can be predicted as

$ET_{path} = \int_0^\theta T_{path} \cdot F(T_{path}) \cdot dT_{path}$

Mathematical Notations

Notations which are used in the proposed model are as follows:

R_1: Transmission area of buds (Omni directional)
R_2: Distance from P to D
A_s: Selected Region for buds in the transmission area
A_1: Region of Segment by R_2 with PP'
A_2: Region of Segment by R_1 with PP'
α_1:Angle between R_1 and SD
α_2: Angle between R_2 and SD
ω: Node density
x: count of nodes in the region of border
n: count of nodes selected out of x nodes
Π: Pie
i: Positive number (i=0 to 1-k)
e: Epidemic value
p_s: chance of successfully selection of a node
q=1- p_s : chance of not selecting a node
P(Y=n): chance of selecting n node out of x nodes
P(k) : chance of selecting exactly k node
P: Probability of selecting at least one node
E(H): assumed no. of hops between source & destination
Z: Distance between source and next-hop node
F(Z): Cumulative distribution function of D_1
f(Z) Probability distribution function of D_1
E(Z): Expected distance between source & next-hop node
θ: Relative angle between two moving nodes
V: Velocity of nodes
V_R: Relative velocity of two nodes
T: Link duration[14]
$f_{V_R}(V_R)$: Probability distribution function of V_R
$f_T(T)$: Probability distribution function of link duration
$E_{T_{path}}$: Estimated Path span

3. Result Analysis

VANET parameter used in the Analysis:-
two horizontal and two vertical roads passed each other.
The lane width is 6m.
The velocity/speed range is 0-50Km/h is used for node movement.
Transmission range varies from 100m to 500m.
The other basic parameters are traffic type as CBR,wireless channel,omni directional antenna and node density area is 1000m *1000m.

3.1. Average Path Span v/s Transmission of Range

The average Path span also depends on Transmission area of the bud in the net. This is clearly seen that, transmission range increases when path-span gets increases. We can analyze the fact that the huge transmission area increases the chances of determining next-bud in the boundary area of sender's transmission area. Within the transmission range, the selection of boundary node provides better result as compare to the internal node. The average Path span depends on the variation of transmission range. Path-span also increases when transmission range gets increase.

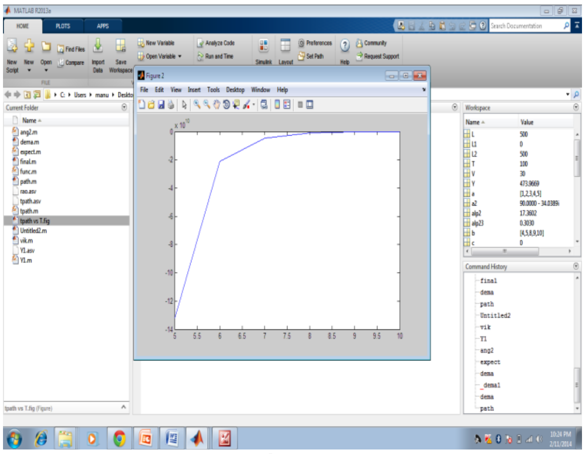


Fig.1: Average Path span v/s Transmission Range

3.2. Average Path Span v/s Count of Hops

Average path span is calculated with the help of each node of the route. As the count of hops in a route increases, the number of links increases. In figure 2, the average Path span varies with the number of hops for fixed transmission range. Average path-span decreases for a constant count of nodes and fixed area, as the number of nodes increase. To minimize the link breakage chances, the number of nodes should be minimum. Figure 2, also shows that with high velocity nodes (e.g. V= 50m/s) has a relatively reduced average Path span as compared to low velocity of nodes (e.g. V= 40m/s).This is due to the increasing probability of link failure with higher velocity of nodes.

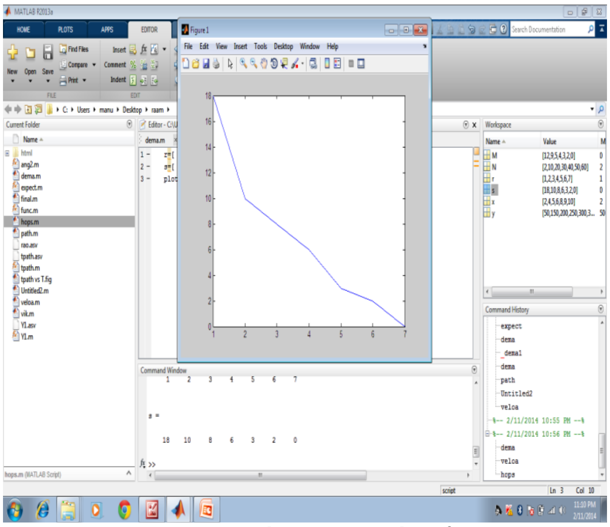


Fig.2: Average Path span v/s Number of Hops

3.3. Average Path span v/s Node density

Calculating node density is also a very tedious task for the path span because the next-hop node probability is increased with increasing the count of vehicles. As the count of nodes or node density increase in the VANETs, getting suitable next-hop node chances are increased. The figure 3 shows that Path span is keep on increasing as the density of the nodes is increased. This is due to the inflation of availability of suitable next node with increasing node density in the area. The closeness between the simulation results for hops=3 is lesser in comparison to hops=2 due to number of nodes increases in network dynamics. The node density is also deciding the nature of the network like dense or spacious.

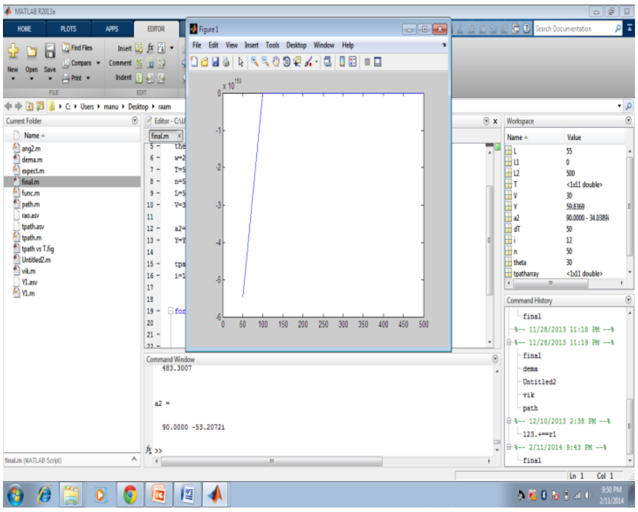


Fig.3: Average Path span v/s Node density

3.4. Average Path Span v/s Velocity of Nodes

The VANETs are known for movement of nodes. Most of link and path breakage in network comes due high velocity of nodes vehicles in and out from the transmission range of the source node. The average Path span is decreases as the velocity of the nodes is kept on increasing. In figure4, the average Path span is varies with the velocity of nodes as the Number of hops are fixed to three for the result. This shows that high velocity of node leads to the link breakage which eventually decreases average path duration. This shows that the Path span is also depends on the velocity of the nodes in the network.

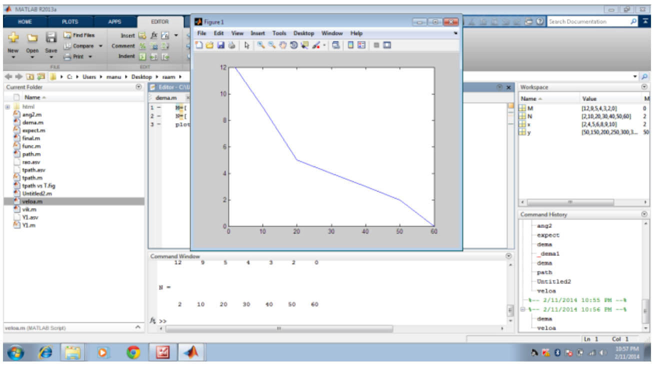


Fig-4: Average Path span v/s Velocity of Nodes

4. Conclusion

The route in VANETs is an important aspect, for improving the throughput and efficiency of the net. The process of locating route and communication between two nodes is done with the help of path span. In VANETs the movement and uncertainty of nodes is a challenging task. Due to mobility of nodes there is a change in network and connectivity graph. Due to failure, a new route has to find again in network by a new path span. Routing protocol is used to find the new path again when current route becomes a failure because of mobility. Performance of VANETs gets effected when communication fails between source and destination due to breakage of route. The assessment of the route for a appropriate path will give the instruction and support to pick a correct track for communication. Bud density, transmission area count of hops and velocities of nodes such design parameters are used to calculate the Path span of the route that affect the Path span of the VANETs[16]. For this, we have posit an analytical model for estimation of Path span using position-based routing concept. This version has been confirmed by the means of simulations. The simulation results are well proximated with the comparison of mathematical equations. It is essential to maintain the path span,in order to maximize the communication link between nodes. Therefore, information can be send at right time to reduce the large number of hazards on the road. We can improve the routing performance and decreases the number of path failures occurs in VANETs with the help of analytical estimation of average Path span.

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