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INTELLIGENT DRIVER MODEL AUTOMATION SYSTEM IN VANET

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***Abstract**: In this paper an algorithm for alternate path is implemented. The evaluation matrices for the shortest available path are velocity of the leading vehicles, distance from source to destination and time delay to reach to destination. Simulation shows, if there is congestion on the current path then the node will find for an alternate shortest path in digital map to the destination. This will avoid the congestion on a single road at intersection points. But the system has to make search every time the vehicle found congestion on the way for destination. The graph given below shows, the traffic moving according to the pause time on the roads due to any reason like traffic light, accident or any other obstacle. X axis is labeled as time delay and Y axis contained no. of nodes/packets moving towards an intersection point to destination. Whenever the no of nodes becomes more, the pause time will be increased. Upper and lower points in the graph show congestion. At these points, where the graph goes upwards, the congestion is increased at a single intersection point. But where the graph goes downwards, the congestion is reduced to a lower value; because some nodes used alternate route/path to reach to the destination.*

Keywords: *vehicular networks, VANET, congestion control, vehicle communication, vehicle communication, Intelligent Transportation System*

1. INTRODUCTION

Vehicular networks potentially have two main types of communication scenarios: car-to-car (C2C) communication scenario and car-to-infrastructure (C2I) communication scenario [1]. These types of communication scenarios allow a number of deployment options for vehicular networks. Vehicular networks deployment can be integrated into wireless hot spots along the road. Such hot spots can be operated individually at home or at office, or by wireless Internet service providers or an integrated operator. On the other hand, vehicular networks deployment can be integrated into the existing cellular systems. Vehicles can even communicate with other vehicles directly without a communication infrastructure, where vehicles can cooperate and forward information on behalf of each other[2]. We notice that combination of these deployment cases is also possible. Moreover, future architecture for intelligent transportation systems (ITS) considers vehicles as active nodes that are responsible for collecting and forwarding critical information.

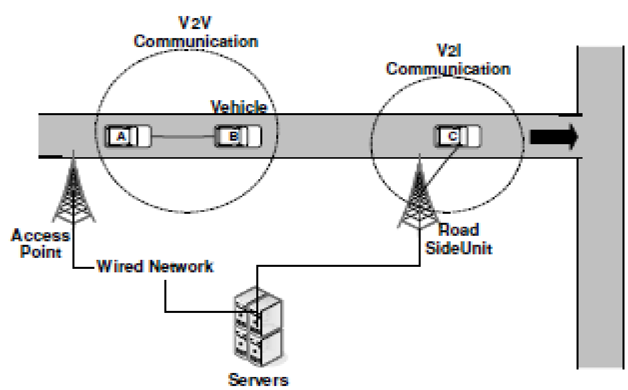

Figure 1: communication architecture

Consequently, vehicular ad hoc networks coexistence with sensor network would potentially take place, where vehicles would be able to collect and process information by means of intelligent sensors and to exchange information with other nodes (fixed or mobile) in a global communication system. Based on their specific characteristics, the technologies for vehicular

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communication can be classified in the following three categories as shown in fig 1 and 2:

1. In-vehicle communication

2. Vehicle-to-roadside/vehicle-to-infrastructure communication

3. Inter-vehicle communication (single- and multi-hop)

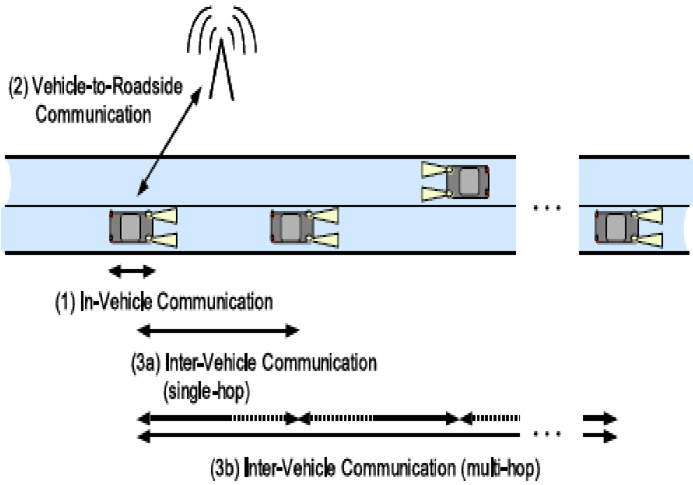

Figure 2: Domains of vehicular communication

1.1 Characteristics of Vehicular Networks

Vehicular networks have special behavior and characteristics, distinguishing them from other types of mobile networks. In comparison to other communication networks, vehicular networks come with unique attractive features, as follows [3-6]:

a. Unlimited transmission power
b. Higher computational capability
c. Predictable mobility
d. High mobility
e. Partitioned network
f. Network topology and connectivity

1.2 Attacks on Vehicular Networks

Since we cannot envision all the possible attacks that will be mounted in the future on VANETs, we will provide a general classification of attacks substantiated by a list of attacks that we have identified so far. We consider only the attacks perpetrated against messages rather than vehicles [8-10].

a. Bogus information
b. Cheating with sensor information:
c. ID disclosure
d. Denial of Service
e. Masquerading

1.3 IEEE Standards

On January 9th, 2006 the U.S. Department of Transportation and the IEEE standardized a Family of Standards for Wireless Access in Vehicular Environments (WAVE) known as IEEE 1609 [7]. IEEE 1609 defines architecture and a set of services and interfaces to support secure vehicle-to-vehicle and vehicle-to-infrastructure communication. The envisioned uses are vehicular safety applications, enhanced navigation, automated tolling, traffic management and many more. IEEE 1609 has two important entities: the On Board Unit (OBU) and the Road Side Unit (RSU). Communication between OBU and RSU (V2I) and OBU to OBU (V2V) is part of the standard.

IEEE 1609 has the following properties [7]:

- . Based on IEEE 802.11p
- . Range up to 1000m
- . Data rates 6-27 Mbps
- . 7 licensed channels in 5.9GHz range
- . Latency 50ms
- . Security can be enforced using PKI
- . Long term stability (because it is controlled by FCC and standards)
- . Designed to accommodate IPv6

The system is designed so as to accommodate both safety and commercial services. It will also support drivers in keeping their vehicles from leaving the road and provide assistance at intersections by means of driver support functionality. The network can also be used for surveillance, resulting in faster detection of damage to roads (potholes, black ice, snow etc.). The system also provides traffic signaling, incident response and impact mitigation. IEEE 1609 consists of four standards [7]:
a) 1609.1{Resource Manager. Manages access to resources,} defines message formats and data storage formats and communication interfaces between components. Furthermore, it specifies the types of devices that may be supported by an OBU.
b) 1609.2{Security Services.}Defines message formats and processing.
c) 1609.3{Networking Service.}Defines network and transport layer services such as routing and addressing. IPv6 is defined for communication in addition to Wave Short Messages (WSM), an efficient WAVE-specific protocol which can be directly supported by applications. The WAVE protocol stack is defined by this standard.
d) 1609.4{Multi-Channel Operations.} An enhancement to the IEEE 802.11 Media Access Control is proposed to accommodate WAVE operations.

1.4 Network Simulator

A mobility simulator is generally used to produce node movement traces that are then fed to the network simulator.

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The network simulator then controls the communications between mobile nodes. As these network simulators support wireless communication, most of them include at least a simple node mobility model, which includes the following models: Random Drunken Model 1, Random Waypoint Model, Trace file network simulator used for simulations of both wired and wireless networks. It supports a wide range of wireless technologies such as MANETs, IEEE 802.11 wireless LANs, WiMAX, Bluetooth, and satellite networks. these provides a graphical editor interface to build models for various network entities from physical layer modulator to application processes, and includes graphical packages and libraries for presenting simulation scenarios and results. Some of simulators are:

- Opnet
- Glomosim
- NS-2
- Omnet
- Swans
- Qualnet

The objective is to provide safety and traffic management: vehicles can notify other vehicles of hazardous road conditions, traffic jamming, or rapid stops. VANETs can be used for many applications with vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. In such a system, the vehicles are assumed to send and receive emergency warning messages or up-to-date traffic information among themselves in a peer-to-peer manner. Main objectives of this paper are as follows.

1. To overcome network congestion the complete MANET is to be fragmented into several independent networks. By this, node will communicate with each other but cannot communicate with nodes outside the partition due to missing network paths.
2. The major problem is to find the proper route for packet/node to be traveled along its destination. For this a protocol may be designed that must be aware of road infrastructure and alternative path to the destination if no direct path is available from sender to destination.
3. We also compare our proposed algorithm with the existing one approach to control congestion on roads.

2. METHODOLOGY

A protocol is implemented on the network simulator ns-2. The code is based on an existing GPSR implementation for ns-2. Using C++ we can implement it and with the help of algorithm this can be done. The simulations are performed on the network simulator ns-2 [NS2], which supports a full simulation of IEEE 802.11 physical and MAC layer.

2.1 Proposed Algorithm

Localization Path Discovery(S,D)

/*S is the Source Point and D is the Destination Point, The Vehicle Node is in Urban Area Scenario where Road are rough and traffic is moving on both sides of road., The algorithm will derive the results respective to the robustness and to find the path efficiently*/

1. To Obtain the Shortest path divide the complete network in N Sub Networks, called N_1, N_2 ……N_m.
2. Select N such that N is a network from N_1 to N_m and N is in same direction of D.
3. For Each Network N_1 to N_m find the Destination Point in same Direction in Network N, called D_n. Find the entire possible Path between Source S_n to D_n called P_1, P_2…P_m.
4. For Each Path, Estimate the
   a)Average Time with No Traffic
   b)Average Time with Average Traffic
   c)Average Time with Congestion.
5. Select the path with Lowest cost, and Include the series of path.
6. Finally, we get a search of Path P_1, P_2, P_3 up to P_n as the efficient and robust path series to move to the Destination
7. For Each Path P_1 to P_n

Start from Node S_i to D_i

/* Move From Source Node to Destination */

a) If(Check (Node$_i$ is Not Moving)

If(Light(RED)=true or Congestion=true)

Find Expected Delay Caused because of Congestion

b) If(Expected Congestion > Threshold)

Find the Alternate Path with cost closer to existing, Select this path as the new path.

8. end

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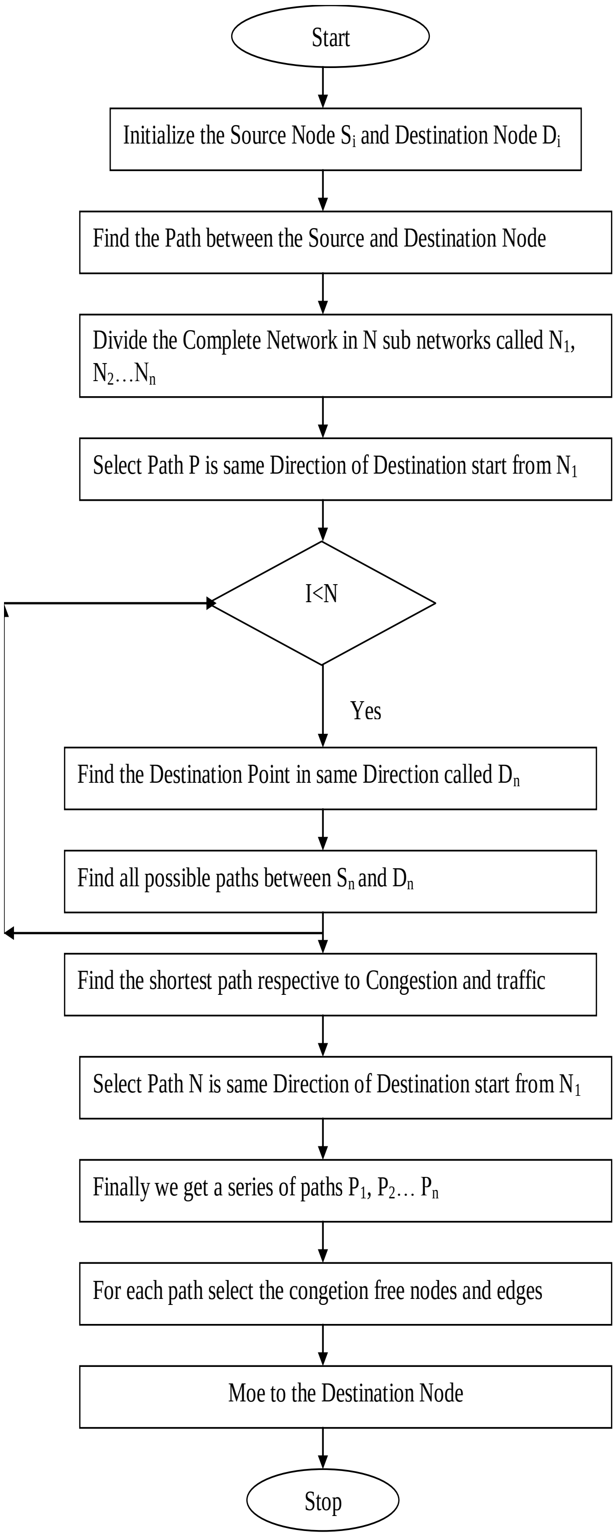

Figure 3: flowchart of proposed algorithm

3. IMPLEMENTATION

The traffic congestion problem is implemented in NS-2; initially there are 30 nodes on the single road in one direction. The whole network is divided into sub-networks and the path from source to destination is also divided into small sub-paths. First the path in which time to reach to the destination is less than threshold the vehicle will follow that path otherwise it will find an alternate path and make that available alternate path as the current path to reach the destination in time.

In snapshot 4 given below, the vehicles are going on their way for the destination in same direction as that of the network partition. The vehicles are making queues at the intersection points. In these queues, the vehicles are at a particular distance apart from each other to avoid the collision. The waiting vehicles at intersection move towards their destination whenever they receive a green signal from the roadside infrastructure near to the traffic light signals And they starts to move whenever they sense a signal for the green traffic light, the vehicles waiting queue length is increased than the threshold. This information is broadcasted by the nearby roadside infrastructure to the vehicles apart from this place of congestion.

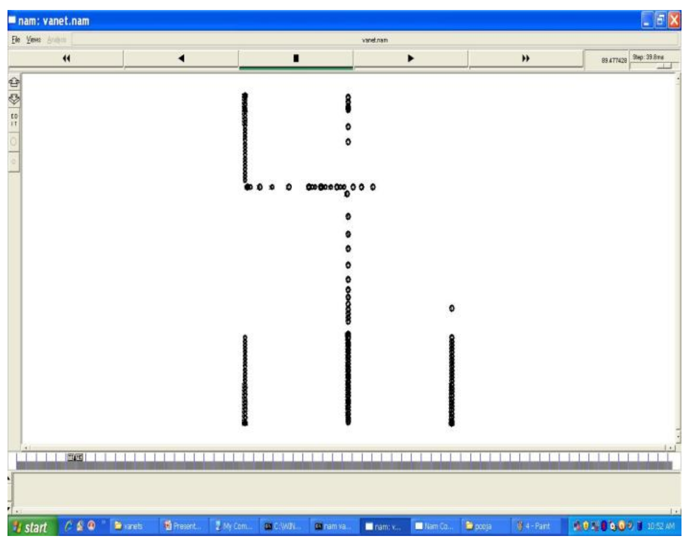

Figure 4: the vehicles movement at different time

So that the coming traffic towards congestion place can decelerate their acceleration or move with enough speed to reach to the congestion point if the waiting time in queue is not greater than the threshold time

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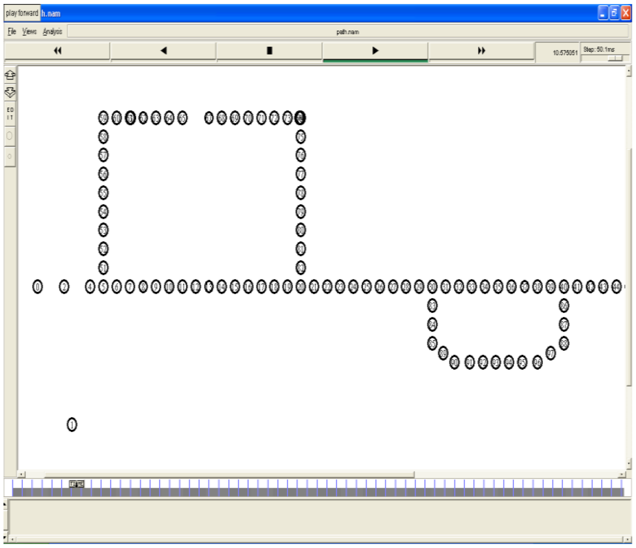

Figure 5: vehicles taking alternate path

As time to reach to the destination through the congested intersection point is greater than the threshold time than the vehicle make a request or query for the alternate path and system search in the available road map for alternate path; which have less or equal time delay as that of current path and make that path as current one. i.e. vehicles change their direction to reach to the destination in expected time as shown in fig 5.

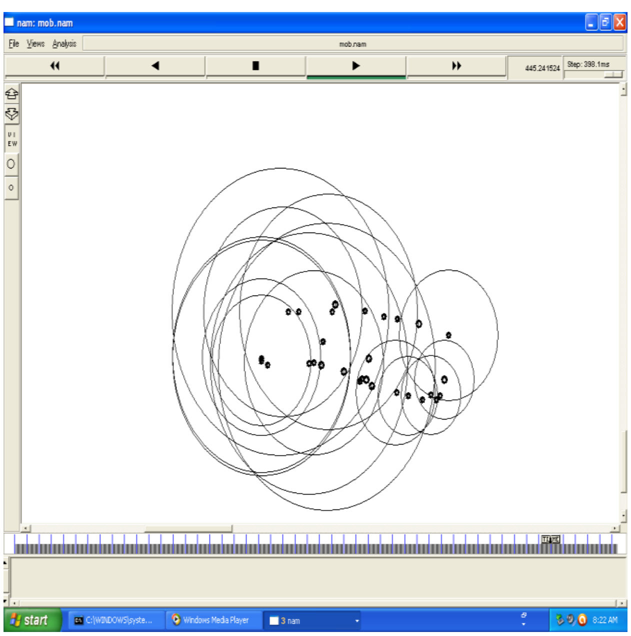

Figure 6: nodes in communication range of each other

In fig 6 and 7, when the moving nodes comes closer to each other they transmit a message periodically that shows their range of communication. i.e, they told each other that they can communicate now, and send required information about their velocity, speed, distance etc. to each other.

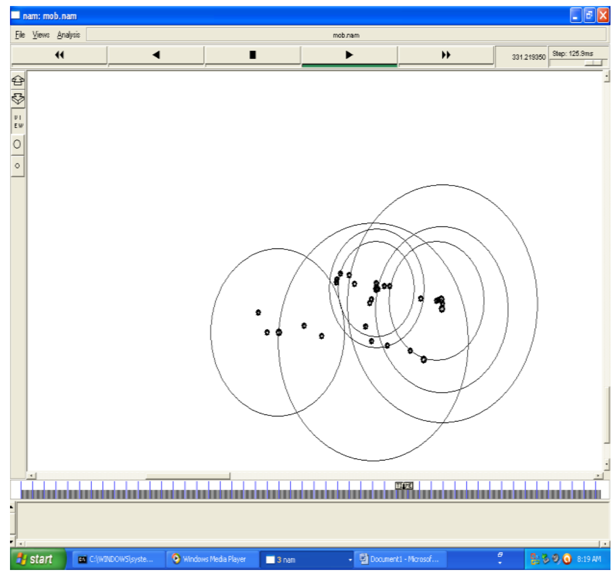

Figure 7: nodes transmitting their coverage area

This information also received by roadside infrastructure and it send message to the nodes far away. The RSU transmits this information to each other also to make sure that there is congestion on the way and the node should take an alternate path to reach to its destination.

4. RESULTS

4.1 Implementation Parameters

The following parameters are considered for the simulation purpose:

Channel used	**Wireless Channel**
Propagation way	TwoWay Ground
MAC Protocol	Mac/802_11
Antenna type	Omni directional
No of nodes	602
Routing protocol	AODV
Bit Rate	Variable Bit Rate (VBR), CBR (Constant Bit Rate)
Time duration	500 sec
Maximum packets in a Queue	50

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An algorithm for alternate path is implemented in the NS-2 simulator. The evaluation matrices for the shortest available path are velocity of the leading vehicles, distance from source to destination and time delay to reach to destination. Simulation shows, if there is congestion on the current path then the node will find for an alternate shortest path in digital map to the destination. This will avoid the congestion on a single road at intersection points. But the system has to make search every time the vehicle found congestion on the way for destination. The graph given below shows, the traffic moving according to the pause time on the roads due to any reason like traffic light, accident or any other obstacle. X axis is labeled as time delay and y axis contained no. of nodes/packets moving towards an intersection point to destination. Whenever the no of nodes becomes more, the pause time will be increased. Upper and lower points in the graph show congestion. At these points, where the graph goes upwards, the congestion is increased at a single intersection point. But where the graph goes downwards, the congestion is reduced to a lower value; because some nodes used alternate route/path to reach to the destination.

Scenarios

nodes: 30,

pause: 3.4028235E38

max speed: 3.4028235E38

max x = 577.9548,

max y: 382.0

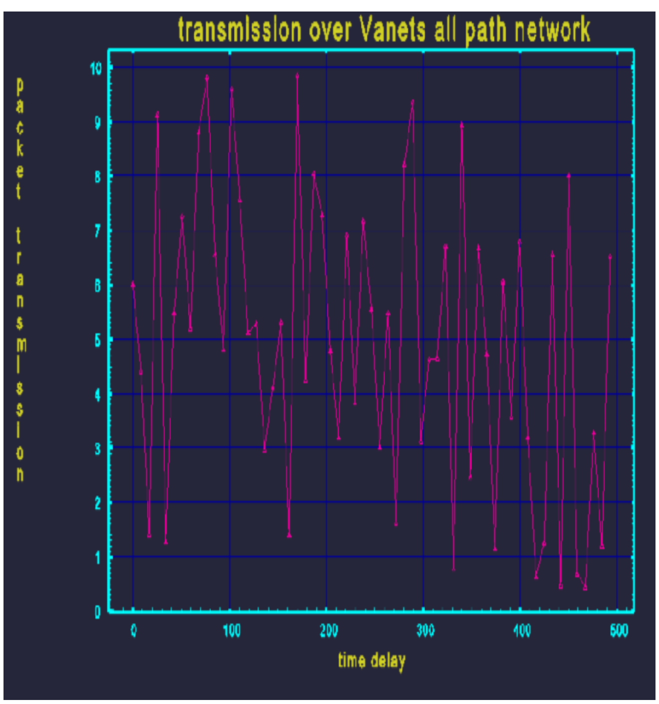

Figure 8: Congestion on current path with a pause time of 3.4s

Scenarios

nodes: 30,

pause: 2.4028235E38

max speed: 18.4028235E38

max x = 577.9548,

max y: 382.0

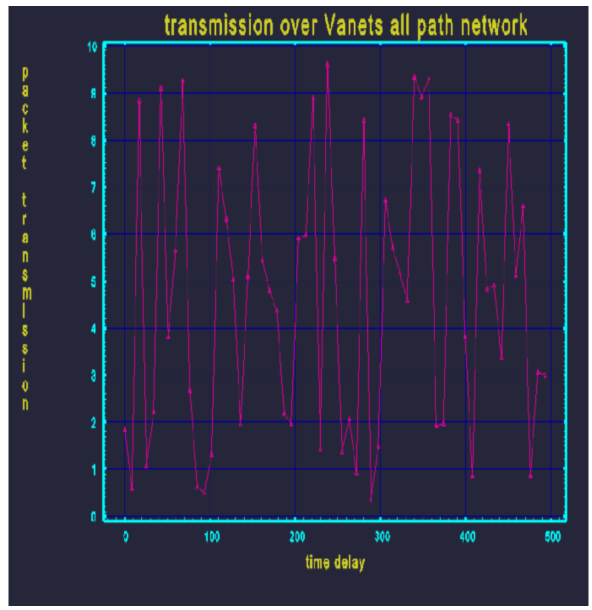

Figure 9: congestion when pause time is 2.4s

Scenarios:

nodes: 30

pause: 8.4028235E38

max speed: 23.4028235E38

max x = 577.9548,

max y: 382.0

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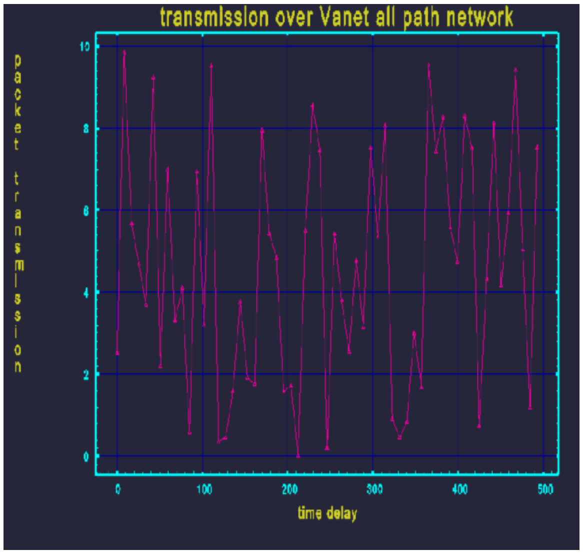

Figure 8: congestion with a pause time of 8.4s

We compare our results with an existing approach. This existing approach works on the basis of an algorithm (Floyd warshell algorithm) which finds all alternative paths from first source whenever a path failure occurred. We make two scenarios with different pause time to show that our proposed system is better to find shortest path from source to destination to reduce total time to reach to the destination.

Scenarios

nodes: 30

pause: 2.4028235E38

max speed: 18.4028235E38

max x = 577.9548,

max y: 382.0

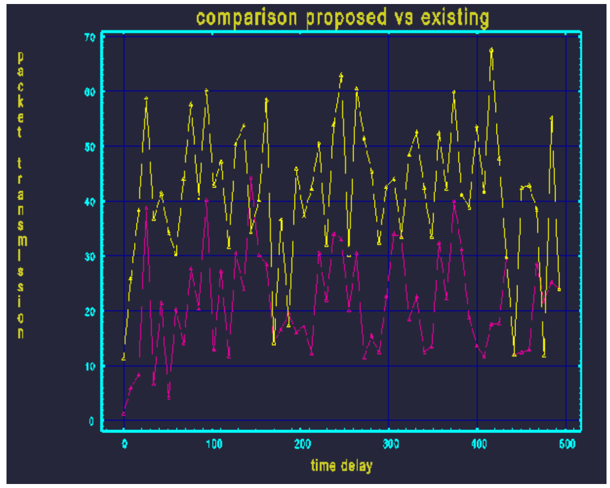

Figure 11: Comparison with existing approach with a pause time 2.4sec

Scenarios

nodes: 30,

pause: 8.4028235E38

max speed: 23.4028235E38

max x = 577.9548,

max y: 382.0

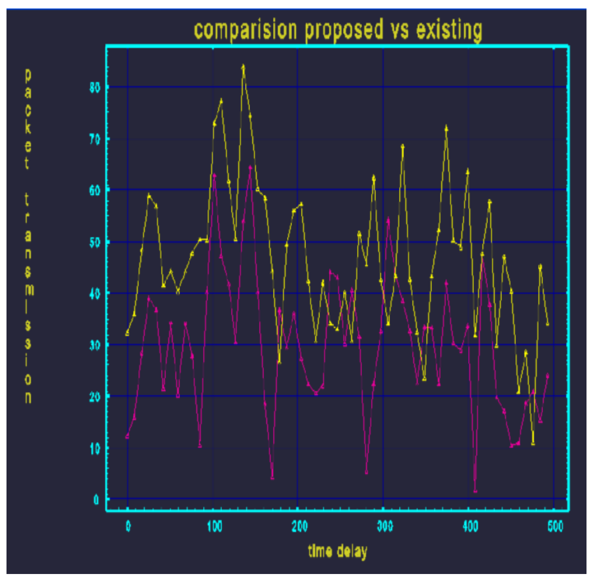

Figure 8: Comparison with existing approach with pause time 8.4sec.

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5. CONCLUSION

There are 3 different scenarios to get optimal and congestion free path on the traffic simulation. We compare our results with an existing approach which works on the basis of algorithm that find the shortest path by taking complete path from source to destination; Where in our approach, the algorithm find shortest path by taking sub-paths from source to destination.

1) This algorithm provides an alternate path if there is congestion at the intersection points on the current path. This helps in reducing the waiting time by taking another route for the destination.

2) Simulation results shows that if the time to reach to the destination via the current path is greater than the threshold time due to congestion or any other reason then the node will query for an alternate path for the destination and make that as current path.

3) The distributed approach of the Intelligent Transportation Systems induces a large number of combinatorial optimization problems. This algorithm focused on optimization of distances traveled by using digital maps. Our solution optimizes the positions where vehicles along their routes would receive information about possible traffic jams.

4) Lower and upper points on the result graphs show congestion. Upper point's shows higher value of congestion, and at the lower points congestion is less. The result shows that our approach is better to control the congestion on road.

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