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Design and analysis of Intelligent Transport Systems in VANETs using AODV Routing Protocol in NS2

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Abstract: The wireless medium plays a vital role in communication era in sharing information from one mobile device to another. These wireless devices (nodes) can form a temporary network called Ad-hoc network or they can use existing cellular network. Vehicular Ad-hoc Networks (VANETs) is a type of Ad-hoc network in which vehicles acts as nodes and communicates with the roadside units. VANETs are more helpful in implementing the Intelligent Transport Systems concepts to provide traffic situation, weather conditions and to perform safety warnings by using authentication mechanisms. In this paper, AODV routing protocol is used to implement the Intelligent Transport Systems (ITS) concepts in VANET. A simulation is performed using AODV routing protocol in NS2 to study the hurdles involved in providing a secure and data transfer between the vehicular nodes. The data analysis is done based on the results collected from the simulation environment. The data's are traced out to find the absolute details of the network. Finally, the graphs are plotted for Throughput of dropped packets and Throughput of packets generated.

Keywords: VANET, AODV, Network Simulation, Intelligent Transport Systems, NS2.

I. INTRODUCTION

VANET is a special case of the general MANET to provide communications among nearby vehicles and between vehicles and nearby fixed roadside equipments. VANET networks, nodes are characterized by high dynamic and mobility, in addition to the high rate of topology changes and density variability VANETs are a subset of MANETs (Mobile Ad-hoc NETworks) in which communication nodes are mainly vehicles.

As such, this kind of network should deal with a great number of highly mobile nodes, eventually dispersed in different roads. In VANETs, vehicles can communicate each other (V2V, Vehicle-to-Vehicle communications). They can connect to an infrastructure (V2I, Vehicle-to-Infrastructure) or Infrastructure to Vehicle (I2V) to get some service.

This infrastructure is assumed to be located along the roads. Some motivations of the promising VANET technology include, Increase traveler safety, Enhance traveler mobility, Decrease travelling time, Conserve energy and protect the environment, Magnify transportation system efficiency, Boost on-board luxury but it is not enough many other services can be served by using this technology.

The goal of most of these projects is to create new network algorithms or modify the existing for use in a vehicular environment. In the future vehicular ad hoc networks will assist the drivers of vehicles and help to create safer roads by reducing the number of automobile accidents.

Vehicles equipped with wireless communication technologies and acting like computer nodes will be on the road soon and this will revolutionize the concept of travelling. VANETs bring lots of possibilities for new range of applications which will not only make the travel safer but fun as well. The VANET is a growing technology that is becoming a very interesting domain for research in computer science.

The Vehicular Communication (VC) makes the steps in the research area to enhance the security and the effectiveness of the communication systems, for example, the traffic status in the road.

The concept of network vehicle was first proposed by a team of engineers from Delphi Delco Electronics Systems and IBM Corporation in the year 1998.

The NS2 simulator is used to simulate the VANET for the research purpose. The VANET architecture could be classified based on: WLAN/Cellular, Adhoc, and Hybrid models (Vehicle to Vehicle (V2V) & Vehicle to Infrastructure (V2I), and Vehicle to Vehicle (V2V) & Vehicle to Roadside (V2R)) .

The VANETs could be considered as a component of the ITS and it helps vehicles communicate with other vehicles for using security and services application.

ITS concepts includes booking parking place, downloading a tourism information, route guidance and payment at toll plaza, etc.

The AODV routing protocol is used as the best option for VANET, because it is used to find the correct destination and to find the efficient route to reach the destination.

The routing information is transmitted whenever there is vehicle movement.

The implementation and analysis is done based on the model created.

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Fig.1 VANET Scenario

II. LITERATURE REVIEW

VANETs are a subgroup of mobile adhoc networks with the distinguishing property that the nodes are vehicles like cars, trucks, buses and motorcycles. The nodes in VANET are also characterized by high node mobility and topology changes. The routing protocols plays an important role in the vehicular communication. Mingliu Zhang et. al., [3] proposed routing protocols for vehicular adhoc networks in rural areas. A cluster based routing protocol are also be done and it has been proposed by Yuyi Luo et. al., [4] for VANET. Omid Abedi et. al., [5] enhanced the AODV routing protocol using mobility parameters in VANET. Jing Zuo et. al., [6] evaluated the performance of the routing protocol in VANET with vehicle-node density. Eicher et. al., [7] has analyzed the impact on road traffic based on Carto- Car messaging. Omid Abedi et. al., [8] proposed the improved route stability and overhead of the AODV routing protocol and making it usable for VANETs. The literature review shows that a proper model and a routing protocol is required for making effective routing and this must be a solution for any real world traffic environments.

III. PROBLEM STATEMENT

The nodes in the VANET are often mobile nodes and so they are easy to deploy and it has no infrastructure. It is not able to find accurately that which vehicle has sent the information to another vehicle or Global Positioning System (GPS) devices. If a vehicle sends false information to a GPS device, it works with that false message and provides erroneous information to other vehicles. Though the nodes are mobile in VANET, the mobility is constrained to the boundaries of the road. The nodes are also characterized by high node mobility and fast topology changes.

Fig.2 Nodes in Ad-hoc Network

Here, in the above figure 1, the outermost nodes are not within the transmitter range of each other. The middle nodes are used to forward packets between the outermost nodes.

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IV. METHODOLOGY

In general, the simulation components are the Nodes, Agents, and Links. The nodes are the participating objects within the simulation environment. The figure 2 shows the general requirement for designing the proposed model. The Agents rely on nodes for specifying the traffic type and the Links are used to specify the medium of connection i.e. wired or wireless between the participating nodes.

The Vehicle database has the complete details number of vehicles. The Router is used to route the information to the destination place. The Traffic status in the Route, Granting permission like Authorization and the Weather forecast are stored inside the Routing protocol. The traffic management center includes Offence detection, Fine notification, Evidence reception and Traffic information.

The computer database is used to maintain the backend information's. The figure 3 shows the general framework design which is discussed in this project.

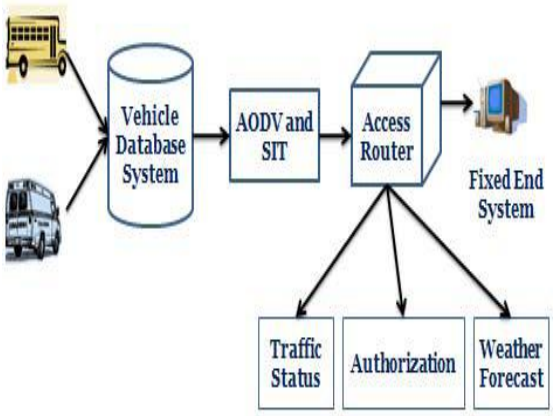

Figure 3.Proposed model for VANET

4.1 System design and Direction-finding

The Network is formed by using the Nodes. The information's like the channel, type and size of the data, and the routing protocol are completely implemented inside each node. The Routing information is stored inside each packet header, so that the efficient routing is formed.

4.2 AODV Routing Execution

In Ad-hoc networks the Ad-hoc On Demand Distance Vector (AODV) is used a routing protocol . AODV helps the vehicles to reach their correct destination with effective routing mechanism. Here, the routing information is not stored in all the nodes.

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4.3 Digital Certificate Confirmation

The Digital Certificate Confirmation (DCC) is done by the SIT (Secure Information Protocol) protocol. The certificates are given to the nodes after updating the information in their database. The best path is found by implementing the proposed on demand routing protocol. The Ticket Granting Machine is validates each node so that the unauthorized node may not can enter or transfer the data. Any node which transfers the data will have information which is received in the form of a data packet. When the Data Packet is transferred the Digital Certificate is validated. The validation is also used to find the complete node details which are used to transfer the data. The information is transferred by using data service from one node to another node.

4. 4 The Node E-Care Center

Regular Node Discovery (RND) is the work of finding the node which subjects to E-Care Center (ECC). It will find out whether the nodes participated has the digital certificate. The RND will reduce the time delay by collecting and updating the information regularly. It does not make the node to stop at the ECC.

4.5. Data Analysis

The data analysis is done based on the results obtained from the simulation environment. The network is traced to find the complete details. Based on the proposed model, the simulation is made and nodes are placed on the required configuration. The Graphs are plotted based on the following consideration with their corresponding value. The Loss Of Packet (LOP), Sending Node (SN) and Receiving Node (RN) and Consumption of Energy (CE) are parameters used. The 300s is used as the Time. The Network Boundary is 500m × 500m .

There are 20 nodes are participated and the Frequency is considered as 100m. The Constant Bit Rate link is 20, which is set to link the nodes. Size of the data packet is 512 bytes. The movement of the nodes inside the network is made to travel in any direction without any restriction and it is set as random. The Throughput is the QoS parameter that is considered for Analysis. The data analysis is done based on the Table 1.

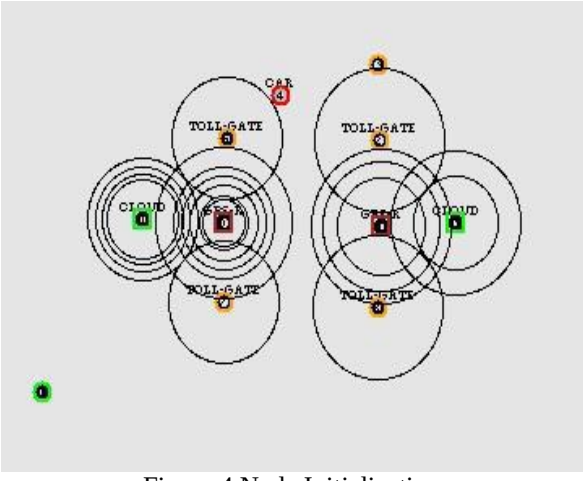

Figure 4.Node Initialization

Table 1. Data Analysis Based on simulation setup

Parameter	Value	Description
Simulator	NS2	Simulator tool
Simulation time	300s	Maximum execution time
Simulation area	500mx500m	Physical boundary of the network
Number of nodes	20	Nodes participating in the nodes
Transmission range	100m	Frequency of the node
Max speed	0,5,10,15,20 m/s	Speed of nodes
CBR flows	20	Constant Bit Rate link used
Data payload	512 bytes	Packet size
Movement model	Random waypoint	Network connection

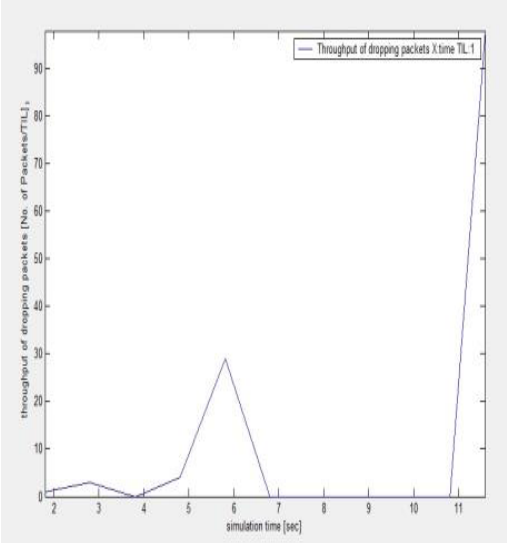

Figure 5. Throughput of dropping packets

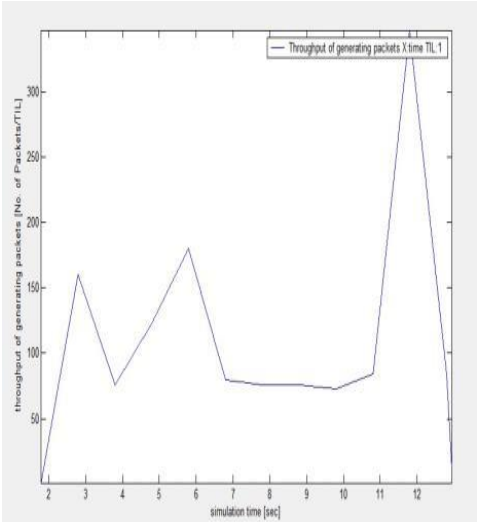

Figure 6. Throughput of generating packets

The graph shows that the packets are not dropped at beginning and the packets are started to drop when there is traffic during the data transfer between the vehicles. The vehicles started to communicate in the normal way but it starts to generate more number of packets where is need to notify the traffic status

V. FUTURE WORK

In future a performance of the system could be improved by modifying the existing routing protocol like AODV and some control mechanisms could be implemented in order provide an absolute solution for our real world traffic environments. In Future we have planned to analyze the performance of routing protocol using NCTUns (National Chiao Tung University Network Simulation) Simulation tool where both traffic and network simulator are tightly coupled together and it supports Intelligent driver model with car following, Intelligent driver model with Lane changing, Intelligent driver model with intersection management. We hope that this will give the real scene of VANET as the vehicles will respond by changing its lane and slowing down speed as in real scenario on road during it movement. We hope the result generated from this tool will be very helpful for the adoption of technology and protocol in VANET.

VI. CONCLUSION

During the data transmission between the nodes, the data may get lost due to the node disconnection from the network. A simple model was designed to study the VANET and the ITS concepts and the simulation is performed using ns2. The graphs were plotted based on the performance of the system and it shows that the packets drop ratio is high when there is more information transfer between the vehicles. The DCC could be used in future in order to find the more correct and efficient route between the nodes. The nodes which are participating in the paths are been authenticate before it enters the routing phase so malicious node which may create link failure are been avoided. The proposed system will also be used to design a routing protocol for VANETs which provide a safe and reliable data transfer between communication points and to overcome the drawbacks of other routing protocols. In future a performance of the system could be improved by modifying the existing routing protocol like AODV and some control mechanisms could be implemented in order provide an absolute solution for our real world traffic environments.

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