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Design and Performance Evaluation of IP Based Intelligent Transportation System with Packet Sender's Location Tracking Scheme

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Abstract- ***In today's modern era the congestion problem of vehicles is increasing, resulting in traffic jam, accidents, etc. Also today's transportation system is far away from intelligent and important message broadcasting within the vehicular network. To overcome these problems there is need of Intelligent Transportation System (ITS) which can boost up the usefulness of the vehicular network infrastructure. In this paper we have designed IP based intelligent transportation system by using WiMAX network protocol with reactive routing protocols like Ad hoc On-demand Distance Vector (AODV) and Ad hoc On-demand Multipath Distance Vector (AOMDV). Also in this transportation system we have incorporated the scheme of particular data packet sender's location tracking to extract the exact location of the specific data packetsender during transmission and reception process for intelligence agency. The performance evaluation of this vehicular ad hoc network (VANET) is done through performance parameter like throughput and delay for AODV and AOMDV routing protocols.***

Keywords –Intelligent Transportation System, WiMAX, VANET, Routing Protocols, AOMDV, AODV, Location Tracking.

I. INTRODUCTION

Intelligent transportation system is the latest trend among researchers to fulfill the today's heavy traffic needs. Suppose weather condition of particular area is not good, we have to face the problems during vehicle travelling from that area. If road condition of the road is not good because of land slide, we will get this information only when we reached to that location. Is it possible to get the correct information about above said problems before travelling or journey? Answer is yes and is it possible because of intelligent transportation system. ITS is the branch of vehicular ad hoc network.VANET is the network of set of vehicular nodes which are used for communication among them for certain applications like safety alert messages, multimedia data transfer, automatic parking system, etc.

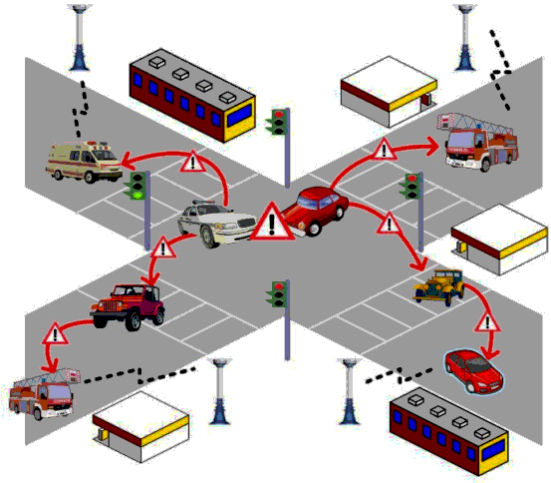

Fig. 1. Data Communication in VANET

Figure 1 shows the data communication in VANET. There are three types of communication in vehicular ad hoc network namely vehicle to vehicle, vehicle to infrastructure and infrastructure to vehicle.Above figure shows that if two vehicles collide with each other, both vehicles will broadcast that information to nearby its vehicles and vehicular infrastructure. So that traffic jam can be avoided before the time.Speed is the important factor in vehicular technology. The speed of the vehicle decides time required to travel specific distance [1].When the speed or mobility is more the power saving factor and connection drop probability is less [2]. Today network size is important factor for any type of network. In few countries VANET is established by using Wi-Fi connectivity which is not sufficient for large coverage area network. So to overcome the problem of coverage area Worldwide Interoperability for Microwave Access (WiMAX) protocol is the unique solution for large coverage area. There are lots of advantages of using WiMAX on Wi-Fi such as more speed up to 70 Mbps, it supports multiple antennas and multiple radio channels scheme, there are two separate operating frequency rages for line of sight and non line of sight, etc.WiMAX provide more suitable and secure data communication as compared to other network protocols. Also WiMAX support for adaptive modulation and coding with hybrid ARQ techniques.The shape of the network represents the channel connectivity in between all vehicular nodes which are available in the coverage area. In temporary network the topology is not constant so network planning is a significant issue to achieve high throughput and capacity of the WiMAX system [3].

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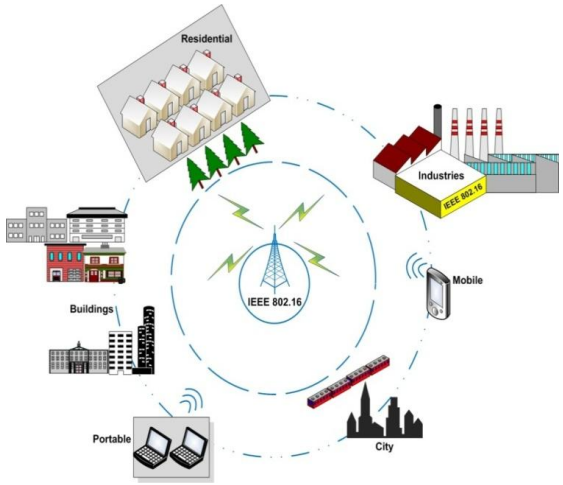

Fig. 2. Applications of WiMAX (IEEE 802.16)

Figure 2 shows the various applications of WiMAX protocol like residential, between buildings, portable devices, whole city connectivity, mobile connectivity, industry applications, etc. routing protocol is used to decide by which route data packet will travel from transmitter to receiver. In this research work we have used reactive routing protocols like AODV and AOMDV. The advantage of reactive routing protocol is it updated the routing table only by request or demand. In these routing protocols multiple routes are available in between source and destination because of multiple channels [4]. For various routing protocols the delay is different with change in number of nodes. Depend on the distance, number of nodes and traffic the delay varies. The AODV routing protocol has more delay than other routing protocols [5].To attain better performance of the network delay should be less as compared to threshold value. Because jitter is very important parameter in any wireless network and jitter is directly depend on the delay. If delay and jitter both are less then video buffering and down streaming will be proper [6]. In advance communication system AMC improves the spectral efficiency. The aim of the AMC technique is to provide appropriate modulation technique by examining the channel data to improve overall spectral efficiency [7]. The end-to-end delay is more in silent relay node because of common transmission region [8]. The traffic load and collision increases delay in the vehicular system [9]. Delay increases because of the increase in routing overhead. Advance AODV routing protocols have less route discovery delay than original AODV routing protocol [10]. Speed, density and topology of the network make effect on the performance of the VANET system [11]. The WiMAX based VANET system provide better throughput and delay as compared to other dedicated network protocols of vehicular network [12]. The use of multiple input multiple output and adaptive modulation and coding techniques can be incorporated in WiMAX based vehicular network to improve the performance of VANET system [13]. The mobility model allows vehicular nodes to generate different speed structures. These mobility models can be demonstrated as a real life traffic scenario in terms of vehicle mobility [14], [15]. The new scheme of data packet sender's location tracking is also adopted in this system to extract the exact location of the specific data packet sender location information. The use of this scheme is, suppose someone used wrong data for broadcasting within the network then system can track the exact location of the sender of that data packet at the instant of time, which means that at some x, y, z location someone send that data packet, we will get the location of that sender of that transmission time.

II. METHODOLOGY

The design of IP based vehicular system is difficult job in terms of real life traffic scenario. So to match the need of today's customer we tried to design this system on network simulator. Figure 3 shows the IP based VANET system. The parameters of the WiMAX are given in table I. These parameters are selected in such way that system will provide better response to the existing traffic scenario.

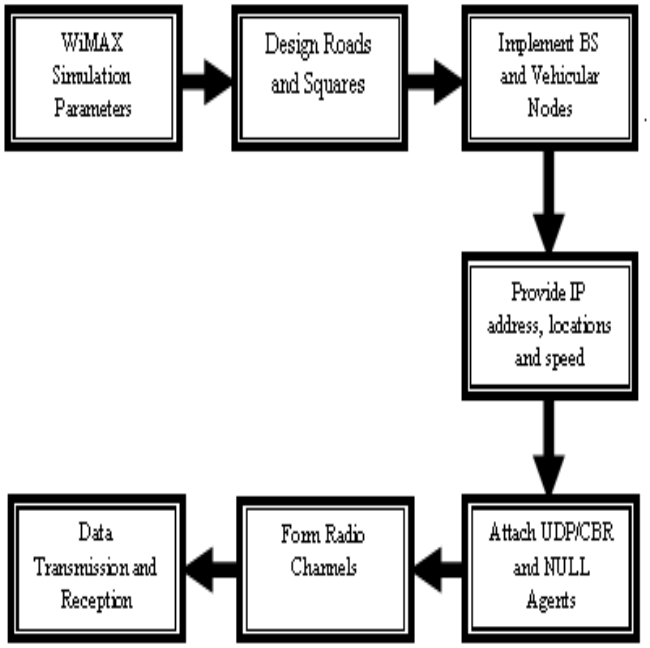

Fig. 3. Block diagram of IP based VANET System

Suppose if we take example of any traffic scene, we can see that there are roads, squares, vehicles, etc. so our first task was to implement these things on the basis of real traffic system. So base station is heart of this system because all data transmission and reception will take place through this base station only.To secure VANET system from third party there is always need of some security algorithm. So this can be fulfilled by using IP generation. The IP address is essential for all Base Station (BS) and each vehicular node in WiMAX network. The IP addresses have to provide by following way.

There is only one network hence IP will start from 0. The base station is in first cluster hence again next number will be 0. BS is the first node hence again 0. So final IP address of BS will be 0.0.0. By this way one can provide IP address to each and every vehicular node. So next IP will be 0.0.1, 0.0.2, 0.0.3 and so on.Now from where vehicle will move and up to which position. So give source and destination positions to all vehicles with specific mobility. Attach UDP/CBR and NULL agents to vehicular nodes according to requirement. Now radio channels will be form in between transmitting and receiving nodes and finally start the data transmission and reception process.

Table–I: Parameters of IP based VANET system

Parameter	Parameter value
Channel type	Wireless Channel
Network interface type	Wireless Phy/OFDM
Mac protocol	IEEE 802.16e
Interface queue type	Drop Tail/PriQueue
Antenna model	Omni directional
Max packet in queue	250
Routing protocol	AODV, AOMDV
Simulation area	1000 m X 1000 m
Packet size	1000 Bytes
Traffic type	UDP/CBR

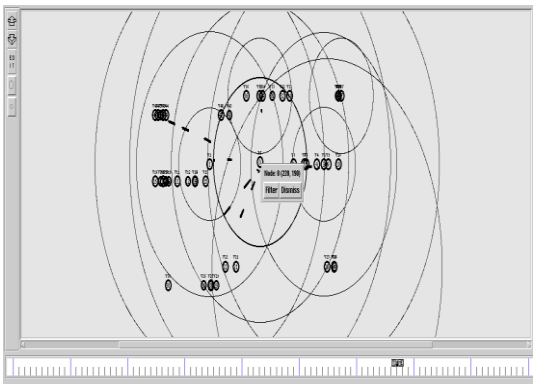

Fig. 4. NAM scenario of VANET network with AODV routing protocol

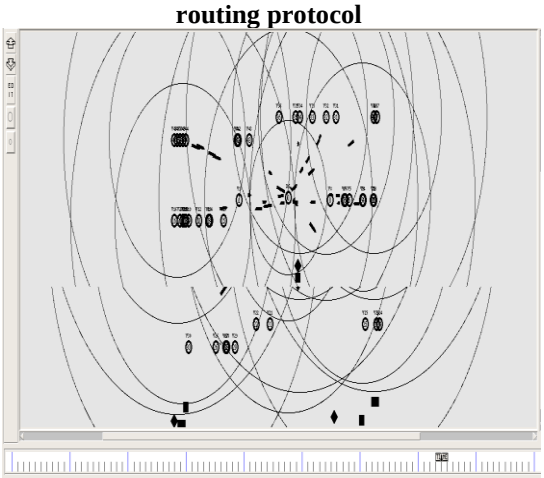

Fig. 5. NAM scenario of VANET network with AOMDV routing protocol

Figures 4 and 5 shows network animator scenario of VANET network with AODV and AOMDV routing protocols. The vehicular nodes, base station, data flow and data loss can be seen in figures 4 and 5. The additional feature of this designed system is to extract the exact location of the sender of specific data packet'stransmission and reception time of instant. The procedure to convert any string into its equivalent binary code is as follows.

Suppose I want to transfer the string "Hello Prabhakar". So first calculate the length of the string in variable n. Then rotate the loop n times. In every iteration save ASCII value of particular character in variable say vali and then convert into its equivalent binary code and then store that result in array and at the last print that array in reverse order.

III. RESULTS

The analysis of vehicular system is based on its network parameters. Here throughput and delay are considered to evaluate the performance of the system. Throughput is nothing but speed. For any communication system the throughput of the network must be high. After designing the VANET system the performance is evaluated for AODV and AOMDV routing protocols.Figures 6 and 7 shows the throughput of receiving bits by AODV and AOMDV routing protocols respectively. Figures 6 and 7 are the throughputs only in between single source and single destination vehicular nodes.

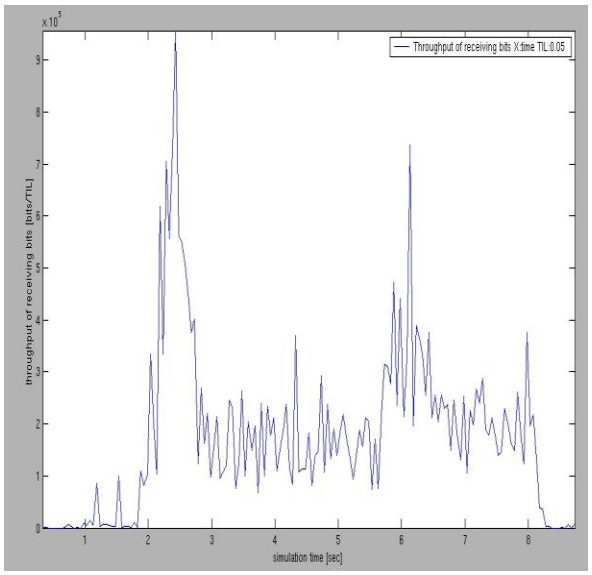

Fig. 6. Throughput of receiving bits by AODV routing protocol

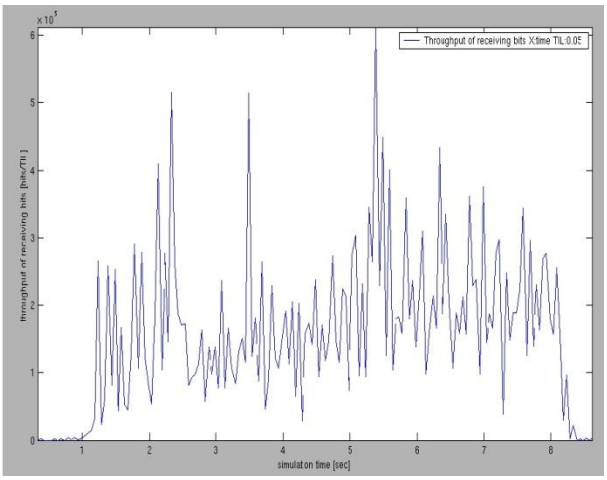

Fig. 7. Throughput of receiving bits by AOMDV routing protocol

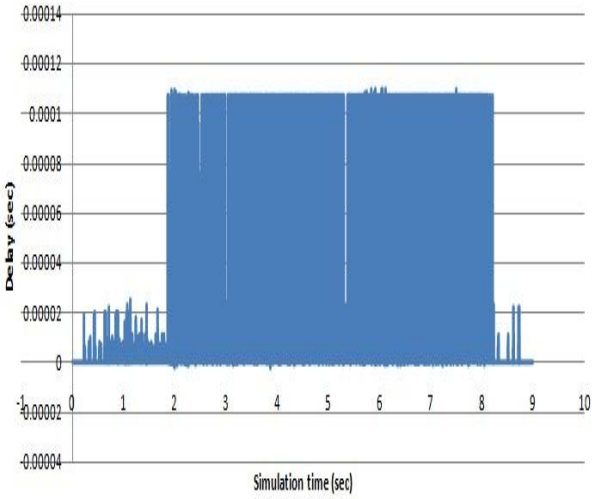

Fig. 8. Delay by AODV routing protocol

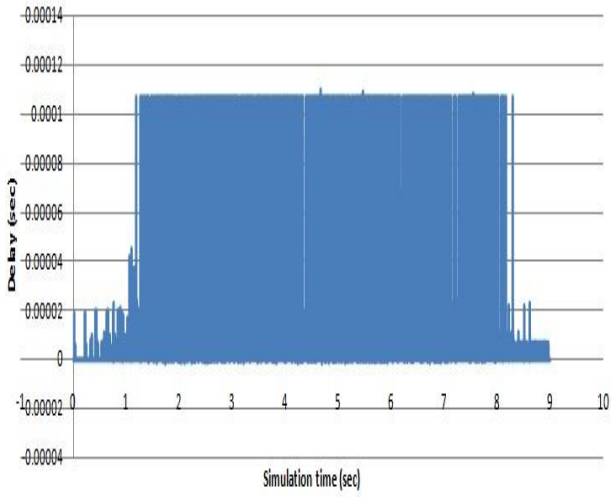

Fig. 9. Delay by AOMDV routing protocol

Table-II: Performance parameters of network

Performance Parameters	AODV	AOMDV
Throughput (kbps)	3574.40	3825.55
Average Delay (usec)	6.69	6.33

Figures 8 and 9 shows the delay of the network for AODV and AOMDV routing protocols. Delay represents the transmission time of the data packet from source to destination. Table II shows the performance parameters for overall network. The throughput by the AOMDV routing protocol is more than that of AODV routing protocol. The average delay of the network is less for AOMDV routing protocol as compared to AODV routing protocol. Figure 10 shows the trace file which shows the location of vehicular nodes. The trace file is the output of the network file which shows the detail information about various events takes place during the communication process. Here we can see that node 24 transmits the data packet to node 26. The packet sequence number is 36. Now from trace file we can analyze that at the time of transmission of this data packet the position of the transmitting vehicular node is Nx=391.65, Ny=321.11, Nz=0.00.

```
s -t 4.596200000 -Hs 24 -Hd 26 -Ni 24 -Nx 391.65 -Ny 321.11 -Nz 0.00 -Ne -1.000000 -NL RTR -Nw --- -Ma 0 -Md 0 -Ms 0 -Mt 0 -Is
24.0 -Id 26.0 -It cbr -Il 580 -If 0 -Ii 421 -Iv 30 -Pn cbr -Pi 36 -Pf 0 -Po 0
r -t 4.601178185 -Hs 16 -Hd 16 -Ni 16 -Nx 380.00 -Ny 1.00 -Nz 0.00 -Ne -1.000000 -NL AGT -Nw --- -Ma 13a -Md 10 -Ms 11 -Mt 800 -Is
17.0 -Id 16.0 -It cbr -Il 620 -If 0 -Ii 418 -Iv 30 -Pn cbr -Pi 20 -Pf 1 -Po 0
s -t 4.603800000 -Hs 19 -Hd -2 -Ni 19 -Nx 331.63 -Ny 288.46 -Nz 0.00 -Ne -1.000000 -NL AGT -Nw --- -Ma 0 -Md 0 -Ms 0 -Mt 0 -Is
19.0 -Id 13.0 -It cbr -Il 650 -If 0 -Ii 422 -Iv 32 -Pn cbr -Pi 22 -Pf 0 -Po 0
r -t 4.603800000 -Hs 19 -Hd -2 -Ni 19 -Nx 331.63 -Ny 288.46 -Nz 0.00 -Ne -1.000000 -NL RTR -Nw --- -Ma 0 -Md 0 -Ms 0 -Mt 0 -Is
19.0 -Id 13.0 -It cbr -Il 650 -If 0 -Ii 422 -Iv 32 -Pn cbr -Pi 22 -Pf 0 -Po 0
s -t 4.603800000 -Hs 19 -Hd 13 -Ni 19 -Nx 331.63 -Ny 288.46 -Nz 0.00 -Ne -1.000000 -NL RTR -Nw --- -Ma 0 -Md 0 -Ms 0 -Mt 0 -Is
19.0 -Id 13.0 -It cbr -Il 670 -If 0 -Ii 422 -Iv 30 -Pn cbr -Pi 22 -Pf 0 -Po 0
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Fig. 10. Trace file showing location of vehicular nodes

Table-III: Text data with its equivalent binary data

Text Data	Equivalent Binary Data
Hello Prabhakar	01001000 01100101 01101100 01101100 01101111 00100000 01010000 01110010 01100001 01100010 01101000 01100001 01101011 01100001 01110010

For this network "Hello Prabhakar" string was transmitted in packet sequence number 36. Table III shows the actual text data with its equivalent binary data. By this way we can generate n bits of binary data from its text data and depending upon the packet size transmit it in number of packets. Here instead of searching for particular data, there is need of only searching packet sequence number for searching sender's location. Here given string is transmitted by node 24 to node 26 and node 24 location is given in trace file of figure 10.

IV. CONCLUSION

Vehicular technology is an emerging technology in the field of secure transportation. WiMAX provide facility to give IP to each and every base station and vehicular nodes. Due to this the data transmission and reception took place only in between registered users within that network as discuss in results section. For any communication system throughput and delay are important parameters. Our result shows that AOMDV routing protocol gives better throughput than AODV routing protocol. Delay should be as low as possible to fast transfer of data. Again AOMDV provides lower delay than AODV. So the conclusion of IP based intelligent transportation system is that because of IP system is secured and no one can hack the important data. Also if anyone tries to send non important messages in the network, the exact location of such users can be identified along with data and such cases can be reduced by using this system.

V. FUTURE SCOPE

The researcher can do further research on this area to improve the performance of the system. One can design WiMAX based VANET system for heterogeneous wireless communication networks. The power optimization techniques can be implemented in VANET system to reduce the power utilization by the vehicular infrastructure. One can try this VANET system for various mobility generator models to examine the performance of such system in various types of traffics and mobility's. The researchers can try to improve the secureness of the vehicular network from third party by using various security encryption and decryption algorithms.

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