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Vehicle-to-Road-Side-Unit Communication Using Wimax

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ABSTRACT

Vehicular Networks is one of the biggest areas of interest due to the wide variety of services they provide. Vehicular ad hoc network (VANET) is a wireless communications technology which is capable of enhancing driving safety and velocity by exchanging real-time transportation information. VANETS comes from the domain of Intelligent Transportation System (ITS). VANET is a Network infrastructure which is established across the roads. Here the mobile nodes or vehicles communicate with other vehicles or fixed nodes. These fixed nodes can be base stations or Road side unit or an antenna fixed on any building etc. The performance of this network is dependent on characteristics of road's traffic. Connectivity in VANETs may degrade drastically in sparse traffic and also high speed highways. Because of fast changing environment the network discontinuity occurs between vehicles & roadside units. A lot of work and research around the globe is being conducted to define the standards for vehicular communications.

In this project we try to find ways to improve the connectivity between the vehicle & roadside units so that we can send the packets in minimum latency period and discuss the challenges facing future vehicular networks.

Keywords - Connectivity in VANET, connectivity issues in VANET, improving connectivity in VANET, V-to-R communication, V-To-R connectivity, WiMax in VANET.

I. INTRODUCTION

A Vehicular Ad-Hoc Network or VANET [10] is a wireless communications technology that uses moving cars as nodes in an adhoc network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars to connect and, in turn, create a network with a wide range. VANET should, upon implementation, collect and distribute information to vehicles. VANET is capable of enhancing driving safety and velocity by exchanging real-time transportation information. In VANETs, the Carry-And-Forward Strategy [1] has been adopted to overcome uneven distribution of vehicles. If the next Vehicle located is in transmission range, then the packet is forwarded to that vehicle.

VANET should, upon implementation, collect and distribute safety information to massively reduce the number of accidents by warning drivers about the danger before they actually face it.

The basic motivation for this Project was the report of the National Crime Records Bureau India reveals. In 2007, 1.14 lakh people in India lost their lives in road mishaps i.e. 13 people die every hour in road accidents in India, The figures in other parts of the world in other years are as enormous as listed above. It goes without saying that any efforts to decrease traffic accidents are meaningful.

By enabling the vehicles to communicate with their neighbors and share their driving states, VANETs can greatly enhance driving safety by avoiding crashes potentially caused by emergent braking, lane changing, and so on. The major design goal of VANETs is to enhance driving safety and decrease traffic accidents. In the future, it can be supposed that with all vehicles involved in VANETs they can be more responsive to the actions of their nearby neighbor nodes, resulting in fewer traffic accidents.

Even studies show that about 60% roadway collisions could be avoided if the operator of the vehicle was provided warning at least one-half second prior to a collision.

II. TECHNOLOGY -WIMAX

WiMax [2] stands for Worldwide Interoperability for Microwave Access. It is a standard based technology. The purpose of WiMax promotes deployment of broadband wireless access networks by using a global standard and certifying interoperability of products and technologies. It focuses on interoperability. OFDM based physical layer and has very high data rates. It also has Scalable bandwidth and data rate support with Adaptive modulation and coding (AMC) & Link-layer retransmissions. It also Support for TDD and FDD & Orthogonal frequency division multiple access (OFDMA).There is Flexible and dynamic per user resource allocation & Support for advanced antenna techniques & Quality-of-service support is also

available. IP-based architecture, Support for mobility, robust security are few features of WiMax.
The technology to be used could also be 3G. But we opted for WiMax because:

- WiMax spectrum is more economical than 3G.(The price paid per Hz is as much as 1000 times lower than for 3G spectrum.)
- WiMax is purely a broadband technology where as 3G is a cellular technology.
- A single WiMax tower can provide coverage to a very large area as compared to 3G.
- WiMax has high download speed up to 70 Mb/s where as 3G has around 14.4 Mb/s.
- WiMax can also be used as a Backhaul Technology avoiding the need of traditional T1/E1 copper lines.
- Issues like: Latency time, Hand Off, High Velocity, Packet drop etc. can be more efficiently tacked with the help of WiMax than 3G.

III. PLATFORM- QUALNET

Qualnet [3] is a network simulation tool that simulates wireless and wired packet mode communication networks. Qualnet Developer is a discrete event simulator used in the simulation of MANET, WiMax networks, satellite networks and sensor networks, among others. Qualnet has models for common network protocols that are provided in source form and are organized around the OSI Stack. There are plenty of network simulators are available like NS2,OMNET++ etc. but we opted for Qualnet because the user friendly support provided by Qualnet with various protocols, environment factors, different terrains and analyzing capabilities are remarkable. A study done by Hsu et al compared performance results from a real world ad hoc wireless network deployment to the results obtained from a model of the network in Qualnet and concluded that Qualnet modeled the deployment scenario with remarkable accuracy, thus validating the ability of Qualnet to model realistic wireless environmental effects.

IV. ISSUES

As there are many technologies which have been implemented in the field of VANET, some are still in use and others have failed because of poor performance. There are many issues with VANET, which affects its performance. One of the successfully implemented technologies was DSRC. DSRC [4] was first used in north-America for toll-collection purpose. But because of the issue of the range, currently this technology is not in use.

ISSUES that affects the VANET:
Range:
DSRC: provides very less range of 300- 500meter. **WIMAX:** provides high range than DSRC. It gives 40-50km of range between two fixed unit (towers) and 15-20km between fixed and mobile unit (vehicle).

- **Packet Routing:** For transmitting information choosing right algorithm can give higher performance.
- **Throughput:** DSRC provides very less throughput than WIMAX.
- **Latency Time:** The standard result says that throughput in VANET should be less than 1 m/s. Practically achieving this not possible but WIMAX gives less latency time for transmitting packets than DSRC.
- **Packet Loss:** This can be known as loss of information. Usually as speed increases, the packet loss also increases. In DSRC loss of information increases when the speed of the vehicle goes beyond 30km/hr. WIMAX can handle very high mobility conditions.

V. PROJECT IMPLEMENTATION

Here in our project implementation we have considered a highway scenario in Qualnet using WiMax technology.

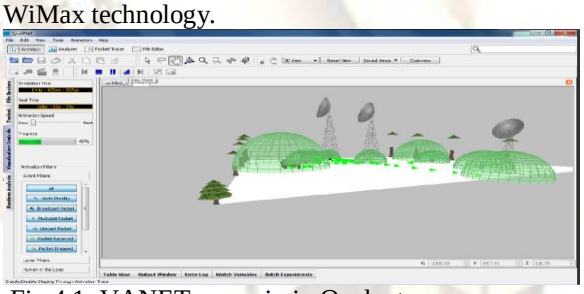

Fig 4.1: VANET scenario in Qualnet

In Our Scenario we have considered a 6 Lane National Highway (Express Way) which is ITS Enabled.

- We have 6 vehicles moving at different speeds in range 72 - 150 km/h labeled node 4-9.
- We have considered 3 base stations in a Road stretch of 24 km with a handover stretch of 0.5km labeled 1-3.

We have used AODV as our Routing algorithm [5], [6]. There are two best protocols for VANET-
1. DSR
2. AODV.

We compared these two protocols and found that there is less packet loss in DSR compared to AODV. But the main goal of our system is to improve the connectivity. In AODV the latency time is very less compared to DSR, that's why we have chosen AODV as routing protocol for system [7], [8], [9].

Assumptions: 1 meter in Canvas is 12m Real World. For the purpose of simulation of our modules we have taken the following parameters:

Parameters	Specifications
Network Simulator	QualNet
Routing Protocols	AODV
Simulation Area	2000m X 2000m
Propagation Model	Two-ray ground reflection model
Number of Vehicles	6
Antenna model	Omnidirectional
MAC Protocol	IEEE 802.16e
Channel Type	Wireless channel
Traffic Type	Constant Bit Rate (CBR)
Source/Destination	Fixed
Max. Speed	150 kmph
Simulation Time	103 second
Data Rate	2 Mbps

Fig 4.2: Simulation Parameters in Scenario

Node ID	VELOCITY(kmph)
1	0
2	0
3	0
4	150
5	100
6	72
7	150
8	100
9	72

Fig 4.3: Velocity of different nodes.

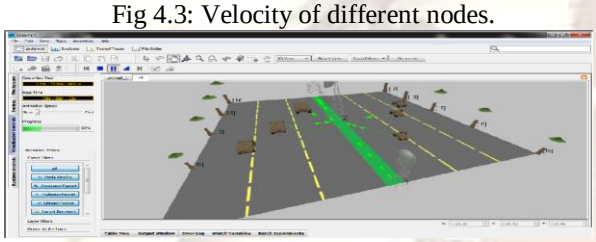

Fig 4.4: VANET scenario (Implemented System) in Qualnet

VI. CONCLUSION

Through our Project Work we can conclude that:

- Packet loss due to high velocity is reduced from 58% [DSRC] to 8% [WiMax] at a speed of 72 km/h.
- Latency time is reduced from 0.6635[DSRC] to 0.2216 at the speed of 72 km/h. Jitter has been reduced from 0.5033 sec to .2696 sec.
- The appropriate routing algorithm suiting WiMax scenario is AODV as compared to other existing routing protocols.
- The range of the network has been tremendously increased from 1.8km [DSRC] to 50km [WiMax].

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