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Integration of WiFi With WiMAX Technology in Vehicular Ad-hoc Networks

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ABSTRACT

Wireless access networks based on IEEE 802.11 and IEEE 802.16 have become very popular in providing different data services. In this paper our first goal is to design and implement an integrated Wimax and Wi-Fi network and compare two of the most promising infrastructure-based wireless technologies such as IEEE 802.16e standard and upcoming IEEE 802.11p standard. We investigate, through simulation, the potential and limitations of both technologies as a communication media for vehicle-to-infrastructure (V2I) communications. The performance of the two systems is evaluated for delay, packet delivery ratio, and throughput. This research work is to integrated of WiFi with WiMAX technology in an Vehicular Ad-hoc and evaluate the performance using the NS2.31 simulator. To improve the packet delivery ratio, and End-to-End delay the proposed system is implemented using Wi-Fi with WiMAX (IEEE 802.16) routing technique. we conclude that, the comparsion results shows integration of WiFi with WiMAX will produce better result when compared the existing schemes.

Keywords : WiFi, WiMAX, Vehicular Ad-hoc Networks.

I. INTRODUCTION

The Vehicular Ad-hoc Networks (VANET) is constrained by high mobility of vehicles and frequent disconnections. The emerging approval of wireless communications has generated broad interest among researchers during the past years. In VANET, intermediate intersections places an inimitable challenge to routing protocols in city environment due to obstacles, node density, low mobility etc. With the sharp increase of vehicles on roads with in the recent years, driving has become more difficult and risky. The main goal of Vehicular ad-hoc network (VANET) is to provide safety and comfort to passengers and help drivers on the roads to anticipate hazards. VANET permit vehicles to avoid issues, both by taking any desired action or by alerting the driver. A VANET turns each participating car into a wireless node and allows cars to connect with each other approximately within 100 to 300 metres and, in turn creates a network within a wide range. As vehicles drop out of the network range and other vehicles may join, connecting vehicles to one another in order that a vehicular network is created. Besides the road safety enhancements that Vehicular Ad-hoc networks will bring too many applications to

enhance the driving and travelling comfort, like Internet access from a car. Wireless access networks based on IEEE 802.11 and IEEE 802.16, known as Wireless Broadband Technologies (WiBro), have become very popular in providing different data services[1].

Wireless technologies are consistently improving many different aspects of their functionalities such as transmission speed, coverage, and quality of service. Traditionally, WLANs are connected to the Internet and/or other WLANs through a wired network infrastructure. Give that there are limitations inherit to Wi-Fi standard. Conventionally Wi-Fi setups still would require a wired connection as their backend to be able to connect to internet. One such solution is the IEEE 802.16 family of Wireless Metropolitan Area Network (WMAN) technologies that render a promising solution to provide backhaul support for WLANs[2]. Another important thing to notice is that the apparent similarity between Wi-Fi and Wimax, the complementary nature in terms of key factor is same between them. Wi-Fi has a short coverage range of approximate 100 meters while Wimax support a significantly greater coverage range of 500 meters and beyond, on the other hand Wi-Fi offers high raw data capacity with poor traffic control capabilities whereas Wimax is capable of highly sophisticated traffic management and QoS control.

II. Overview of IEEE 802.11 Technology

With the accomplishment of wired local area networks, the local computing market is moving toward WLAN with the same speed as wired LAN. WLANs are supple data communication system that can be used for many applications with high mobility. WLANs provide high flexibility than the wired LAN. The IEEE 802.11 committee is responsible for WLAN standards and WLANS include IEEE 802.11a (Wi-Fi 5), IEEE 802.11b (Wi-Fi), IEEE 802.11g, IEEE 802.11 p, IEEE 802.11 x is also sometimes known as Wi-Fi.

The IEEE 802.11a specifications use the unlicensed 5 GHz band and can handle 54 Mbps over short distances. The IEEE 802.11b specifications use the data rates at a maximum speed of approximately 11 Mbps of raw data at indoor distances and outdoor distances of several miles as an unlicensed use of the 2.4 GHz band (Schroth, 2005). IEEE 802.11 g standard applies the 802.11 a modulation standard and offers backward compatibility for 802.11 b devices. The IEEE 802.11p data rates at a maximum speed of 27 Mbps. IEEE 802.11p produces better performance when compared to IEEE 802.11b. IEEE 802.11 x is an extension of wired Ethernet, bringing Ethernet-like principles to wireless communication[3].

Most of the VANET research is focused only on Wi-Fi technology. Wi-Fi is implemented using IEEE 802.11p (Dedicated short range communication) which supports a transmission range of 500 m. Wireless technologies are always improving many special aspects of their functionalities such as coverage, speed and quality of service. Historically, WLANs are connected to the Internet through a wired network infrastructure. Wi-Fi standard have certain limitations and conventionally Wi-Fi setups still would require a wired connection as their backend so that it can be connected to the internet and may be used to offer broadband wireless[4].

One such solution is the IEEE 802.16 own family of Wireless Metropolitan Area Network (WMAN) technologies that render a promising technique to offer backhaul support for WLANs. Another important critical issue to notice is that the apparent similarity between Wi-Fi and WiMAX, the complementary nature in terms of key element is identical between them. Wireless has a rapid

coverage of approximately one hundred meters even as WiMAX support a drastically extra coverage variety of 500 meters and beyond, alternatively Wi-Fi offers high raw facts potential with terrible traffic managing competencies while WiMAX is able to ensure state-of-the-art traffic management and QoS.

Most of the VANET research work is implemented using IEEE 802.11p which supports a transmission range of 500 m. The interesting possibility for WiMAX in the developed world is the capability to serve as the backhaul connection to the developing Wi-Fi.

III. Overview of 802.16 (WiMAX)

In 1998, the IEEEs fashioned a group referred to as 802.16 to expand a well known wireless metropolitan area network or wireless MAN. Initially, this group also focused on developing solutions with in the 10GHz to 66GHz band, with the primary applications being delivering with high-speed connections without installing fiber optic cable. The IEEE 802.16 group produced a wireless MAN that was approved in 2001[5]. The Wireless MAN consists of two main layers such as MAC layer that uses frequency division duplexing, time division duplexing and physical layer that used single-carrier modulation techniques. IEEE 802.16a was completed in 2003, the physical layer that supported for orthogonal frequency division multiplexing and MAC layer, as well as support for orthogonal frequency division multiple access[6].

The IEEE 802.16 group is responsible for wireless metropolitan area network (WMAN) standards and IEEE 802.16 standards including WiMAX technology. WiMAX is an advanced technology mainly designed to meet the need for very high speed wide area internet access at low cost. WiMAX can usually support data rates at a maximum speed of 70 Mbps. The WiMAX specification improves upon many of the limitations of the Wi-Fi standard given by high bandwidth and encryption[7]. WiMAX is a worldwide interoperability for Microwave Access and developed by IEEE 802.16 group. WiMAX support higher frequency range, high data rates, point to multi-point configuration, wide coverage range, Qos (Quality of services) for various wireless broadband applications[8]. The distinction between WiMAX and Wi-Fi is speed and distance[9][10].

IV. Simulation Parameters

Parameters	Values
NS Version	NS_2.35
Topology size	5000 x 5000
No of vehicles	15
Data packet size	1500
Routing protocol	DSDV
Traffic type	CBR
Packet type	UDP
IEEE	802.11p, 802.16
Radio Propagation model	Two way Ground

V. Performance Evaluation

In the proposed work, we evaluate the performance of the QOS factors based node selection and comparsing wifi and wimax using NS2 version 2.34. It is introduced in which the node capacity is computed for the routing process. This method computes the delay, bandwidth, stability, interference for each and every link in the network. Compare to the existing system(WiFi,WiMAX), integration of WiFi with WiMAX produce a high performance (high packet delivery ratio and throughput).

5.1 Routing metrics

Packet collision rate is the number of data packet collisions occurring in a network over a specified

period of time. It indicates the rate at which data packets crash or lost during in the collisions. The rate of collision packet is measured in terms as a percentage of the data packets successfully sent out through the destination.

End-to-end delay :

This is the delay elapsed between the packet generation at the source and successful reception at the destination.

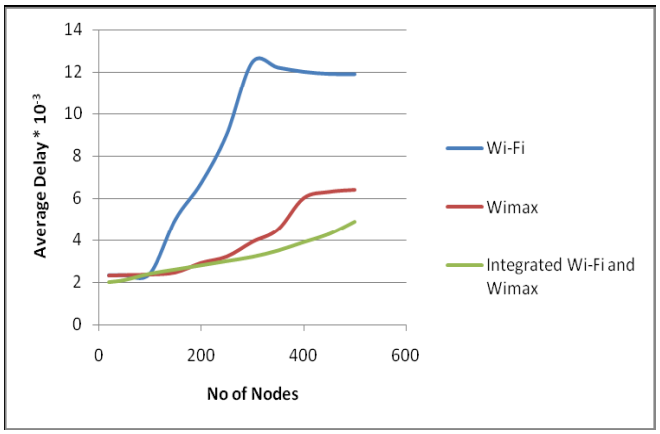

Fig 1. Average Delay

In this figure 1, it shows the X-axis denotes total number of the nodes and the Y-axis denotes Average delay. Compare to the WiFi,WiMAX, the proposed integrated Wi-Fi with WiMAX produces less delay.

Packet delivery ratio :

It is defined as the ratio of the number of delivered data packet to the destination. This illustrates the level of delivered data to the destination.

Packet Delivery Ratio =

$$\frac{\sum \text{Number of packet receive}}{\sum \text{Number of packet send}}$$

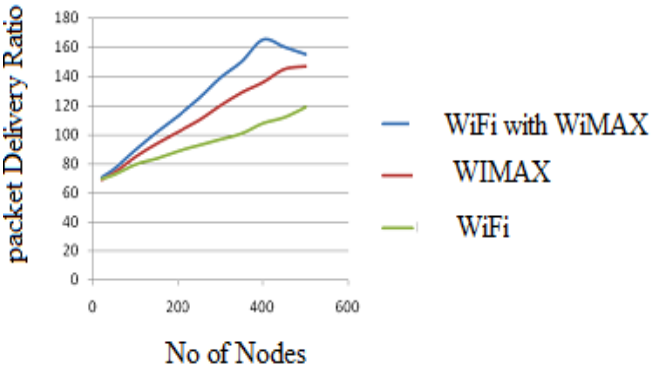

Fig 2 : Packet Delivery Ratio

In this figure 2, it shows the X-axis denotes total number of the nodes and the Y-axis denotes packet delivery ratio. Compare to the WiFi,WiMAX, the proposed integrated Wi-Fi with WiMAX produces high packet ratio.

Packet loss rate :

Packet loss rate is the percentage of data packets that are lost during the process of transmission as shown in fig 3..it is calculated using the formula

$$\text{Packet loss} = \frac{\text{Number of lost packets}}{\text{Number of received packets}}$$

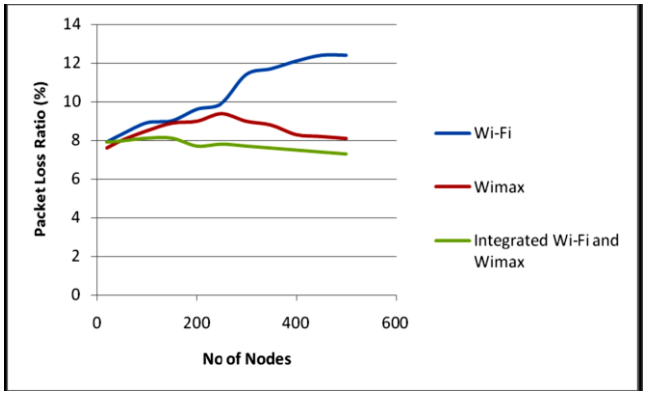

Fig 3. Packet Loss Ratio

In this figure 3, it shows the X-axis denotes total number of the nodes and the Y-axis denotes packet loss ratio. Compare to the WiFi, WiMAX, the proposed integrated Wi-Fi with WiMAX produces less packet loss.

VI. CONCLUSION

In this research work, derived that Wi-Fi and Wimax both have their advantages and disadvantages and widely used technologies these days. Wi-Fi in comparison to WiMAX is superior response of a wireless network. The problem in Wi-Fi network is overcome by the Wimax network. Comparing these, Wi-Fi network and WiMAX technology is more secure and reliable service. As a result, merging these two technologies gives us better result and response with respect to quality of service, mobility, coverage and practicability. Together, Wimax and Wi-Fi are ultimate partners for service providers to deliver appropriate, reasonable mobile broadband Internet services in additional places. They are open IEEE wireless standards built from the ground up for Internet Protocol (IP)-based applications and services. Our stimulated architecture shows better result in above parameters as compared to other individual environments such as Wi-Fi and WiMAX. So merging of two technologies results in better delivery of QoS services especially in case of voice with data. Now day integration is very common. It provides us with benefits which are proved by above results.

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