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A Novel Combined DSRC-WiMAX Technology for different Vehicular Communication Scenario's

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ABSTRACT

Authors have proposed a Novel Combined hybrid Architecture for various vehicular communication scenarios to the advancement of deployed Intelligent Transportation System (ITS). In our Scenario, the existing Dedicated Short Range Communication (DSRC) (IEEE 802.11 p) and Mobile WiMAX (IEEE 802.16 e) acts as an on-board Unit (OBU). As OBUs move between communication range, Vehicle exchange information between OBUs on vehicles as well as Road side Unit (RSU). In addition, Fixed WiMAX (IEEE 802.16 d) acts as an RSU, it will communicate between fixed base stations (BS) and it covers wide coverage more than 30 Km range by overcome the drawback of existing 1000 Meter DSRC Communication . In this paper, we proposed various communication scenarios by considering Hybrid DSRC / WiMAX technology can get over tricky communication gaps between vehicles.

Keywords: DSRC, OFDMA, OFDM, WiMAX, QPSK, QAM

I. INTRODUCTION

We have proposed the hybrid infrastructure between DSRC and WiMAX for efficient vehicular communication. Mobile WiMAX offers wide range communication between vehicles and infrastructure and it also act as On-Board unit (OBU) in vehicles [1]. By using an existing technology such as Mobile WiMAX and fixed WiMAX deliberate a wide area coverage with high mobility condition and provides a communication to a large number of users. At the same time, DSRC OFDM used to communicate between vehicles in-between 1Km(1000M) distance and it serving high-speed broadband Internet without significant roadside infrastructure.

1.1. DSRC(IEEE 802.11p) to Fixed WiMAX IEEE 802.11d)

Authors have proposed combined physical layer OFDM approach between DSRC and WiMAX for efficient vehicular communication. By considering BPSK and 16 QAM modulation techniques used to converge the 64 FFT subcarrier and 256 FFT subcarrier with 10MHz bandwidth could combine these two existing technologies (IEEE 802.11p and IEEE 802.11d)[2] as well as it provide better communication between vehicles and infrastructure.

1.2. DSRC (IEEE 802.11 p) to Mobile WiMAX (IEEE 802.11 e)

Authors have analyzed the dynamic environment model by utilizing the combined framework of DSRC and Mobile WiMAX is to reducing the overhead cost as well as minimizing the excessive base station. By combining two different existing technologies DSRC and WiMAX depicts the point to point multichannel communication between vehicles. These two technologies establishing communication by transmitting OFDM symbol from DSRC to WiMAX OFDMA in 10MHz bandwidth frequency. The Mobile WiMAX

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requires 1024 FFT subcarrier to uplink the data into DSRC and 64 FFT subcarrier frequency requires to downlink the data from DSRC to WiMAX of 10 MHz bandwidth for orthogonal frequency[7]. By converging these OFDM and OFDMA provides a point to point communication in high mobility environment.

2. PROPOSED ARCHITECTURE

In our proposed architecture explained in detail about combined frame structure of Fixed WiMAX OFDM and Mobile WiMAX OFDMA [3] explained in figure 1. Therefore 256 FFT subcarrier frequencies required for uplink the data into Mobile WiMAX as well as 512 FFT subcarrier frequencies requires for downlink the data in OFDMA channels [8]. In Fixed WiMAX, 200 subcarriers frequency used to transmit the data in the form of OFDM symbol. In OFDMA, 512 FFT subcarriers used to uplink the data into different burst time [5]. Therefore OFDMA channels represent both frequency and Time (FDD and TDD) duplexing to receive the signal. These received data is allotted to various time slots depends on burst time as well as modulation techniques (QPSK).

3. DIFFERENT HYBRID SCENARIOS FOR ITS

There are three Scenarios for combined OFDM framework for efficient Vehicular communication

3.1. Scenario 1: DSRC(OFDM) to Fixed WiMAX(OFDM)

For OFDM to OFDM i.e., for DSRC to DSRC capable vehicles, communicating range is within 1000 meters [4], where vehicles within this range can communicate with each other provided they are in the same clusters.

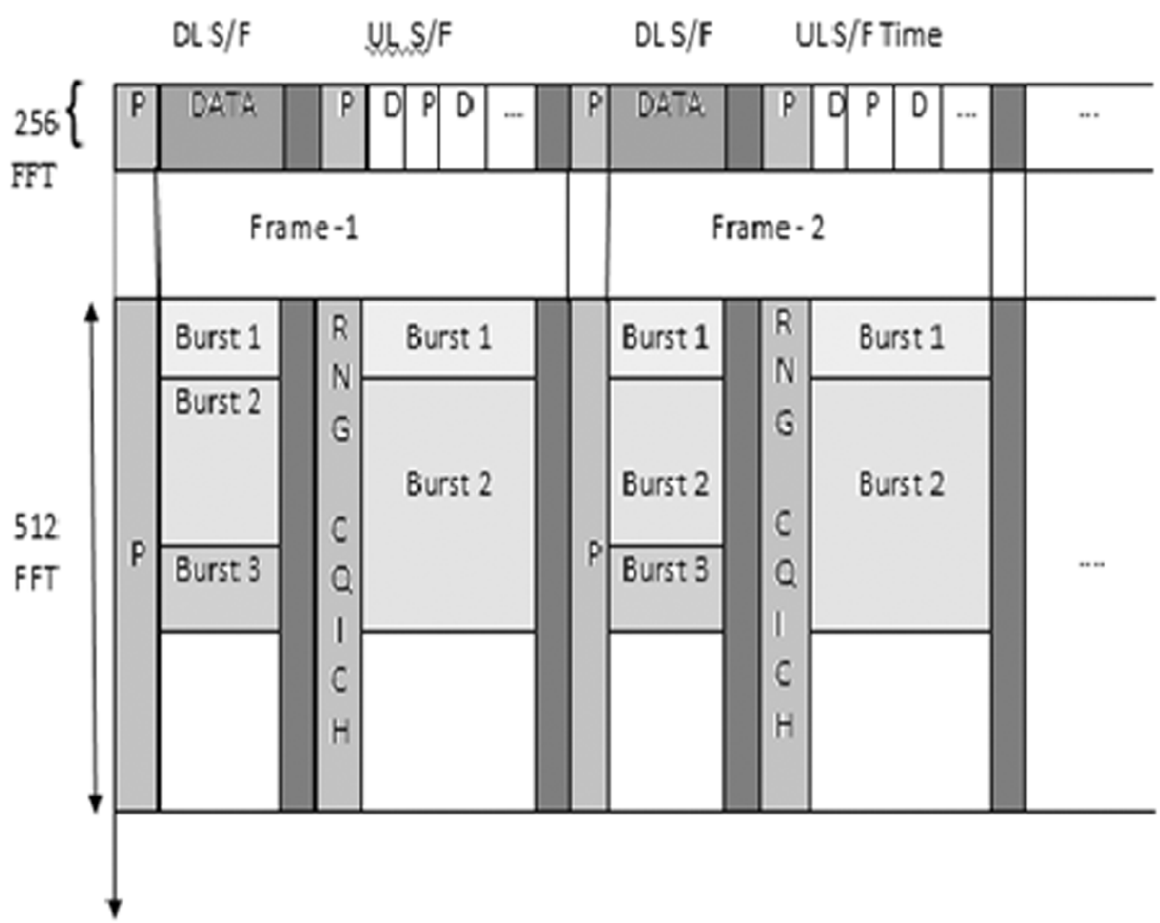

Figure 1: IEEE 802.16d and IEEE 802.16e frame structure

3.2. Scenario 2: DSRC (OFDM) to Mobile WiMAX(OFDMA)

For this scenario, the transmission from OFDM to OFDMA comes in the picture i.e., for DSRC to Mobile WiMAX, communicating range is within 5Kms for DSRC to communicate to WiMAX base stations, whereby as we are considering mobile WiMAX, OFDMA comes into the main picture where vehicles with DSRC transceivers within this range can communicate with WiMAX base stations.

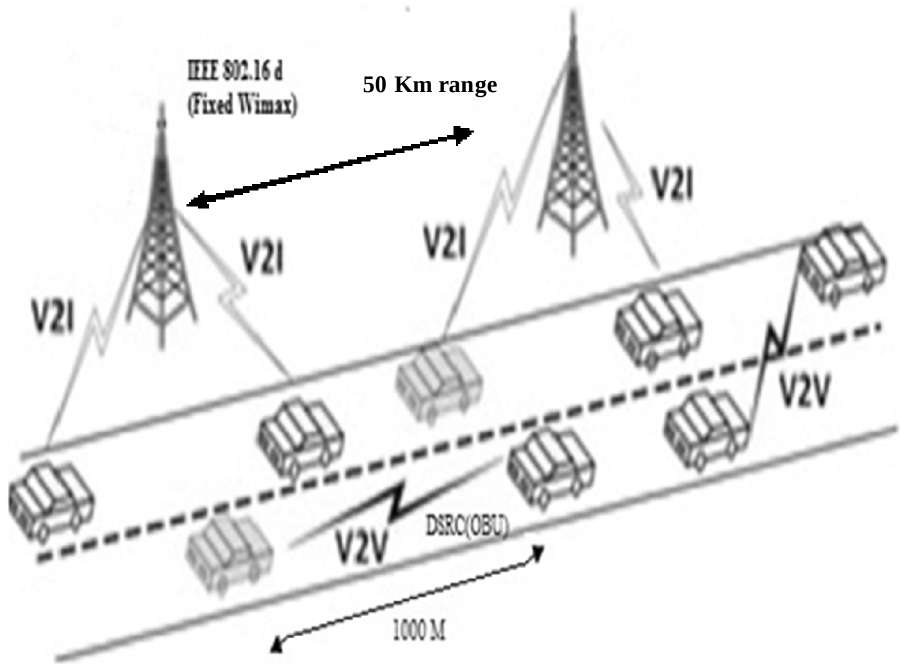

Figure 2: DSRC to DSRC & DSRC to Fixed WiMAX infrastructure

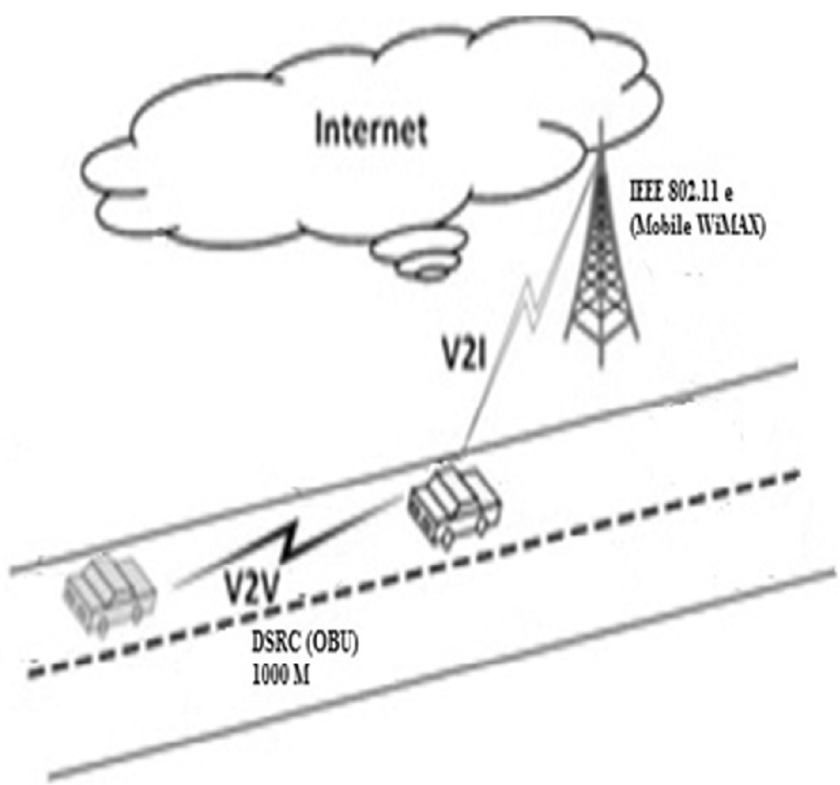

Figure 3: DSRC (OFDM) to Mobile WiMAX (OFDMA) infrastructure

3.3. Scenario 3: Mobile WiMAX(OFDMA) to Fixed WiMAX

For this scenario, the transmission from OFDMA to OFDM comes in the picture i.e., for Mobile WiMAX to Fixed WiMAX, communicating range is within 5Kms for vehicles having Mobile WiMAX to communicate to Fixed WiMAX base stations[6].

Taking into consideration a secluded roadway where only one vehicle is moving and wants to communicate with the base station, if this vehicle is having DSRC transceivers then if it is not in the range of 5Kms to communicate then it is not possible for this vehicle to communicate with the BS, therefore if this vehicle has mobile WiMAX transceivers then it is possible for this vehicle to communicate with the base station [10].

4. SIMULATION PARAMETERS AND RESULTS

In the above table depicts the possible parameters of converging existing technologies such as DSRC, WiMAX (Both fixed and Mobile) for efficient broadband vehicular communication.

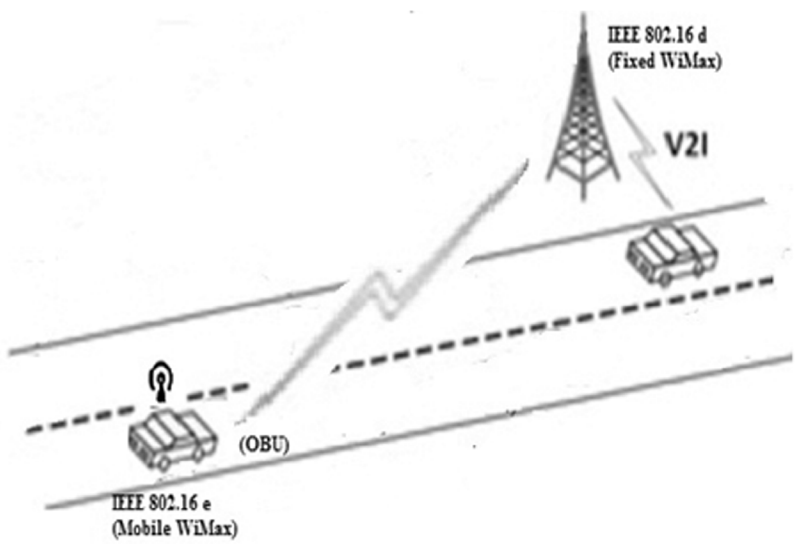

Figure 4: Fixed WiMAX(OFDM) to Mobile WiMAX(OFDMA) infrastructure

Table 1
Mobile WiMAX and Fixed WiMAX possible parameters

Characteristic	*Fixed WiMAX*	*Mobile WiMAX*
Industry standard	802.16 d - 2004	802.16 e -2005
Access Type	Fixed	Portable and Mobile
Modulation	OFDM	OFDMA
Duplexing	TDD	TDD and FDD
Types of Service providers	DSL, Cable Modems and Competitive Access Providers	Mobile Operators, DSL, Cable Modems, Wireless and Wired ISPs
Handoffs	No	Yes
Preferred Frequency Bands	2.5, 3.4 – 3.6, 5.8 GHz	2.3 – 2.4. 2.5 – 2.7, 3.3 – 3.4, 3.4 – 3.8 GHz
FFT Size	256	128, 512, 1024, 2048
Number of used data subcarriers	192	72, 360, 720, 1440
Number of Pilot Subcarriers	8	12, 60, 120, 240
Guard Band subcarriers	56	44, 92, 184, 368
Channel Bandwidth	3.5 MHz	1.25, 5, 10, 20 MHz
Subcarrier Frequency Spacing	15.625 KHz	10.94 KHz
Guard time	8 µs	11.4µs
OFDM symbol duration	72µs	102.9µs
Modulation	BPSK, QPSK, 16 QAM, 64 QAM	BPSK, QPSK, 16 QAM 64 QAM

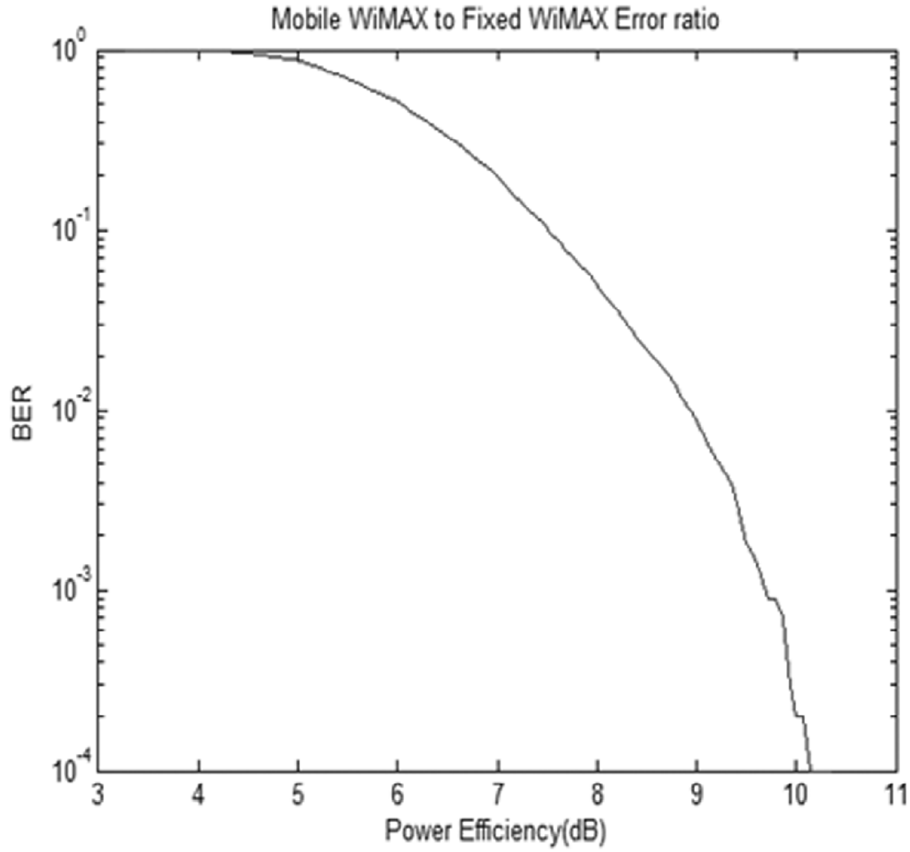

Figure 5: Mobile WiMAX downlink channel

System bandwidth: 5 MHz.

Data modulation format: QPSK

Transmitter IFFT size: 512.

Subcarrier (tone) spacing: 9.765625 kHz (= 5 MHz / 512).

OFDMA input block size: 16 symbols.

i.e. QPSK modulation techniques for OFDMA uplink frame structure

Δf * symbol rate = 512 FFT * ½ = 256 FFT.

In the above equation, explaining the Mobile WiMAX, 512 FFT subcarrier frequencies are transmitted into 256 FFT subcarrier of Fixed WiMAX by using QPSK Modulation Techniques [9].

In figure 4. Depicts the time variation of 512 FFT Subcarrier OFDMA channel and it modulated into QPSK and it establish the communication into 256 FFT subcarrier channel varying by burst time in the form of minimize the bit error rate and quantized the channel delay.

5. CONCLUSION

This paper proposed the three different scenarios for efficient vehicular communication by considering existing vehicular and cellular standards can be enhance the performance of ITS. In this hybrid framework, all vehicles are equipped with both DSRC and Mobile WiMAX would enable high speed signal handoffs communications in dynamic environment. Mobile WiMAX supports mobility and standardize framework between vehicles and fixed base stations. Therefore all vehicles can directly communicate with fixed base station and improves propagation of the signal in any handoff situations.

REFERENCES

[1] Ramjee Prasad and Fernando J. Velez, "OFDMA WiMAX Physical Layer, WiMAX Networks, Techno–Economic Vision and Challenges," Springer. ISBN: 978-90-481-8751-5. 2010.

[2] IEEE P802.16-2004/Cor1/D3 Corrigendum to IEEE Standard for Local and Metropolitan Area Networks–Part 16: Air Interface for Fixed Broadband Wireless Access Systems, IEEE, New York, 2005.

[3] "Nabih Jaber, Nicholas C. Doyle 2 and Kemal E. Tepe 1,"New combined WiMAX/DSRC infrastructure design for efficient vehicular networking", Jaber et al. EURASIP Journal on Wireless Communications and Networking Springer, 2012.

[4] Jijun Yin Tamer ElBatt, Stephen Habermas, "Performance Evaluation of Safety Applications over DSRC Vehicular Ad Hoc Networks", VANET'04, Philadelphia, Pennsylvania, USA, October 1, 2004.

[5] http://www.rfwireless-world.com/Terminology/fixed-wimax-versus-mobile-wimax.html

[6] G. Doug, Mobile WiMAX–Part I: a technical overview and performance evaluation. (WiMAX Forum, August 2006). http://www.wimaxforum.org/ technology/downloads/Mobile_WiMAX_Part1_Overview_and_Performance. pdf Accessed July 2010

[7] Dedicated Short Range Communications (DSRC) Message Set Dictionary, SAE Std. J2735, SAE Int., DSRC Committee, Nov. 2009.

[8] Ran, Moshe. A mixed OFDM downlink and single carrier uplink for the 2-11 GHz licensed bands. s.l. : IEEE 802.16a, 2002.

[9] T. Kanesan 1, Student Member, IEEE, W. P. Ng 1, Senior Member, IEEE, Z. Ghassemlooy1, Senior Member, IEEE and C. Lu2, Member, IEEE, "FFT Size Optimization for LTE RoF in Nonlinear Fibre Propagation" ,Communication Systems, Networks & Digital Signal Processing (CSNDSP), IEEE 2012.

[10] Frank Ohrtman, "Fixed vs Mobile WiMAX Mobility Monomania?", president, WMX systems, LLC, URL:http:// www.MindCommerce.com, July 2007.