Performance analysis of a novel OWDM-IDMA approach for wireless communication system

Awatif Rouijel, Benayad Nsiri, and Driss Aboutajdine

***Abstract*: Efficiency and adaptivity play a major role in the design of fourth-generation wireless systems (4G). These systems should be efficient in terms of bandwidth and power allocation and will satisfy the users requirement on low power consumption, little interferences with other systems, and high rate transmission. Moreover, low complexity transceivers are expected. This paper will propose a novel multiple access technique called OWDM-IDMA (Orthogonal Wavelength-Division Multiplexing-Interleave Division Multiple Access) as the combination of the OWDM (Orthogonal Wavelength-Division Multiplexing) and IDMA (Interleave Division Multiple Access) schemes. The IDMA and OWDM principles are also outlined. The comparison between the conventional OFDM-IDMA and the proposed OWDM-IDMA is performed in term of Power to Average Power Ratio PAPR, as well as evaluating the performance of our presented technique over Additive White Gaussian Noise AWGN multipath channels by estimating the BER (Binary Error Rate).**

***Index terms*: IDMA, OWDM, OFDM, CWT, DWT, ESE, DWPT, IDWPT.**

I. INTRODUCTION

Since the 1980s, the telecommunications sector is growing dramatically thanks to technological advances in several scientific fields. This progress is clearly shown in mobile radio communications with the emergence of different generations of mobile telephony. At the same time, applications that can benefit from this technology have continued to diversify. OFDM (Orthogonal Frequency Division Multiple) is considered to be promising for wireless communications due to his resistance to fading caused by multipath propagation. Therefore, it is principally adopted in different standards like WIFI(802.11), WIMAX(802.16), ADSL,...

The OWDM technique is presented as a novel alternative to OFDM, it consist to use the wavelets filter banks. IDMA (Interleave-Division Multiple-Access) [1][2] is a special case of random waveform CDMA that is mainly limited by MAI (Multiple Access Interference) and ISI (Inter Symbol Interference); indeed with IDMA, different users are, solely, distinguished by user-specific interleaves. These interleavers can be selected randomly and orthogonality is not essential. Turbotype iterative MUD (Multi-User Detection) has been extensively studied to mitigate MAI and ISI, and significant progress has been made. Recently, OFDM (Orthogonal Frequency-Division Multiplexing) and IDMA (Interleave Division Multiple-Access) [3][4] can be combined in an OFDM-IDMA scheme, since it can alleviate ISI by the OFDM technique and cancel multiple access interference (MAI) by the IDMA technique [5]. This technique uses rectangular waveform as a filter shaping. This choice has the advantage of allowing an efficient implementation of modulation and demodulation using DFT (discrete Fourier transform algorithms). However, this waveform is not optimal in a radio-electric transmission. This function is poorly localized in frequency and sensitive to temporal dispersion of the propagation channel. Recently, the use of cyclic prefix solves this problem. Contrariwise it can cause a loss of spectral efficiency.

The other major drawback in the OFDM signal is its large envelope fluctuation, which may degrade the efficiency of power amplifiers of the transmitters by forcing them to operate at lower average power [6]. This phenomenon is quantified by the PAPR, and results from the superposition of a large number of usually statistically independent sub-channels that can constructively sum up to high peaks. The amplifier power consumption depends largely on the peak power than the average one. Thus, occasional large peaks lead to low power efficiency.

In this contribution, we propose a new multiple access technique, called OWDM-IDMA as the combination of OWDM and IDMA techniques, this technique is suggested to solve the problem of the rectangular waveform in OFDM modulation. In fact, through the formalism of wavelets and their application to wavelet packets and filter banks, it is possible to construct orthogonal basis in time and frequency whose properties will develop a Multicarrier communication system using more accurately the radio-electric spectrum. Moreover, the use of IDMA technique can make the system more robust against MAI, and lead to a significant performance enhancement.

The system performance is analyzed. A signal-to-noise (SNR) evolution technique is applied to predict the performance in terms of BER. The rest of the paper is organized as follows. In Section II, the basics of IDMA are discussed. In Section III, we present the transceiver architecture of OWDM-IDMA. The third section outlines a definition of PAPR and investigates the

Manuscript received June 15, 2012; revised September 20, 2012.
This work is supported by The "Acadmie Hassan II des Sciences et Techniques".
Awatif ROUIJEL and Driss ABOUTAJDINE are with the *University Mohammed V- Agdal,GSCM-LRIT laboratory associated with CNRST, Rabat, Morocco,* (e-mails: awatifrouijel@gmail.com, aboutaj@fsr.ac.ma)
Benayad NSIRI is with the *University Hassan II, Casablanca, LIAD and LPMMAT laboratory, Faculty of sciences, Morocco,* (*e*-mail: nsiri2000@yahoo.fr)

performance of our proposed OWDM-IDMA scheme using numerical examples. Finally, a conclusion is given in Section VI.

II. OVERALL TRANSMITTER AND RECEIVER PRINCIPLE OF IDMA

The technique of multiple access IDMA can allocate the same frequency band to several users while allowing them to transmit simultaneously. IDMA can be seen as a special case of CDMA where the spreading is done by an arbitrary equal low rate channel code for all users which the separation is done by user-specific interleavers.

A. Transmitter structure

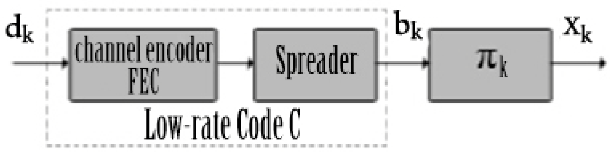

Fig. 1. Transmitter structure for IDMA system

Fig.1 shows the transmitter structure of the multiple access scheme under consideration with *K* simultaneous users. The input data sequence d^k of the k^{th} user is encoded basically on a low-rate code *C*, generating a coded sequence $b_k = \{b_k(j);\ j = 1 \ldots\ldots J\}$ where *J* is the frame length (here, "chip" is used instead of "bit" as the FEC encoding may include spreading or repetition coding.). Then bk is permutated by an interleaver π_k, producing $X_k = X_k(j)$. The interleavers π_k, are not similar for different users. We assume that the interleavers are generated independently and randomly. The key principle of IDMA is that the users are solely distinguished by their interleavers [7,8]. After chip matched filtering, the received signal from *K* users can be written as:

$$r(j) = \sum_{k=1}^{K} h_k(j) X_k(j) + n(j) \quad j=1,2,..,J \quad (1)$$

where $\{n(j)\}$ are the samples of a complex AWGN process with variance σ^2 in each dimension, and h_k is the channel coefficient for the k^{th} user. The channel coefficients $\{h_k\}$ are assumed to be known at the receiver side.

B. Receiver Structure

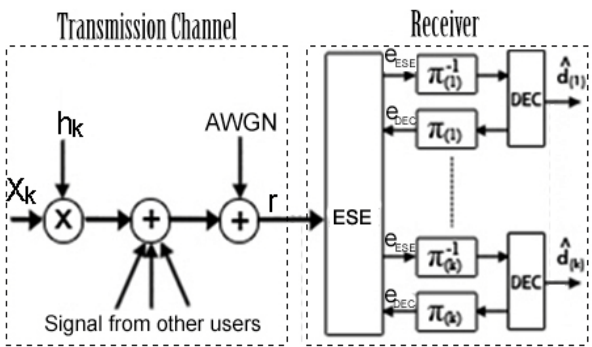

Fig. 2. Receiver structure for IDMA system

The receiver in Fig.2 consists of an elementary signal estimator (ESE) and K single-user a posteriori probability (APP) decoders (DECs). The multiple access and coding constraints are considered separately in the ESE and DECs. In the iterative detection process, the ESE and DECs exchange extrinsic information in a turbo-type iterative way [5].

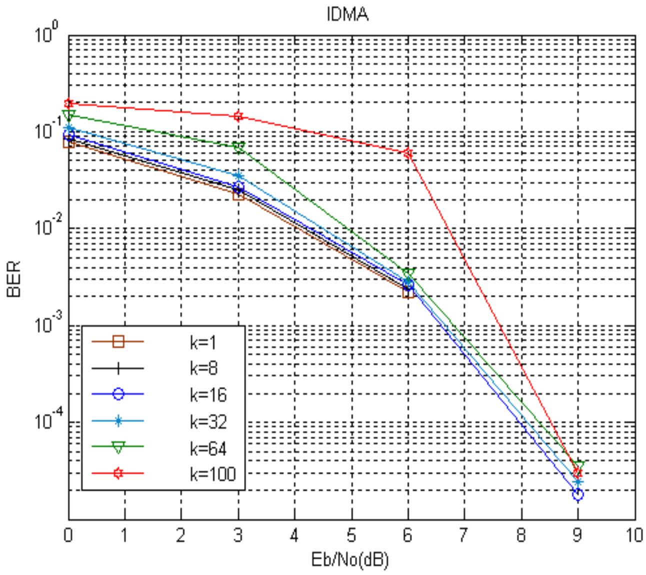

Fig. 3. Performance of chip-by-chip detectors for IDMA systems over AWGN channels

In Fig.3, we consider BPSK modulation, the number of users k=1, 8, 16, 32, 64, 100, a common length-64 spreading sequence for all users and the length of the information block is N = 256 bits per user. We see that the IDMA scheme can achieve near single-user performance even for K = 64 (measured at BER $= 10^{-3}$). This represents a very high loading as the spreading length is only 64.

III. OWDM-IDMA PRINCIPLES

To keep up with the demanding requirements of multimedia, high quality video streaming, and other high bandwidth applications, the trend towards ever increasing data rates is expected to continue. However, because of limited spectrum availability and constrained transmit power, new signaling approaches will be required to sustain the upward climb.
As cited above, we propose to study the performance of OWDM-IDMA, which can meet the exigencies mentioned previously.

The Discrete Wavelet Transform

The Discrete Wavelet Transform (DWT), which is based on sub-band coding is found to yield a fast calculation of Wavelet Transform. It is easy to implement and reduce the computation time and the required resources. In the case of DWT, a time-scale representation of the digital signal is obtained by using digital filtering techniques.

The DWT is calculated by successive low pass and high pass filtering of the discrete time-domain signal as shown in Fig. 4-(a).

The signal is denoted by the sequence *x[n]*, where n is an integer. The low pass filter is denoted by G_0 while the high pass filter is denoted by H_0. The $\downarrow 2$ is the down-sampling function achieved by discarding alternate samples [9]. The maximum number of levels depends on the length of the signal.

Fig.4-(b) shows the reconstruction of the original signal from the wavelet coefficients. Basically, the reconstruction is the reverse process of decomposition. G_0 and H_0 are exchanged with the synthesis filters G_1 and H_1, whereas the $\uparrow 2$ is the zero insertion function (up-sampling) [10].

After reviewing the whole wavelets theory, it is possible to define a wavelet functions for Multicarrier modulation. So we can define the principle of Multicarrier modulation using wavelet packets.

The basic principles of Multicarrier modulation using wavelet packets are illustrated in Fig.5. At the transmitter side, symbols are transformed from the wavelets domain to time domain by an IDWPT (Inverse Discrete Wavelet Packet Transform); at the reception, the received signal is transformed to time domain by a wavelet DWPT (Discrete Wavelet Packet Transform)[11,12].

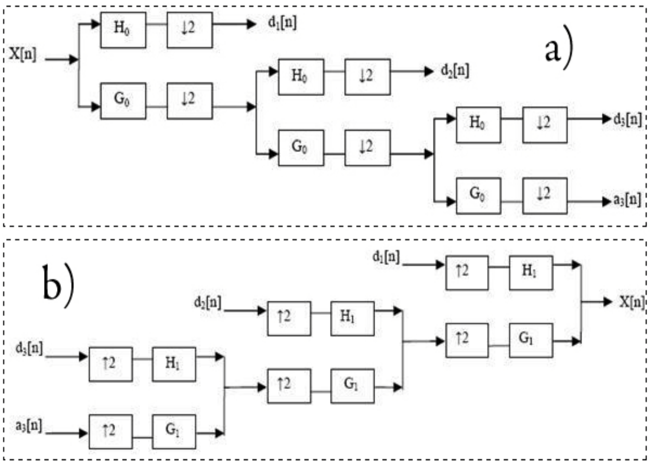

Fig. 4. Three-level wavelet decomposition (a) and reconstruction (b)

In Fig.5, the blocks S and A represent the decomposition and reconstruction respectively, also called analysis-synthesis scheme.

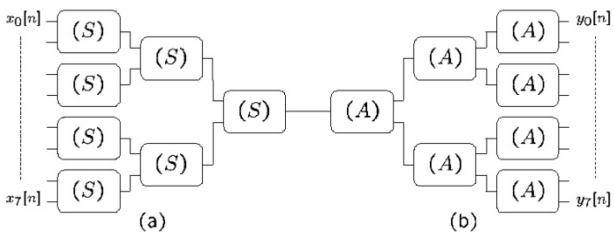

Fig.5. Principle of modulation (a) and demodulation (b) Multicarrier using wavelets

B. OWDM-IDMA Structure

In this paper, we propose a new technique, called OWDM-IDMA, which is the combination of the OWDM and IDMA techniques. The use of OWDM technology in this scheme offers better properties. The first ideas of using wavelet transform in communication were made in multidimensional signaling techniques. Wavelet packet waveforms have the property of localization in both frequency and time domains. Using the time domain localization property of wavelet packet waveforms, a multi-carrier IDMA system based on wavelet packets can be designed to achieve both frequency and time domain diversity. Moreover, OWDM-IDMA can alleviate ISI by the OWDM technique and limit multiple access interference by the IDMA technique [13], using a low-complexity iterative MUD technique that is applicable to systems with a large number of users. Fig.6 shows the transmitter/receiver structure of an OWDM-IDMA system with *K* users.

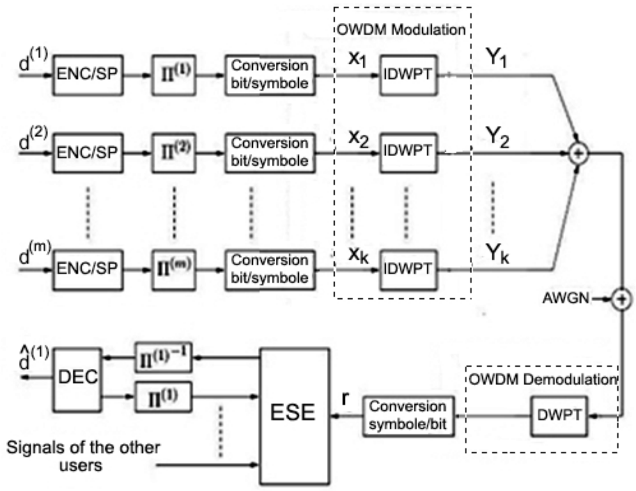

Fig.6. Transmitter/receiver structure for OWDM-IDMA

At the transmitter of k^{th} user, the information data is encoded into a sequence $c_k = c_k[m]$. Each coded bit ck is interleaved by a user-specific interleaver π_k, then the resultant signals, again denoted by $x_k(n)$, are modulated by using IDWPT producing $Y_k(n)$, The received signal equals the sum of the signals received from all transmitters [13]. The multiuser received signal can be written as:

$$R(n) = \sum_{k=1}^{K} h_k\,(n) Y_k(n) + z(n) \qquad (2)$$

with:

$$Y_k(n) = \sum_{n=-\infty}^{+\infty} \sum_{m=0}^{M-1} x_k(n) \varphi_{m,n}(t) \qquad (3)$$

where h_k is the channel coefficient for user-k, $\{z(n)\}$are samples of an AWGN with variance $\sigma^2 = N_0/2$, $Y_k(n)$ is a chip sequence for user k after OWDM modulation, *M* denotes the number of sub-channels associated with the transmission, and n represents the transmission time.

As shown in Fig.6, the structure of the OWDM-IDMA receiver consists of DWPT for demodulation OWDM, an elementary signal estimator (ESE) and K a posteriori probability decoders (APP DECs). After OWDM demodulation by using DWPT, the iterative processes for receiver IDMA can be applied in the receiver signal *r(n)* to detect the users information data.

$$r(n) = \sum_{k=1}^{K} H_k(n) x_k(n) + Z(n) \qquad (4)$$

where $H_k(n)$ is referred to as the channel gain of the n^{th} chip for k^{th} user, Z(n) is Gaussian noise with mean zero and variance σ_n^2 . The ESE operation can be carried out in a chip-by-chip way [14]. Thus, the iterative process does not include the OWDM demodulation. If the number of paths L is large, this structure reduces significantly the calculation complexity of the receiver. Information provided to the ESE detector is then the same kind of IDMA multiuser system on single path channel. Thus to retrieve the information from each user, the ESE detector considers only the MAI interferences.

IV. PEAK TO AVERAGE POWER RATIO

A major drawback of multicarrier modulation relies on fact that they have a large envelope fluctuation. The reason behind this phenomenon is simple: Since a multicarrier signal consists of a number of independently modulated subcarriers, when the sub-symbols for each subcarrier are added up coherently, the maximum instantaneous power of the multicarrier signal could be much larger than its average power [17]. Typically, PAPR is used to quantify the envelope excursions of multicarrier signals. The PAPR of any continuous signal x(t) is defined as the ratio between the peak envelope power and the average envelope one, i.e. [19].

$$PAPR(x) = \frac{max|x_k|^2}{mean|x_k|^2} \qquad (5)$$

where x_k is the discrete multicarrier symbol.High PAPR directly translates into high peak power which may exceed the linear dynamic range of the power amplifier. A multicarrier modulation symbol having a relatively large PAPR may become distorted during power amplification. One or more relatively large samples of the multicarrier symbol may attempt to drive the output of the amplifier towards its maximum output level. When the amplifier's maximum output level is reached, the amplifier clips the sample, resulting non-linear distortion of the output signal. Non-linear distortion affects the quality of the signal. Hence, the receiver may experience difficulties in recovering the transmitted data. To overcome this problem, a number of different methods have been employed to reduce the effects of non-linear distortion by the amplifier or altogether eliminate non-linear distortion. In one such method, we must resort to either high quality linear amplifier or backing off the operating point of the non linear amplifier. This leads to inefficient amplification, excess battery consumption and very expensive transmitter which strongly limit widespread industrial applications.

V. SIMULATION RESULTS AND DISCUSSION

In what follows, we demonstrate the advantages of OWDM-IDMA using numerical results. For this, we consider the uplink scenario. The number of Haar wavelets pulses is 64. For simplicity, we only consider encoded systems. K is the number of simultaneous users in the system.

Fig.7 shows average BER performance of the OWDM-IDMA system (with randomly generated interleavers and a common length-16 spreading sequence for all users) with AWGN channel, using BPSK modulation. The maximum number of iterations is 10, length of the information block is $N = 3072$ bits per user, All channel coefficients are set to $h_k = 1$, and the number of users K is set to $1, 4, 8, 16, 20$. The unique constraint used in selecting the spreading sequence for OWDM-IDMA is that it should contain a balanced number of $+1$ and -1 (so as to ensure randomness). We simply use $+1, -1, +1, -1$, for all users.

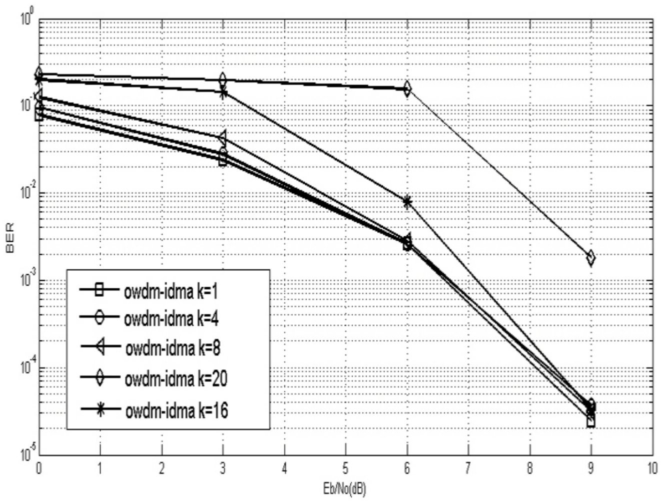

Fig.7. The simulated performance curves for OWDM-IDMA .In this example, we assume that Information bit length = 3072, iteration number =10, number of users=1, 4, 8, 16, 20.

It is observed from Fig.7 that near single-user performance is achievable for large K values and the performance of OWDM-IDMA degrades slightly when $K > 20$. This degradation is caused by the MAI that become critical when the number of users increases. On the other hand, the OWDM-IDMA system support more users than spreading factor ($K > S$) and the loading rate can reach 125% for $K = 20$ users. The trigger point the system's convergence with a number of users approximately twice as large as the spreading code length is located at $6dB$.

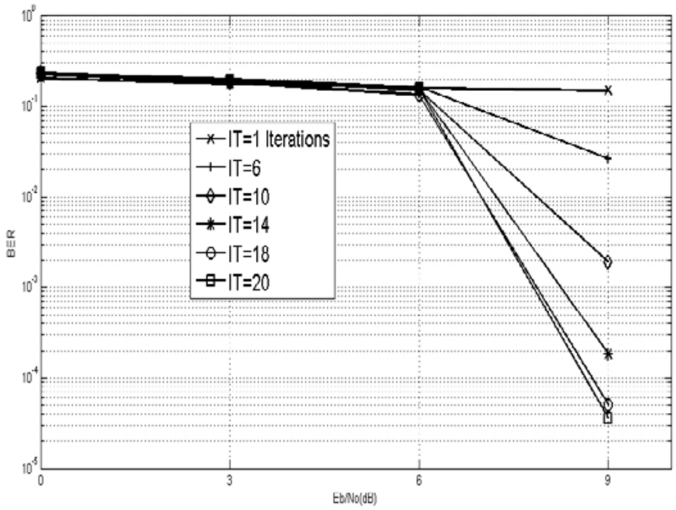

Fig.8. Convergence property of the OWDM-IDMA system in AWGN with K=20, S=16, and Ninfo=3072.

Fig.8 illustrates the convergence property of the above OWDM-IDMA system in AWGN channel, with *K=20* and *S=16*. It can be seen that convergence is generally achieved within fourteen iterations.

As a performance measure for the proposed technique, we use the complementary cumulative distribution function (CCDF) of the PAPR, which is defined as:

$$CCDF(PAPR_0) = Prob[PAPR > PAPR_0] \quad (6)$$

Where $PAPR_0$ is the given threshold.

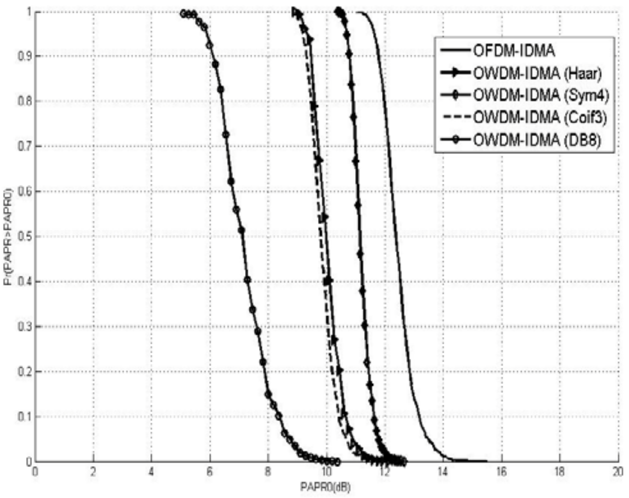

Fig.9. PAPR comparison of OFDM-IDMA Vs. OWDM-IDMA.

Performances of the proposed system are compared to OFDM-IDMA system with 4-QAM symbols modulated on $M = 128$ subcarriers as shown in Fig.9 depict the CCDF of the proposed technique for Haar, Coifelet, Daubechies and Symlet wavelets. It is shown that the OFDM-IDMA signal has a PAPR which exceeds $12.4dB$ for less than 0.4 probability; in contrast to $10dB$ in the proposed technique using Haar wavelets for the same probability, $9.8dB$ when 3[th] Coiflet wavelets is used, $11.3dB$ when 4[th] Symlet wavelet is used and $7.5dB$ when 8[th] Daubechies wavelet is used [20].

A $4.9dB$ reduction is reached with the 8[th] Daubechies wavelet; this result is very interesting but, the complexity of this system is higher than the complexity of OFDM-IDMA modulation. This is due to the fact that OFDM-IDMA signal can be represented by a sum of multiple subcarriers waves. Therefore, it presents very high values of the peak to average power ratio. Consequently, the OFDM-IDMA system becomes very sensitive to the nonlinearity of the of the high power amplifier, which is required in order to spread the signal over the channel. Furthermore, the performance of PAPR reduction increases as the wavelet order increases. This is due to the fact that the higher the order of the wavelet, it becomes more dispersed temporarily and more fluctuated. We can conclude that the PAPR reduction capability depend on the choice of the wavelet.

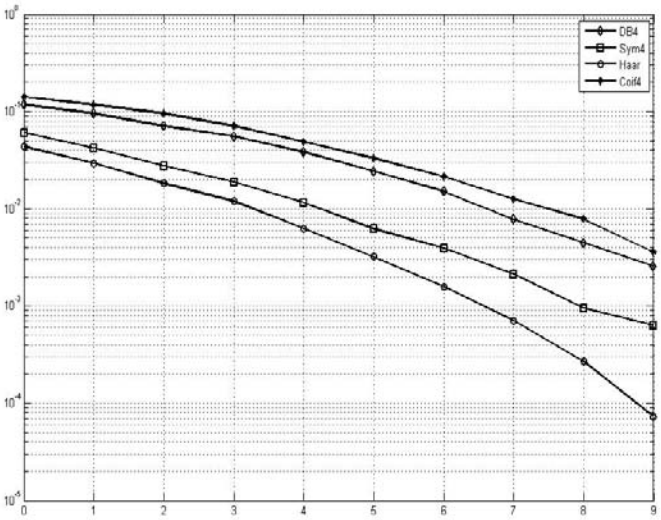

Fig.10. BER performance of OWDM-IDMA system with different wavelets in AWGN with *K=4*.

Fig.10 depicts the BER performance of OWDM-IDMA system with different wavelets. The simulation results show that the BER of Haar wavelet is noticeably better than the other wavelets and BER values still decrease with the increasing of SNR. For the other three wavelets, Db4 and Sym4 have the same support length but shorter than Coif4, therefore their performance are better than Coif4. SymN wavelet has a good symmetry which helps it get better performance than DbN wavelet.

Fig.11 shows the performance of the above system with Haar wavelets in AWGN multipath channels with different tap numbers. $K = 4,\ N = 3072$ bits and $h = [0.407, 0.815, 0.407]$ [21]. The Zero Forcing equalizer is used. The Zero-Forcing Equalizer applies the inverse of the channel to the received signal, to restore the signal before the channel [21]. We can see that performance improves uniformly with increasing tap number due to improved diversity.

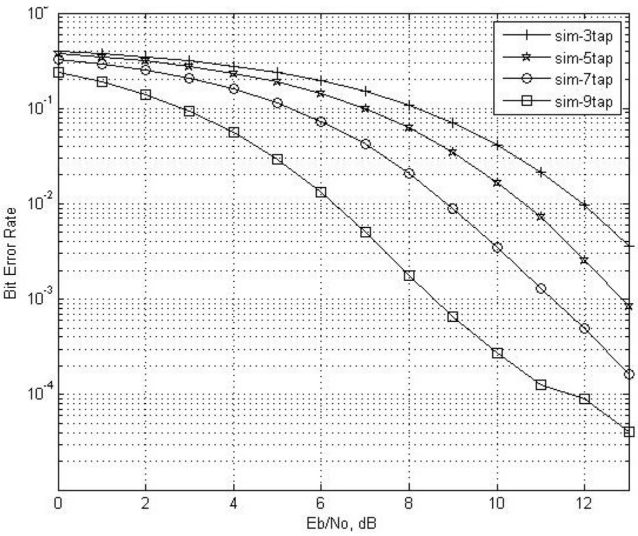

Fig.11. Performance of OWDM-IDMA system in AWGN multipath channels.

VI. CONCLUSION

In this paper, we have outlined the basic principles of OWDM-IDMA technique as a promising multiple access modulation for wireless networks. The proposed technique is compared to OFDM-IDMA modulation and achieves a significant reduction of PAPR value for a low number of channels. Among advantages of OWDM-IDMA system, the most important are:

- Use of different family of pulses that have both wide time and frequency support.
- The pulses are broad-time, since their time support is long.
- High bandwidth efficiency [5].

In addition, the filter type can be dynamically chosen. It includes low-cost MUD for systems with large numbers of users, robustness and diversity in multipath environment. The OWDM-IDMA appears to be a competitive candidate for future wireless communication systems. We expect that the basic principles can be extended to other applications.

REFERENCES

[1] Li Ping, L. Liu, K. Y. Wu, and W. K. Leung, ”Approaching the capacity of multiple access channels using interleaved low-rate codes,” IEEE Comm. Lett., vol. 8, pp. 4-6, Jan. 2004.

[2] Li Ping, L. Liu, K. Y, Wu, and W. K. Leung, ”On interleave-division multiple-Access,” in Proc ICC’2004. Paris, France, 2004.

[3] L. H. Liu, J. Tong, and Li Ping, ”Analysis and optimization of CDMA systems with chip- level interleavers,” IEEE J. Select. Areas Commun., vol. 24, no. 1, pp. 141-150, Jan. 2006.

[4] Li Ping, L. Liu, K. Y. Wu, and W. K. Leung, ”Interleave-division multiple-access,” IEEE Trans. Wireless Commun. Vol. 4, pp. 938-947, Apr. 2006.

[5] Li Ping, Q. Guo, and J. Tong, ”The OFDM-IDMA approach to wireless communication systems,” IEEE Wireless Communications ,June 2007.

[6] J. Armstrong . Peak-to-average power reduction for OFDM by repeated clipping and frequency domain filtering. Electronic Letters; 38(5):246247. 2002.

[7] Li Ping, L. Liu, K. Y. Wu, and W. K. Leung, ”A unified approach to multi-user detection and spacetime coding with low complexity and nearly optimal performance,” in Proc. 40th Allerton Conference, Allerton House, USA, pp.170-179, Oct. 2002.

[8] X. Liu, X. Xiong, P. Yang ”Modeling and Simulation for IDMA Systems Based on Simulink”, Pacific-Asia Conference on Circuits,Communications and System, 2009.

[9] G.Strang, and T. Nguyen, Wavelet and Filter Banks, Wellesley, Cambridge, 1997.

[10] Alan R. Lindsey. Wavelet Packet Modulation for Or- thogonally Multiplexed Communication. IEEE Transactions on signal processing, mai 1997.

[11] M. Gauttier and J. Lienard, ”Application of Wavelet Packet based Multicarrier Modulation to wireless Transmissions”, ANN.Tlcommun, 62, n 7-8 2007.

[12] Y. T. Chan, ”Wavelet Basics”, Kluwer Academic Publishers, ISBN 0-7923-9536-0.

[13] A. ROUIJEL, B. NSIRI, A. FAQIHI, D. ABOUTAJDINE,”A new approach for wireless communication systems based on idma technique ” ISIVC’2010 , 30-2 Oct 2010 , Rabat MAROC.

[14] Li Ping, K. Y. Wu, L. Liu et W. K. Leung, .A simple, unified approach to nearly optimal multiuser detection and space-time coding, Information Theory Workshop, ITW’02, (pp. 53-56),Inde, Oct. 2002.

[15] I. Mahafeno, C. Langlais, and C. Jego, ”OFDM-IDMA Versus IDMA with ISI Cancellation for Quasi-Static Rayleigh Fading Multipath Channels,” Proc. 4th Int’l.Symp. Turbo Codes and Related Topics, Munich, Germany, Apr. 3-7, 2006.

[16] S. Chang, M. Lee and J. Park, ”A high speed VLSI architecture of discrete wavelet transform for MPEG-4”, IEEE Transactions on Consumer Electronics, Volume 43, Issue 3, pp.623 - 627, Aug 1997.

[17] S. Merchan, A. G. Armada, and J. L. Garcia,”OFDM performance in amplifier nonlinearity,” IEEE Trans. Broadcast., vol. 44, pp. 106-1 14, Mar. 1998.

[18] S.L. Linfoot, M.K. Ibrahim, M.M. Al-Akaidi De Montfort Univ., Leicester, ”Orthogonal Wavelet Division Multiplex: An Alternative to OFDM”, IEEE Transactions on Consumer Electronics, Vol. 53, No. 2, MAY 2007.

[19] J. Tellado, Multicarrier modulation with low PAR: Applications to DSL and Wireless. Massachusetts, USA: Kluwer Academic Publishers, 2000.

[20] A. ROUIJEL, B. NSIRI, D. ABOUTAJDINE, ”Peak to Average Power Ratio Analysis for OWDM-IDMA system ” ICMCS’2011 , 7-9 Apr 2011 , Ouarzazate MAROC.

[21] G.L. Stber, Principles of Mobile Communication, 2nd edition, Kluwer. Academic Publishers, 2001.

Awatif Rouijel Received her master degree in computer science and telecommunication from University Mohammed V-Agdal, Rabat, Morocco, in 2009. She is currently pursuing the PhD at University Mohammed V-Agdal Rabat, LRIT laboratory, Rabat, Morocco. His research interests include signal processing, multi-user detection, code division multiple access (CDMA), interleave division multiple access (IDMA), orthogonal wavelength-division multiplexing (OWDM), orthogonal frequency division multiplexing (OFDM) and multi-carrier CDMA (MC-CDMA).

Benayad Nsiri received in 2000 his D.E.A (French equivalent of M.Sc. degree) in electronics from the Occidental Bretagne University in Brest, France; his Ph.D. degree from Telecom Bretagne in 2004. While in 2005, he received a MBI degree in computer sciences from Telecom Bretagne, and in 2010 he received HDR degree from Hassan II University, Casablanca, Morocco. Currently, he is a Professor in Ain chock faculty of sciences, Hassan II University at Casablanca, Morocco; a member associate in LPMMAT laboratory, Hassan II University and a member associate in Lab-STICC laboratory at Telecom Bretagne, Brest, France. His research interests include but not restricted to communication, signal and image processing, adaptive techniques, blind deconvolution, MCMC methods, seismic data and higher order statistics.

Driss Aboutajdine Received the Doctorat de 3rd Cycle and the Doctorat d'Etat-es-Sciences degrees in signal Processing from the Mohammed V-Agdal University, Rabat, Morocco, in 1980 and 1985 respectively. He joined Mohammed V-Agdal University, Rabat, Morocco in 1978, first as an assistant professor, then as an associate professor in 1985 and since 1990, he is professor with the Faculté des Sciences. Heading the GSCM-LRIT lab. Since November 2001 he is the national coordinator of a National Information Technology network of excellence. On May 2006 and November 2007, he was elected respectively Fellow member of the Moroccan Academy Hassan II of sciences and technology and the Third World Academy of Sciences TWAS. Professor Aboutajdine has advised and co-advised more than 50 PhD theses, contributed to more than 200 articles in regional and international conferences and journals and given several invited conferences in different conferences and workshops in Canada, Spain, France, Senegal and Tunisia. He has contributed as Guest editor of special issues of international Pattern recognition Journal and Revue Calculateurs parallels. He is also member of the editorial board of many international journals such as Traitement du Signal, International Journal of Image/Video Processing .The official Journal of ISESCO centre for promotion of scientific research and International Journal of Information Science and Technology. He organized the international symposium ISIVC2000 in Rabat and ISCCSP2006 in Marrakech, Morocco, co-organized ICISP'01 in Agadir Morocco ISIVC2004 in Brest France, ISIVC2006 in Tunisia and ISIVC2008 in Bilbao, Spain. Since October 1999 he is IEEE Senior Member. His research interests include statistical and adaptive signal and image processing, pattern recognition and their applications.