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An Optimize Scheme for Resource Management in WiMAX Network

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Abstract- Interest in broadband wireless access (BWA) has been growing due to increased user mobility and the need for data access at all times. A technology, based on IEEE 802.16 standards, is known as WiMAX (Worldwide Interoperability for Microwave Access) promise to provide best quality of services (QoSs) with minimum utilization of available resources [4] [6]. The problem of assuring QoS is basically that of how to allocate available resources among users in order to meet the QoS criteria such as delay, delay jitter etc. This paper proposes an algorithm for scheduling the users on the basis of channel condition to maximize the throughput, to assure QoS guarantees and to maximize channel capacity in WiMAX network. And then performance analysis of the WiMAX network is done on the basis of simulation results.

Keywords- WiMax, Resource allocation, OFDM, Quality of Service (QoS), IEEE 802.16

1. INTRODUCTION

Wireless networks are gaining popularity to its peak today, as the user's wants wireless connectivity irrespective of their geographic position. Wireless communication systems had been facing high level of ISI which originates from multipath propagation and inherent channel delay spread. WiMAX networks, based on IEEE 802.16 [7] [8] has gained much attention recently for its capability to support high transmission rates, low latency, minimum delay and real time applications; in short highly demanding QoSs for various applications on a metropolitan scale. WiMAX technology is designed to accommodate both fixed and mobile broadband applications. WiMAX networks defines two important layers: **1)** Physical Layer **2)** Media Access Control (MAC) Layer. The purpose of the PHY layer [3], which is based on orthogonal frequency division multiplexing (OFDM) [5], is to reliably deliver information bits from the transmitter to the receiver, using the physical medium. The MAC (Media Access Control) layer of IEEE802.16

resides above the PHY layer and responsible for allocating resources for SSs (subscriber stations) and provide security and key management.

OFDM is a multicarrier modulation technique that has recently found wide adoption in a wide-spread variety of high-data-rate communication systems like WiMAX systems. A high-data-rate system will generally have $\tau \geq Ts$, where Ts is symbol duration and τ is channel delay spread and the inter symbol interference (ISI) becomes very severe in WiMAX systems etc. Multicarrier modulation divides the wideband or high data rate incoming data stream into parallel L narrowband or lower data rate sub-streams, *each* of which has $Ts/L >> \tau$ and these sub-carriers or tones become effectively ISI free. Then each of which is then transmitted over a different orthogonal-frequency sub-channel.

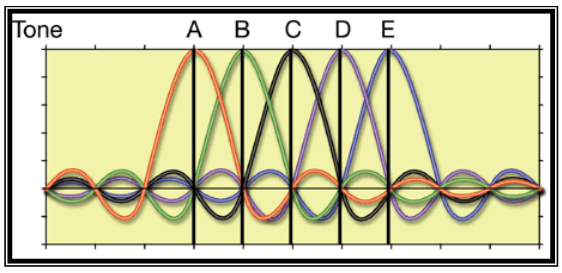

Figure 1: OFDM Signal showing orthogonal Carriers

Similarly in OFDM carriers are appropriately spaced to insure orthogonality and therefore it is an elegant and efficient scheme for high data rate transmission in a non-line-of-sight or multipath radio environment to overcome inter symbol interference (ISI). Also OFDM is spectrally efficient i.e. OFDM saves the half of bandwidth used in FDM.

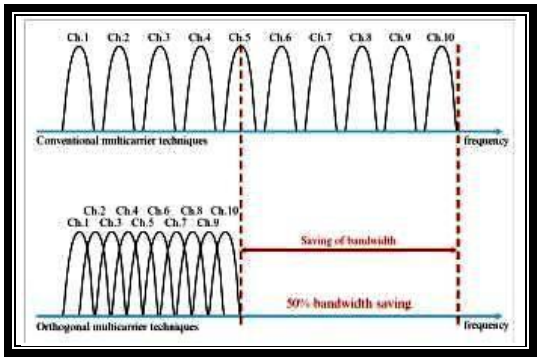

Figure 2: FDM Vs OFDM

In WIMAX five types of services are defined by IEEE 802.16 standard to support different types of QoS services [3]. They are Unsolicited Grant Service (UGS), Real-Time Polling Service (rtPS), Extended rtPS (ertPS), Non-Real-Time Polling Service (nrtPS), and Best Effort (BE).

2. PROBLEM FORMULTION

Wireless bandwidth is a scarce resource that needs to be used efficiently. There is an intense need for power optimization in wireless network. Though a lot of work has been done, there still remains a scope for improvement in wireless channel. In this paper we propose an algorithm, is called Water Filling Algorithm [2], which maximize the capacity of frequency selective channel. An important principle of WiMAX is that it is connection oriented. This means that a subscriber station (SS) must register to the base station (BS) before it can send or receive data. In this paper

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also an OFDM signal is generated for the communication.

3. GENERATION AND RECEPTION OF OFDM SIGNAL

As we all know basic communication system consist of three main components:

a. **Transmitter:** Transmitter is the device that is used for transmission of desired information to specified channel.
b. **Channel:** Channel is the interface (Wired or Wireless) between transmitter and receiver over which information is transmitted.
c. **Receiver:** Receiver is last component of any communication system. It receives the information that has transmitted by the transmitter from the specified channel.

In the Figure 3 OFDM communication system is shown:

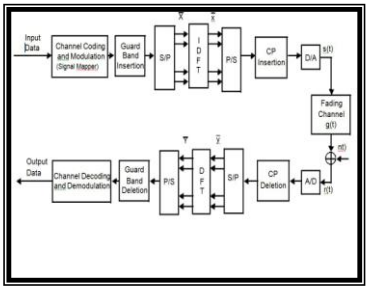

Figure 3: OFDM Communication System

Important Points:

We have used MATLAB tool to generate and receive the OFDM signal. Here we have used following parameters to perform simulation. Total no. sub-channels =64, Bits per symbols=52 and length of CP= 16. The snap shot of simulation result is shown below:

Modulation: Here we have used BPSK digital modulation. Digital modulation [1] is the scheme that transfers base band digital information (stream of bits) over an analog band pass channel.

Channel Coding: In communication systems channel coding [2] is used to detect and/or correct the errors.

Guard band: This ensure that transmissions of distinct information signals do not interfere with one another. Guard band are used to provide immunity to propagation delays and echoes.

IFFT/FFT: We know analysis of any signal is easy in time domain compare to frequency domain. So IFFT technique is used to convert the frequency domain signal into time domain signal. FFT performs its opposite operation i.e. time domain to frequency domain.

Cyclic Prefix: The cyclic prefix [13] is a repeat of the end of the symbol at the beginning. Cyclic prefix is used to allow multipath to settle before desired information arrives at the receiver thus provide robustness to multipath.

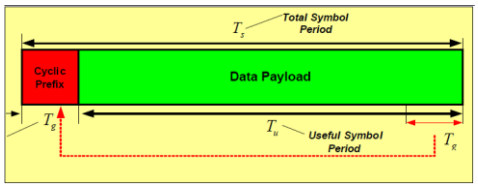

Figure 4: Addition of Cyclic Prefix

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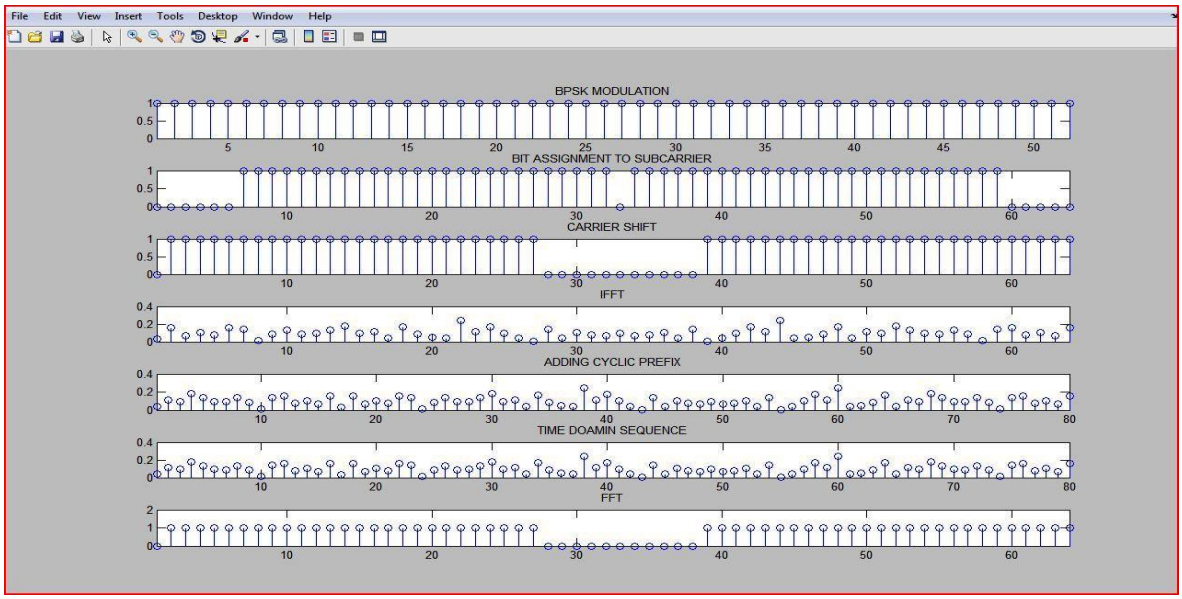
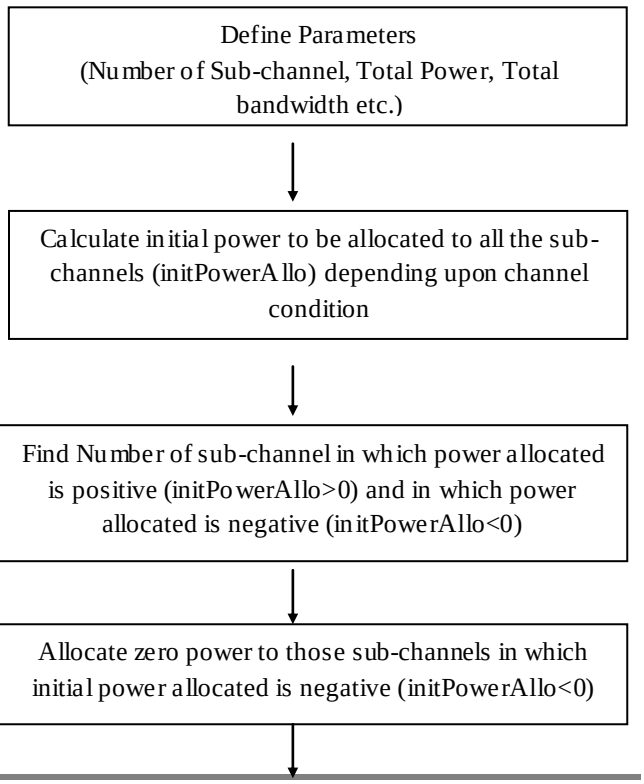


Figure 5: ODFM Signal Generation and Reception

4. PROPOSED ALGORITHM

Since OFDM modulation divides the total bandwidth into number of sub-channels. The large number of sub-channels experience frequency selective fading or distortion if the proper cyclic prefix is not added to the beginning of each OFDM symbol. Therefore capacity of the channel is degraded. The resource allocation should be based on the channel conditions in order to maximize the through-put. WiMAX system uses Multi-user diversity and adaptive Modulation to know the status of the channel. To maximize the capacity of a frequency selective channel, the water-filling algorithm is used. In this algorithm resource (Transmitter Power) allocation is done on the basis of channel state or condition. The water filling algorithm assigns more power to sub-channels which experience good condition and may assign no power to bad conditioned sub-channels (sub-channels with deep fading).

Algorithm Flow Chart:



Thus capacity of channel is improved. Here we are giving flow chart for the proposed Water Filling Algorithm (WFA).

Calcualte new power to be allocated to those sub-channels for which initPowerAllo>0
And calculate the capacity

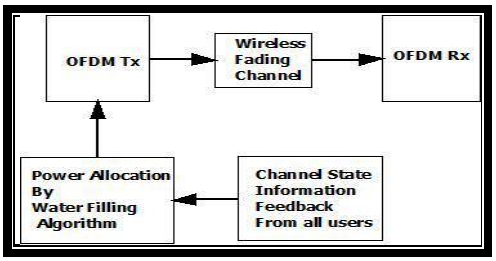


Figure 6: Working Operation of WFA

5. SIMULATION RESULTS

Result 1:

Here we have assumed a channel of fixed noise power. Resources are allocated to sub-channels according to Channel SNR. We have performed the simulation with 8 sub-channels and total transmitted power of 10 watts. The output of simulation is shown below:

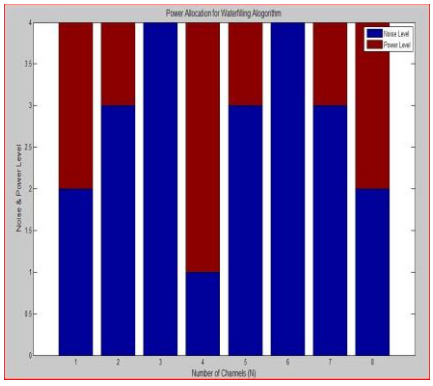


Figure 7: WFA for fixed noise power channels

Result 2:

In this simulation power is allocated to sub-channels with random behaviour of the Rayleigh fading channel. The simulation parameters are given as:

Serial No.	Name Of the Parameter	Value of the Parameter	
1	Number of Sub-channel	64	64
2	Total Power	10	10
3	Total Bandwidth	10	10
4	Noise Density	1	1

Power is allocated to only those sub-channels for which initial power allocation is positive and sub-channels with negative power are eliminated without allocating any power. From the simulation results we see that entering the same value of the above parameters we get different Shannon channel capacity 20.3616 and 21.0495 in both the cases. It is due to random nature of channel. And power is allocated according to channel SNR. The snap shots for both the cases are shown in Figure 7 and Figure 8 respectively:

We can see both the simulation graphs are different for the same value of the parameters it is due random nature of channel.

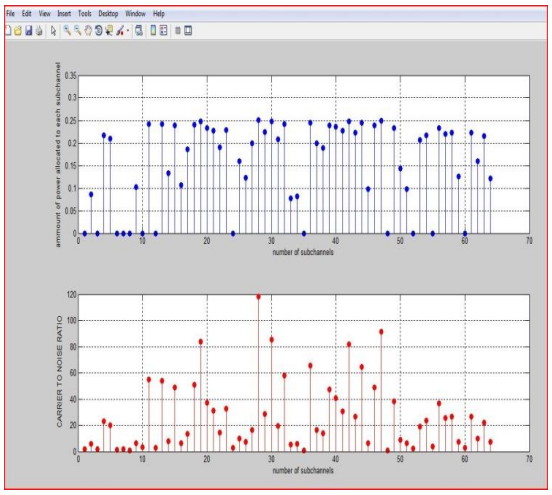


Figure 7: Power Allocation for 64 sub-channels

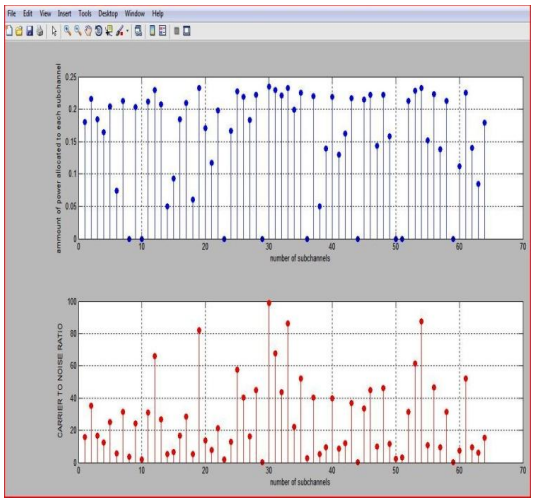


Figure 8: Power Allocation for 64 sub-channels

6. CONCLUSION N AND FUTURE SCOPE

Since WiMAX Network is based on OFDM. Therefore we have generated the OFDM signal then received it. As we all know the real time Quality of services (QoS) to the respective users can not be asserted unless the limited system resource transmitter power are intelligently used and properly optimized. In this paper we have proposed a WFA approach to optimize the power of the transmitter in frequency selective channel. This scheduling scheme is based on channel awareness for making the decision about power allocation to improve the throughput.

Optimization for WiMAX scheduler is still an on-going research topic. There are several research area to work in, for example, polling mechanism, back off optimization, overhead optimization and so on.

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