Optimize Transmission of 2D Data over Integrated Mobile WiMAX and WiLAN Network

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Abstract

The problem of multiuser downlink resource allocation in Mobile WiMAX system was studied. Three different network scenarios considered for the transmission of image data. Resource allocation done using Active Set Optimization and Genetic Algorithm for all the three network scenarios. Simulation results show that information fed back and association among subcarriers play vital role to improve system performance. As compared to reduced complexity resource allocation Active Set Optimization and Genetic Algorithm seems especially attractive as the number of users increases for Image Data. It is observed through simulation that the System using Genetic Algorithm performs better than Active Set, Linear Resource Allocation in terms of significantly decreasing the computational complexity and achieve higher capacities, while being applicable to a more general class of systems. As Genetic Algorithm follows constraints of stochastic processes it didn't give results highest in all Experiment Conducted. It is also observed that for Integer-Binary Objective function Performance of Genetic Algorithm is not that much satisfied because of its stochastic processing. Also processing time required to reach final optimize variables values is too much.

INTRODUCTION

The problem of multiuser downlink resource allocation in Mobile WiMAX system was studied in last semester. Simulation results showed that information fed back and association among subcarriers play vital role to improve system performance[1]. As compared to reduced complexity resource allocation Active Set Optimization and Genetic Algorithm seems especially attractive as the number of users increases[2]. It is observed through simulation that the System using Genetic Algorithm performs better than Active Set, Linear Resource Allocation and Root Finding in terms of significantly decreasing the computational complexity and achieve higher capacities, while being applicable to a more general class of systems. As Genetic Algorithm follows constraints of stochastic processes it didn't give results highest in all Experiment Conducted. It is also observed that for Integer-Binary Objective function Performance of Genetic Algorithm is not that much satisfied because of its stochastic processing. Also processing time required to reach final optimize variables values is too much[3].

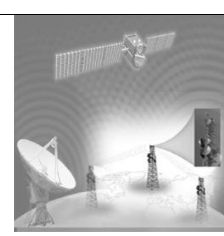
As in WiMAX latency period is too important because Base Station have to allot the resources in short span of time to its active users, GA fails to reach Optimize variables value within that period and took too much time. So we came to the conclusion that for such type of Networks Active-Set Optimization is best suited instead of Genetic Algorithm though the fitness functions value is greater than the results obtained by Active-Set Optimization Technique[4].

BITMAP PACKET FORMATIONS

Step 1:

Table-I *Image Properties*

Sr.No.	Attribute	Value
1	File Name	Antenna256.bmp
2	Mode	Grayscale
3	Resolution / size (Pixel)	256 X 256
4	Depth	8 Bit
6	Compression	RLE



Example: Input Image with 256 X 256 size used for Transmission using 100 Subcarriers with 64 QAM symbol size is 8 Bits hence (256*256=65536) symbols required to transmit our Image.

Total Number of Symbols for Total 100 Subcarriers = $\frac{65536}{100} = 655.36$

Total Number of Frames required to transmit 656 Symbol Data = $\frac{655.36}{48} = 13.65$

Hence 13.65≈ 14 Frames required to Transmit above mentioned Image. If channel is good then time required to Transmit above

Image for our Experiment is:

64KB=256*256*8bits=524288Bits = 14 * 5ms = 70 ms

524288 Bits transmitted in 70ms hence within 1 Sec we can transmit 7489828.5 Bits per with Bandwidth Requirement is = 100(Subcarriers) * 10.94KHz (subcarriers Spacing) =1094KHz=1.094MHz.

Means,

Table II *Data Rate For 3 Modulation Schemes*

Time Required to transmit	**No. of Frames Required**	**Bandwidth**	**Transmitted Bits**	**Transmitted Bits (KB)**
1Sec	14	1.094MHz	7489828.5	914.2857KB=>9.14MB
Capacity for(64QAM)	**6.84 Bits/Sec/Hz**			
QPSK	55	1.094MHz	1906501.8	232.7KB
Capacity	**1.74 Bits/Sec/Hz**			
16QAM	28	1.094MHz	3744914.2	457.14KB
Capacity	**3.423 Bits/Sec/Hz**			

For simplicity we consider 8 x 8 Image, after reading image file we get above Matrix in MATLAB with ascii values in between 0 to 255. E.g. 144 Represents value of first pixels value of Inputted Image

Step 2: Sample Image Matrix

144	154	160	164	159	159	153	150
182	189	193	196	194	193	183	181
216	222	226	231	113	222	213	200
139	111	125	122	109	83	69	48
16	57	71	116	119	111	15	54
38	71	37	90	96	86	92	51
40	36	11	49	41	44	4	60
26	3	28	27	27	57	2	10

Step 3: Convert Base for QPSK

For QPSK we have to change its base from 8 bit to 2 bits per symbol after changing Base of Inputted Image we can calculate following Matrix for 1st row only:

144	**154**	**160**	**164**	**159**	**159**	**153**	**150**
0	**2**	0	0	3	3	1	2
0	**2**	0	1	3	3	2	1
1	**1**	2	2	1	1	1	1
2	**2**	2	2	2	2	2	2

Step 4: Data Mapping (Data on 100 Subcarriers)

Sub Carrier number→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
	0	0	1	2	2	2	1	2	0	0	2	2	0	1	2	2	3	3
	3	3	2	1	1	3	3	1	2	2	3	1	1	3	2	1	3	0
	3	2	0	0	1	0	3	0	1	2	2	0	0	3	2	0	0	1

Step 5: DPSK data Table

2	1	4	2	4	1	1	1	1	1	4	4	1	4	4	2	3	4	2	1	2	1	2	3	2
2	1	1	4	2	3	2	3	1	1	2	2	1	1	2	4	2	3	3	3	1	4	3	1	3
4	2	3	1	4	2	4	4	4	1	3	3	2	3	2	1	1	4	4	4	2	4	2	2	1

Step 6: Apply output from Step 5 to IFFT to achieve time domain wave

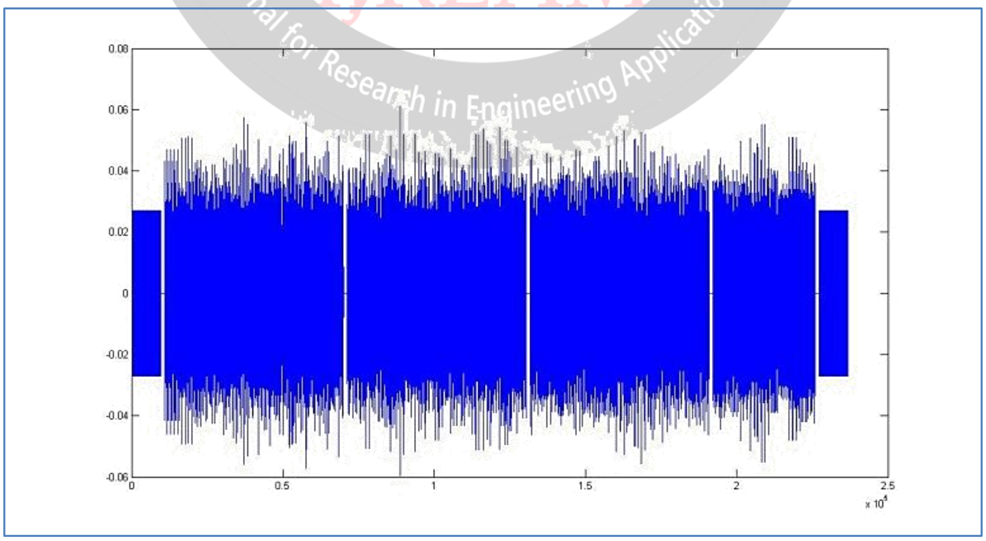


Figure.3Time domain representation of frame of 5 ms.

SIMULATION EXPERIMENT – I

Single User Scenario

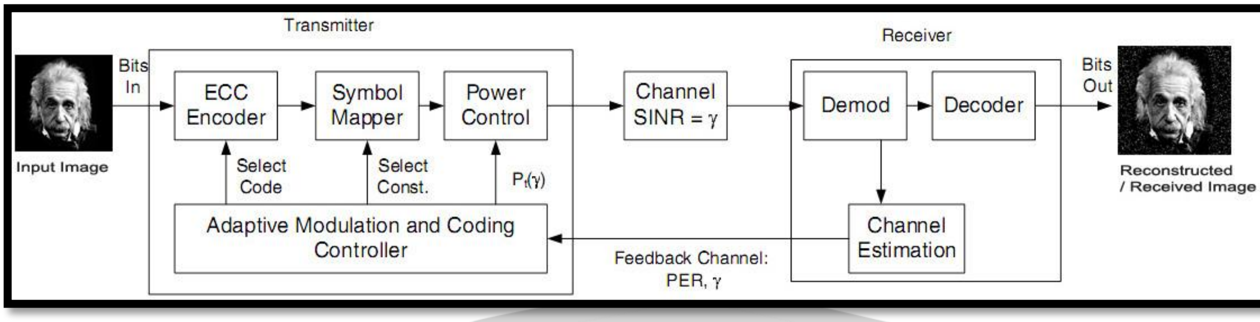


Figure.4Single user scenario

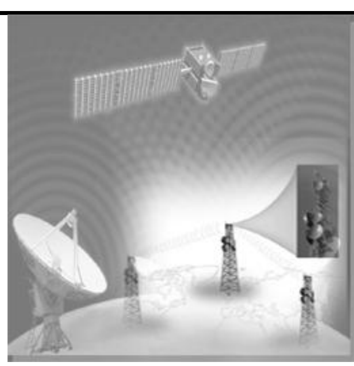
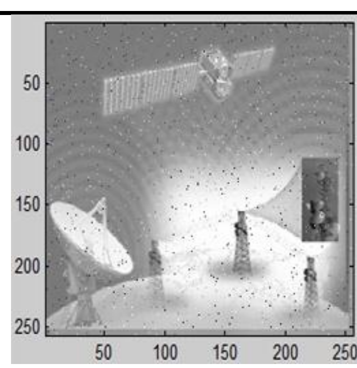
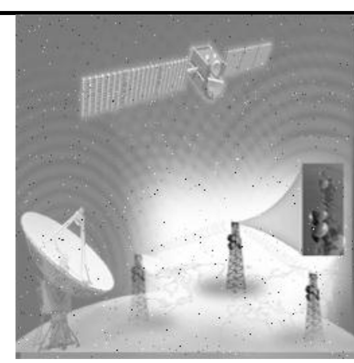
Aim:

1) Vary Image size by keeping SINR constant and Measure Quality of Received Image.
2) Change Modulation Scheme and Measure SNR.
3) Change Modulation Scheme for Appropriate SNR Range

A block diagram of system is given in Fig.4. For simplicity, we first consider a single-user system attempting to transmit as quickly as possible through a channel with a variable SINR—for example, due to fading. The goal of the transmitter is to transmit data from its queue as rapidly as possible, subject to the data being demodulated and decoded reliably at the receiver. Feedback is critical for adaptive modulation and coding[5]: The transmitter needs to know the "channel SINR γ, which is defined as the received SINR γr divided by the transmit power Pt, which itself is usually a function of. The received SINR is thus γr= γ. Pt.[6]

WiMAX systems use adaptive modulation and coding in order to take advantage of fluctuations in the channel. The basic idea is quite simple:[7] Transmit as high a data rate as possible when the channel is good, and transmit at a lower rate when the channel is poor, in order to avoid excessive dropped packets. Lower data rates are achieved by using a small constellation, such as QPSK, and low-rate error-correcting codes, such as rate convolutional or turbo codes. The higher data rates are achieved with large constellations, such as 64 QAM, and less robust error correcting codes; for example, rate convolutional, turbo, or LDPC codes. In all, 52 configurations of modulation order and coding types and rates are possible, although most implementations of WiMAX offer only a fraction of these. These configurations are referred to as burst profiles[8].

Following table shows Received Images for various SNR with QPSK modulation on 100 Subcarriers. As SNR increases Received Quality of Image improves. We found that above SNR=7 images received SNR reaches to Infinity.

		
Original Image	SNR =3	SNR= 4

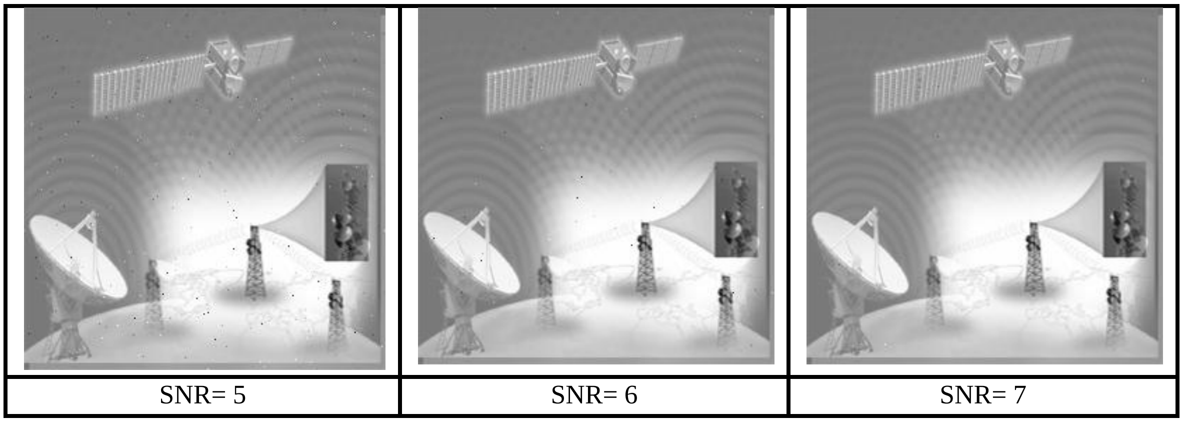


Figure.5 Using QPSK on 100 subcarriers for SNR>3 and SNR<7

Similarly we carried out same experiment for 16QAM modulation scheme for different SNR. Following table shows Image Quality for different SNR for the same parameters set as above.

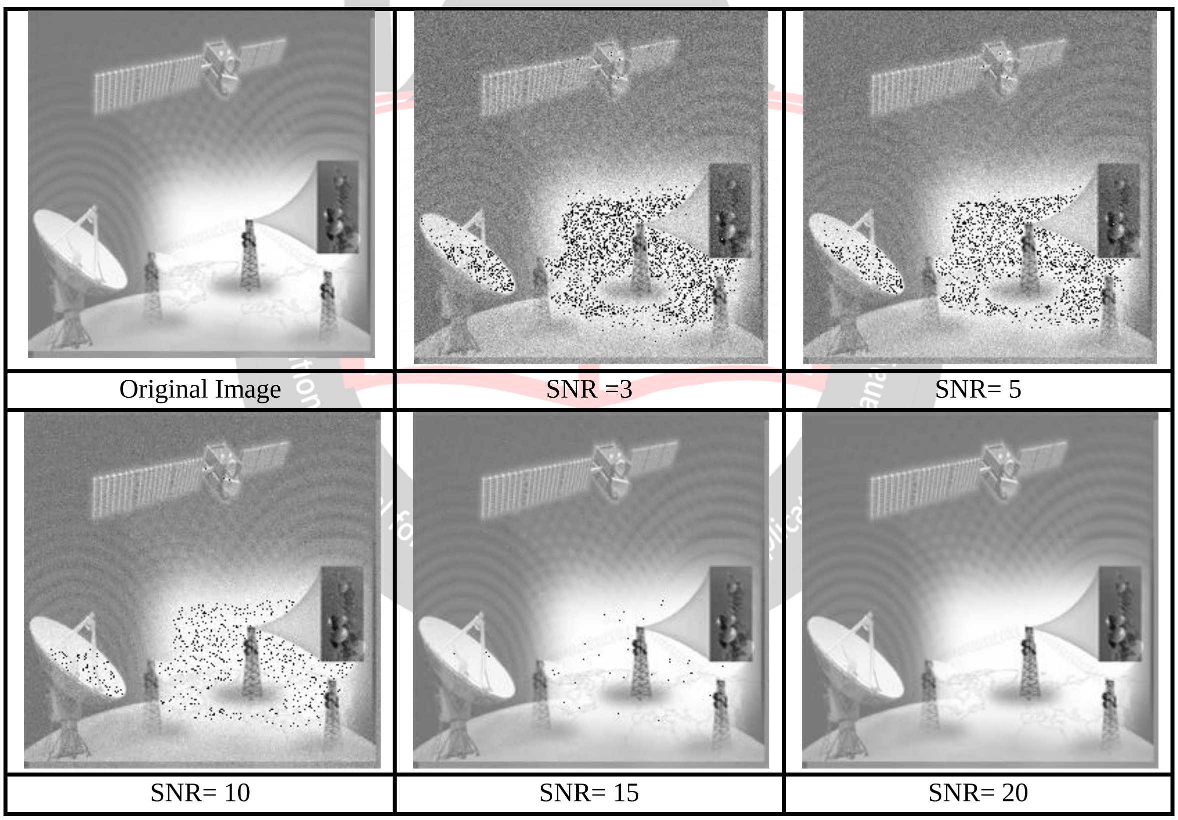


Figure.6 using 16 and 64 QAM on 100 subcarriers for SNR>3 and SNR<25

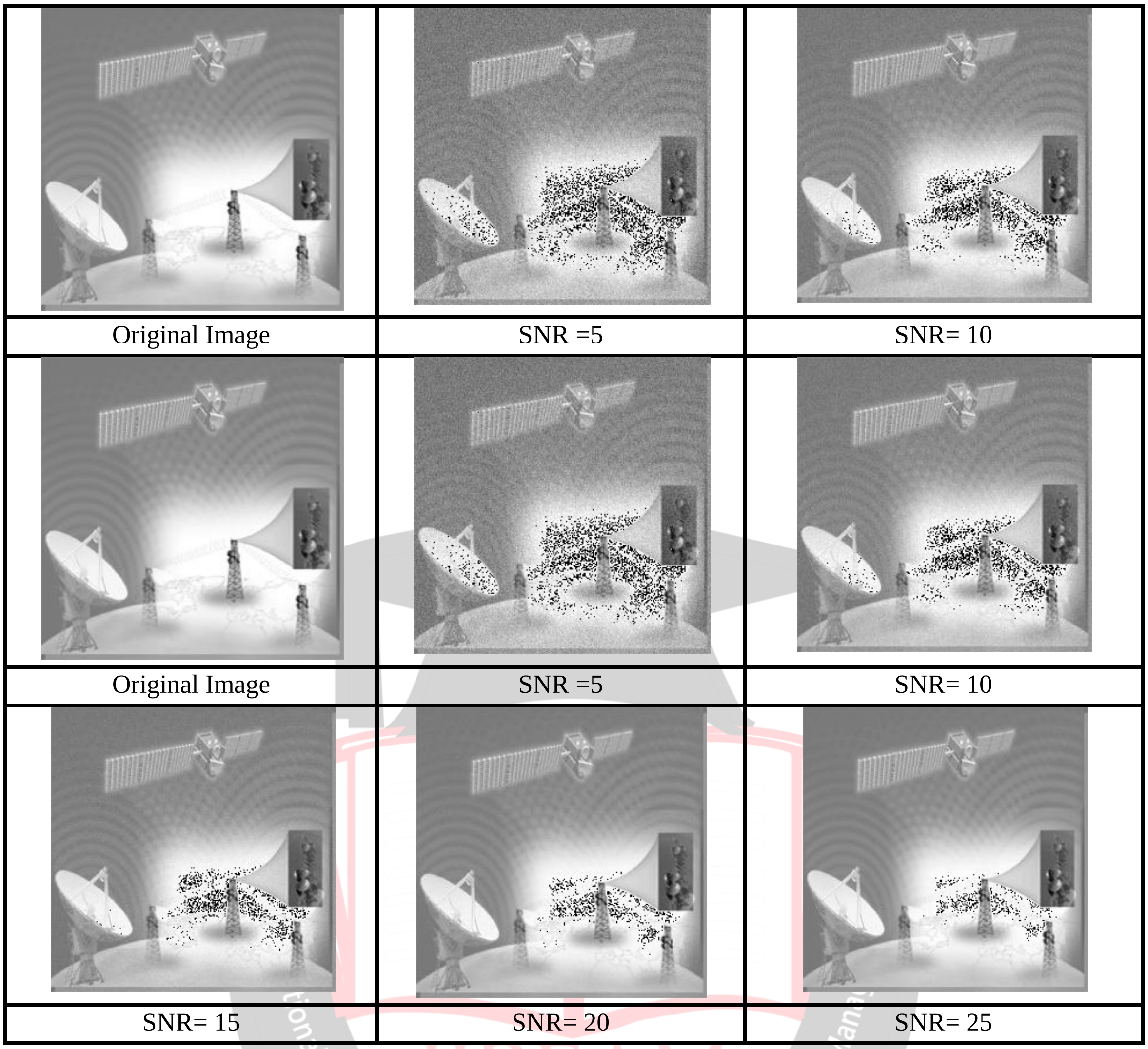


Figure.7 Using 16 and 64 QAM on 100 subcarriers for SNR>3 and SNR<25

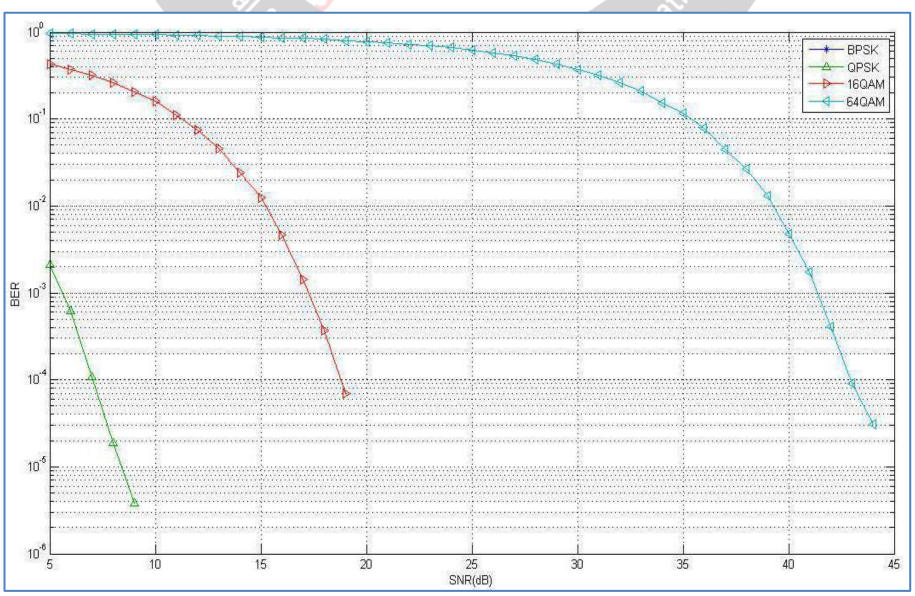


Figure. 8. BER versus SNR for various modulation schemes

CONCLUSION AND FUTURE PLANNING

The problem of multiuser downlink resource allocation in Mobile WiMAX system was studied. Simulation results show that information fed back and association among subcarriers play vital role to improve system performance. As compared to reduced complexity resource allocation Active Set Optimization and Genetic Algorithm seems especially attractive as the number of users increases for Image Data. It is observed through simulation that the System using Genetic Algorithm performs better than Active Set, Linear Resource Allocation in terms of significantly decreasing the computational complexity and achieve higher capacities, while being applicable to a more general class of systems. As Genetic Algorithm follows constraints of stochastic processes it didn't give results highest in all Experiment Conducted. It is also observed that for Integer-Binary Objective function Performance of Genetic Algorithm is not that much satisfied because of its stochastic processing. Also processing time required to reach final optimize variables values is too much.

As in WiMAX latency period is too important because Base Station have to allot the resources in short span of time to its active users, GA fails to reach Optimize variables value within that period and took too much time. It is also observed that as number of subcarriers increases beyond 72 Genetic Algorithm couldn't find unknown variables values. So we come to the conclusion that for such type of Networks Active-Set Optimization is best suited instead of Genetic Algorithm though the fitness functions value is greater than the results obtained by Active-Set Optimization Technique.

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