Analysis of M-Array QAM Technique Used For the Study of OFDM

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Abstract: In modern day technology, wireless communication network (4g) is chosen for multiple carriers under the modulation technique like orthogonal frequency division multiplexing that is a special case of multicarrier transmission. A single data stream is transmitted over large data rates with an optimum bit error rate, reduction of signal to noise ratio, placed orthogonal to each other under this modulation technique. In this paper with different array quadrature amplitude modulation (QAM) technique is implemented under the Matlab, Simulink with different output waveforms are recorded.

1. Introduction

In the market for several years wireless communications have been done rapidly developing for mobile phone technology. In an increase demand for WLAN, new methods of obtaining high capacity wireless networks are coming into picture. Most of the method used for WLAN under the maximum data rate of 11Mbps is currently implemented. [1] For OFDM based technology newer WLAN standards such as IEEE802.11a and HiperLan3 are currently used in the market under the range of data rate of 54 Mbps. In upcoming technology markets under WLAN day by day, data rate is mainly demanded under the data rate of 100 Mbps.[2] OFDM technique is so much efficient to fulfill the requirement of high data rate with maximum spectral efficiency. In OFDM technique, which is present, so much used under wireless as well as number of wired communication. To increase the signal robustness against narrow band interference, a single data stream is able to transmit under number of sub carriers under WLAN systems.[4] Digital transmission is growing up under the fast improvement of data rate transmission under OFDM technique into a new era for future engineers. In this paper the performance of QAM( quadrature amplitude modulation ) under different array scheme for frequency spectrum and signal to noise ratio under the mathematical coding of Matlab, Simulink[5]. In the given block diagram different blocks are represented under different mathematical formulation like FFT, IFFT , SNR and serial to parallel (MUX) and parallel to serial (DEMUX), clipping etc.

Fig.1 block diagram of OFDM with 512QAM technique.
In the above block diagram basically gives an idea about the signal is different modes like transmitter, receiver, channel etc.

2. Different Digital Modulation Techniques

In different digital modulation techniques are provided different part of knowledge regarding higher data security, information capacity, compatible with data service, etc. different techniques are compared given below as per their merits.

(i).Binary Amplitude Shift Keying (BASK). It is used to shift the carrier wave amplitude between two amplitude levels.

(ii).Binary Frequency shifts Keying (BFSK):it is related to shifts the carrier between two different frequencies that produce multiple sideband frequencies.

(iii). Binary Phase Shift Keying (BPSK): in this modulation shifts the sine carrier wave 180° for each change in binary state
Differential Phase Shift Keying (DPSK): in this type of modulation technique received bit phase is compared to the previous bit signal.

Quadrature Phase Shift Keying (QPSK): it is a popular variation of BPSK, the modulator produces two sine carriers apart at an angle of 90°. And also produces four unique sine signals shifted by 45° from one another.

M-Array Quadrature Amplitude Modulation (QAM): the technique of modulation is designed under the combination of amplitude and phase to carry the concept of transmitting more bits per symbol.

From all of these different techniques this paper has basically given analysis regarding QAM technique under different M-array of data bit rates and SNR (signal to noise ratio) under development of coding in the Matlab, Simulink.

3. M-Array Quadrature Amplitude Modulation For OFDM

The phenomenon of M-array quadrature amplitude modulation is the concept of transmitting more bits per symbol under the combination of amplitude and phase, in which 8QAM represents the transmit of 3 bits per symbol, similarly different range of bits per symbol like 16QAM, 64QAM, 256QAM, 512QAM etc. QAM has a quality of efficient spectrum, only difficulty face in case of demodulation in the state of presence of noise (SNR), signal to noise ratio. It is widely used in Wi-Fi, cellular telephone systems (4g) to produce a maximum data rate in limited bandwidth under OFDM.

In OFDM it is basically used to combine modulation and multiplexing to improve spectral efficiency. In this transmission channel is divided into many smaller channels or sub carriers due to which no guard bands are needed, helpful to avoid interfering with one another signal. Then, according to block diagram serial data is transmitted under parallel slower data rate, further these data are modulated under different digital modulation technique like BASK, BPSK, DPSK, 16QAM, 256QAM etc. so that mainly complex modulation is proceeding under different digital signal processing techniques like IFFT (inverse fast Fourier transform) generate the signal can be transmitted at transmitting channel. It is a mathematical discrete signal calculation part to avoid signal from noise.

Then the data will transmit from slower rate parallel path to serial like de-multiplexer after that different parts like noise under SNR (signal to noise ratio) to avoid from noise generated in the transmitted signal. Two different parts like multipath related to spectrum efficiency of signal, fading of signal to be avoided, loss of data transmitted. After that receiving channel which will also contain a DSP mathematical technique like FFT is helpful to recover signal at the received channel station. It is very spectral efficiency, which is depend upon the number of sub-carriers. The main coding of 512QAM for OFDM analysis under the Matlab, Simulink with recorded graph plots.

4. Simulation Results in MATLAB

The main objective of this paper is to implement the 512QAM modulation technique use for the study of OFDM under noise variation in the transmitted signal and received signal. In editor command of MATLAB coding of 512QAM for different parameter variations are calculated. The results are basically recorded under different data bit transmission with a variation of SNR (signal to noise ratio) in the graph plots. MATLAB code is written as,

```matlab
clc;
b= 512; % no. of bits process............%
d = randint(b,1); % random binary data...........................%
s = 16; % size of signal constellation.........................%
sbs = 312.5e6; % sub carrier spacing.................%
sf = 3.6e12; % carrier frequency.....................%
sp = 3.2e-6; % useful symbol period...............................%
il =0.8e-6; % useful interval length.........................%
tsd= (sp+il); %total symbol duration...........................
bs = log2(s); % no. of bits per symbol...................%
m = modulate(modem.qammod(s),dsysm); %modulate using QAM......................................%
figures;
```

In the code the variable `b` represents the number of bits, `d` represents the random binary data, `s` represents the size of the constellation, `sbs` represents the subcarrier spacing, `sf` represents the carrier frequency, `sp` represents the useful symbol period, `il` represents the useful interval length, `tsd` represents the total symbol duration, `bs` represents the number of bits per symbol, and `m` represents the modulated output using QAM. The code utilizes the `randint` function to generate random binary data and the `modulate` function to perform QAM modulation. The final result is displayed graphically.
The graph plots are recorded under different points for the data stream to be transmitted and received. The transmitted and received signal spectrum, OFDM spectrum, signal with noise and original message as well as recorded message in the received channel are given in fig2, fig3, fig4, fig5, fig 6 etc.

Fig2. OFDM signal transmitted for 512QAM.

Fig3. OFDM spectrum under 512QAM technique.

Fig4. OFDM received signal to noise with 512QAM technique.

Fig5. Recorded message received on received channel.
Fig 6. Original message received on receiving channel.

5. Table

<table>
<thead>
<tr>
<th>Sr.no.</th>
<th>M-array</th>
<th>SNR( signal to noise ratio)</th>
<th>Carrier frequency(cf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64 bits</td>
<td>4</td>
<td>3.6e3</td>
</tr>
<tr>
<td>2</td>
<td>128 bits</td>
<td>6</td>
<td>3.6e6</td>
</tr>
<tr>
<td>3</td>
<td>256 bits</td>
<td>8</td>
<td>3.6e9</td>
</tr>
<tr>
<td>4</td>
<td>512 bits</td>
<td>10</td>
<td>3.6e12</td>
</tr>
</tbody>
</table>

6. Conclusion

Thus the purpose of this MATLAB coding has achieved for 512QAM. It makes the study of OFDM processing under the 512QAM technique of variation on SNR( signal to noise ratio) very easy. By simply taking different values of SNR, we can easily observe the BER variation on a graph as compared to original and recorded message. If we can move in details of the FFT mathematical calculation, then just by changing the values of FFT points, we can easily observe the effect on OFDM received frame under 512QAM modulation technique for sub-carrier data transmitted. Such that some parameter variation gives the analysis of modern day OFDM technique with the combination of common modulation technique like M-array QAM(quadratre amplitude modulation).

7. References


