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Fading Techniques in Wireless Communication and their Appropriate Solution- A Review

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ABSTRACT

In this paper, fading models are considered. Fading is deviation of the attenuation of signal affecting certain parameters and various components. In this paper, I represent the disadvantages of fading.

Fading can cause poor performance in a communication system because it can result in a loss of signal power without reducing the power of the noise. This signal loss can be over all of the signal bandwidth. Furthermore this review paper also describes its appropriate solution OFDM that will reduce fading in some extent.

General Terms
SLM, PAPR, OFDM, MIMO, 4G, 5G, ISI

KEYWORDS: *FDMA, OFDM, SLM, PAPR, PTS, MIMO, ISI, BER*

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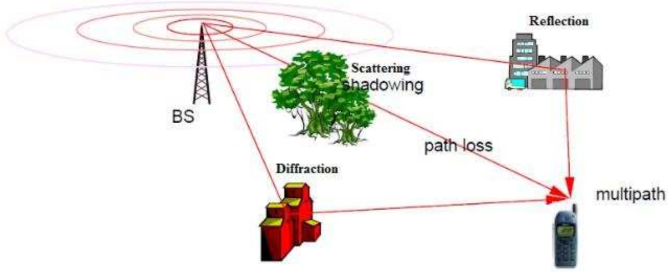
INTRODUCTION

Fading is the time variation of received signal power due to change in transmission medium or path known as fading. Fading depends on various factors as mentioned above. In fixed scenario, fading depends on atmospheric condition such as rainfall, lightning etc. In mobile scenario, fading depends on obstacles over the path which is varying with respect to time. These obstacles create complex transmission signal.



The figure -1 depicts amplitude chart for slow fading and fast fading types

TYPES OF FADING:

FAST FADING:

The phenomenon of fast fading is represented by rapid fluctuations of signal over small areas (i.e., Bandwidth). When the signal arrives from all the directions in the plane, fast fading will be observed for all directions of motion.

Fast fading occurs when channel implies response changes very rapidly within the symbol duration.

High Doppler spread

Symbol period > Coherence time

Signal variation < Channel variation

Fast fading is a result of reflections of local objects and motion of objects relative to those objects.

SLOW FADING:

Slow fading is the result of shadowing by buildings, hills, mountains and other objects over the path.

Low Doppler Spread
Symbol period << Coherence Time
Signal Variation >>Channel Variation

Slow fading results in a loss of SNR Error correction coding and receiver diversity techniques are used to overcome effects of slow fading.

Implementation of Fading models or fading distributions:
Implementations of fading models or fading distributions include Raleigh fading and Rican fading. These channel distributions or models are designed to incorporate fading in the baseband data signal as per fading profile requirements.

RAYLEIGH FADING:
In relay model, only non-Line of slight (NLOS) components simulated between transmitter and receiver.

MATLAB provides "Rayleigh Chan" function to simulate Rayleigh channel model.

The power is exponentially distributed.

The phase is uniformly distributed and independent from the amplitude. It is the most used type of fading in wireless communication.

RICIAN FADING:
In Ra model, both line of sight (LOS) and non-lines light (NLOS) components are simulated between transmitter and receiver.

MATLAB provide "Rican Chan" function to simulate Rican channel model.

FADING MITIGATION TECHNIQUES IN WIRELESS MOBILE COMMUNICATION SYSTEM:

INTRODUCTION
In wireless communication, multipath is the propagation phenomena that results in radio signals reaching the receiving antenna by two or more paths. The causes of Considered various channel related impairments and position of transmitter/receiver following are the types of fading in wireless communication system. Large scale fading, small scale fading and fading models. As we know, fading signals from ground and surrounding buildings as well as scattered signals from trees, people and towers present in the large area. There are two types of fading viz. large scale fading and slow scale fading.

LARGE SCALE FADING:
Large scale fading occurs when an obstacle comes in between transmitter and receiver. This interference types causes significant amount of signal strength reduction. This is because EM wave is shadowed or blocked by the obstacle. It is related to large fluctuations of the signal over distance.

SMALL SCALE FADING:
Small scale fading is concerned with rapid fluctuations of received signal strength over very short distance and short time period. Based on multipath delay spread there are two types of small scale fading viz. flat fading and frequency selective fading. These multipath fading types depend on propagation environment.

FLAT FADING:
The wireless channel is said to be flat fading if it has constant gain and linear phase response over a bandwidth of the transmitted signal.In these types of fading all the frequency components of received signal fluctuate in same proportions simultaneously. It is also known as non-selective fading.

Signal BW<< Channel BW

Symbol period >> Delay spread

The effect of flat fading is seen as decrease in SNR. This flat fading channel is also known as amplitude varying channels or narrowband channels.

FREQUENCY SELECTIVE FADING:
It affects different spectral components of a radio signal with different amplitudes. Hence the name selective is fading.

Signal BW > Channel BW

Symbol period < Delay Spread

Multipath includes atmospheric scattering, ionosphere reflection, reflection from water bodies and terrestrial objects such as mountains and buildings. Multipath radio signal propagation occurs on all terrestrial radio links. The radio signals not only travel by the direct line if sight (LOS) path, but as the transmitted signal does not leave the transmitted antenna in only the direction of receiver, but over a range of angles even when a directive antenna is used. Consequently, the transmitted signal spread out from transmitter and they will reach other object: hills, buildings, reflections surfaces such as the ground, water etc.

When the radio signals arrive at the receiver via variety of paths, the overall signal received is the sum of all the signals appearing at the antenna. Sometimes these signals may be phase with main signal and will add to it to increase its strength at other times, they will be out of phase with the main signal, therefore resulting in overall signal strength reduction.

Background information:
Multipath is the propagation phenomenon that results in radio signals reaching the receiving antenna by two

or more paths. Fading refers to the distortions that are carriers modulate telecommunication signal experiences over certain propagation media.

In wireless system, fading is due to multipath propagation and is sometime referred to as multipath include fading. Fading is term used to describe the fluctuation in a received signal as a result of multipath component. Several replicas of the signal arrive at the receiver, having traversed different propagation paths, adding constructively and destructively the fading can be defined as fast fading or slow fading. Additionally, fading can be defined as flat or frequency Selective fading

MULTIPATH EFFECTIVE FADING:

In principle, the following are the main multipath effects:

1. Rapid changes in signal strength over a small travel distance or time interval.
2. Random frequency modulation due to varying Doppler shifts on different multipath signals.
3. Time dispersion or echoes caused by multipath propagation delays.

The following physical factors influence small-scale fading in the radio propagation channel:

1. Multipath propagation – Multipath is the propagation phenomenon that results in radio signals reaching the receiving antenna by two or more paths. The effects of multipath include constructive and destructive interference, and phase shifting of the signal.
2. Speed of the mobile – The relative motion between the base station and the mobile results in random frequency modulation due to different doppler shifts on each of the multipath components.
3. Speed of surrounding objects – If objects in the radio channel are in motion, they induce a time varying Doppler shift on multipath components. If the surrounding objects move at a greater rate than the mobile, then this effect dominates fading.
4. Transmission Bandwidth of the signal – If the transmitted radio signal bandwidth is greater than the "bandwidth" of the multipath channel (quantified by coherence bandwidth), the received signal will be distorted.

Orthogonal Frequency Division Multiplexing:

Orthogonal frequency division multiplexing (OFDM) is the method of data transmission where a single information stream is split among several closely spaced narrowband sub channel frequencies instead of a signal wideband channel frequency and it is mostly used in wireless data transmission.

In a traditional single-channel modulation scheme, each data bit is sent serially or sequentially one after another. In OFDM, several bits can be sent in parallel, or at the same time, in separate sub stream channels. This enables each sub stream's data rate to be lower than would be required by a single stream of similar bandwidth. This makes the system less susceptible to interference and enables more efficient data bandwidth.fig1. Show an OFDM spectrum.

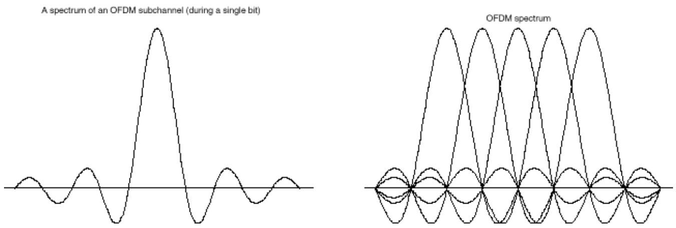
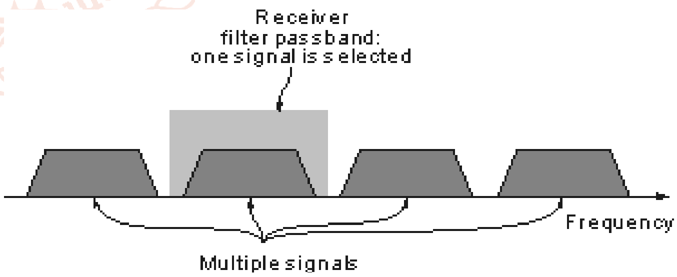


Fig. 1OFDM SPECTRUM

OFDM is a form of multicarrier modulation. An OFDM signal consists of a number of closely spaced modulated carriers. When modulation of any form – voice, data, etc. is applied to a carrier, then sidebands spread out either side. It is necessary for a receiver to be able to receive the whole signal to be able to successfully demodulate the data. As a result when signals are transmitted close to one

Another they must be spaced so that the receiver can separate them using a filter and there must be a guard band between them. This is not the case with OFDM. Although the sidebands from each carrier overlap, they can still be received without the interference that might be expected because they are orthogonal to each another. This is achieved by having the carrier spacing equal to the reciprocal of the symbol.

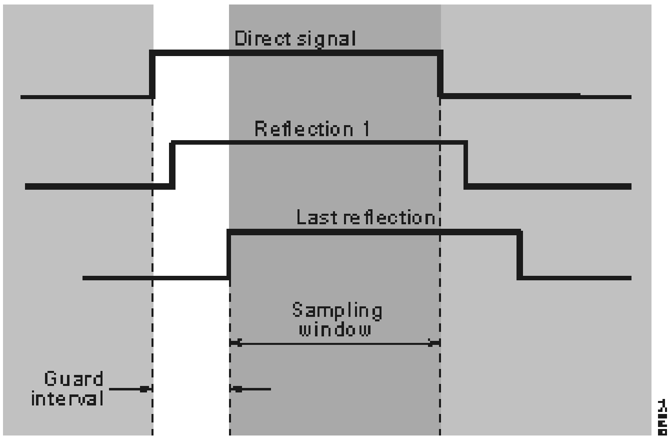


OFDM Signals

DATA ON OFDM:

The data to be transmitted on an OFDM signal is spread across the carriers of the signal, each carrier taking part of the payload. This reduces the data rate has the advantage that interference from reflections is much less critical.

This is achieved by adding a guard band time or guard interval into system. This ensure that the data is only sampled when the signal is stable and no new delayed signals arrive that would alter the timing and phase of the signal.



OFDM guard interval

The distribution of the data across a large number of carriers in the OFDM signal has some further advantages. Null caused by multipath effects or interference ones being many or all of the corrupted data to be done because the error correction code is transmitted in a different part of the signal.

Received correctly. By using error coding techniques, which does mean adding further data to the transmitted signal, it enables

ORTHOGONALITY:

In OFDM the sub-carrier frequencies are chosen so that the sub-carriers are orthogonal to each other, meaning that cross-talk between the sub-channels is eliminated and inter in OFDM spectrum, multiple closely spaced orthogonal subcarrier signals with overlapping spectra are transmitted to carry data in parallel this is greatly simplifies the design of both the transmitter and the receiver; unlike conventional FDM, a separate filter for each sub-channel is not required.

1. OFDM TRANSCEIVE EXPLANATION

OFDM is a Multi-Carrier Modulation (MCM) scheme, which uses closely spaced multiple subcarriers to transmit data. Data to be transmitted is split and transmitted using multiple subcarriers instead of using a single carrier. The key idea is instead of transmitting at a very high bit rate, the data is transmitted over multiple sub channels each carrying lower bit rates. To generate OFDM successfully their relationship between all the carriers must be carefully controlled to maintain the orthogonality of the carriers. For this reason, OFDM is generated by firstly choosing the spectrum required based on the input data, and modulation scheme used. Each carrier to be produced is assigned same data to transmit. The required amplitude and phase of them are calculated based on the modulation scheme. OFDM system involves mapping of symbols onto a set of orthogonal subcarriers that are multiples of the base frequency. This can be implemented in digital domain using Fast Fourier Transform (FFT) and Inverse Fast Fourier Transform (IFFT). These transforms are important from OFDM perspective as they can be viewed as mapping digital input data onto orthogonal subcarriers. The IFFT takes frequency-domain input data and converts it to the time-domain output data (analog OFDM symbol waveform). This waveform is transmitted by the OFDM transmitter. The receiver receives the waveform and uses FFT transform to convert the data back from time-domain into frequency domain to recover the data back. This is done by finding the equivalent wave for, generated by a sum of orthogonal sinusoidal components. The amplitude and phase of the sinusoidal components represent the frequency spectrum of the time domain signal. The IFFT performs the reverse process transforming a spectrum (amplitude and phase of each component) into a time domain signal. An IFFT converts a number of complex data points, of length that is a power of 2, into the time domain signal of the same number of point's .Each data point in frequency spectrum used for an FFT or IFFT is called a bin. The orthogonal carrier required for the OFDM signal can be easily generated by setting the amplitude and phase of each frequency.

2. PROBLE M OF PEAK-TO-AVERAGE POWER RATIOIN OFDM SYSTEM

One of the most serious problems is the high peak to average power ratio (PAPR) of the transmitted FDM signal, since these large peaks introduce a serious degradation in performance when the signal passes through a nonlinear high power amplifier (HPA). High PAPR results from the nature of the modulation where multiple subcarriers/sinusoids are added together to form the signal to be transmitted .When sinusoid the peak magnitude.

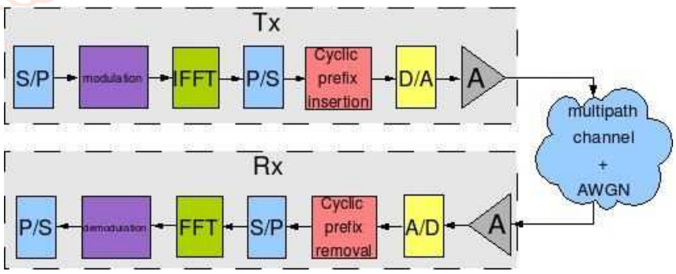


Fig.2.OFDM Trans receiver Structure

Fig2 shows the configuration for a basic OFDM Transmitter and Receiver

For an OFDM system with N sub-carriers, the peak power of received signals is N times the average power when phase values are the same .The PAPR of baseband signal will reach its theoretical maximum at(dB) = 10log N. For example, for a 16 sub-carrier system, the maximum PAPR is 12 dB. Never the less, this only a theoretically .In reality the probability of reaching this maximum is very low.

SPATIAL MULTIPLEXING:

Spatial multiplexing or space division multiplexing is a multiplexing technique in MIMO wireless communication, fiber-optic communication and other communications technologies used to transmit independent channels separated in space. It is MIMO wireless protocol that sends separate data signals or streams between antennae to enhance wireless signal performance or functionality. It is a type of "spatial diversity" and an engineering trick that helps to increase the possibilities for various types of end- to-end transmission.

Spatial multiplexing takes advantage of the differences in the channels between transmitting and receiving antennas pair to provide multiple independent streams between the transmitting and receiving antennas, increasing throughput by sending data over parallel streams.

SPATIAL MULTIPLEXING FOR 5G WIRELESS COMMUNICATIION:

In spatial multiplexing, is used in slow fading for 5G wireless communication. Increased demand for higher data rates and channel capacity is driving the need to use the RF spectrum more efficiently. As a result, 5G wireless system will use mm Wave frequency bands to take advantage of the increased bandwidth. The higher operating frequencies enable large-scale antennae arrays, which can be used to mitigate serve propagation loss in the mm wave band. Large arrays can also be used to implement a MIMO system in which unique signals can be transmitted from different antenna elements in the array. MIMO system enables spatial multiplexing technique that can be used to improve data throughput.

5G system require a large antenna arrays, applying digital weights on each antennae element is not always practical due to cost and space limitations, so we use hybrid beam forming techniques can be applied in a mixed RF and digital beam forming system to alleviate these restrictions. In a hybrid beam form system, both the precoding weights and the combining weights are combinations of baseband digital weights and RF band analog weights. On transmit side, the baseband digital weights modulate the incoming data streams to form input signals at each RF chain and the analog weights then translate the signal at each RF chain to signal at each antennae element. The process is reversed on the revive side.

CONCLUSION:

In this paper, we are find the solution of fading reduce techniques. The first technique is OFDM (orthogonal frequency diversity multiplexing), this technique is the method of data transmission and is used wireless data transmission. The second technique is spatial multiplexing that is used to transmit independent cannel separated in space. These technologies are reduce fading problem.

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