

A Survey on Different Methods of Channel Estimation in a 3G Private Mobile Network Using a Six Port Receiver

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Abstract- A 3G private mobile network receiver channel is estimated. The performance characteristics of the receiver are analyzed in terms of bit error rate (BER). A six port rake receiver using WCDMA technology is used to check the viability of the receiver. A comparative study is done on the various usages of the six port rake receiver (SPR) for channel estimation. A least complex calibration technique is used in the WCDMA communication system for a multipath fading environment. The viability of the SPR front end in a WCDMA system is investigated.

Keywords- 3G system, software defined radio (SDR), six port receiver front end (SPR), WCDMA communication system, Bit error rate (BER) profile, re-configurability, multipath fading channel.

I. INTRODUCTION

Third generation (3G) mobile communication systems in the recent years is a great achievement in increasing the transmission rate and its effectiveness. These days there are an increasing number of cellular standards with a wider range of frequency bands in different regions with an option of reconfiguration. This feature is available only to the RF front-end. The receiver should be able to support high data transmission rate and should also be multimode and multi standard to provide forward and backward compatibility. The WCDMA communication system which is an example of 3G mobile communication standard has a greater coverage area and higher transmission rate. It supports voice calls, text and MMS services at higher data speeds so that mobile operators are able to deliver higher bandwidth for broadband internet services.

A Software Defined Radio (SDR) is a flexible platform that provides reconfiguration and multi-mode operations. It plays a vital role in the wireless communication systems. This radio directly digitizes the output from the antenna and all receiver blocks after which it can be implemented in the software or hardware applications of the embedded system. With recent advances in semiconductor processing technology, software-define radio (SDR) is one potential method to enhance the flexibility of communication systems.

Six port based receivers are software configurable receivers. The principle of operation of the six-port receiver is based on the measurement of four independent powers, when the local oscillator (LO) and RF signals are introduced into the remaining two ports. It is chosen for its simplicity and broad bandwidth.

II. LITERATURE SURVEY

A literature survey is essential to analyze the importance of the proposed work.

A. Novel Modulation Scheme and six - port based Rake Receiver

The bit error rate performance of UWB systems is degraded as energy is spread out by multipath fading. In the case of DS-UWB systems, since the spreading factor is relatively small for high data rates as compared with that of traditional DSSS systems, they are highly exposed to inter pulse interference (IPI) and energy spread. There is therefore a need to compensate the multipath fading effects and the use of a RAKE receiver is the solution.

A new modulation scheme named QBOK (quadrature binary orthogonal keying) is presented. The new scheme provides a better protection against multipath fading which leads to outperform 4-BOK modulation and besides it allows more simultaneous users to be served. The performance of the proposed modulation against the existing one is compared. The only way to implement a rake receiver in DS-UWB is to use a two dimensional receiver which avoids signal processing at chip rate. In DS-UWB QBOK there is an easy relationship between s1 and s^1, the former is the Hilbert of the latter, are I-Q related. A RF front-end capable of doing I-Q channels splitting and down-conversion passively based on a six-port network was proposed. It consists of a six-port network with two input ports (received signal and local oscillator) and four outputs ports which are appropriate linear combinations of the inputs. These outputs signal are additively mixed in zero-bias Schottky diodes and combined in twos to obtain I-Q channels.

Spreading code	Ternary codes ($L_c = \{24, 12\}$ [4])
Chip rate	1.368GHz($= 1/T_c$)
Pulse shape	root-raised cosine($\alpha = 0.3$)
Channel estimation	realistic $\tau_{max} = 60$ ns
Channel models	CM1(LOS), CM2 and CM3(NLOS) CM4(NLOS, RMS delay=26ns)[7]

TABLE . I Simulation Parameters for DS-UWB Systems

B. Four port communication receiver with digital IQ regeneration

It was introduced in the year 2010, advances in semiconductor processing technology, software-define radio (SDR) is one potential method to enhance the

flexibility of communication systems. In this respect, six-port based receivers seem to be possible and suitable candidates towards software configurable receivers. The crucial advantage over the conventional homodyne system is their simple architecture requiring only the reference oscillator as an active RF component, making this technology attractive for future low-cost and broadband RF-front-ends. Nevertheless, mobile terminals require device with a small size and low power consumption. For SDR applications, the low-pass filters (LPFs) in front of the analog-digital converters (ADCs) have to be adjustable to the multiple standards. Thus, LPFs and ADCs use a large chip area and a significant part of the overall power consumption. Thus, it is desired to limit the number of output ports of the six-port as much as possible in order to reduce the number of ADCs and LPFs.

The development of SDR technology based on four-port receiver scheme has been investigated. The results obtained at the frequency 2.45 GHz for a QPSK modulation scheme demonstrate that the FPR is a viable alternative to the conventional five (six)-port receiver. This simplification is desirable not only because it reduces the costs, the circuit size and the power consumption, but it also makes the receiver architecture similar to a conventional quadrature receiver. The four-port receiver can support multi-modulation schemes and multi-band communications. So, this system is a valuable candidate for front-end implementations of future wideband SDR especially for an operation at very high frequencies. Several applications are planned to operate in the 60-GHz bands. In particular, high data rates applications such as future wireless local area networks with data rates of up to 1 Gb/s are aimed.

C. Concurrent Dual Band six- port Receiver

A novel concurrent dual-band receiver architecture that used only one six-port correlator circuit to down convert two signals into two different bands simultaneously was proposed. Two different signals with different modulation techniques and bandwidth could be obtained. There are no disadvantages on the carrier frequencies of the two signals. The only condition is that the two signals have to be within the bandwidth of the receiver. The mathematical model for the receiver is derived and subsequently implemented to evaluate its performance. Thus by analytically choosing the frequencies of the two local oscillator signals sent into the six-port correlator, the in-phase (I) and the quadrature (Q) components of each of the two input RF signals can be obtained from the filtered high-pass and low-pass components of the diode detectors outputs. A modified memory polynomial black box model is used to calibrate the receiver. A training signal of similar characteristics of that of the received signal is sent to estimate the calibration constants. Verification of the model, performance evaluation and the robustness of the receiver are done using two signal pairs of different modulation types. With a data rate of 2 Mbps, a 64-QAM signal and 16-QAM signal is received. The measured EVMs were 1.9% for the 64-QAM and 1.8% for the 16-QAM. EVMs of 1.9% and 2.0% are obtained for real communication signals, WCDMA and LTE. A plot for bit error rate (BER) is done to evaluate 16QAM and 64QAM at 2 Mbps data rate. The receiver is

modeled mathematically and the validated with the measurement.

D. Broadband RF Front-End Based on the Six-Port Network Architecture for software Defined Radio

This provides the advantages of using a six port receiver over other receivers. This paper presents a Software Defined Radio (SDR) six-port receiver for a novel broadband mobile communications system. The frequency ranges from 700MHz to 6 GHz, which operate up to 100 MHz-wide channels. The six-port receiver has been satisfactory proved for data rates up to 75 Mb/s. The use of a six port receiver is emerging as a most promising alternative. It consists of a linear passive network and some power detectors, so frequency conversion takes place without using an I-Q mixer. The main characteristic of the six-port architecture is its extremely large bandwidth, with additional capabilities such as multi- band and multi-mode. Six-port networks can operate at very high frequencies, even to the extent of meter-wave frequencies. It is estimated that six-port transceivers can perform rates of at least 200 Mb/s.

III.PROPOSED WORK

All the above mentioned articles have their own advantages but the concept of re configurability is not being taken into consideration. The research article- Performance Analysis of a six- port Receiver in a WCDMA Communication System including a multipath Fading Channel lays stress on the using a six port receiver (SPR) front end which supports high data transmission rates and also is reconfigurable to support various communication standards with different frequency bands. WCDMA communication system is selected because it has a greater coverage area that provides higher transmission rate and more services to consumers. Perez-Duenas et al. proposed a six-port based rake receiver for direct sequence ultra wideband systems (DSUWB), which has been considered a type of physical layer (PHY) suitable for high-speed wireless personal area networks (WPANs) in IEEE 802.15.3a. The six-port receiver (SPR) is an alternative direct conversion receiver whose structure is composed of a passive six-port wave correlator and four diode power detectors. The SPR performance is degraded due to the non-idealities in the wave correlator circuit, the receiver being typically broadband and highly reconfigurable. This drives the detectors outside of their square law region and a suitable calibration technique mitigates these structural drawbacks to achieve good performance across a broad frequency band at the cost of increasing the computation complexity. The SPR is even more impressive in concurrent dual band receiver operation that uses the same architecture as in the case of single band, thus avoiding hardware component duplication which is typical in state-of-the-art concurrent dual band receivers. While previous work investigated some SPR configurations requiring low power consumption and no calibration for low power applications such as millimeter-wave (especially in the 60 GHz band). The least complex calibration technique is sufficient in case of a WCDMA communication system.

IV.CONCLUSION

The proposed model ensures the re configurability concept besides providing high data transmission rate and also a proper utilization of different frequency bands. It investigates the viability of an SPR front end in a WCDMA communication system in a multipath fading channel. The BER profile for the communication system is plotted and analyzed.

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