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RESEARCH ARTICLE

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AN ADVANCED TRDMA FOR GREEN WIRELESS COMMUNICATION

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ABSTRACT

Telecommunication usage as sky rocketed in recent years and will continue to grow as developing nations reach to wireless as their communication of choice. With the explosive growth of wireless communication industries in terms of network infrastructure and various new applications, the energy consumption of wireless network and device is experiencing a dramatic increase. The traditional multiple access technique CDMA exhibit some drawbacks. This realization has leads to a push towards green communication that strives for improving energy efficiency of communication. A wireless channel access method named Time Reversal Division Multiplexing Access is one application based on the TR communication technology, has a potential of reduction in power consumption. But when the transmission multiple input is required the TRDMA system may result in fading and thermal noise. For high data service most channels are considered as dispersive and causing ISI. The TRDMA system mitigate ISI in dispersive fading channel. Here apply the proposed method in greenhouse monitoring wireless technology and also compared it with conventional transmission, reveals significant transmission power reduction. Satisfying simulation results are obtained for the proposed method which reveals high interference alleviation ratio, exhibits large multipath diversity gain, mitigate ISI in dispersive fading channels, low radio pollution, bit error rate improvement over CDMA all these makes it a high speed broadband wireless communication method in future. As such it is an ideal paradigm for the development of green wireless system.

Key words: network Green wireless communication, energy efficiency, low radio pollution, power consumption, high interference alleviation ratio

1. INTRODUCTION

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor. In wireless communication systems it is often desirable to allow the subscriber to send simultaneously information to the base station while receiving information from the base station. The spectrum competency of wireless communication is gaining popularity with increasing demand for the wideband wireless

services. Capacity demand in wireless local area network has developed over the last decade. So there has been witnessed a large growth in the wireless communication market. Data rate can be further improved and the reliability of wireless system can be also improved by overcoming the problems that usually occurs in the system. In recent years, with the explosive growth of wireless communication industry in terms of network infrastructures, network users, and various new applications, the energy consumption of wireless networks and devices is experiencing a dramatic increase. Because of ubiquity of wireless applications, such an increasing energy consumption not only results in a high operational cost and an urgent demand for battery/energy capacity to wireless communications operators, but also causes a more severe electromagnetic (EM) pollution to the global environment. Therefore, an emerging concept of "Green Communications" .In CDMA, the same bandwidth is occupied by all the users, however they are all assigned separate codes, which differentiates them from each other. CDMA utilize a spread spectrum technique in which a spreading signal (which is uncorrelated to the signal and has a large bandwidth) is used to spread the narrow band message signal. CDMA gives the user entire spectrum all of the time. CDMA spread spectrum technology in which it uses unique spreading codes to spread the baseband data before transmission. While employing the space time coding CDMA technique there are some limiting factors. Tight synchronization is required to use orthogonal codes, cause self-interference, which dominates the performance in most CDMA systems. Another major problem in CDMA technology is channel pollution, where signals from too many cell sites are present in the subscriber's phone but none of them is dominant. In fast-fading, channel is no longer constant over a period of time. As a result of rapid time variation of the channel, the orthogonality of STC is lost in CDMA. This will cause error in decoding and hence the system performance is degraded. For high data rate service, most channels considered as dispersive, causing inter-symbol interference. In this paper, design a Green wireless communication with low energy consumption, low radio pollution, high interference alleviation ratio, and large multipath diversity gain. This technology must ensure Time reversal (TR) signal transmission is an ideal paradigm for green wireless communications. A new TR-based multiplexing scheme, time-reversal division multiplexing (TRDM) system can be proposed and this proposed system is implemented in green house monitoring wireless system. Time reversal signal transmission exploits the multipath propagation and thereby provides a great potential for low complexity energy efficient communication. This concept is implementing in 'Greenhouse Monitoring Wireless Technology' and compares it with conventional transmission, can reveals significant transmission power reduction. Satisfying simulation results can be obtained for the proposed method which reveals high interference alleviation ratio, exhibits large multipath diversity gain, mitigate ISI in dispersive fading channels, low radio pollution, bit error rate improvement over CDMA, all these makes it a high speed broadband wireless communication method in future.

II CDMA FOR WIRELES COMMUNICATION

In CDMA, the same bandwidth is occupied by all the users, however they are all assigned separate codes, which differentiates them from each other. CDMA utilize a spread spectrum technique in which a spreading signal (which is uncorrelated to the signal and has a large bandwidth) is used to spread the narrow band message signal. CDMA gives the user entire spectrum all of the time. CDMA spread spectrum technology in which it uses unique spreading codes to spread the baseband data before transmission. The receiver then dispreads the wanted signal, which is passed through a narrow band pass filter. The unwanted signals are not dispread and will not be passed through the filter. The codes are a sequence of zeros and ones produced at a much higher rate of that of the baseband data. The rate of spreading code is referred to as chip rate. In a traditional handoff, the connection to the current cell is broken and then the connection to the new cell is made. Since CDMA uses the same frequency, the connection to the new cell site can be made without breaking the connection of the current cell. CDMA also have better security and higher data and voice transmission quality because of the spread spectrum technology it uses. Multiple antennas when used, appropriate space-time coding (STC) techniques can achieve huge performance gains in

multipath fading wireless links along with CDMA. Space-time block codes have a most attractive feature of the linear decoding/detection algorithms and thus become the most popular among different techniques. The application of space time coding in CDMA system has shown to improve received signal at the mobile user. Over the past five to ten years, communication systems have been developing rapidly in wireless and cellular network arena. As a user demand grows, conventional communication systems such as TDMA and FDMA are becoming inadequate for some application in today's communication requirements. A new system called CDMA replaces the above mentioned systems. The idea of this system is to transmit signals simultaneously through a linear band limited channel without inter channel or inter symbol interference. This new system utilizes the spread spectrum technique where the message signal can occupy both time and frequency domains simultaneously, thus the system capacity is significantly increased. To design multi channel transmission must concentrate on reducing cross talk between adjacent channels. One of the most promising cellular standard is IS-95. Today widely used data communication scheme is spread spectrum communications. It has many features that make it suitable for secure, multiple accesses and many other properties that are needed in a communication system.

A: CDMA TRANSMITTER

In CDMA transmitter, the input data bits are spread by PN sequence generator. The spreading is actually done by multiplying the data bits with that of the PN sequence code generated. The frequency of PN sequence is higher than the Data signal. After spreading, the Data signal is modulated and transmitted. There are several schemes available for modulation, viz. BPSK, QPSK, M-QAM etc. The most widely used modulation scheme is the BPSK. In this design, BPSK modulation is used to modulate and transmit the spread signal.

B: PN SEQUENCE GENERATOR

The important block of CDMA communication system is the PN sequence generator. A Pseudo-random Noise (PN) sequence/code is a binary sequence that exhibits randomness properties but has a finite length and is therefore deterministic. The PN sequence generator can be implemented using LFSR's to generate several types of PN sequences. Maximal length sequence are LFSR based PN sequence generators which can produce the maximum possible length sequence. For n bit size shift registers the PN sequence length will be 2n-1 bits.

C: CDMA RECEIVER

In CDMA receiver, the input to the system is the BPSK modulated signal. This signal would have been affected by noise and other interference in the communication channel. The DS-SS CDMA receiver should be designed carefully to reproduce the data signal with least error. The BPSK modulated input signal is multiplied by the locally generated carrier wave by the oscillator. The multipliefd signal is then passed through the low pass filter to get low frequency components only. A decision device is used to approximate the signal to binary sequence. This binary sequence is the spread sequence of the data signal. The most sensitive part of the DS-SS receiver is the synchronization of the locally generated PN sequence and the sequence obtained from the decision device. Even a single bit mismatch may lead to noise instead of the data signal. Suitable technique is used to achieve synchronization and multiply the local PN sequence code with that of the received PN code. The Data signal is obtained after the multiplication process.

III : PROPOSED SYSTEM

An emerging concept of Green Communications has received considerable attention in hope of finding novel solutions for above limiting factors. Which improve energy efficiency, relieve/reduce radio pollution to unintended users, and maintain or improve performance metrics. The time-reversal (TR) signal transmission, an ideal paradigm for green wireless. In this paper, a wireless channel access method named time reversal division multiple access (TRDMA) is being proposecond**.** To satisfy as a green wireless technology, one must meet two basic requirements: one is low energy consumption and the other is low radio pollution to others besides the intended transmitter and receiver. Traditional approaches include time division multiplexing (TDM), frequency division multiplexing (FDM), and code division multiplexing (CDM). The recent advance in multi-input multi-output (MIMO) has brought in anew multiplexing scheme named spatial

division multiplexing (SDM), where different users can be distinguished by their channel response vectors due to the equipment of multiple antennas. In a rich scattering environment, since different users have different unique multi-path profiles which depend on their physical locations and TR transmission treats each path like a virtual antenna, it is possible to utilize multi-path profiles as a way to distinguish different users, which may facilitate the multiplexing. Therefore, a new TR-based multiplexing scheme, time-reversal division multiplexing (TRDM), can be developed. The time reversal technique is based on the channel Reciprocity. It is proposed to use TR structure in both transmitter and receiver section where signals of different users are separated solely by TRDMA. The single user wireless communication consists of two phases: recording phase and transmission phase.

In this paper, consider a slow fading wireless channel with a large delay spread. The channel impulse response (CIR) at time k between the transmitter and the receiver in discrete time domain is modeled as

h[k] =

Wireless communication mainly deals with EM waves. The transmitted signal x(t) in forward direction the effect of the channel is modeled as a filter with impulse response h(t). Then the received signal is given by

R(t)=x(t) h(t)

The time reversing the result in r(-t). In frequency domain

R(f)=X(f)H(f)

The time reversal technique is based on the channel reciprocity. Hence the channel has same response h(t) in the reverse direction. Transmitting r(t) back through the same channel result in

Y(f)=Ri*(f)H(f)

Y(f)=X*(f)H*(f)H(f)

Y(f)=AX*(f)

Time reversing the reversed signal and converting back to the time domain result in the same signal that was transmitted. The transmitter side consisting of a transmitter and a transceiver section. The transmitter for transmitting the data and transceiver for retransmitting the time reversed data. The single user wireless communication consists of two phases: recording phase and transmission phase.

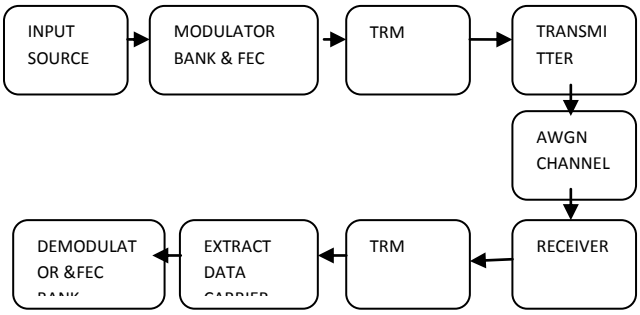

Fig: 1 The block diagram of TRDMA system

Signal received in the complex environment will have undergone multiple reflection, refraction and scattering. It consist of the sum of multiple time delayed and attenuated version of original signal. When the received signal is time reversed and retransmitted the different delay components go through the same channel in reverse and converge on the same source location. This convergence occurs in both time and space. TRDMA is used as wireless channel access method on high resolution spatial focusing effect.

A: **RECORDING PHASE**

The message signal that we need to be transmitted from any source is first transmitted through the transmitter in to the complex environment. Then the signal or message is scattered back from the scattering environment and recorded in the TRM. The TRM at the transmitter side record the channel response and store the time reversed message. The time-reversal mirrors shown in the block diagram can be arrays of transducers which are used to focus the signal

B: TRANSMISSION PHASE

The system starts the transmission phase after the recording phase. The information symbols transmitted are random variables. After time reversed the signals are retransmitted by transceiver and a more focused wave travels toward the target or the intended user. in this phase The information sequences are then fed to TRMs. The received signal consists of signal, inter-signal-interference and inter-user-interference. When the received signal is time-reversed and retransmitted, the time-delayed components radiate through the same channel and converge on the original location of the source. This convergence occurs both in space and time.

V: SIMULATION RESULTS

In this part we compare the performance of TRDMA system to that of CDMA system with the help of some simulation results and evaluate several performance metrics, including the transmit power, inter symbol interference, SNR, noise level, BER over both Rayleigh fading channel and Ricean fading channel.

A. POWER REDUCTION

According to our simulations results with typical parameter setting, the power consumption for TRDMA transmission can be as low as 70% of that needed for the CDMA transmission. When we analyse the power consumption over both fading channels the TRDMA shows the better performance. Although it is difficult to analyze accurately, it has been shown that the temporal focusing effect of TR can significantly reduce the presence of ISI by reducing the channel delay spread. Thus we expect a similar higher level of power reduction can be achieved. Therefore TRDMA expected to achieve a much better efficiency than CDMA. This shows that TRDMA can achieve highly efficient communication without requiring much complexity for the transmitter and receiver. It is worth noting that the simulation result shown here in fig.3 & 2.

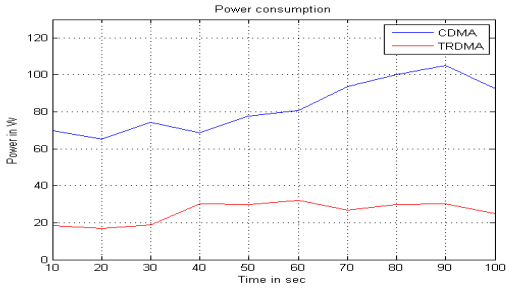

Fig. 2 Power reduction by TRDMA and CDMA obtained by simulation over Rayleigh fading channel

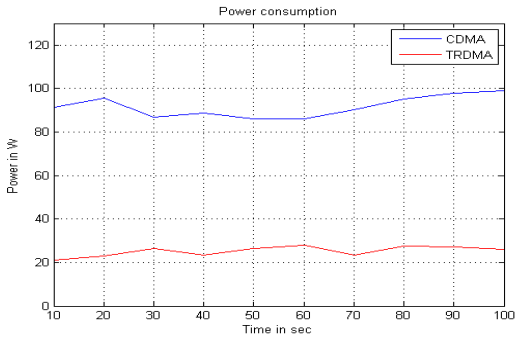

Fig. 3 Power reduction by TRDMA and CDMA obtained by simulation over Ricean fading channel

B.

C.

D.

A. INTERFERENCE ALLEVIATION RATIO

In this part we will compare the interference that a transmitter causes to an intended receiver using TRDMA transmission to that using CDMA transmission. According to our simulation results with typical parameters under the ideal assumption that channel responses of two different locations are completely independent, interference could be 12 dB lower in Recian fading channel and 22 dB over Rayleigh fading channel by using TRDMA system. Even for a practical environment correlation between channel responses does exist. Therefore the interference caused to an receiver with TRDMA transmission is greatly reduced compared to CDMA system. The simulation results for both CDMA and TRDMA over both fading channel are shown in fig.5 & 4.

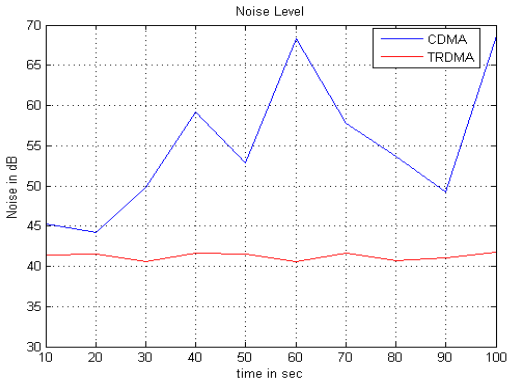

Fig. 4 ISI by TRDMA and CDMA obtained by simulation over Rayleigh fading channel

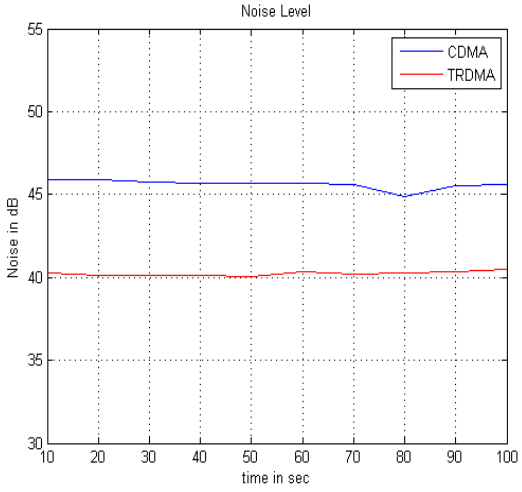

Fig.5 ISI by TRDMA and CDMA obtained by simulation over Recian fading channel

E. EFFETIVE SNR

The effective SNR of the proposed and existing system are evaluated in this section. The received signal can be categorized in to signal, ISI and noise. We can estimate the SNR and the resulting simulation output is shown in fig.6 & 7 over both channels.

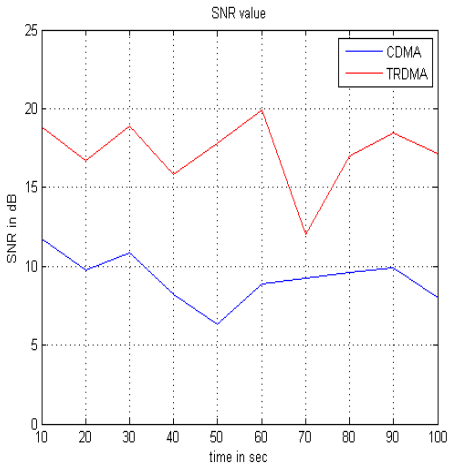

Fig. 6 SNR of TRDMA and CDMA obtained by simulation over Rayleigh fading channel

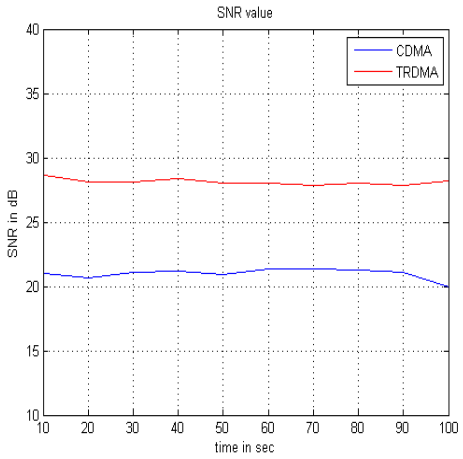

Fig.7 SNR by TRDMA and CDMA obtained by simulation over Recian fading channel

A. BER

In this part, we investigate TRDMA's improvement of bit error rate over CDMA by taking benefit of the high resolution and pin-point spatial focusing effect. If large amount of errors occur when data is sent through the data link, integrity of the system might have to be compromised. Hence, it's important to access the performance of a system and BER provides an ideal way in which this can be achieved. Bit error rate is calculated the total number of bit errors in the amount of bits sent.

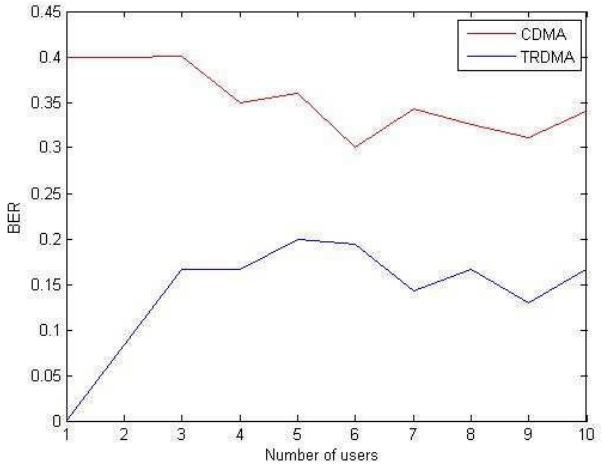

Fig. 8 BER of TRDMA over CDMA

VI. EXPERIMENTAL SETUP

Greenhouses are often used for growing flowers, vegetables, fruits, and tobacco plants. Most greenhouse systems still use the manual system in monitoring the temperature and humidity in the greenhouse, a lot of problems can occur not for worker but also affected production rate because the temperature and humidity of the greenhouse must be constantly monitored to ensure optimal conditions. The Wireless Sensor Network (WSN) can be used to gather the data from point to point to trace down the local climate parameters in different parts of the big greenhouse to make the greenhouse automation system work properly. This paper presents the design of low cost greenhouse monitoring system to monitor a greenhouse temperature and humidity parameters by applying the Time Reversal technology as the TRDMA system. During the design process, ARM processor, LCD Display, transceiver modules, MAX232 and sensors as the main hardware components is used as hardware components while C compiler, Proteus, visual Basic and Keil were used for software elements. The data from the greenhouse was measured by the sensor then the data will be displayed on the LCD screen on the receiver and also displayed on the PC which support up to 100 m range. By using this system, the process of monitoring is easier and it also cheaper due to the TR system's potential of over an order of magnitude of reduction in power consumption and interference alleviation, as well as a very high multi-path diversity gain.

CONCLUSION AND DISCUSSION

In this paper, we argue and show that TR-based transmission system is an ideal candidate for green wireless communications. In the proposed method the system performances such as Bit Error Rate, SNR, power consumption, interference alleviation ratio, and multipath diversity gain can compare with the conventional system. By receiving pilot pulses from the receiver and sending back the reversed waveforms, the transmitter can focus energy at the receiver in both spatial and temporal domains with high resolution, and thus harvest energy from the environment and cause less interference to other receivers. We have investigated the system performance, including power reduction, interference alleviation, and multi-path diversity gain. The results show that the TR system has a potential of over an order of magnitude of reduction in power consumption and interference alleviation, as well as a very high multi-path diversity gain. By utilizing the location-specific signatures that exist in the multi-path environment we develop both single antenna and multiple antenna system model. We simulated and evaluated a variety of performance metrics such as bit error rate, effective SINR and achievable sum rates. We also demonstrated the proposed system in Green house monitoring system and compared the power consumption with conventional method.

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