Development of Efficient Two Way Cooperative Communication System using Different Modes with MRC & QAM

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Abstract - The wireless communication is a very means of information sharing over air and sometimes it will benefits us due to easy setup than wire line networks. Now lots of problems persists when distance between devices are quite longer than usual, and in such cases the signals got distorted to reach before receiving devices. For such kind of situation co-operative networks came into existence. In this paper a wireless co-operative mobile network is considered to enhance the performance using QAM modulation schemes with different relaying modes like amplify and forward (AF), and decode and forward (DF) with different data sizes and iterations. The outcomes calculated in terms of bit error rate which is better than the existing co-operative mobile network.

Keywords - Co-operative Mobile Network, QAM Modulation, AF, DF.

I. INTRODUCTION

The introduction of mobile and wireless communication systems in the late 20thcentury has radically changed the life of human being, especially in the economical and social aspects. In addition to the more traditional services such as speech, video, and data, the pervasive use of wireless communication systems can also provide other services to improve the quality of life, including health care, home automation, etc. Nevertheless, the main challenge in designing and operating a wireless communication system is to be able to provide a high throughput transmission with good reliability under limited radio spectrum, interference, and time variation of the wireless channel. With the rapidly growing demand for various services of the next-generation wireless communication systems, such as high-speed wireless Internet access and wireless television, the requirements for high data transmission rates and reliable communications over wireless channels become even more pressing. In fact, the past decades have witnessed explosive interest and development from both industry and research community in the design of wireless communication systems to increase the data transmission, improve reliability and optimize power consumption. Such interest anddevelopment promise to continue for years to come.

The basic concept of cooperative transmissions is to allow several single-antenna terminals to perform as a virtual multi-antenna terminal. In a scenario with a single relay terminal, an original signal and an uncorrelated redundant signal are respectively transmitted by a source terminal and a relay terminal. This cooperation scheme consumes more resource than a non-cooperative scheme. Therefore, the main issue in cooperative transmissions consists in both maximizing the spatial diversity and minimizing the resource consumption.

There are many different criteria that can be used to evaluate the performance of a communication system, such as average signal-to-noise ratio (SNR), outage probability, average bit-error-rate (BER), etc. The average BER, which quantifies the reliability of the entire communication system from “bits in” to “bits out”, is of primary interest since it is most revealing about the nature of the system behavior. As a matter of fact, the main challenge of the system designer in wireless communications is to develop new communication systems with improved BER performance as compared to existing systems under similar constraints such as power, bandwidth, complexity, etc.

II. RELAYING PROTOCOLS

In the literature, there are three main approaches to achieve cooperative diversity. The first approach is based on repetition coding among participating nodes, i.e., the source and relays transmit the signal to the destination over orthogonal channels. The destination decodes the transmitted data based on the received signals from different nodes that experience independent channel fading, thereby obtains the full diversity order. However, the approach typically suffers a certain throughput loss since the number of required channels cannot be less than the number of relays.

Forwarding Schemes:

In a cooperative scenario, a relay terminal (or a set of relay terminals) has to help a source terminal to forward data to a destination terminal. There are two common forwarding schemes that are used for data forwarding at a relay terminal: Amplify-and-Forward (AF) and Decode-and-

Forward (DF). First, a system model is specified. We study the cooperative transmission between a source terminal S and a destination terminal D with the help of a relay terminal R. We consider a slow Rayleigh fading channel model. Our analysis focuses on the case of slow fading, to capture scenarios in which delay constraints are on the order of the channel coherence time. A half duplex constraint is imposed across each relay terminal, i.e. it cannot transmit and listen simultaneously. Moreover, transmissions are multiplexed in time, they use the same frequency band.

Depending on the signal processing performed at relays, cooperative protocols can be classified into three main groups: amplify-and-forward (AF), decode-and-forward (DF), and compress-and-forward (CF) [1,2]. The two processing methods considered in this work are AF and DF.As illustrated in Fig. 2.1a, with DF, the relays decode the source's messages, re-encode and re-transmit to the destination. A major challenge with the DF method is that it is not simple to realize the cooperative diversity. This is due to possible retransmission of erroneously decoded information by the relays in the DF method [3,4, 5]. There are many ways to overcome such a challenge. For example, an error detection code can be added at the source. Based on the decoding result in the first phase, the relay can decide to retransmit or remain silent in the second phase [9,10].

III. PROPOSED METHODOLOGY

The proposed system is shown in the below block diagram refer Fig. 3.1. The proposed system is utilizing the cooperative modes which is completed with the help of relay. When relay is considered to complete the transmission process there are two different ways we can utilize relay one is detect and forward mode(AF) and another is amplify and forward mode (DF). Both the modes are slightly different from each other.

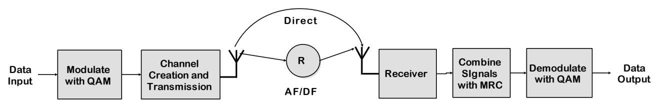

Fig. 3.1 Block Diagram of the Proposed Methodology

The wireless co-operative mobile system is having set of blocks which are proposed in the below figure for the optimum performance. The block diagram having major blocks which are QAM modulation which is applied of the data to be transmitted. Than the initialization of cooperative channel block in source to destination (SD) source to relay (SR) and relay to destination (RD). After that the calculation of signal power to transmit signal over channel and during transmission noises will be added in the signal. After reception of signals from various channels i.e. source to destination (SD) source to relay(SR) and relay to destination (RD) at the receiver with Amplify and Forward and Decode and Forward(DF) mode will combine using combining method Maximal Ratio Combining (MRC). After combining of the signals the final signal is demodulated with QAM modulation block to get the output data.

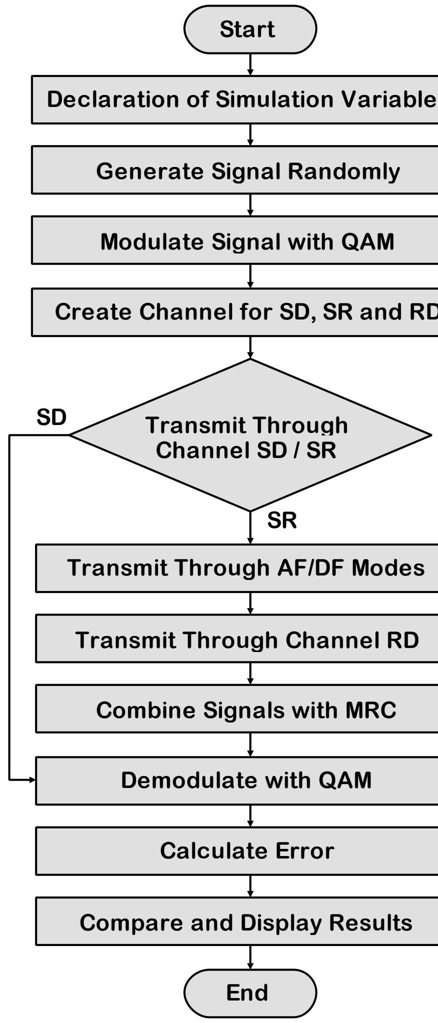

Fig. 3.2 Flow Chart of the Proposed System Execution

The above explained proposed co-operative mobile communication system is implemented on simulation tool and the algorithm is explained in the flow chart step by step below.

a) Start of simulation
b) Create simulation environment using variables
c) Generate data to transmit over network
d) Modulate data with QAM modulation
e) Initialize cooperative channels for source to destination(SD), source to relay(SR) and relay to destination(RD)
f) Calculate noise power
g) Calculate signal at destination and at relay

h) Now demodulate signal with QAM modulation and calculate error without cooperation

i) Combine signal with MRC, Demodulate signal and calculate Error with AF Relaying protocol

j) Combine signal with MRC, Demodulate signal and calculate Error with DF Relaying protocol

k) Calculate BER for all modes, compare and display

l) End of simulation

IV. SIMULATION RESULTS

The proposed cooperative mobile system and its simulation algorithm explained in the previous section is analyzed and the results are calculated in terms of BER and the graphs are given below.

From the results it can be analyzed that the proposed cooperative mobile network gives minimum bit error rate (BER) using QAM modulation with 100000 data and it can also be derived out that as the data size increases performance of the system also increases.

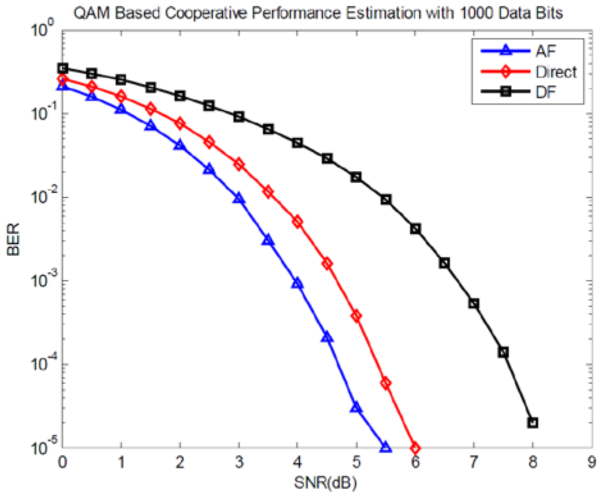

Fig. 4.1 Bit Error Rate of Proposed System with 10^3 Data Bits

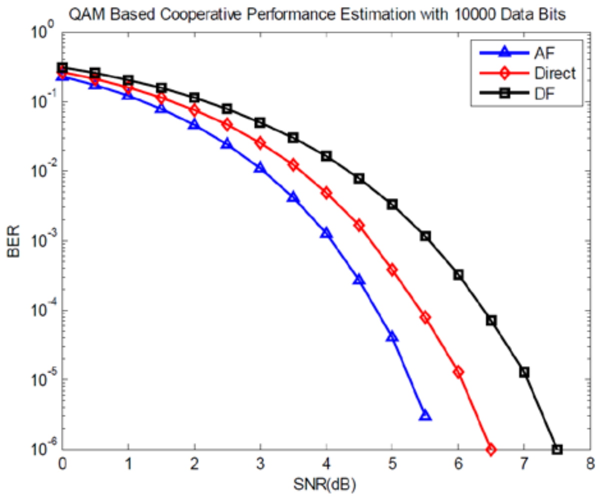

Fig. 4.2 Bit Error Rate of Proposed System with 10^4 Data Bits

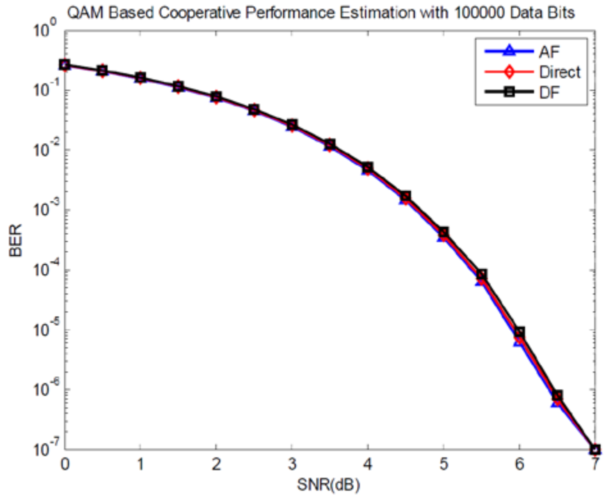

Fig. 4.1 Bit Error Rate of Proposed System with 10^5 Data Bits

Table 1: Comparison of Bit Error Rate

SNR	Existing System	Proposed System
0	$3.0x10^{-1}$	$2.5x10^{-1}$
2	$2.5x10^{-1}$	$8.0x10^{-2}$
4	$2.0x10^{-1}$	$5.0x10^{-3}$
6	$1.5x10^{-1}$	$7.0x10^{-6}$
8	$8.0x10^{-2}$	$1.0x10^{-7}$

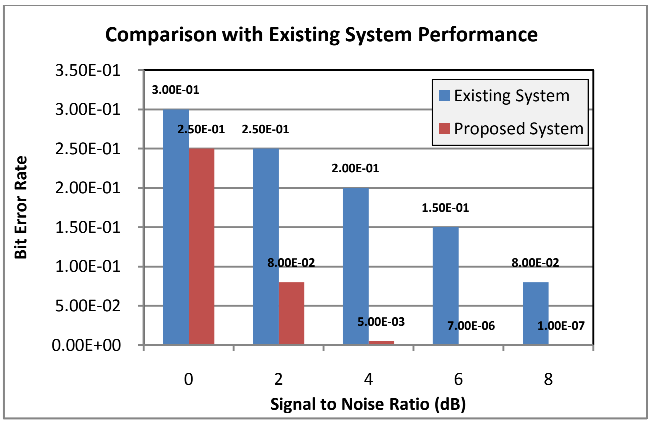

Fig. 4.3 BER Comparison with Existing System

V. CONCLUSION AND FUTURE SCOPE

The proposed system explained in the previous sections is simulated and the simulation results. From the simulation outcomes it can be analyzed that end to end and the BER is calculated. The BER calculated with QAM with 1000, 10000 and 100000 bits data sizes and BER achieved is 10^{-5}, 10^{-6} and 10^{-7} respectively. For further enhancement in the system performance proposed methodology can be integrated with the detection methodology and digital filtering will added feature to reduce error.

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