Efficient Wireless Cooperative System Integrated with Various Modes and QPSK

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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 QPSK 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, QPSK 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 otherservices to improve the quality of life, including health care, home automation, etc.Nevertheless, the main challenge in designing and operating a wireless communicationsystem is to be able to provide a high throughput transmission with good reliabilityunder limited radio spectrum, interference, and time variation of the wireless channel.With the rapidly growing demand for various services of the next-generation wirelesscommunication systems, such as high-speed wireless Internet access and wirelesstelevision, the requirements for high data transmission rates and reliable communicationsover wireless channels become even more pressing. In fact, the past decadeshave witnessed explosive interest and development from both industry and researchcommunity in the design of wireless communication systems to increase the datatransmission, 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-antennaterminals to perform as a virtual multi-antenna terminal. In a scenario with a single relayterminal, an original signal and an uncorrelated redundant signal are respectivelytransmitted by a source terminal and a relay terminal. This cooperation scheme consumesmore resource than a non-cooperative scheme. Therefore, the main issue in cooperativetransmissions consists in both maximizing the spatial diversity and minimizing theresource consumption.

There are many different criteria that can be used to evaluate the performance ofa communication system, such as average signal-to-noise ratio (SNR), outage probability,average bit-error-rate (BER), etc. The average BER, which quantifies the reliabilityof the entire communication system from “bits in” to “bits out”, is of primaryinterest 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 communicationsis to develop new communication systems with improved BER performanceas 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., thesource and relays transmit the signal to the destination over orthogonal channels. Thedestination decodes the transmitted data based on the received signals from differentnodes that experience independent channel fading, thereby obtains the full diversityorder. However, the approach typically suffers a certain throughput loss since thenumber 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 asource terminal to forward data to a destination terminal. There are two commonforwarding 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 destinationterminal D with the help of a relay terminal R. We consider a slow Rayleigh fadingchannel model. Our analysis focuses on the case of slow fading, to capture scenarios inwhich 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 listensimultaneously. Moreover, transmissions are multiplexed in time, they use the samefrequency band.

Depending on the signal processing performed at relays, cooperative protocols canbe classified into three main groups: amplify-and-forward (AF), decode-and-forward (DF), and compress-and-forward (CF) [1,2]. The two processing methodsconsidered 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 methodis that it is not simple to realize the cooperative diversity. This is due to possible retransmissionof erroneously decoded information by the relays in the DF method [3,4, 5]. There are many ways to overcome such a challenge. Forexample, an error detection code can be added at the source. Based on the decodingresult in the first phase, the relay can decide to retransmit or remain silent in thesecond phase [9,10].

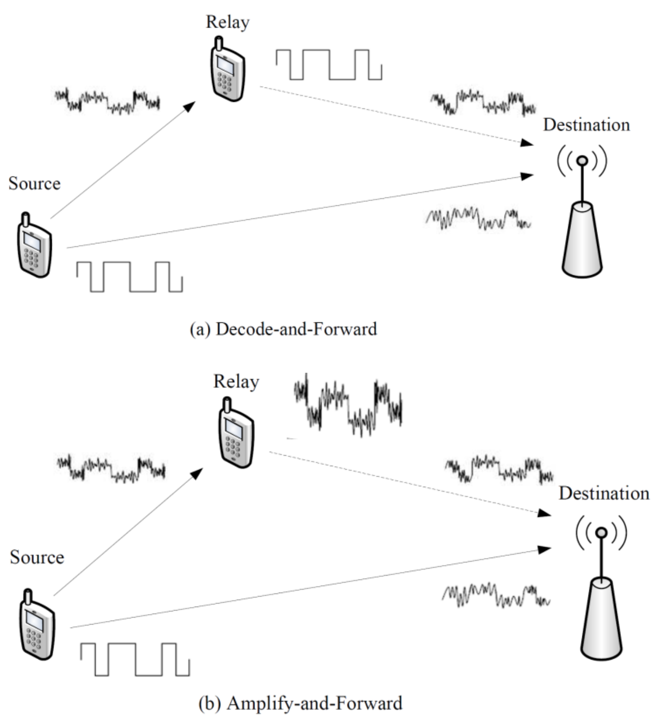

Fig. 2.1 Illustration of Amplify-and-Forward and Decode-and-Forward signalprocessing methods.

In particular, a cooperative maximum ratio combining (C-MRC) detector was proposed at the destination to collect the full diversity order by taking into consideration the instantaneous BER of the source-relaylink. How to avoid error propagation by using adaptive techniques at the relays(s) incoherent/no coherent DF cooperative networks is one of the main objectives of thiswork.

With AF, as depicted in Fig. 2.1b, the relays receive noisy versions of the source'smessages, amplify and re-transmit to the destination. The AF method is furthercategorized as variable-gain or fixed-gain relaying based on the availability of CSI atthe relays. The variable-gain AF relaying scheme requires the instantaneous CSI ofthe source-relay link at the corresponding relay to maintain a fixed transmit powerat all time. On the other hand, the fixed-gain AF relaying scheme does not need the instantaneous CSI, but the average signal-to-noise ratio of the source-relay linkin order to maintain a fixed average transmit power at each relay [3,6,7,8]. Although the AF method does not suffer from the error propagationproblem as the DF method, it presents another problem, that of noise accumulationat the relays. However, it is still attractive since it puts a less signal processing burdenon the relays. With AF, the destination requires the perfect knowledge of CSI ofall the transmission links propagated by its received signals in order to perform acoherent detection, e.g., employing MRC detection.

Channel Access:

The main limitation of cooperative communications is the resource consumption. Indeed,a cooperative transmission consumes more resource than a direct non-cooperativetransmission since there are at least two transmissions: the one from the source terminaland the one from the relay terminal. This is due to that fact that these two transmissionsshould not interfere. Thus, they should take place on two orthogonal, non-interferingchannels. This is a channel access issue. The channel access is generally processed at theMAC layer since cooperation needs a dynamic resource allocation process. But this issuecan also be addressed at the physical layer when the resource allocation is rather static.Allocating resource is then referred to as a multiplexing issue.

Multiplexing issues:

The source signal and the relay signal should not interfere. These signals should betransmitted over orthogonal channels. Orthogonality can be provided in many ways.

Time-division multiplexing:

The most straightforward method to allow source and relay terminals to transmit dataorthogonally is the separation in time, called time-division multiplexing. The originaldata and relayed data are transmitted in non-overlapping time intervals.

Frequency-division multiplexing:

For the frequency-division multiplexing technique, the idea is to transmit original andrelayed data using separated carrier frequencies. This idea is suitable for cellular systemsbecause the frequency band of the uplink is separated into small frequency channels.Therefore, the source terminal and relay terminal(s) can cooperately transmit their data tothe base station in different frequency channels. However, this idea is not suitable for adhoc wireless networks since all mobile terminals use the same frequency band.

Code-division multiplexing:

In [19], [20], and [21], the orthogonality between source and relayterminals is achieved via spreading codes, just like in CDMA (Code Division MultipleAccess) systems.

Space time coding:

Transmit diversity can be achieved using space time codes. In typical scenarios, spacetime codes allow the transmissions of orthogonal versions of a same signal over severaltransmit antennas. When these antennas are distributed over several single antenna relayterminals, the same amount of spatial diversity can be achieved. Note that distributingspace time codes on each terminal is resource consuming and that an additional amountof resource is necessary for orthogonal transmission when the number of terminalsexceeds two [22], [18], and [15].

III. 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 QPSK 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 AWGN 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 QPSK modulation block to get the output data.

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 QPSK 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 QPSK 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*

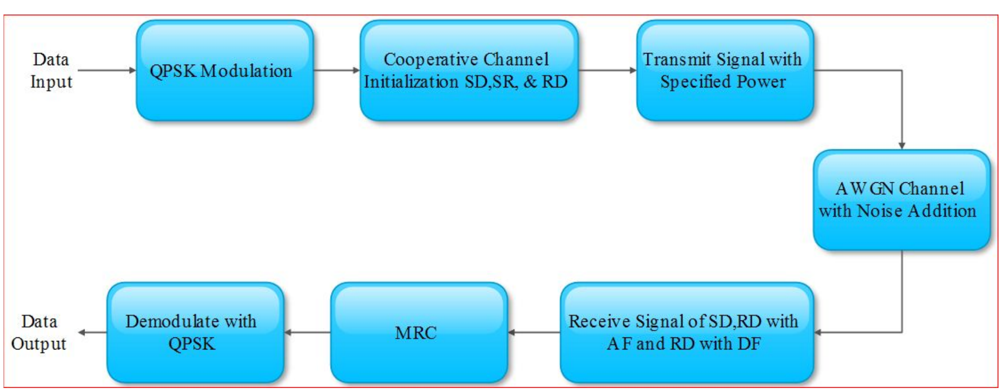

Fig. 3.1 Block Diagram of the proposed methodology

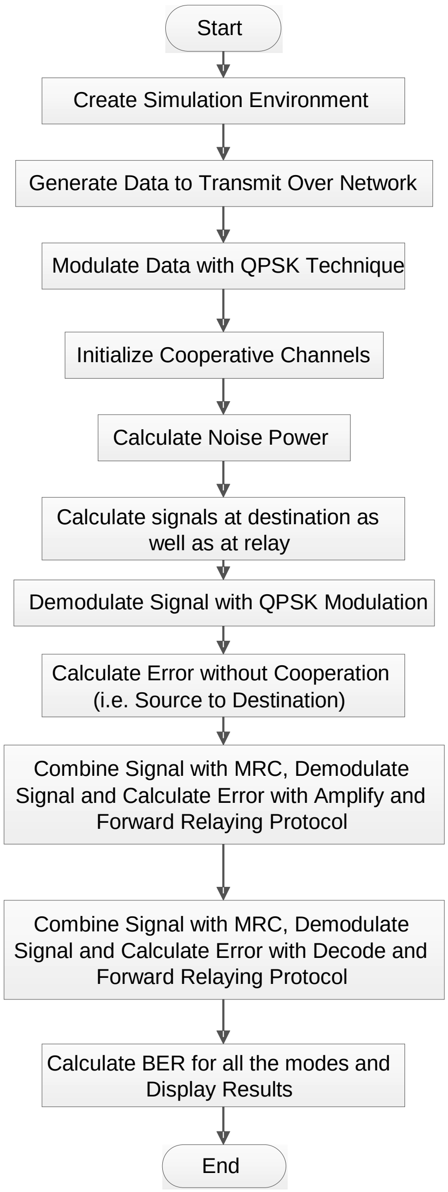

Fig. 3.2 Flow chart of the proposed methodology

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 QPSK modulation with 100000 data and it can also be derived out that as the data size increases performance of the system also increases.

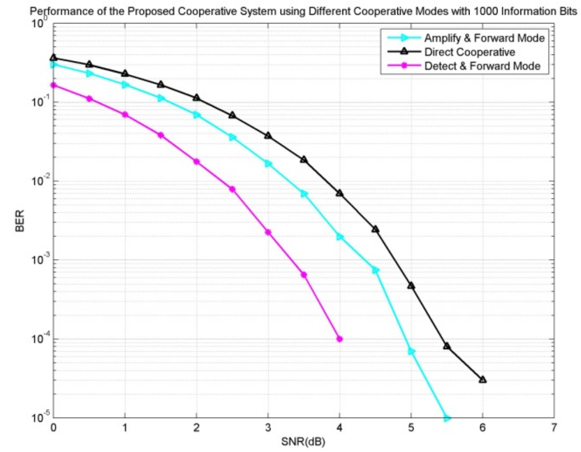

Fig. 4.1BER performance of the Co-operative Mobile System with 1000 data and QPSK Modulation

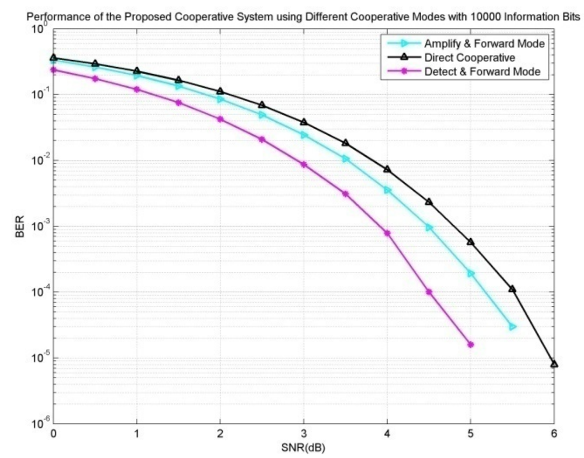

Fig. 4.2BER performance of the Co-operative Mobile System with 10000 data and QPSK Modulation

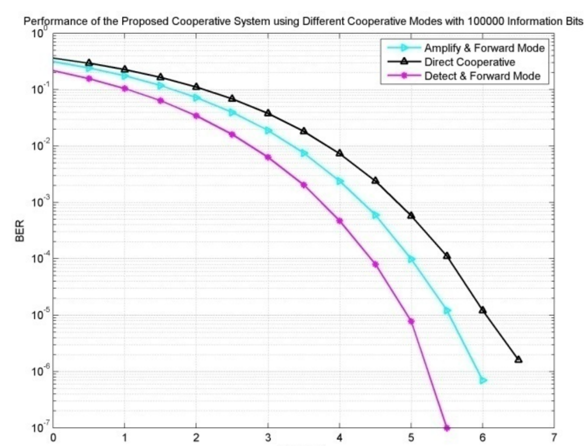

Fig. 4.3BER performance of the Co-operative Mobile System with 100000 data and QPSK Modulation

V. CONCLUSION AND FUTURE SCOPE

The system discussed in this paper is analyzed end to end and the BER is calculated. The BER calculated with QPSKwith 1000, 10000 and 100000 bits data sizes and BER achieved is 10^{-5}, $10^{-5.5}$ and 10^{-7} respectively. In the future aspects of the mobile system the efficient combining techniques will also help to enhance the performance.

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