Performance Enhancement of Co-operative Mobile Network Using 2-PSK Modulation Scheme

Intzar Ansari Hemant Kumar Soni

***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 2-PSK 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, 2-PSK Modulation, AF, DF.**

I. INTRODUCTION

The introduction of mobile and wireless communication systems in the late 20th century 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 and development 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].

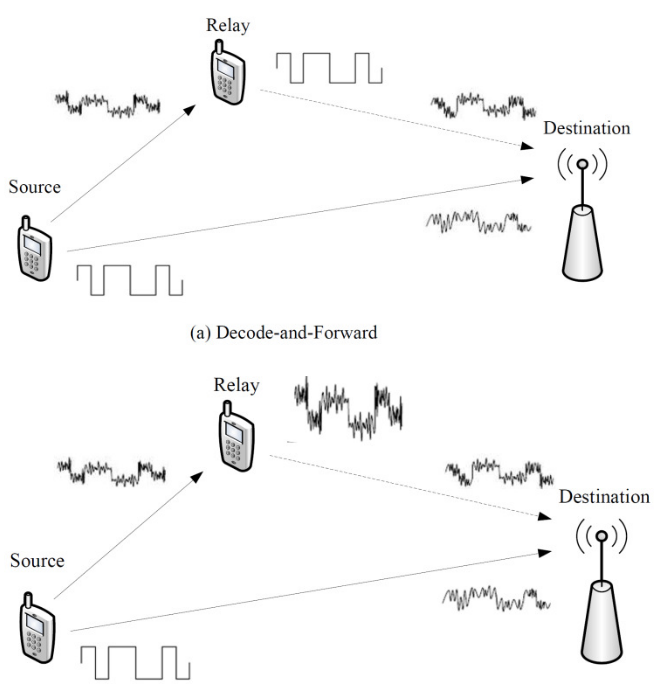

Fig. 2.1 Illustration of Amplify-and-Forward and Decode-and-Forward signal processing methods.

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-relay link. How to avoid error propagation by using adaptive techniques at the relays(s) in coherent/noncoherent DF cooperative networks is one of the main objectives of this work.

With AF, as depicted in Fig. 2.1b, the relays receive noisy versions of the source's messages, amplify and re-transmit to the destination. The AF method is further categorized as variable-gain or fixed-gain relaying based on the availability of CSI at the relays. The variable-gain AF relaying scheme requires the instantaneous CSI of the source-relay link at the corresponding relay to maintain a fixed transmit power at 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 link in 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 propagation problem as the DF method, it presents another problem, that of noise accumulation at the relays. However, it is still attractive since it puts a less signal processing burden on the relays. With AF, the destination requires the perfect knowledge of CSI of all the transmission links propagated by its received signals in order to perform a coherent 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-cooperative transmission since there are at least two transmissions: the one from the source terminal and the one from the relay terminal. This is due to that fact that these two transmissions should not interfere. Thus, they should take place on two orthogonal, non-interfering channels. This is a channel access issue. The channel access is generally processed at the MAC layer since cooperation needs a dynamic resource allocation process. But this issue can 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 be transmitted 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 data orthogonally is the separation in time, called time-division multiplexing. The original data 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 and relayed data using separated carrier frequencies. This idea is suitable for cellular systems because 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 to the base station in different frequency channels. However, this idea is not suitable for ad hoc wireless networks since all mobile terminals use the same frequency band.

Code-division multiplexing:

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

Space time coding:

Transmit diversity can be achieved using space time codes. In typical scenarios, space time codes allow the transmissions of orthogonal versions of a same signal over several transmit antennas. When these antennas are distributed over several single antenna relay terminals, the same amount of spatial diversity can be achieved. Note that distributing space time codes on each terminal is resource consuming and that an additional amount of resource is necessary for orthogonal transmission when the number of terminals exceeds 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 PSK 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 PSK modulation block to get the output data.

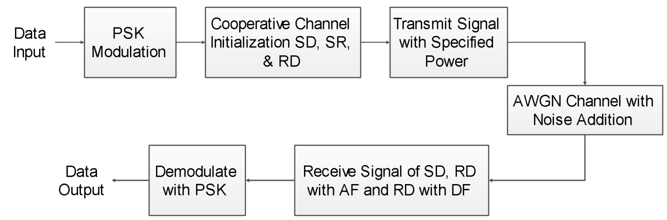

Fig. 3.1 Block Diagram of the proposed methodology

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 PSK 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 PSK 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*

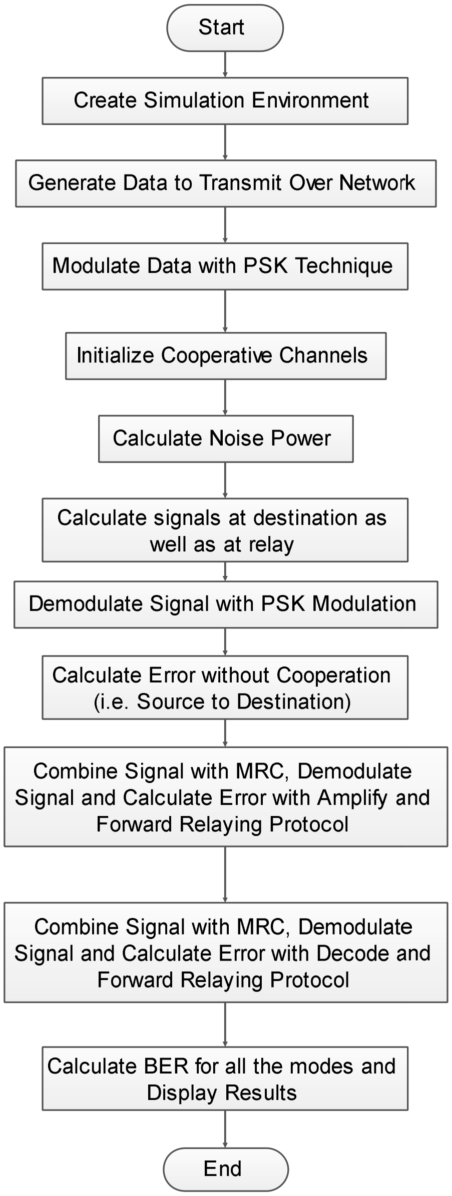

Fig. 3.2 Flow chart of the proposed methodology

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

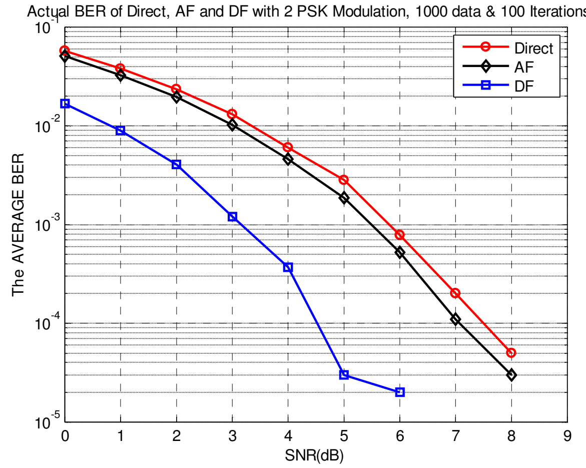

Fig. 4.1 BER performance of the Co-operative Mobile System with 1000 data and 2-PSK Modulation

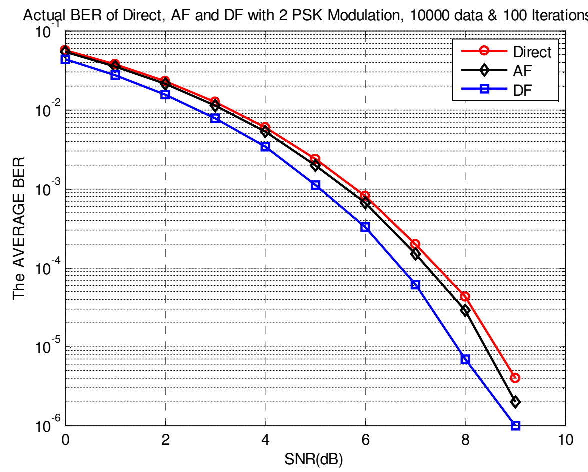

Fig. 4.2 BER performance of the Co-operative Mobile System with 10000 data and 2-PSK Modulation

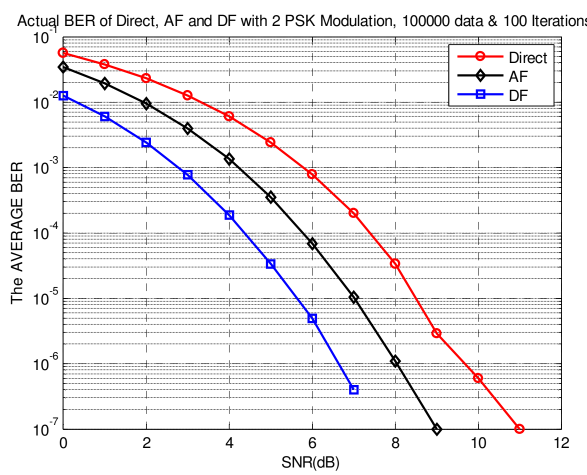

Fig. 4.3 BER performance of the Co-operative Mobile System with 100000 data and 2-PSK Modulation

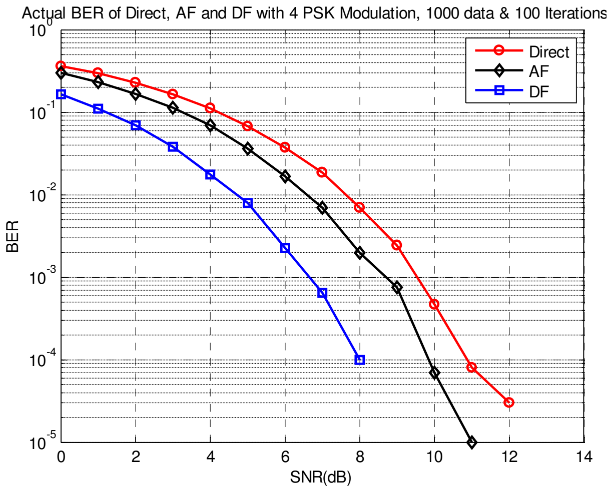

Fig. 4.4 BER performance of the Co-operative Mobile System with 1000 data and 4-PSK Modulation

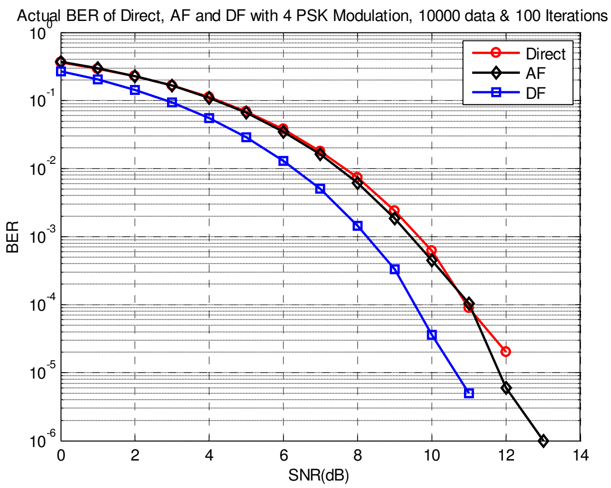

Fig. 4.5 BER performance of the Co-operative Mobile System with 10000 data and 4-PSK Modulation

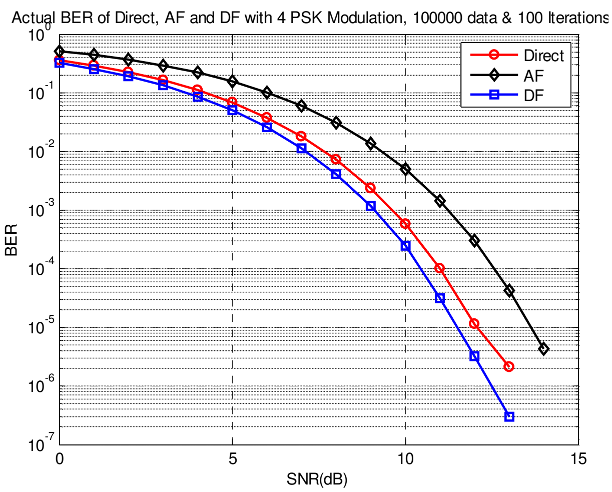

Fig. 4.6 BER performance of the Co-operative Mobile System with 100000 data and 4-PSK Modulation

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 2-PSK modulation with 1000, 10000 and 100000 data sizes are $10^{-4.5}$, 10^{-6} and 10^{-7} respectively after change in modulation technique to 4-PSK with 1000, 10000 and 100000 data sizes and BER achieved is 10-5, 10^{-6} and $10^{-6.5}$ respectively. In the future aspects of the mobile system the efficient combining techniques will also help to enhance the performance.

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