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Efficient Cooperative Relay Network using Different Relay Selection with MRC and ML Detection

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***Abstract* - The cooperative relay network is the integrated part of the long distance communication system and the better performance of it makes communication reliable as well as improve quality of service better. In this paper we have simulated the cooperative relay network with four different relay selection modes having harmonic and maximum values of SNR. The proposed approach contains the combining techniques employed at the receiver to combine various signals received from different channels like SD, SR and RD. The combining techniques referred here is C-MRC and SC with different relay modes AF(Amplify and Forward) and DF(Detect and Forward). The system is followed by detection techniques, maximum likelihood(ML), MMSE and ZF to reduce the bit error rate(BER).**

***Keywords* - Relay Selection, AF, DF, C-MRC, SC, MMSE, ZF and ML.**

I. INTRODUCTION

It has been well established that wireless channels suffer from many impediments, leading to unpredictable and time-varying variations in the received signals. These distortions generally can be divided into two categories, large-scale propagation effects and small-scale propagation effects, based on the distance over which variations occur.

Basically, large-scale propagation effects refer to variations that occur over large distances. The variations are regularly because of path-loss and shadowing [2]. Path-loss, as the name implies, is the attenuation of the transmission power due to distance travelled by the signal. Shadowing is the attenuation of transmission power due to absorption, scattering, reflection, and diffraction of obstacles between a transmitter and a receiver. In our study, to simplify the large-scale propagation model without loss of generality, the simplified path-loss model, in such transmission power decays with distance proportional

The parameter is the path-loss exponent that is usually between 2 and 3. When 2, the model stands for the free space path-loss model in which no obstruction is located between a transmitter and a receiver. If obstacles are involved, path-loss attenuates more rapidly with distance. Small-scale propagation effects refer to variations that occur over short distances.

These variations are usually due to the constructive and destructive additions of multipath fading signals [4]. It is usually used to describe rapid variations of the amplitudes, phases, or may be delays of the received signals over short period of time or distance. There are numerous important factors that influence the small-scale propagation, these are multipath fading, Doppler frequency shift, and bandwidth of transmitted signals. Amongst, multipath fading is one of the main topics in this study so it will be discussed in more detail. Multipath fading occurs in most wireless channels where multipath propagation exists, when any element moves, or when surrounding environment changes. Multipath propagation describes a common phenomenon in wireless channels. In this case, transmitted signals reach the destination through not only the light of sight (LOS) path but also any other possible paths due to reflection, scattering, or diffractions of obstructions, as shown in Fig. 1.1.

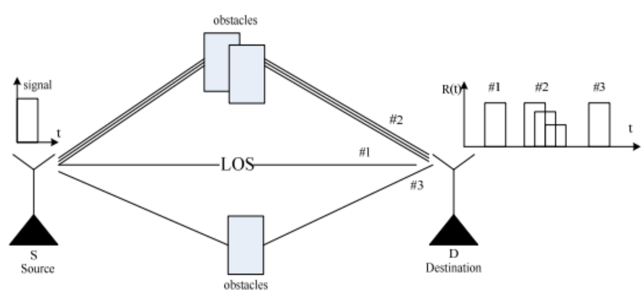

Fig. 1.1 Multipath propagation

Therefore, the destination receives multiple faded replicas of transmitted signals that carry different magnitudes, different phases, and different time delays. These differences are difficult to be measured or predicted since they change with time and the environment. Those random factors can lead to the overall received signal completely faded away at some points in time. They also may cause the power of the received signal increase considerably at other points in time. Obviously, the unpredictable and time-varying fluctuations make wireless channel extremely unreliable.

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Theoretically, multipath fading is usually described in statistical ways since the geometry and dielectric properties of wireless propagation environment are unknown, especially when the number of multipath components goes to large [5]. In order to exploit the channel model we use in our study, an important channel parameter, coherence bandwidth, may be introduced. Coherence bandwidth is used is to measure the range of frequencies over which the channel passes all spectral components with approximately same gain and linear phase. If the coherence bandwidth is larger than the symbol bandwidth, the fading channel can be treated as flat fading. In this research work, we adopt a Rayleigh flat fading channel model. We also assume that the channel coefficients corresponding to different paths are independent and identically distributed.

II. PROPOSED METHODOLOGY

The cooperative relay system is made the communication possible with relay based approach which is the kind of amplification during transmission to reduce the error and noises inserted by the wireless channel.

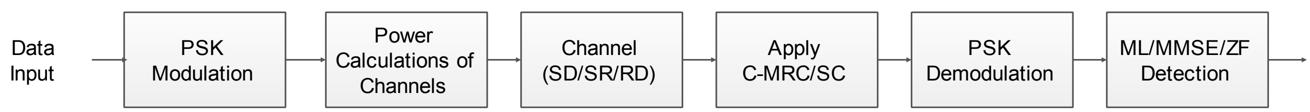

Fig. 2.1 Block Diagram of Proposed Methodology

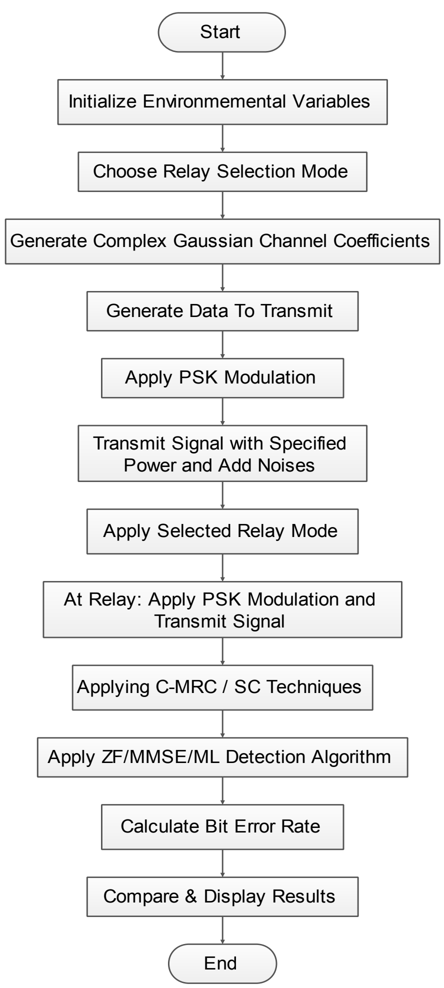

Fig. 2.2 Flow Chart of Proposed Methodology

But system still need to be improved to make long distance communication possible with less noises and distortions during transmission. The same thing kept in mind the a cooperative relay system is proposed in this paper. Which is explained in this section. The block diagram of the proposed cooperative relay system with relay selection scheme with multiple modes amplify and forward (AF) and detect and forward(DF) followed by combining technique coherent-maximal ratio combining (C-MRC) and selection combining (SC). To reduce the effects of errors detection algorithms are applied which are maximum likelihood (ML), minimum mean square error(MMSE) and zero forcing (ZF). The whole system is shown with the major blocks in Fig. 2.1. Where data is randomly generated to achieve the all the possibility of noise encounters. The channel considered here gaussian channel which is the most near to practical channel behavior. After applying combining techniques at the receiver signal is then detected by the detection algorithms and then finally get the data at the output.

The proposed system is explained using the block diagram in the Fig. 2.1, and this system is simulated in the simulation environment and the simulation steps are shown in the Fig. 2.2 with the help of flow chart. In the simulation step first the simulation environment need to be created with the help of variables, followed by the initialization of the channel coefficient initialization which are source to destination (SD) , source to relay (SR) and relay to destination(RD) having four different relay selection schemes. The data is generated randomly to achieve all the possibilities with the system integration.

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Then the proposed methodology is applied i.e. combining techniques followed by linear(MMSE, ZF) and non-linear(ML) detection techniques to get the optimum results. Last step is to compare and display all the possible relay selection results with different techniques and modes.

III. Simulation Results

In this section the experimental results of the proposed system are displayed and compared for linear and non-linear detection techniques which are given in below figures.

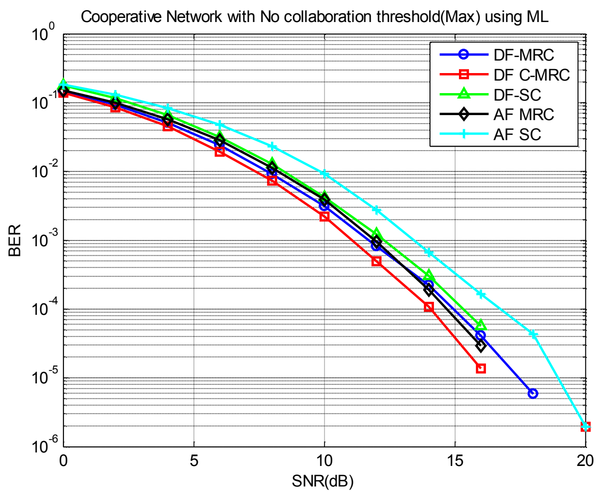

Fig. 3.1 BER Vs SNR for Relay Selection with No Collaboration Threshold(Max) using ML

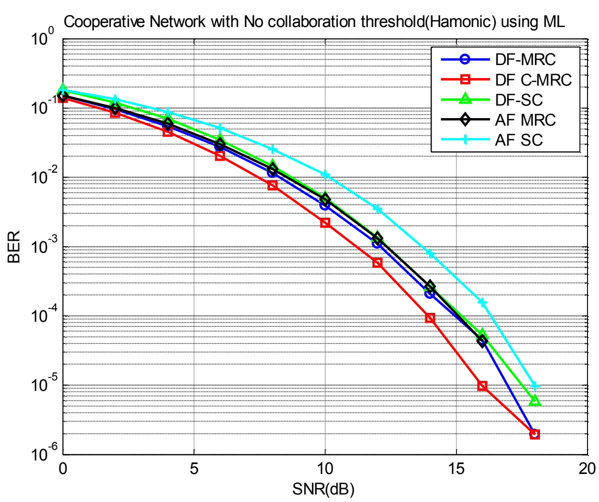

Fig. 3.2 BER Vs SNR for Relay Selection with No Collaboration Threshold(Harmonic) using ML

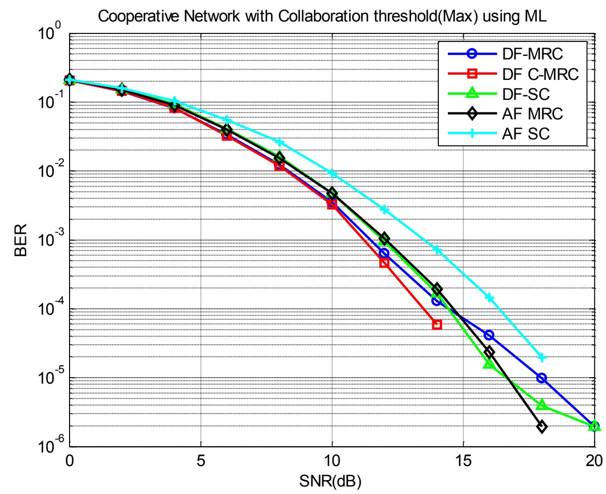

Fig. 3.3 BER Vs SNR for Relay Selection with Collaboration Threshold(Max) using ML

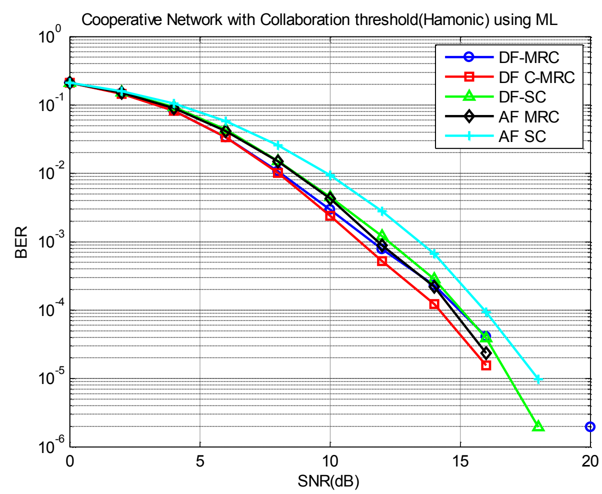

Fig. 3.4 BER Vs SNR for Relay Selection with Collaboration Threshold(Harmonic) using ML

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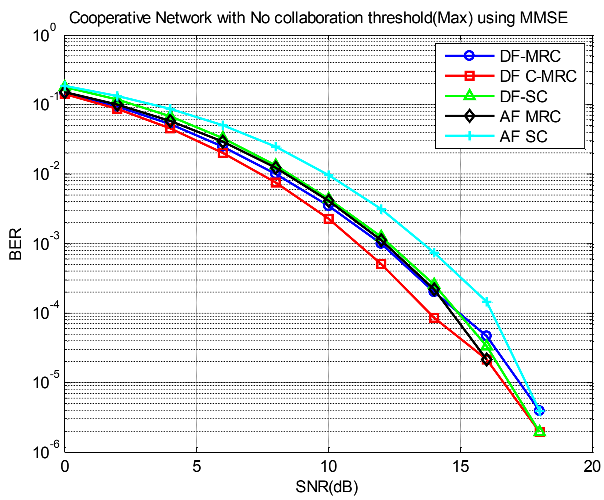

Fig. 3.5 BER Vs SNR for Relay Selection with No Collaboration Threshold (Max) using MMSE

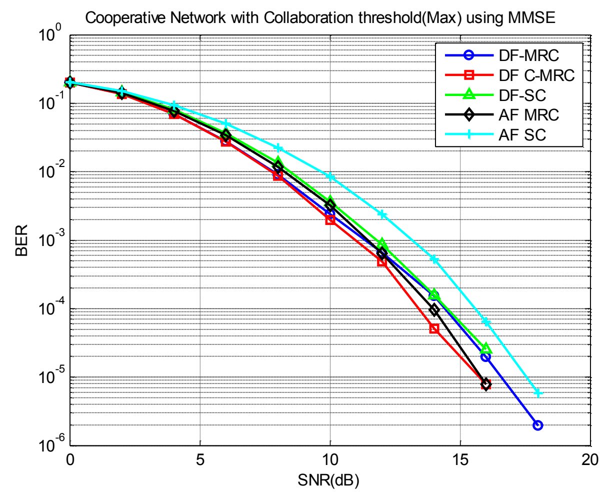

Fig. 3.7 BER Vs SNR for Relay Selection with Collaboration Threshold (Max) using MMSE

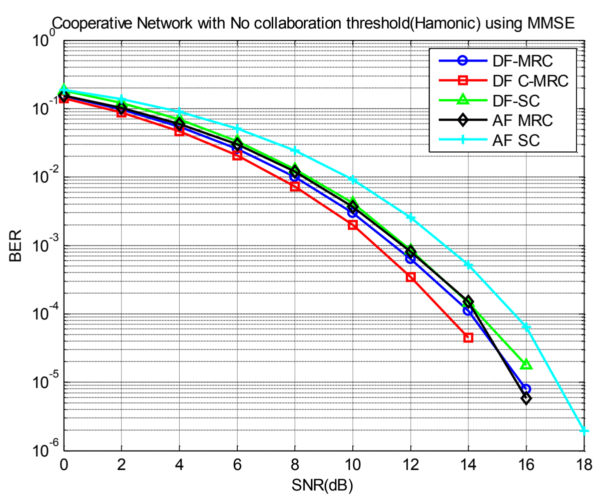

Fig. 3.6 BER Vs SNR for Relay Selection with No Collaboration Threshold (Harmonic) using MMSE

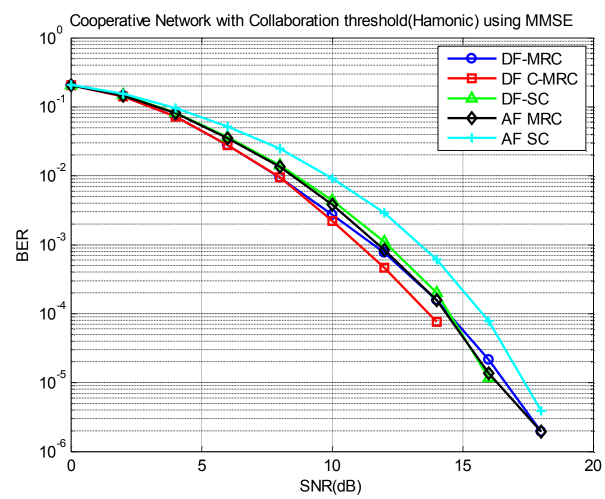

Fig. 3.8 BER Vs SNR for Relay Selection with Collaboration Threshold (Harmonic) using MMSE

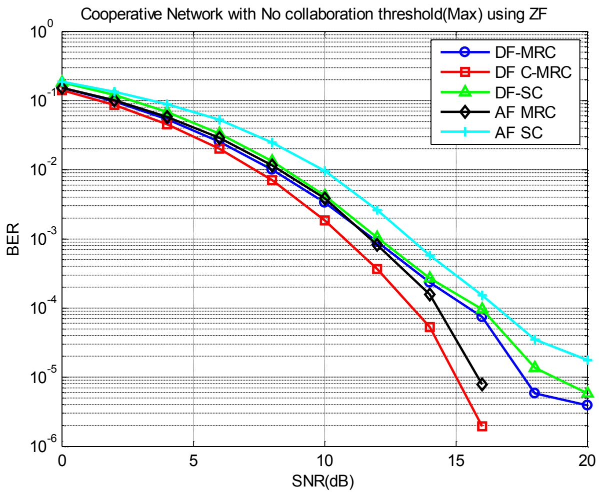

Fig. 3.9 BER Vs SNR for Relay Selection with No Collaboration Threshold (Max) using ZF

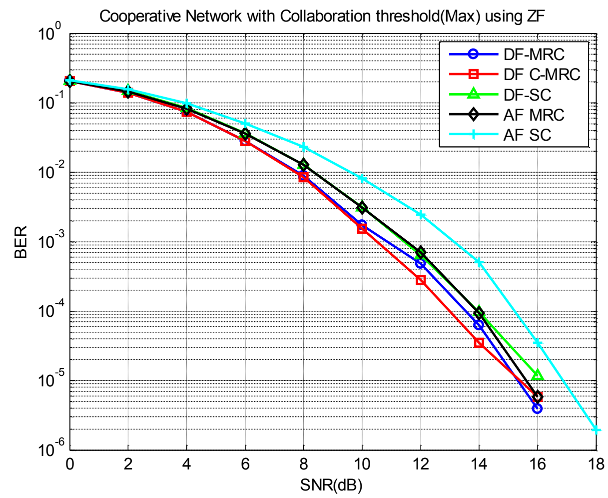

Fig. 3.11 BER Vs SNR for Relay Selection with Collaboration Threshold (Max) using ZF

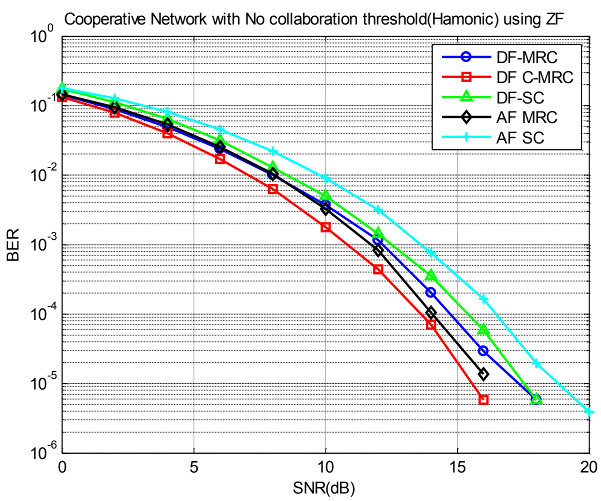

Fig. 3.10 BER Vs SNR for Relay Selection with No Collaboration Threshold(Harmonic) using ZF

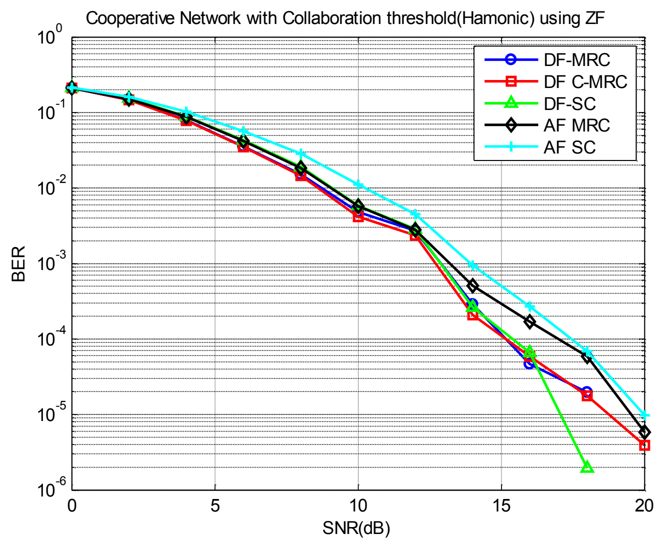

Fig. 3.12 BER Vs SNR for Relay Selection with Collaboration Threshold(Harmonic) using ZF

From the above simulation results of proposed system with MRC and SC with four different relay selection schemes with detection algorithms. And it can be seen that the cooperative relay communication system outperform with coherent-MRC and maximum likelihood(ML) detection algorithm as well as ZF and MMSE.

IV. Conclusion And Future Scope

From the simulation results we can say that the results of the proposed approach is better with the coherent maximal ratio combining (C-MRC) using Amplify and Forward(AF) followed by with all the detection algorithms MMSE, ZF and ML. It can been seen the simulation results in the previous section if this paper.

In the future the application of filtering and advanced detection algorithms make system more robust and error free.

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