Design of Appropriate Controller to Remove the Impacts of the Data Transmission Network and Achieving Proper Performance of the System

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***Abstract* - One of the most important issues in the cooperative communication networks is choosing how to participate and selecting the relay. The relay determination plays an effective role on the performance of these networks. By choosing a proper relay, we can improve the performance dramatically. In this paper, the methods of participation and relay selection in the cooperative communication networks are examined. At this end, using the relationship of probability of the system's symbol error, we conclude the best relay station for these networks by three ways of "decoding partnership and forward", "amplifying-forward and decode" and "forwarding the selective sample" as well as for two modulation "PSK and QAM." So that, an optimizing issue can be addressed in which, the provision of meeting the system quality is that the probability of symbol error is less than a threshold value. Then, based on the obtained relationships, the amount of power consumed is utilized by three cooperative methods to determine the best approach in terms of consumption of the nodes power.**

Keywords: Relay selection, decoding, network capacity, Cooperative Telecommunication

I. INTRODUCTION

In the receiver, we can approach the maximum ratio of signals to the noise using the independence of fade coefficients of receiving signals as well as combining them. However, in many cases due to limitations on size, cost, hardware of wireless devices, taking advantage of using multi antennas at the transmitter or receiver is not possible. Therefore, the new system with multi- antennas at a station, can utilize the other groups' antennas. The critical idea on the cooperative telecommunication is that all the users can help each other to transmission of the signals in the cooperative way. Each user's data can be sent not only by itself but also the other users can send it as well, so the information received at the destination is more reliable, because by multiplicity, fade is also reduced. The basis of this method can be relied by the relay and multi-hopping method. Multi-hopping (frequency hopping spread) is of one of the oldest methods of sending information over long distances. This method can easily overcome the signal attenuating. In wireless networks, the multi-leap ideas for two reasons "increasing the transmission rate" and "minimizing the power consumption" is very important. For example, in a sensor network with energy-constrained sensors, using some leaps to send data to the destination is essential. Thus, how to efficient use of network resources and to increase the network lifetime is of important debates. By emerging the cooperative telecommunication technology, the recourses of cooperative groups (energy & channels) are participated, and it provides an effective way to save the nodes energy and increases the lifetime of the network as well. In addition, selecting the appropriate relay leads to decrease the consumed energy, which uses the auxiliary nodes located between the origin and destination. This action improves the communication and expands the area under cover, on the other hand, the power control in order to increase the energy consumed for transferring each data package in the network node is of much importance. The major goal of collaborative systems is to increase the network capacity, reducing the power consumption and to extend the area covered by the network. The concept and idea of cooperative telecommunications is somewhat different from the works undertaken on the relay channel.

In recent years, several methods have been suggested from the simple methods of decoding and forwarding, to more methods of distributed relaying that are complex. These methods are such as decode-and-forward and distributed coding. These methods also include using decode-and-forward, amplify-and-forward and cooperative coding method. In addition to increasing the popularity of cooperative telecommunication and relay, how much performance is improved is of remarkable points. In some studies done on the relay selection, selecting only a contributor one ahs got so important. In these cases, it is paid that the slag attributed by the orthogonal channels is minimized and the complexity of the selection process is reduced. In some resources, the conclusion is that the design of a time - space code for a number of relays is difficult. They suggest an opportunistic relay (OR) that is a plan of distributed relay selection with no need to the general information of geographical status to select a single relay.

Of the resources available for a collaborative network can mention the frequency spectrum and even the network nodes. As already described, one of the ways to deal with fading is multiplicity. Collaborative networks build up the spatial multiplicity in the wireless networks. One of the most important factors in the design of cooperative communication system is to select a suitable relay and in this thesis, we have evaluated the issue of relay selection in the cooperative networks in the following. In addition, on another significant factor in the collaborative telecommunication systems to improve the system, performance is allocation of optimized power to the users, and here we have tried to allocate the optimized power to the users, meanwhile to evaluate the relay selection base on the position..

II. SYSTEM MODEL

The System model comprises a transmitter, a relay, and a receiver as in Figure (1). We assume a two phased cooperative approach in the wireless networks.

In the first phase, each node sends off data to the destination and the other nodes receive the information simultaneously. In the second phase, any node help to the other nodes with sending the information received in the first phase. Each node may decode received data and then send it or simplify and send it simply. In both phases, the nodes send data through the perpendicular channels. To better understanding the participation thought, we focus on two-user cooperative plan. In the first phase, user 1 sends data to the destination, and the user2 receives data. User 2 helps the user 1 with sending data in the second phase. Similarly, when the user 2 helps user1 with sending its data to the destination in the first phase, user1 receives and then sends it to the user destination 2 in the second phase. Due to the symmetry of the two users, we just analyze the performance of the first user.

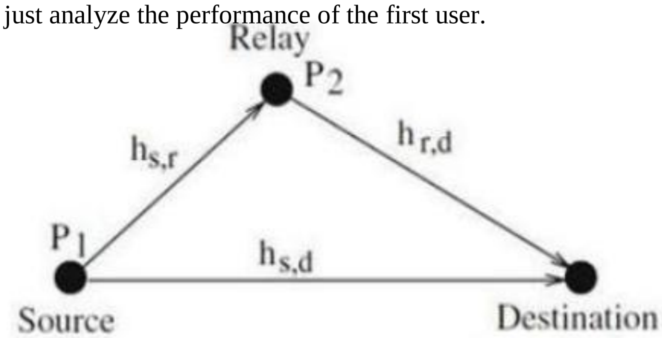

Figure (1) System Model

A. Selecting the appropriate relay and controlling the power to DF cooperative system:

Here, in order to examine the subject of distance-based optimization, we utilize the relationship between the average fade channel $\sigma_{i,j}^2$, Fade, and the distance between the nodes [1]:

$$\sigma_{i,j}^2 = C.d_{i,j}^{-n} \qquad (1)$$

In which:

$\sigma_{i,j}^2$: The channel variance between two nodes i and j

$d_{i,j}$: The distance between two nodes i and j

n: The power of wireless channel losses and

C: Constant value

Without loss of subject generality, the C is assumed 1 since then. So for the average probability of symbol error for the channel with Riley feeding:

$$P_e \approx \frac{N_0^2 d_{s,d}^n}{b^2 P_1}\left(\frac{A^2 d_{s,r}^n}{P_1} + \frac{B d_{r,d}^n}{P_2}\right) \qquad (2)$$

And for MPSK modulation, we have:

$$b = b_{PSK}, A = \frac{M-1}{2M} + \frac{\sin\frac{2\pi}{M}}{4\pi}, B = \frac{3(M-1)}{8M} + \frac{\sin\frac{2\pi}{M}}{4\pi} - \frac{\sin\frac{2\pi}{M}}{32\pi} \qquad (3)$$

For MQAM modulation, we have:

$$b = {b_{QAM}}/{2}, A = \frac{M-1}{2M} + \frac{k^2}{\pi}, B = \frac{3(M-1)}{8M} + \frac{k^2}{\pi} \qquad (4)$$

In this part of article, we suggest a strategy of optimized relay selection of the efficient energy for DF cooperative transmission. In the proposed method, the relay selection criteria, is the relay distance to the optimized relay situation while the source transmission power, relay, or both is minimal. In this method, minimizing the source transmitter power, relay, or both of them have been considered in compliance with the SER condition. The optimality subject is defined as follows, in which, $\overline{P_{SER}}$ is considered as threshold for the probability of symbol error. P^{min} Is minimum power to transmit each byte of information to the node destination.

$$\begin{cases} min(P = P_1 + P_2) \\ s.t\, P_e \le \overline{P_{SER}} \end{cases} \qquad (5)$$

Using equation (1) we can solve the subject. We rewrite the subject condition as:

$$\left(\frac{A^2 d_{s,r}^n}{P_1} + \frac{B d_{r,d}^n}{P_2}\right) \le E \qquad (6)$$

Where E equals:

$$E = \frac{\overline{P_{SER}}\, b^2 A^2}{N_0^2 d_{s,d}^2} \qquad (7)$$

To solve the optimization equation we use the Lagrange equations:

$$F(P_1, P_2) = P_1 + P + \beta\left(\frac{A^2 d_{s,r}^n}{P_1^2} + \frac{B d_{r,d}^n}{P_1 P_2} - E\right) \qquad (8)$$

P_1^{min} : Minimum transmitter power of the source node and

P_2^{min}: Minimum transmitter power of nodes relay

$\beta(\beta \ne 0)$: Lagrange equation coefficient

Firstly, we examine the effect of the path loss power changing in BPSK modulation, i.e. for various n, we obtain the matrices corresponding to the minimum total power, the minimum transmitter power of source node and the minimum transmitter power of the relay node. In PSK modulation for Various M and different path loss powers, the optimal situation of the relay is on connective line of node from the origin to the destination.

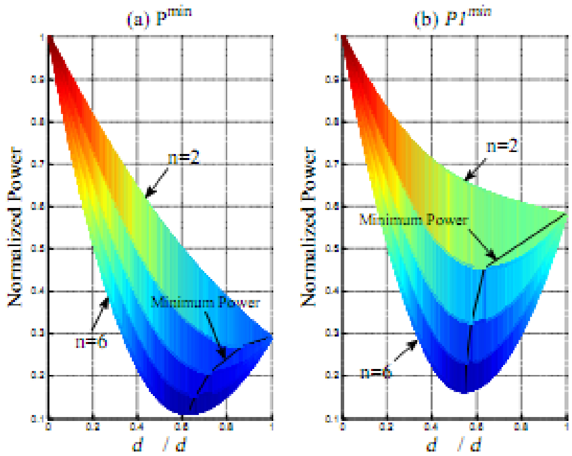

Figure (2): changes of total consumption power based on the changes of the relay position and the path loss power

In Figure 2 it is shown that for the drop in the path 2, the graph is quite descending, but for greater n at a point between the source node and the destination one, the minimum power is obtained which connect to each other with black lines.

Figure 3 shows that through changing the modulation, the optimal position of the relay will also change. With the increase of M, the total consumption power increases. Figure 3 also shows that for two QAM and PSK modulation with identical M, the QAM modulation consumes less power.

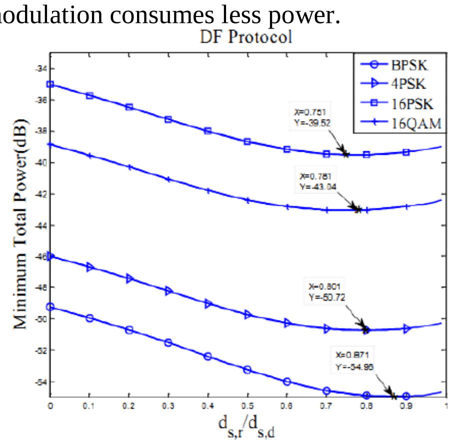

Figure (3) the total consumption power based on the relay position for different modulations

In the QAM modulation, the share of relay power in the total power is less. Therefore, it can be said that in the DF cooperative approach, the QAM modulation has priority.

III. REVIEWING THE AFFECTIVE PARAMETERS ON THE OPTIMAL RELAY POSITION AND CONSUMED POWER:

In this section, we pay to how different parameters affect the optimal relay and the amount of consumed power in summary.

A. Path loss power: with increase of the path loss power and PSK & QAM modulation, in order to minimizing the total power, the relay optimal position from the origin tends to the center. In addition, in order to minimizing the transmitter power node, with increase of n around the center of the node the source tends to the center. In all states, to minimize the transmitter power of the relay node, the relay node should be near the destination node. It is obvious by increasing n the total power and transmitter power of the relay node increases as well.

B. Probability of symbol error: Lower considered error for the threshold value, more powers. Since the threshold value displays as a coefficient with inverse relationship with the powers [2], so its changes does not have any effect on the relay optimal position, hence we have considered the Reference [2] symbol error in all the relationships.

C. Modulation: As shown in the previous sections, the modulation changes in two cooperative methods AF and ISDF unlike the DF cooperative approach does not change the optimal relay position. In both PSK & QAM modulation, with increasing the signals system, the consumption power increases.

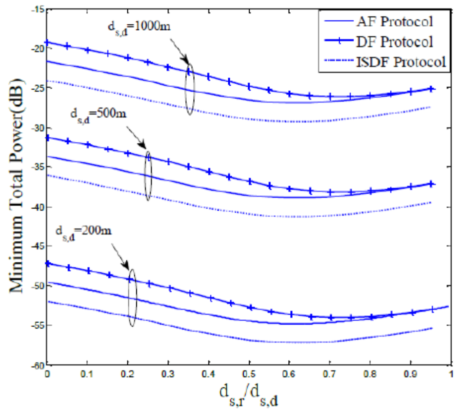

Figure (4) the total power consumed based on the relay position for different modulations

D. Distance between the origin node and the destination node: As noticeable in the Figure (4) by increasing the distance of the source node and the destination node, the consumption power increases, however the optimal relay position is fixed for all the distances, means that $d_{s,r}/d_{s,d}$ remains same even by changing the distance of the origin node and the destination node.

IV. CONCLUSION AND DISCUSSION

At first, we examined the error probability in the decoding and retransmission cooperative method, and then based on the obtained relationships, the optimizing subject was stated in which the goal was to find a situation for the relay with minimizing the consumption power in addition to satisfy the condition of the channel quality – considered as the probability of symbol error -. The simulation results show that for all three proposed cooperative methods, the optimal relay location changes with changing the power of the path loss. It was also shown that in the DF cooperative method unlike the other AF & ISDF methods, the optimal relay position depended on the modulation type and with enlargement of modulation signals system, the optimum point tended towards the center. Comparison between the three cooperative methods **AF, DF,** and **ISDF** for two **PSK** & **QAM** modulations shows that the **ISDF** approach has the lowest consumption power and **DF** the maximum consumption power among the three stated methods.

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