The Performance Improvement of Long Range Inter-relay Wireless Cooperative Network using Three Time Slot TDMA based Protocol

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Abstract— ***Time division multiple access (TDMA) amplify and forward based protocols for cooperative wireless networks have been investigated previously by various researchers. However, the analysis for these protocols is not considered for long range cooperative wireless networks over Rician fading channel. Therefore, the aim of this paper was to propose three time slot TDMA based transmission protocol for inter-relay cooperative wireless network with longer distances between source to relays and destination as well as between relays to destination. It is concluded that the proposed protocol shows less BER performance for long range inter-relay cooperative network over Rician fading channel as compared to two time slot long range cooperative network. Moreover, the proposed protocol shows better performance in terms of less BER values when the inter-relay distance is minimum.***

Keywords: **Cooperative inter-relay wireless communication, AF Protocol, TDMA, Path Loss Models, BER.**

I. INTRODUCTION

The mobile radio channel suffers due to fading effects during transmission of data from source to destination and undergoes through several signal variations at destination. In order to mitigate fading, diversity communication is used to send the same data over independent fading paths (diversity branches). There are some common techniques such as micro diversity, macro diversity, space diversity, frequency diversity and time diversity, which are used at the transmitter and receiver to achieve diversity communication [1]. The diversity achieved by the above methods tends to increase the size, complexity and total power of the wireless network devices. To solve this problem cooperative diversity communication has been introduced recently.

In cooperative diversity communication the diversity is achieved due to cooperation among users or relays, for example, in case of two users or relays and one destination, each user or relay is not only responsible for transmitting their own information data, but the information of their partner user or relay as well to the destination, virtually seeking the advantages of MIMO spatial diversity [2-5]. Each user in cooperative diversity acts as a relay for another user using either amplify and forward (AF) or decode and forward protocol (DF) in order to transmit the information to destination. In DF the relay decodes the received signal from the source and forwards to destination, while, in AF the relay amplifies the received signal from source and forwards to destination [3], [6].

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Cooperative communication solves the issues of size, cost, and hardware limitations of multiple antennas [7]. Moreover, cooperative communication also helps to reduce the effects of multi-path fading and increase capacity of wireless channel as well as achieves high data rates [8-9].

Different multiple access techniques such as time-division multiple access (TDMA), frequency division multiple access (FDMA), and code division multiple access (CDMA) have been proposed by researchers to achieve high diversity order at destination [10-12].

In [13], the authors proposed three different two time slots TDMA based transmission protocols. The protocols implement varying degree of broadcasting and receive collision at destination. In each protocol the relay either amplify and forward or decode and forward the received signal from source. In [14] a novel scheme of cooperative network using three time slots is analyzed. The cooperative network is based on data exchange between relays in the third time slot in order to enhance the link performance between relays and destination. In [15], the authors proposed hybrid TDMA-FDMA based three time slots protocol with inter-relay communication over Nakagami-m fading channel. In [16] the authors proposed TDMA based three time slot protocol with inter-relay communication over Nakagami-m and Rician fading channels. In the first time slot the source broadcasts to both the relays and destination. in the second time slot the relays exchange their data as well broadcasts to destination. In the 3rd time the relays broadcasts the previously exchange data in the 2nd time slot to destination. The source remains silent in the 2nd and 3rd time slots and does not broadcasts to destination in these slots.

To the best of our knowledge the BER analysis for inter-relay communication using longer distances between source to destination and relays as well as between relays to destination has not been investigated. A path loss issue and shadowing effects arises in case of longer distances between source to destination and relays as well as between relays to destination. In order to coup the path loss and shadowing issues a proper path loss model is required during BER analysis for inter-relay communication.

In our work, a three time slot TDMA based protocol using path loss model with inter-relay communication is proposed. BER analysis is investigated and repeated for proposed model using 7 different selected path loss models. The BER analysis results are then compared with the results obtained from previously proposed protocol in [13]. It is shown that the proposed protocol performs better in terms of less BER as compared to two times slot protocol proposed in [13].