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Cooperative Diversity Analysis using DF Relay Network over Rayleigh Fading Channel

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ABSTRACT: This paper, presents analytical expression for the outage probability of cooperative communication system using various DF relay protocol strategies which enhance coverage and potentially increase capacity. At the destination, the signals from multiple relay are combined using selection combiner. We first derive expression for the outage probability which encompass the Rayleigh fading. It is shown that increase the number of relay decrease the outage probability at high signal to noise ratio.

KEYWORDS: Cooperative communication, Decode forward relay, Rayleigh fading channel, outage probability, selection combining.

I. INTRODUCTION

Transmission over wireless channel suffers with random fluctuation in signal level known as fading and from cochannel interference [1]. Diversity is a very powerful technique to mitigate fading and improve robustness to interference. Cooperative relaying has been adopted as an effective strategy to improve network capacity and link reliability in emerging standards, such as long term evolution-advanced (LTE-A) and IEEE802.1m [2].

Relay- There are two popular relaying protocol are amplify-and-forward (AF) and decode-and-forward (DF). In cooperative link, the message sent by the source arrives at the destination through relay nodes. Relay can afford analogprocessing, they can amplify-and-forward (AF) the source waveform to the destination. Unfortunately, analog AF transceivers require expensive RF chain to mitigate the coupling effects present. This motivates digital processing at relay nodes to sample and store the source waveform digitally before retransmission. Because such relays forward the decode message to the destination, they are known as decode-and-forward (DF) relays. In AF scheme, the source signal is just scaled by gain before being forwarded to destination, where as in DF scheme, some signal processing and coding need to be performed by the relay before the source signal isforwarded. So we concentrate only on decode and forward relaying protocol [2] [3].

Diversity- Diversity is prime important due to the nature of wireless environment. Providing additional independent copies of the same information via shadowing and fading channel yield diversity gain by having a relay providing a copy in additional to the information received already via the direct link. In several relay providing copies in parallel. The probability depend upon rate hence diversity gain at asymptotically high SNRs as

$$Pout = \frac{const[R]}{SNR^{d}}$$

Where d is diversity gain or diversity order.

In the slow fading environment, once a channel is in deep fade, message coding is no longer effective in improving transmission reliability, and cooperative relay network in Rayleigh fading channels. Among the multiple parallel DF relays that are deployed in the networks, the best one the correctly decode the message are utilized to forward signal from the source to destination. The signals received from the multiple relay to different destination using selection combiner. We first derive PDF and the cumulative density function (CDF) for number of Rayleigh fading channel.

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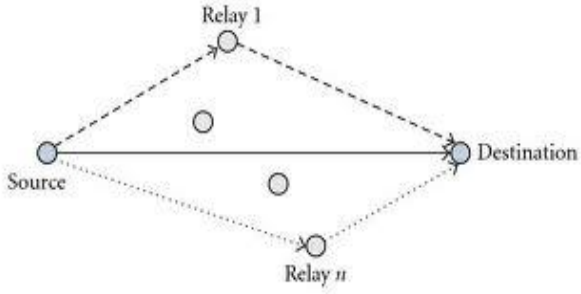
II. RELATED WORK



The above fig. show a simple cooperative diversity relay network using N relaying branches. In this paper, it assumed that it operates in two phase: the relays-receive phase and the relay- transmit phase. Throughout this paper, it assume that no channel knowledge in the transmitter, perfect channel state information in the receivers and perfect synchronization channel state information in the receivers implies that the S-R channel is known to the relay terminal, while the R-D channel are known to the destination terminal. Depending upon relaying mode that is DF mode. Such a relaxation of the assumption channel knowledge will be heighted in corresponding discussion.

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III. ANALYTICAL CALCULATION

Input-output relation for DF mode- the signal transmitted by source terminal is $x_s[n]$ the signal received at destination one $y_d[n]$

It is assumed that there is single source and single destination. So that signal receive at relay from source is given as

$$y_{sr_i}[n] = x_s[n]h_{sr_i} + z_{r_i}[n]$$

In the above equation h_{sr_i} is channel gain and z_{sr_i} is additional noise.

$$y_{r_id}[n] = x_{r_i}[n]h_{r_id} + z_{r_id}[n]$$

Presenting the calculation of cumulative distribution function of instantaneous channel gain of various wireless link in a cooperative diversity relay network

1. Outage probability calculation

Outage probabilities of DF relay using selection combiner-

$$Pout = \left[\prod_{i=1}^{n}\left\{\min\left(\gamma_{sr_i},\gamma_{r_id}\right)\right\}\right]^n$$

$$Pout = \min\left(\gamma_{sr},\gamma_{rd}\right)^n$$

$$= \left[1-\max\left(\gamma_{sr},\gamma_{rd}\right)\right]^n$$

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Outage probability of Rayleigh fading channel

$$Pout = \exp\left(\frac{\gamma_{th}}{\gamma}\right)$$

The cumulative function of above function are given as

$$Pout = 1 - \exp\left(\frac{-\gamma th}{\gamma}\right)$$

Hence the outage probability for Rayleigh fading channel from source to relay and relay to destination using selection combiner are given as

$$Pout = \left[1 - \left\{\exp\left(-\frac{\gamma_{th}}{\gamma_{sr}}\right)\right\} \times \left\{\exp\left(\frac{\gamma_{th}}{\gamma_{rd}}\right)\right\}\right]^{n}$$

IV. PROPOSED ALGORITHM

The outage probability of Rayleigh fading channel is given in figure 5.1 for $1 \times 1 T_X$ and R_X system, where carrier transmit antenna are employed to transmit BPSK data symbol over Rayleigh fading channel through the two hop that is source to relay and relay to destination via multiple DF relay protocol.

Simulation parameter for outage probability versus SNR

Parameter	**Value**
Symbols	BPSK
No. of hop	2
T_X and R_X	1×1
No. of relay	5
Type of relay	DF
SNR	1:10
Threshold SNR	3

Outage probability when SNR is constant and threshold SNR vary

The parameter for this plot are taken as

Simulation parameter for outage probability versus threshold noise

Parameter	**Value**
Symbols	BPSK
No. of hop	2
T_X and R_X	1×1
No. of relay	5
Type of relay	DF
SNR	3
Threshold SNR	1:10

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V. SIMULATION RESULTS

As in Rayleigh fading channel both SNR form source to relay and relay to destination assumed to be identical. In fig.1 it illustrates the validity of our analysis via providing the analytic-al expression. Moreover, the enhancement on system performance due to use of more relay is obvious in this figure.

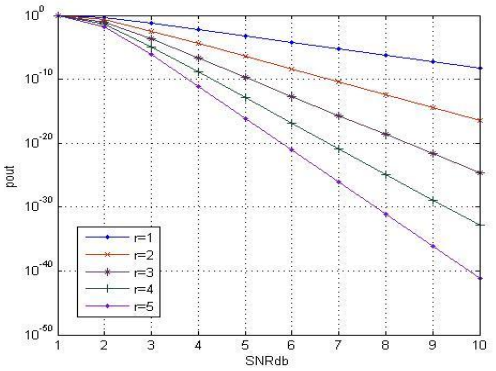

Fig.1 Outage probability of N decode-and–forward

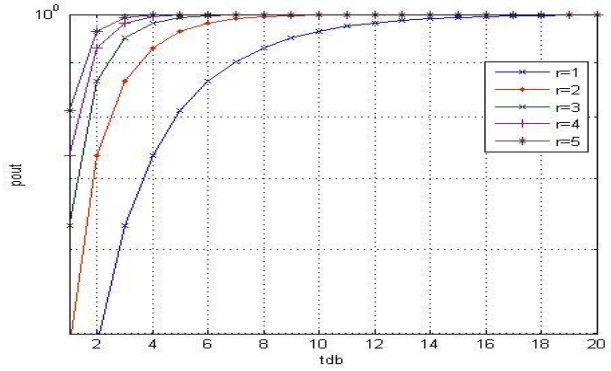

Fig.2 Outage probability of m decodes-and forward protocolv/s SNR protocol v/s threshold SNR

VI. CONCLUSION AND FUTURE WORK

In this paper we evaluate the outage probability of dual hop opportunistic DF relay system in the presence of interference at both relay and the destination node. We derived an outage probability for Rayleigh fading channel expression with low complexity having N relay which use DF protocol. Weanalysed the outage probability of wireless cooperative relay network over twohop that is source to relay and relay to destination, to this end we derived a valid expression of PDF andCDF. In this section we have derived exact expression for the outage probability of various DF protocol. We have verified all these result using MATLAB simulation. The plot of outage probability in figure 1 shows that as the number of relay increase the outage probability decreases.

In figure 2 also shows that as number of relay in cooperative communication increase the outage probability decrease but outage probability increases with increase of threshold value. Above all plot show that the performance improve by increasing the number of relay as compared to using single relay or signal travel through the hop form source to destination.

In this thesis we proposed cooperative strategies for the multicast and broadcast traffic model. Cooperation is large network with a different traffic model that assumes a single source destination link. We considered a simple two hop protocol the precludes communication among relay, rather relay process information received from the source and destination. Our view is that for such pair, the relay network in between is a resource that use efficiently. With the multiple relay we use selection diversity technique through which best pair of relay hop selected have best signal strength hence it also reduces the complexity of calculation. We can exploit the above work with MIMO system and can use other diversity technique to improve the system performance

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BIOGRAPHY

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