MAT JOURNALS

Journal of Analog and Digital Communications
Volume 3 Issue 3

Performance Enhancement of Wireless Networks Using Cooperative Diversity Techniques

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DOI: http://doi.org/10.5281/zenodo.2446670

Abstract

Channel weakening is one among the significant issues in wireless communication which can be overcome by the exploiting diversity gain, achieved via cooperation between nodes and relays. In order to improve the gain, generally, we require more than one transmitting antenna in a node, which is not too common due to the limits in size and complexity of wireless mobile devices. Anyway by offering reception apparatuses to other single-receiving wire hubs in a multi-client condition i.e., agreeable decent variety, a virtual multi-radio wire cluster is framed and transmit-assorted variety is cultivated. In our proposed work, a network containing a sender, a destination and a fixed relay, is analyzed with modified cooperative diversity scheme such as Amplify-Quantize and Forward (AFQ) and compared with existing cooperative communication protocol i.e., Amplify and forward (AF). Moreover the performance of the proposed work is evaluated in terms of Bit-Error Rate, SNR and Outage Probability.

Keywords: *Amplify-Quantize and Forward, Cooperative Diversity, Signal-to-Noise-Ratio, Outage Probability.*

INTRODUCTION

Wireless Communication is the fastest growing technical area in the communication field, in which information from one point to other id transmitted without using any physical medium such as wires, cables, etc. They assume critical job in the cell organize that dispersed over land territories known as cells. Here cell is served by no less than one settled area handset called base stations (BS). These BS provide the cell with the network coverage which can be used for transmission of voice, data, and other types of content. Each cell typically uses a different set of frequencies from neighboring cells.

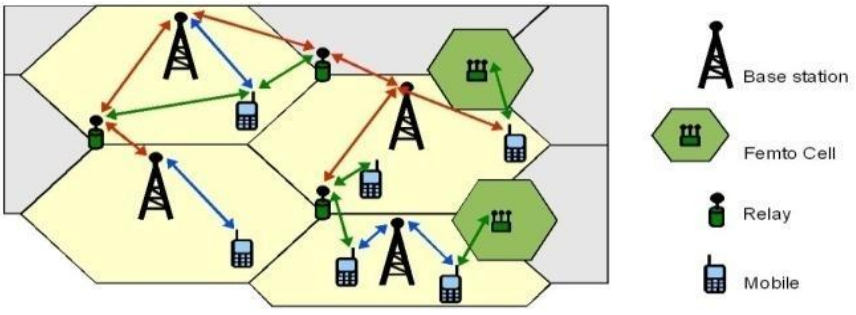

Fig: 1. *Cellular Communication network*

Due to rise of transmission services, number of users and technical issues, the future generations of cellular communications need higher data rates, recommended standards and a lot of reliable transmission link by keeping satisfactory quality of service (QOS). To achieve the above said, we need system with multiple input multiple-output (MIMO) associate antennas for exchanging information effectively through spatial multiplexing at low cost. But in implementation aspect, MIMO creates an issue by occupying as. Large area in mobile handsets for retaining many antennas. Hence to overcome the above implementation issue and improving signal to noise ratio, we use transmit diversity technique by utilizing cooperative communication that is transmitting information with help of other single antenna mobile nodes.

In this paper, section II discuss about the related works following our proposed work in section III. Section IV provides information about cooperative communication, where simulation and results are provided in section V

RELATED WORKS

In cooperative communication system Bit error rate (BER) performance analysis has been done by Rahat Ali Khan, Muhammad Abdul Aleem and Asad Ali Shaikh and cooperative communication based on wireless network [13]. The helpful correspondences with either an intensify and-forward (AF) or translate and-forward (DF) participation convention utilizing Mat lab programming and furthermore they think about the single and multi-hand-off situation in these recreations. Comparison of AF and DF protocols with single and multi-relay better output show that in amplify and forward protocol. In AF protocol single relay has 0.57% of gain is achieved by BER and multi relay has 0.60% but DF protocol single and multi-relay is not achieved BER performance. In this paper authors Om Jee Pandey, Aditya Trivedi and Mahendra Kumar Shuklasays that outage performance of Decode and forward (DF) and Amplify and forward (AF) protocols in cooperative wireless communication is evaluated in terms of outage probability [10]. Outage probability analysis helps in deciding whether the targeted quality of service (QoS) is achievable or not. Performance of DF protocol is going to be higher just in case of low SNR whereas performance of AF protocol is going to be higher in case of high SNR. Comparison of AF and DF protocol the Amplify-forward protocol gives better outage performance in high SNR region. And they also note that as the number of cooperative nodes increased, system outage performance got improved in AF protocol. Jeehoon Lee, Minjoong Rim and Kiseon Kim [7] authors say that selection amplify-and-forward (AF) relaying scheme is proposed which has the lower outage probability than that of a conventional AF relaying scheme in cooperative relay networks. In real wireless environments, as the channel of source-to-destination (SD) link varies with an increase in time, so they obtain a diversity gain through the SD link by retransmission in common with a conventional AF relaying scheme. Performance improvement by adaptively determinative the sending node between the relaying and supply nodes. We have a tendency to propose a technique for adaptively determinative between AF relaying and retransmission schemes, and show that the extra diversity gain is obtained by the planned theme.

PROPOSED WORK

Create the cooperative communication environment with immovable relay nodes by initializing the nodes. Number of nodes to be used (i.e.3 nodes) source, relay and destination.

Generate the input signal to source node and transmit input signal to destination node and also copies of signal is transmitted to relay node. Before transmission, the Signal is coded using error control code (Trellis Code).

And afterward pursued by group of stars mapping (QPSK tweak system) QPSK adjustment procedure utilizes four points on the heavenly body graph, equi spaced around a hover with four stages and can encode two bits for every image. At the point when dissected numerically, it very well may be demonstrate that QPSK can be utilized to twofold the information rate contrasted and a BPSK framework while keeping up a similar transfer speed of the flag or to keep up the information rate of BPSK however dividing the data transfer capacity required [12].

$$S_{QPSK}(t)=\sqrt{\frac{2Es}{Ts}}\cos[2\pi f_c t+(i\text{-}1)\frac{\pi}{2}] \quad i=1,2,3,4$$

Rayleigh fading channel is created among the three nodes for transmitting information, i.e., source to relay, relay to destination and source to destination.The Rayleigh distribution is commonly used to describe the statistical time varying nature of the received envelope of a flat fading signal, or the envelope of an individual multipath component [11]. The Rayleigh distribution has a probability density function (pdf) given by

$$P(r)=\begin{cases}\left\{\frac{r}{\sigma 2}\exp\left(-\frac{r^2}{2\sigma^2}\right)(0 < r <\infty)\right. \\ 0 \qquad (r<0)\end{cases}$$

Relay process the received signal, i.e., performs amplification, quantization and forwards the signal towards destination. At the destination, the receiver performs selection diversity technique (MRC) to choose the best among the received signal before demodulation and detection. Performance of the proposed work is evaluated in terms of BER and outage portability.

COOPERATIVE COMMUNICATION PROTOCOL

To change cooperation among users, completely different relaying protocol and techniques can be used reckoning on the relative user location, channel conditions, and transceiver quality. These are strategies that outline however information is processed at the relays before onward transmission to the destination.

AMPLIFY AND FORWARD (AF)

An amplify-and-forward is simple cooperative signaling method. Every client in this technique gets an uproarious variant of the flag transmitted by its accomplice. As the name infers, the client at that point intensifies and retransmits this uproarious form. The base station consolidates the data sent by the client and accomplice, and settles on an official conclusion on the transmitted piece in Fig. In spite of the fact that clamor is enhanced by participation, the base station gets two autonomously blurred variants of the flag and can settle on better choices on the discovery of data. This strategy was proposed and examined by Laneman [8]. It has been shown that for the two-user case, this method achieves diversity order of two, which is the best possible outcome at high SNR.

In amplify-and-forward it's assumed that the underside station is conscious of the bury user channel coefficients to undertake best coding, so some mechanism of exchanging or estimating this knowledge ought to be incorporated into any implementation. Another potential challenge is that sampling, amplifying, and retransmitting analog values is technologically nontrivial. Yet, amplify-and-forward could also be an easy methodology that lends itself to analysis, and then has been very useful in furthering our understanding of cooperative communication systems.

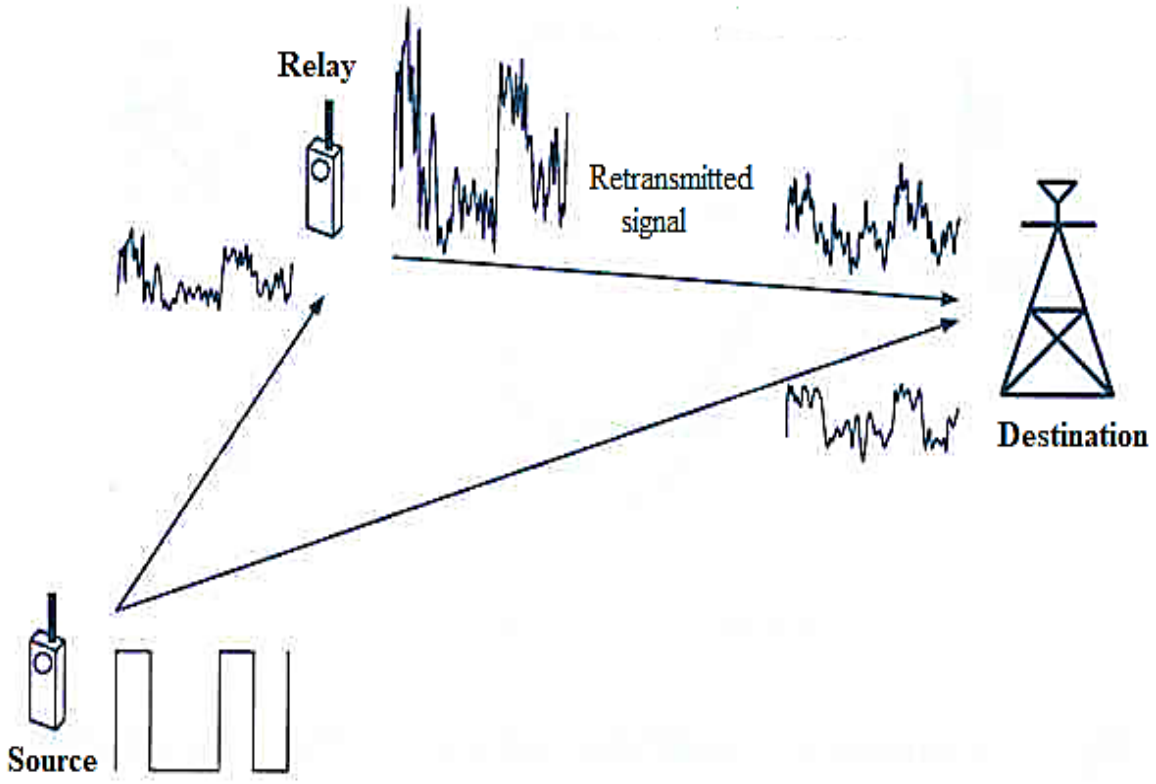

Fig: 2.*Amplify and forward protocol*

AF protocol is used in that condition when relay has limited amount of time for encoding and decoding. In this situation, the relays 1st amplify the signals (by adding amplification factor) and then broadcast to the destination. The only negativity of this protocol is that during amplification phase, the noise is also amplified.

AMPLIFY QUANTIZE AND FORWARD (AQF)

Amplify quantize and forward (AQF) protocol performs amplification, quantisation and forwards the signal towards destination. Quantisation mean associate analog signal is completed by discretizing the signal with variety of quantisation levels. Quantisation is representing the sampled values of the amplitude by a finite set of levels, which suggests changing a continuous-amplitude sample into a discrete-time signal. Each sampling and quantization ends in the loss of data.

A straightforward implementation of a QF relaying system that is similar to the AF relaying system would involve the coarse quantization of the sum of the signals received in the first and second slot from T0 and T1, respectively, and the broadcasting of these quantized samples in the third slot, where T0 and T1 is a time slots [19].While the initial purpose of division is to avoid the storage of analog samples, this approach but would need the relay to store the analog samples received from T0 within the initial slot, till the information from T1 is received within the second slot and also the 2 may be additional and amount, wherever the relay one by one quantizes the signals received within the initial and second slot and so properly combines the amount values.

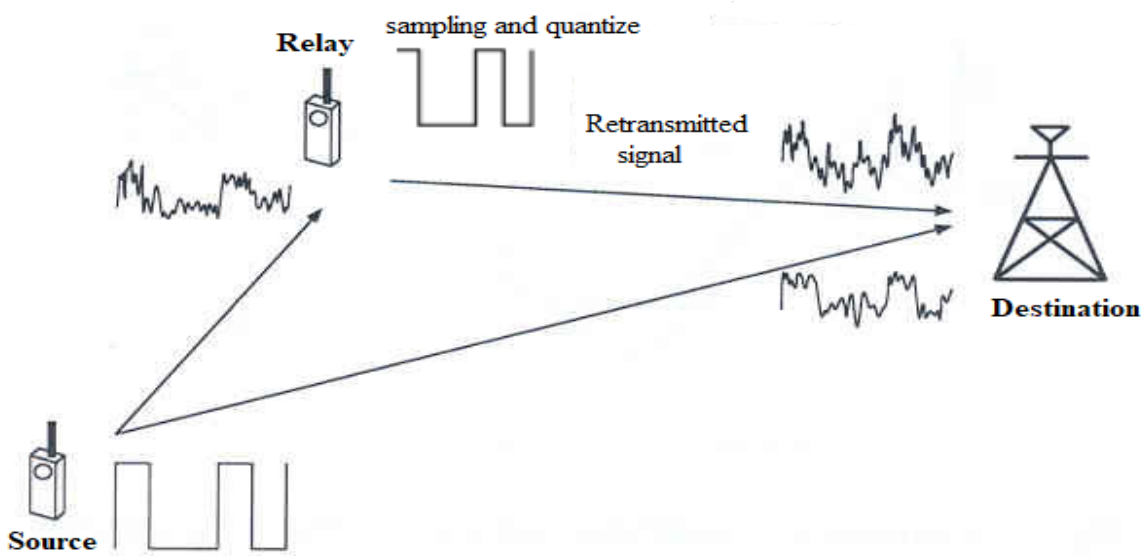

Fig: 3. *Amplify quantize and forward protocol*

AQF protocol uses limited relay resources i.e., limited processing power and memory to achieve cooperative diversity. In AQF protocol, the relay amplifies, the signals then quantize the amplified signals to finite number of bits per sample [10].

ADVANTAGE OF AQF

- Amplify quantize and forward protocol has low complexity in half duplex
- We can achieve the high data rate because of number of bits is reduced.
- Bandwidth is used efficiently.
- It has less time delay.
- AQF protocol it's very suitable for low complexity application like sensor networks

SIMULATION AND RESULTS

In our proposed work we have used modified Cooperative diversity protocol, known as Amplify-quantize forward, to improve or maximizing the performance of networks. We have shown a comparative analysis of our proposed work with the existing cooperative communication protocol, namely amplify and forward (AF), by evaluating Bit-error rate (BER) and outage probability with respective to various levels of signal to noise ratio (SNR).

SNO	PARAMETERS	TYPES
1	Channel type	Rayleigh fading channel
2	Modulation scheme	QPSK
3	Relay node	Fixed relay
4	Propagation model	Two ray propagation
5	No .of Relay	1
6	Error control code	Trellis code
7	Combining technique	Maximal ratio combiner

Table: 1. *Simulation Parameters*

COMPARISON OF AF AND AQF PROTOCOLS

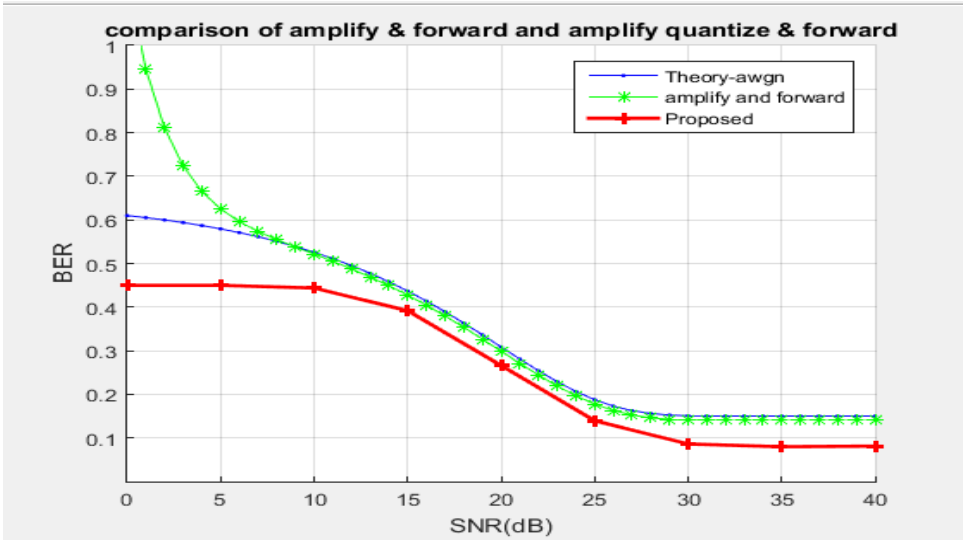

Fig: 4. *Comparison of Bit-error-rate between AF and AQF*

The BER performance of the cooperative diversity protocols as a function of the SNR ratio is shown in Figure 4. This parametric shows the probability of error that have occurred during the transmission of information between source and destination via fading channels. The position of relay is considered to be fixed in between source and destination, and it is assumed to be working in two path environment .i.e., path between source and destination node (LOS) and path between source and destination node via relay node (NLOS). The result shows that the proposed AQF (Amplify-Quantize-Forward) system achieves a better BER performance than for the AF (Amplify-Forward) system. Both the cooperative protocols system outperforms their one-way counterparts and due to the increased diversity, all the cooperative systems clearly outperform the better cooperative system.

OUTAGE PROBABILITY

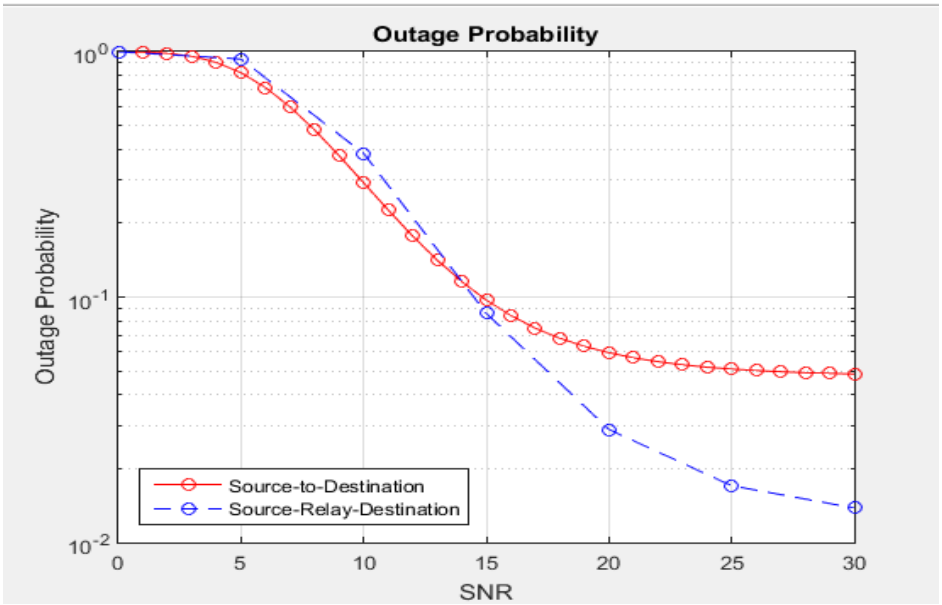

Fig: 5.*Comparison of Outage probability between AF and AQF*

Outage probability output evaluated in term of various levels of signal to noise ratio (SNR). In the proposed work, the outage probability is analyzed by consider three fixed nodes (i.e. source, relay and destination). The above simulation result shows that proposed protocol gives better results than exists cooperative diversity protocol i.e. AF

CONCLUSION AND FUTURE WORK

Thus proposed work the performance is evaluated in terms of Bit-error rate in cooperative diversity protocols as a function of the SNR ratio for amplify and forward (AF) and amplify quantize and forward (AQF) of cooperative protocols and also outage probability analysis for fixed three nodes (i.e. source, relay and destination). Our conclusion from the simulation results is that the Amplify quantize and Forward (AQF) protocol has shown that better performance compare to amplify and forward (AF) protocol. And also analysis of outage probability for three nodes shows that better Signal strength in source-relay-destination when compare to source-destination nodes in relay has fixed terminal. The future works consider the relay node has a movable terminal (i.e. UAV). Unmanned aerial vehicle commonly known as a drone.

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Cite this article as:
M.Keerthana Lakshmi, & G.Sivakannu. (2018). Performance Enhancement of Wireless Networks Using Cooperative Diversity Techniques. Journal of Analog and Digital Communications, 3(3), 26–33. http://doi.org/10.5281/zenodo.2446670