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ARQ Strategies and Protocols for relay Co-operative system

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Abstract: *Two novel automatic repeat request (ARQ) strategies for relay cooperative systems over Rayleigh fading channel: one uses relay ARQ and the other destination ARQ. The BER performance of these two strategies is derived in fast block fading. Numerical analysis and simulation show the systems can get more performance gain when the inter-channel (the source to the relay) quality is bad in the relay ARQ strategy. In the destination ARQ strategy, when the uplink qualities of the source and relay to the destination are poor, the average received SNR of the destination is much low, the systems performance can be improved efficiently. ARQ which requests the data link layer of the transmitter to repeat the packet when a packet is erroneously received by the receiver, has been widely Adopted in current wireless systems, such as 3G wireless systems, wireless MAN system etc. Since retransmissions are activated only when the receiver fails to decode a packet, the ARQ technique is very efficient in improving system throughput and combating with channel fading.*

Keywords: *Networking, Telecommunication.*

1. INTRODUCTION

Cooperative relaying is a promising and effective way to combat wireless channel fading and to exploit distributed spatial diversity, the single-antenna terminals in a cell can share their antennas and other resources to create a "virtual array". A variety of relay protocol have been studied and analysed. There are mainly two ways of relaying, the non-regenerative relaying amplifies the received signal and forwards to the receiver, while the regenerative relaying decodes and forwards the received symbols. But these systems performance are limited to the link quality from the source to the relay. So combining cooperation with ARQ has aroused some interests. Whether ARQ depending on whether the packet is successfully decoded or not by the relay or destination [l, 2] when the uplink qualities of the source and relay to the destination are bad, the average received SNR of the destination is low, the systems performance is improved limited, and this also bring much time delay. We get more performance gain when the quality of the source to the relay is poor, and the uplink qualities of the source and relay to the destination are low. Thus the lower the SNR, the more the gain, the higher the SNR, the less the gain, even no gain when the Performance is satisfied with desire, and it can also reduce much time delay.

2. LITERATURE REVIEW

In the paper " Cooperative ARQ in wireless networks : protocols description and performance analysis " the y have introduced Cooperative transmission is an efficient technique to realize diversity gain in wireless fading channels via a distributed way. In this paper, we consider a wireless network composed of a source, a relay and a destination terminal [9]. We exploit the limited feedback from the destination and propose three different cooperative ARQ protocols, which combine the incremental relaying and selection relaying protocols. An analysis model to analyze and compare the data link layer packet error rate (PER) of different ARQ protocols in slow fading wireless channel is established [2]. Furthermore, the spatial diversity performances of the various protocols are investigated and it is demonstrated that full spatial diversity (second-order in this case) can be achieved by the three proposed protocols. Simulation results are given, which verify the performance analysis [2]. The trade-off between performance and implementation complexity of the three protocols is also discussed [1].
In the paper "Cooperation through ARQ" they have introduced the Cooperative multiple access channel with single antenna sources and a multiple antenna destination. In order to fully exploit the degrees of freedom in this channel, multiple sources must transmit independent streams of information

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simultaneously [2]. Under the standard coherent model, we argue that no half-duplex cooperation protocol can simultaneously achieve the maximum diversity and multiplexing gains of this channel. We avoid this limitation by developing a framework for cooperation through an Automatic Retransmission request (ARQ) mechanism. In the proposed cooperation protocol, users are only allowed to cooperate after receiving the first round of AWK signals [2]. Our characterization of the achievable diversity-multiplexing trade- off with the proposed protocol reveals that it attains both full diversity and full-rate. Furthermore, our analysis reveals the asymptotic optimality of the proposed protocol, as the number of ARQ rounds grows. To establish the gain offered by the proposed protocol, we compare its trade-off curves with that of the multiple access ARQ channels [2].

In the paper "Design of ARQ protocols for two-user cooperative diversity systems in wireless networks" they have introduced Automatic repeat-request (ARQ) protocols for two-user cooperative diversity system employing Alamouti space-time coding is investigated in this paper. A whole cooperative transmit frame of an original cooperative system consists of three sub-frames. According to different feedback schedules in a transmit frame at the destination, two basic ARQ protocols, namely post-cooperating and pre-cooperating, are proposed and analyzed [3]. We show that both proposed ARQ protocols can improve the throughput in two-user cooperative system. Pre-cooperating protocol yields 50% gains in users' throughput than post-cooperating protocol if both users have high user-destination average received signal-to-noise ratio (SNR) at the destination. Nevertheless, if both of user-destination average received SNRs are low, post-cooperating protocol is more effective than pre-cooperating protocol [4]. Proposed protocols provide useful basic tools for designing more complicated ARQ protocols. Multiple antennas at the receiver and transmitter are often used to combat the effects of fading in wireless communication systems. However, implementing multiple antennas at the mobile station is impractical for most wireless applications due to limited size of the mobile unit. Recently a new form of spatial diversity, cooperative diversity, has emerged as an alternative way to achieve diversity with a single antenna at the mobile. The main idea of cooperative diversity is to exploit the broadcast nature of wireless transmission and create a virtual antenna array through cooperating users. Each cooperating user is responsible for transmitting not only its own information, but also the information of its partners [5].

3. NEW PROPOSED SCHEME

In this method, here we implement the ARQ strategies and protocols for relay cooperative systems. For that we used ns2.34 for the simulation. We implement our project in Wimax 802.16 and used the BPSK for the modulation. Here we find out the packet error rate and throughput of the cooperative system with ARQ. On that basis we get performance of the system. Finally we get the results we plot the graphs packet error rate Vs Avg. SNR and Throughput Vs Avg. SNR and we can conclude that performance gain of the system improved efficiently.

4. ARQ PROTOCOLS AND TECHNIQUES

4.1 COOPERATIVE ARQ PROTOCOLS

Automatic repeat request (ARQ), which requests the data link layer of the transmitter to repeat the packet when a packet is erroneously received by the receiver, has been widely adopted in current wireless systems, such as 3G wireless systems, wireless MAN system etc. Since retransmissions are activated only when the receiver fails to decode a packet, the ARQ technique is very efficient in improving system throughput and combating with channel fading. An alternative way to provide spectrally efficient and reliable transmission relies on various diversity techniques, such as time, frequency and spatial diversity. Multiple independently faded signals are appropriately combined at the receiver, to realize the diversity gain and improve reliability and spectral efficiency. Multi user cooperative diversity technique, which achieves spatial diversity gain in a distributed way, has been widely studied these days .Multiple antennas on different users are formed as a Virtual Antenna Array (VAA) to transmit cooperatively. Fig.4.1 shows the general scenario considered in multi user cooperative communication, where the relay terminal T2 and the source terminal TI transmit the same information to destination terminal T3 cooperatively. Since the signals from TI and T2 experience independent channel fading, diversity gain is obtained.

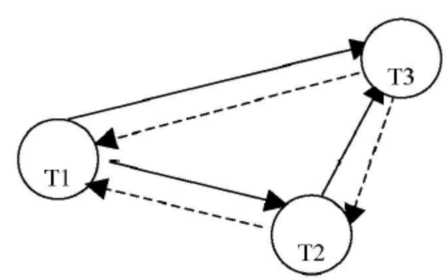

Fig.4.1 A simplified network model.

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Three different cooperative ARQ protocols which combine incremental relaying and selection relaying and only allow relay terminal to repeat when the information is correctly decoded in the relay and incorrectly decoded in the destination. In the initial transmission interval, the source terminal transmits a packet and the relay terminal, as well as the destination terminal, attempts to receive it. Retransmission occurs in the second interval when the destination terminal fails to decode the packet. The three cooperative ARQ protocols behave differently in the retransmission period: protocol I requests the relay terminal to repeat the packet; the one with higher channel gain between the source and relay terminal is requested to repeat the packet in protocol II; both the source and relay terminal repeat the packet simultaneously in protocol III, using space-time code .

4.2 ARQ TECHNIQUES

4.2.1STOP AND WAIT ARQ

Stop-and-wait ARQ is a method used in telecommunications to send information between two connected devices. It ensures that information is not lost due to dropped packets and that packets are received in the correct order. It is the simplest kind of automatic repeat-request (ARQ) method. A stop-and-wait ARQ sender sends one frame at a time; it is a special case of the general sliding window protocol with both transmit and receive window sizes equal to 1. After sending each frame, the sender doesn't send any further frames until it receives an acknowledgement (ACK) signal. After receiving a good frame, the receiver sends an ACK. If the ACK does not reach the sender before a certain time, known as the timeout, the sender sends the same frame again[6]. The above behavior is the simplest Stop-and-Wait implementation. However, in a real life implementation there are problems to be addressed. Typically the transmitter adds a redundancy check number to the end of each frame. The receiver uses the redundancy check number to check for possible damage. If the receiver sees that the frame is good, it sends an ACK. If the receiver sees that the frame is damaged, the receiver discards it and does not send an ACK, pretending that the frame was completely lost, not merely damaged [7].
One problem is where the ACK sent by the receiver is damaged or lost. In this case, the sender doesn't receive the ACK, times out, and sends the frame again. Now the receiver has two copies of the same frame, and doesn't know if the second one is a duplicate frame or the next frame of the sequence carrying identical data. Another problem is when the transmission medium has such a long latency that the sender's timeout runs out before the frame reaches the receiver. In this case the sender resends the same packet. Eventually the receiver gets two copies of the same frame, and sends an ACK for each one. The sender, waiting for a single ACK, receives two ACKs, which may cause problems if it assumes that the second ACK is for the next frame in the sequence. To avoid these problems, the most common solution is to define a 1 bit sequence number in the header of the frame. This sequence number alternates (from 0 to 1) in subsequent frames. When the receiver sends an ACK, it includes the sequence number of the next packet it expects. This way, the receiver can detect duplicated frames by checking if the frame sequence numbers alternate. If two subsequent frames have the same sequence number, they are duplicates, and the second frame is discarded. Similarly, if two subsequent ACKs reference the same sequence number, they are acknowledging the same frame[2,8]. Stop-and-wait ARQ is inefficient compared to other ARQs, because the time between packets, if the ACK and the data are received successfully, is twice the transit time (assuming the turnaround time can be zero). The throughput on the channel is a fraction of what it could be. To solve this problem, one can send more than one packet at a time with a larger sequence number and use one ACK for a set. This is what is done in Go-Back-N ARQ and the Selective Repeat ARQ [6,4].

5. ALGORITHM

In the first part we will consider mobile node and base station

1. Packet will generate at mobile node and ready to send.
2. Now it sends to receiver as Base station.
3. Packet travels through wireless channel.
4. Packet receives at base station.
5. Base station sends ACK to transmit next packet.
6. If packet drops then Base station sends NACK to mobile node to re-transmit packet.

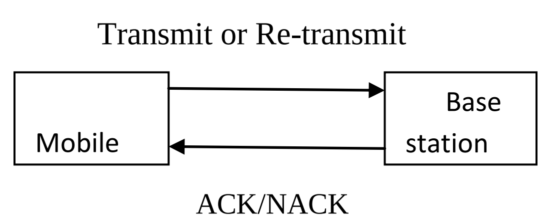

Fig. 5.1 Packet transmission from mobile to Base station.

Now in the second part we will consider relay node and base station.

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1. Same Packet will generate at Relay node and ready to send like mobile node.
2. Now it sends to receiver as Base station.
3. Packet travels through wireless channel.
4. Packet receives at base station.
5. Base station sends ACK to transmit next packet.
6. If packet drop then Base station sends NACK to Relay node to re-transmit packet.

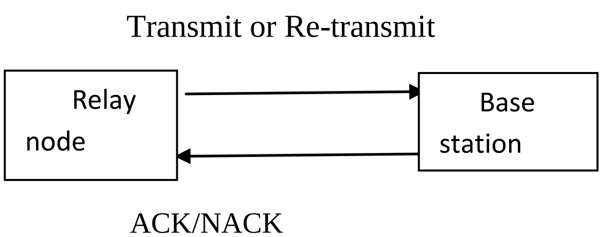

Fig. 5.2 Packet transmission from Relay to Base station.

6. RESULTS

We find out results by simulating in ns 2.34 for ARQ with relay and without relay. We calculate throughput and PER using AWK file and observe the graphs with the help of GNU plot application. We calculate Throughput for with ARQ and without ARQ for different SNR and we get the required results what we expected from that by observing graphs we can say that the performance of ARQ with relay is better than without relay. As SNR value increases the throughput of the system increases in both cases but by comparing we can say that with relay system performance is good. We get fewer throughputs in without ARQ system. Here we plot graphs with ARQ, without ARQ and combination of both.

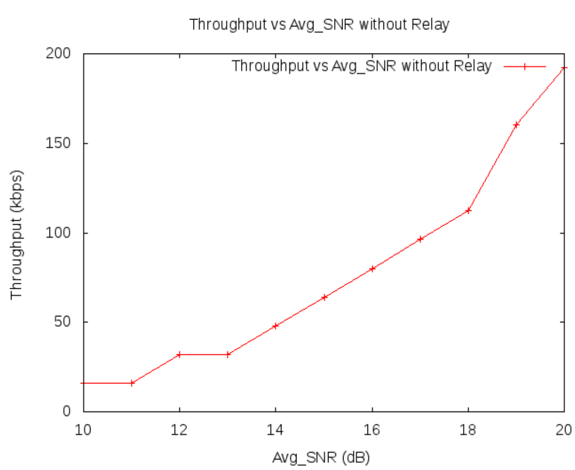

Fig. 6.1 Throughput Vs Avg_SNR without Relay.

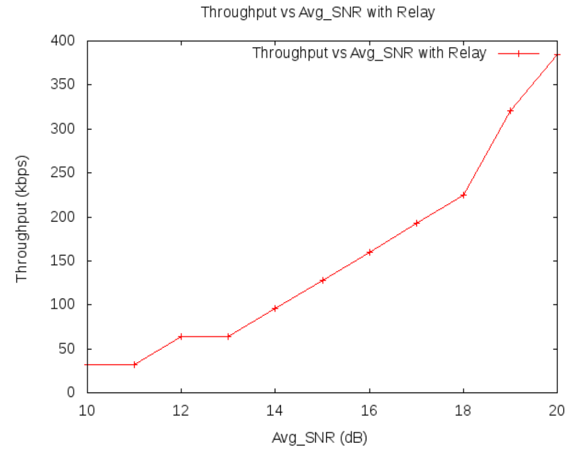

Fig. 6.2 Throughput Vs Avg_SNR with Relay

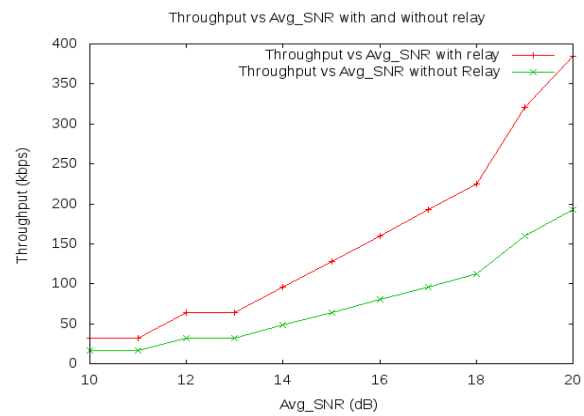

Fig. 6.3 Throughput Vs Avg_SNR with and without relay.

7. CONCLUSIONS AND FUTURE WORK

From the two different aspects of relay and destination, here we find out the packet error rate and throughput of the cooperative system with ARQ. With the help of this method we can improve the performance gain efficiently.

7.1 Future Scope:

Using OFDM modulation scheme we can increase the high data rate transmission and we can improve the performance of the system

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