Cooperative Communication and Its Techniques

Krunal K Vataliya¹ Balvant J Makwana² Narendrasinh B Gohil³

¹P.G. Student ²,³ Assistant Professor

¹,²,³ Department of Electronics & Communication Engineering
¹,³ Shantilal Shah Engineering College, Bhavnagar. ² Government Engineering College, Bhavnagar.

Abstract— Nowadays in deployment and flexibility in radio resources configuration are the main features of future wireless communication system. A cooperative wireless communication system is proposed to follow the same principle aiming at improving the all over performance of wireless system. In this paper we will analyze the recent developments and trends in the area of wireless Ad hoc network. This article will also discuss various main cooperative signal methods.

I. INTRODUCTION

Increasing demand for wireless multimedia and interactive internet services along with rapid proliferation of multitude of communication and computational gadgets are fuelling intensive research efforts on the design of novel wireless communication system architectures for high speed, reliable and cost effective transmission solution. The mobile wireless channel suffers from fading in particular spatial diversity is generated by transmitting signals from different locations thus allowing independently faded versions of the signal at receiver. Cooperative communication generates this diversity in new and interesting way. For a preliminary explanation of the ideas behind the cooperative communication as shown in figure 1. This figures shows two mobile agent communicating with the same destination, However it may be possible for one mobile to receive the other, thus it can forward overhead information along with own data.

Fig. 1: Cooperative Communication

For development of cooperative communication me must go through some issues like including the loss of rate to the cooperating mobile, overall interference in the network, cooperative assignment and hand-offs, farness of the system, and transmits and receive requirements of the mobiles. Cooperation is more suitable to ad hoc wireless networks and wireless sensor networks then cellular networks.

Fig. 2: Relay Channel

In many respects the cooperative communication we consider its different from the relay channel. First, recent develop are motivated by the concept of the diversity in the fading channel, while Cover and EL Gamel mostly analyze capacity in an ADDITIVE WHITE GAUSSIAN CHANNEL (AWGN), SECOND IN THE RELAY CHANNEL, the relays sole purpose is to help the main channel, whereas in cooperation the total system resources are fix, and users act both as information sources as well as relay.

II. HISTORICAL BACK GROUND

The basic ideas behind the cooperative communication can be traced back to the groundbreaking work of cover and EL Gamel on the information theoretic properties of the relay channel [1]. This work analyzes the capacity of the three node network consistence of a source, a destination and relay. It was assumed that all nodes operates in the same band, so the system can be decompose into a broadcast channel from the view point of the source and a multiple excess channel from the view point of the destination (FIG.2).

III. COOPERATIVE COMMUNICATION

In conventional communication, data is transmitted between the source and destination, no user provides assistance to one another. When one node transmits its data, the entire nearby node overheard is transmission cooperative communication aims to process and forward this overheard information to the respective destination to create spatial diversity, which can in result increase the system performance.

In cooperative wireless communication, we are concern with the wireless network, of the cellular or ad-hoc variety, where the wireless agents, which we call users, may increase their effective quality of service via cooperation.
As shown in figure 1, the source S is transmitting data to the destination D, while the relay station R is also here the transmission. The relay station also process and forward this message to destination where both of receive signals are combine, as both copies of the signal are transmitted through independent paths, this result into spatial diversity. In cooperative communication, each wireless user is assumed to transmit own data as well as acts as cooperative agent (Relay) for the other users.

IV. COOPERATIVE TECHNIQUES
Cooperative Transmission technique describe that how the received data is processed at the relay station, before forwarding it to the destination, in this article we will review and compare various cooperative strategies.

A. Decode and Forward
The detect and forward method is the most preferred method of processing data in the relay/partners/ neighbouring nodes, and is the closest to the idea of the traditional relay in this technique the relay detect the source data, decodes and then it transmit to the desire destination(Fig. 4). The concept of Decode and forward technique shown in the figure 4.

B. Amplify and Forward
Another simple cooperative signaling is amplify and forward method. As the name suggests amplify and forward technique simply amplify the signal received by the relay before forwarding it to the destination. The base station combines the information sent by the users and partners, and makes a final decision on the transmitted bit (Figure 4). However one major drawback of this technique is that the noise in the signals is also amplified at the relay station, and the destination receives two independently faded version of the signal.

C. Coded Cooperation
Coded cooperation is the method that integrates cooperation in to the channel coding in another two cooperative techniques described above, the partner/relay station just we transmit the receive data bits by decoding (DF Method) or Amplifying method (AF Method). Unlike these two techniques the received data bits in coded cooperation are broken in to two parts. One part transmitted by the user and other part is transmitted by partner. The concept of the two user coded cooperation system is shown in Figure 6.
The key to the efficiency of coded cooperation is there all this is managed automatically through code design, with no feedback within the user.

In coded cooperation each of the users data is encoded a code word that is partitioned in two segments, containing $N_1$ bits and $N_2$ bits respectively. Consider that the original code word has $N_1 + N_2$ bits; puncturing this code word down to $N_1$ bits, we obtain the first partition, which itself is a valid code word.

The time segments of $N_1$ and $N_2$ bit intervals are called frames. For the first frame, each user transmits a code word consisting of $N_1$ bit code partition. Each user also attempts to decode the transmission of its partners. If this attempts is successful its determine by CRC code, in the second frame user calculate and transmit the second code partition of its partners, containing code bits. Thus each user always transmits a total of $N=N_1 + N_2$ bits per source block over the two frames. We define the level of cooperation as $N_2/N$, the percentage of the total bits for each source block the user transmits for its partner. Figure 7 illustrates the Coded cooperation frame work.

Various channel coding method can be used with in this coded cooperation frame work.

V. OTHER PRACTICAL ISSUE

In cellular systems, time-division multiple access (TDMA) ones, the uplink and downlink transmissions are work on different frequency bands. Ordinary mobiles receive only downlink band but cooperative mobile also receive uplink band, require input filters and frequency conversion. While in ad-hoc wireless network users transmits and receive both on the same frequency band, this is less of an issue.

Another technology issue is transmitted and receive requirement on the mobile, in CDMA the mobiles may be required to transmit and receive at the same time. Transmit signals can be up to 100db above the level of the receive signals, which not isolated by a directional couplers. For this problem there are two solution discuss here. First cooperating users may agree to time share their transmission, which create a many-TDMA scenario where each transmits for fifty percent of the time as twice the power. Second, a CDMA systems are hybrid with more than one frequency band allocated to the uplink channel, then the base station may require that cooperating mobiles reside on the separate band.

It is also imported to the base station to handle the cooperative communication. The amount of additional information varies for different techniques. In the detect and forward method the base station needs to know the error probability of the inter user channels for optimal detection whereas in amplify and forward this is not required. While conventional channel estimation method can be used to extract necessary information from the direct and relayed signal. For coded cooperation as well as the hybrid detect and forward technique, no knowledge of the inter user channel is needed in the base station. The base station to know whether the users have cooperated or not. A simple solution is that base station simply decodes according to each of the possibilities in succession until successful decoding results. This strategy maintains the over system performance and the rate at the cost of some added complexity at the base station.

VI. CONCLUSION

Here we have describes various techniques of cooperative communication, a technique that allows single antenna mobiles to share their antenna and thus enjoy some of the benefits of multiple antenna system. We can get basic idea of cooperation and all its techniques.

Practical issues and requirement on the system design with the help of cooperation are discussed.

REFERENCES