Cooperative Communication in Wireless Communication Networks

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Abstract

Recently from industrial and academic point of view the concept of cooperative communication in wireless communication networks has drawn considerable attention as it can be useful in addressing the performance limits of wireless communication networks because of customer mobility and the shortage of network resources. In this article, we discussed the possible benefits of such an approach and also talk about its difficult issues. We put center of attention on three cooperative communication scenarios are, cooperative communication to improve channel stability via spatial diversity, cooperative communication to improve throughput via resource assembling, and cooperative communication to realize faultless service condition. We discussed issues which arise at different layers of the network protocol, with a prominence on the physical, network, and transport layers, and also paid attention in future study.

I.INTRODUCTION

Cooperative communication is fastest growing research areas, as it is the method of operating jointly; differ of operating individually in aggressive environment. Recently, such a concept is a key enabling expertise for efficient spectrum use in future research areas of wireless communication networks. The reason behind the exploration of cooperative communication in wireless communication networks because of the user mobility sustainability and limited power and radio spectrum resources, which place a vital role in terms of capacity and performance.

We put center of attention on three cooperative communication scenarios. In the first scenario, cooperative communication between different entities is employed to improve the wireless communication channel stability via spatial diversity [1], [2]. In the second scenario, the resource assembling of resources offered by cooperating entities done to improve the wireless communication throughput [3], [4]. In third scenario, the cooperative communication to realize faultless service condition [5], [6]. In earlier researches, we focuses on developing strategies for cooperative communication in wireless communication networks at the physical layer for cooperative communication. On the other hand, there are many issues at different layers of network protocol by cooperative communication procedure. So, as to achieve the objective of cooperative communication a few modifications are required at the networking. Actually, cooperative communication would not be noteworthy without these few modifications. In this paper, we deal with the topic of cooperative communication in wireless communication networks via answering the following questions: What are the possible benefits of using cooperative communication? What are the issues that arise at the different layers of the protocol stack in order to sustain cooperative communication and how can resolve them? What are future study directions in this area?

II.COOPERATIVE COMMUNICATION BENEFIT

Here, we have a discussion about the possible benefits of employing cooperative communication in wireless communication networks. These possible benefits are

A.Improved Channel Stability

The wireless communication channel undergo via a number of phenomena that reduce its stability. These phenomena include shadowing, path loss, and fading. Cooperative communication in wireless networks can increase the stability of the communications by cooperative spatial diversity [1], [2]. When the direct transmission between the original source and destination is not successful, other network entities can cooperate with the source node to forward the data towards the destination. Hence, communication took placed via different transmission paths between the source and destination nodes via the cooperating entities. So, many copies of transmitted information received by the destination node. Destination node based on spatial diversity can improve the transmission accuracy by merging the data received from different entities. This concept is illustrated in Figure 1(a) cellular communication in downlink transmission from a BTS (Base Transceiver Station) to a user MS (Mobile Station), where the data packets is transmitted from the source node towards the destination node with the help of cooperative communication. In this environment, a cooperative node is none other than relay (pass on) node with an enhanced channel situation over the direct transmission channel from the source to the destination as shown in Figure 1(a).

Reduction of Nosiness

There are many nodes in broadcast region of the wireless communication medium which results in interference to each other in their coverage area. This reduces the signal to noise ratio at the destination node and

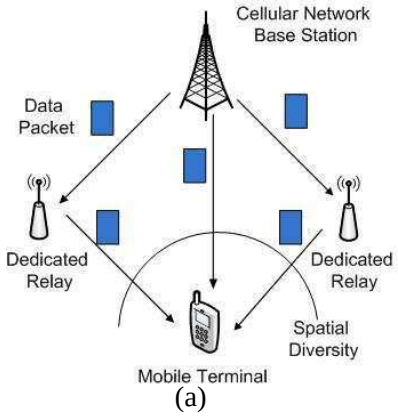
in turns degrade receiving performance. With the help of cooperative communication the transmitted power requirement at source node reduced to a level by the introduction of cooperative relay. This is because of good relay links channel condition, which significantly reduces the nosiness region [7], as illustrated in Figure 1(b). Hence, cooperative communication also helps to develop the energy efficient wireless communication design.

A. Improved System Throughput

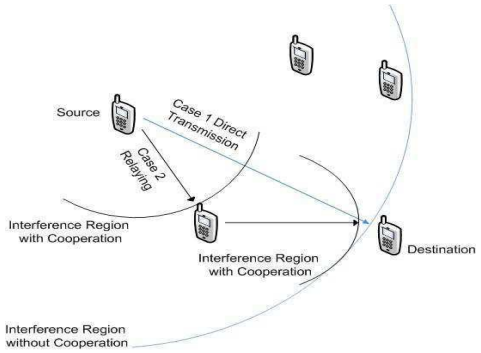
The system throughput improvement benefits directly the channel stability by employing the cooperative communication at different layers (physical, network and transport layers). Cooperative communication improves the throughput via assembling of resources of cooperating entities [3], [4]. In earlier cooperative communication scenario information is sent from source to destination via different paths in each of which carrying the same transmit information. But, by employing cooperative communication scheme at network and transport layer transmitted information packets sent from source to destination via different paths carrying different data packets i.e. not the copy of source transmit information on each path. These results in throughput optimize between the source and destination nodes. In telecommunication network, MS, BTS, or other contact point can be cooperative entities having enough resources. So, that when resources of these entities are assembled the data rate between source and destination node increased. Figure 2 for example, where the corporative approach is used between wireless telecommunication network and wireless local area network (WLAN) to provide a high throughput at MS.

A. Faultless Service Condition

In telecommunication networks users are more concerned about call dropping rather than call accessibility. As sudden call dropping cause lose of communicating channel or link between the MS based on the network parameters.



(a)



(b)

Fig. 1. Cooperative communication to improve channel stability: (a) Spatial diversity; (b) Interference reduction.

Faultless service condition can be promise by using cooperative communication scheme at the network and transport for current call [5], [8]. By the use of cooperative shown in figure 3, when the service is interrupted along main path between source and destination (Ch1), then can be continuous via cooperative path (Ch2,Ch3). In telecommunication network, MS, BTS, or other contact point can be cooperative entities having enough resources.

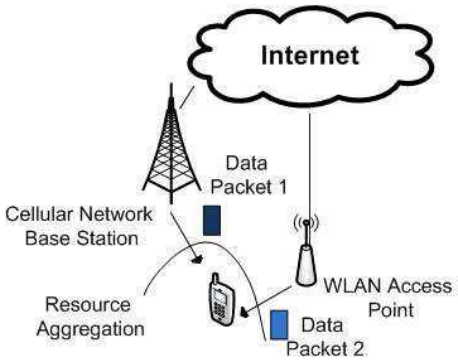


Fig. 2. Cooperative resource assembling via a cellular network and a WLAN

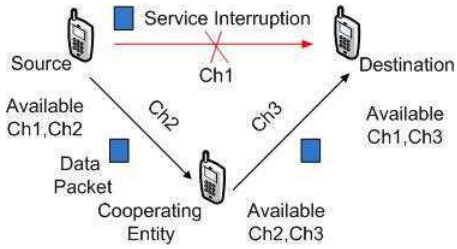


Fig. 3. Cooperative communication for faultless service provision.

I. ISSUES AT DIFFERENT LAYERS

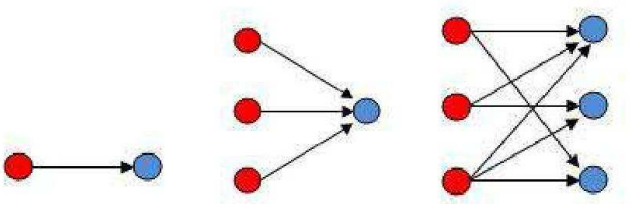
Though cooperative communication has many possible plus points in wireless communication networks. On the other end, some issues also occur while taking it in practical application. To bear the cooperative communication scheme at different layers some modification are required in accordance to the role played by each layer of the network protocol. Cooperative communication can be used to get better quality-of-service (QoS) via different means such as spatial diversity to improve channel stability, resource assembling to increase throughput, and achieving faultless service provision. To achieve the above mentioned goals, we put center of attention on issues at the physical, medium access control (MAC), network, and transport layers.

A. Physical Layer Challenges

To improve the channel stability of a wireless communication channel different relaying schemes are used. These relaying strategies are amplifying and forward (AF), decode and forward (DF), and compress and forward (CF) [1], [2]. This advancement also adds complication at physical layer. For best decoding at destination node the channel coefficient must be known. As channel coefficient becomes time dependent for cellular communication nodes [2]. This in turns leads to additional complexity to physical layer hardware.

B. Network Layer Challenges

To carry information between node (source) to node (destination), network layer characterize the routing protocol via cooperative communication. As compared to simple communication between source nodes to destination node cooperative communication requires cooperative links rather than point to point links. There are two types of cooperative links defined MISO (Multiple Input Single Output) and MIMO (Multiple Input Multiple Output) [9]. Thus, network layer faces issues in defining best possible routing protocol for cooperative communication.



(a) (b) (c)

Fig. 4. Link definitions in cooperative networks: (a) Point-to-point; (b) M ISO; (c) MIMO

C. Transport Layer Challenges

To improve throughput via resource assembling with cooperative links routing needs to deal with the following challenges at the transport layer. The source and destination nodes in cooperative routing uses number of IP addresses for a single node. Since, transmission control protocol (TCP) of transport layer is not designed to several IP addresses [10]. Thus, the solution is to use multiple TCP between the end nodes.

II. FUTURE DIRECTIONS

For further study of cooperative communication many issues are open.

Mobility- The most important part of telecommunication system to sustain service even though user is mobile. For this mobility of source and/or destination node can be projected.

III. CONCLUSION

In wireless communication networks cooperative communication has possible payback which includes: improved channel stability via spatial diversity and throughput, reduced energy consumption, and to realize faultless service condition. Along with that some issues arises at network protocol layer and solution to deal with these issues being proposed. For further study of cooperative communication many issues are open and need to be taken in account at different layers. At last, for commercial use a suitable structure to be develop for cooperative communication in wireless communication networks.

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