Benefits of Cooperative Offloading in Cognitive Radio Networks

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Abstract

Recently, several mobile operators have reported a dramatic growth in mobile data traffic [1]. Moreover, the release of smart phones has increased the demand for fast data transfer by providing sophisticated mobile services such as video applications, gaming, and cloud computing services. This growth in mobile traffic causes a risk of a heavy network congestion and results in a decrease of the quality of service. Since network systems may locate in the same geographical area, the offloading of traffic to other available networks provides a solution for efficient resource optimization. The benefits of traffic offloading can be maximized by incorporating cognitive radio technology into a network design.

In this demo, we present a prototype implementation of an offloading cognitive radio network. In addition, we compare the cooperative and non-cooperative offloading techniques and show the differences in their network performances. In detail, we highlight the benefits of cooperative traffic offloading with throughput and fairness. The throughput illustrates the advantages of offloading from the operator point of view and the fairness value represents the achieved proportion of the common resource usage among the operators.

The demonstrated cognitive radio network is composed of multiple Linux enriched second generation wireless open-access research platform (LE-WARP) test beds, a distributed cognitive

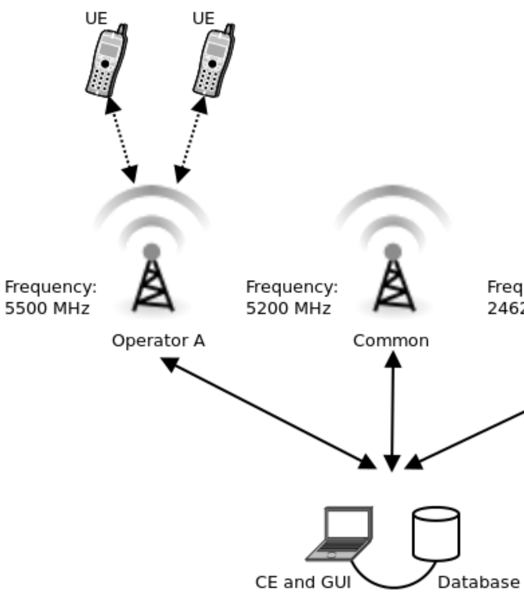

Fig. 1. Demo setup

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engine with a database, and a graphical user interface (GUI). LE-WARP test beds are programmed to function as base stations and mobile clients. The functionalities of the cognitive engine are distributed among LE-WARPs and the PC which is running the database and the GUI. LE-WARPs are gathering information about the network and they are constantly updating the database. The master CE on the PC delivers relevant information to the base stations. Due to the messaging, each base station is fully aware of the current network status and therefore capable of making decisions about resource usage according to this information.

The demo setup is shown in Fig. 1. It consists of a cognitive radio network which includes in of three base stations, four mobile clients and the master cognitive engine. Mobile clients are connected to base stations via wireless link. Base stations and a master CE are connected together via wire. Two of the base stations are considered as rival operators, operator A and operator B, whereas the third base station provides available resources for both operators.

The demonstration compares cooperative and non-cooperative scenarios. In non-cooperative scenario the operators A and B compete the common resources. This case corresponds the reality today between operators. Respectively in the cooperative scenario, the operators share the common resources in a cooperative manner; the operators request a permission from the master CE to access to the common resources. If the common resources are fully occupied, the master CE re-arranges mobile clients so that resource usage of the system is optimal. The comparison shows that the cooperative offloading provides increased throughput gain and fairness.

Index Terms: Cognitive radio, Cellular networks, WARP.

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