**Proof of concept of inter-cell interference rejection for 5G Small cells networks**

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A novel 5th Generation (5G) radio access technology (RAT) is expected to be introduced in the mass market around 2020 to cope with the exponential increase of the data traffic demand [1]. Recent studies on heterogeneous networks have revealed that the enormous capacity requirements of 5G can be achieved by deploying a large number of small cells, operating over a dedicated portion of the spectrum [2]. The same spectrum may be shared by the neighbor cells, which inherently increases inter-cell interference levels, and causes significant impact on the cell’s throughput performance.

The traditional approaches for mitigating inter-cell interference are based on planned frequency reuse or distributed spectrum sharing mechanisms. The main principle of such approaches is to assign statically or dynamically orthogonal spectrum chunks to neighbor cells that may experience significant mutual interference [3]. The usage of advanced baseband processing at the receiver has also been proved to be effective in mitigating inter-cell interference. In particular, the 5G concept presented in [4] relies on the usage of Interference Rejection Combining (IRC) receivers as main interference mitigation technique. The principle of the IRC receivers is to exploit the degrees of freedom of the Multiple Input Multiple Output (MIMO) transceivers, for projecting the significant interfering signals over an orthogonal subspace, with respect to the desired signal, thus diminishing their detrimental impact. The benefits of IRC receivers in improving the network throughput in dense small cells networks have been assessed with system level simulations in [5].

However, besides simulation studies, there is an increasing interest by both industry and academia for a more tangible evidence of the effectiveness of interference mitigation techniques in realistic small cell deployments. Software defined radio (SDR) testbeds represent a flexible and cost-effective paradigm for an agile experimentation of wireless research concepts. In that respect, our SDR testbed has been previously used for the real-world validation of distributed spectrum sharing in a local area network [6]. Based on an extended version of the testbed, our new demonstration will prove the potential benefits of IRC receivers in a practical deployment scenario. The resulting benefits in terms of improved throughput performance with respect to Maximum Ratio Combining (MRC) receiver will be shown in real-time. Different frequency reuse schemes are also considered.

The target setup involves four cells located in close proximity within an indoor office environment (Aalborg University premises) such that various levels of interference coupling exist among the cells. Each cell consists of two nodes: one access point (AP) and one user equipment (UE). The four cells are deployed across multiple rooms within the same floor. Each node (AP/UE) is composed of two Universal Software Radio Peripheral (USRP200) SDR boards connected by a MIMO cable and a host computer equipped with the ASGARD software platform [7], as shown in Figure 1. All involved nodes are connected with the testbed server which controls the entire system through a backhaul connection (Ethernet or WiFi). The testbed server also collects Key Performance Indicators (KPIs), primarily SINR and rank-adapted throughput from the receiving nodes and displays the KPIs run-time on a graphical user interface.



Figure 1, MIMO transceiver testbed node

The APs transmit to their affiliated UEs over the same bandwidth, thus generating mutual interference. At the UE, two receiver options are considered: the aforementioned IRC, and the traditional Maximum Ratio Combining (MRC) receiver, which aims at maximizing the useful signal power but is completely inter-cell interference-unaware. The measured Signal-to-Interference-plus-Noise Ratios (SINRs) and throughput are fed to the testbed server through the backhaul connection. The performance of each cell as well as the overall network performance can be displayed in runtime with a Graphical User Interface (GUI), or logged for offline analysis.

The demonstrator will be able to show the benefit of IRC receivers in terms of overall downlink data throughput over both traditional MRC receivers and frequency reuse solutions.

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