Linear physical-layer network coding for fifth generation radio access networks

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In fourth generation mobile radio systems such as LTE-Advanced the concept of cooperative multipoint (CoMP), sometimes also known as network MIMO, was already established in order to minimize the effect of intercell interference, especially on cell-edge users. In principle network MIMO eliminates intercell interference by serving each user from a combination of neighbouring base stations. One major disadvantage of this is that it tends to greatly increase the backhaul load, since on the downlink user data needs to be sent to multiple base stations, and on the uplink sampled signals from each base station need to be sent at high precision to some combining point.

This paper analyses an alternative approach, using physical layer network coding. In this concept, each base station decodes some function of the user data, which is linear in a finite field or ring algebraic sense (the simplest example of this is the XOR function). These functions are then forwarded to the destination, which is able to decode the source data. The backhaul capacity required to convey the functions is the same as the source data rate.

An earlier paper has considered the performance of this scheme for a very simple network topology involving only two sources and two relays. This paper, after outlining the concept, will analyse its performance for larger and more complex networks, in comparison with ideal and practical CoMP systems, and examine the effect of different numbers of users and base stations.