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Master thesis 30 credit (ECTS) on "Simultaneous Transmission and Reception in Integrated Access and Backhaul Networks"

The fifth generation of wireless networks (5G) must provide high-rate data streams for everyone, everywhere at any time. To meet such demands, it is required to use large bandwidths. Here, it is mainly concentrated on millimeter wave-based (potentially, massive multiple-input and multiple-output (MMIMO)) links as a key enabler to obtain sufficiently large bandwidths/data rates. Importantly, the presence of very wide bandwidths makes it possible to include the wireless backhaul transport in the same spectrum as the wireless access. For this reason, 3GPP has considered such integrated access and backhaul (IAB) network configurations where a (potentially, fiber-connected) access point (AP) provides other APs as well as the customer-premises equipment (CPEs) inside its cell area with wireless backhaul and access connections, respectively [1]-[4]. In this way, the IAB network can be considered as a complement for the existing fiber or wireless backhaul systems, with lower costs, no digging and shorter time-to-market.

In a multi-hop IAB network, each IAB node in the chain of the nodes acts as child node towards upstream IAB nodes and parent towards downstream IAB nodes. Also, each IAB node contains two sub-units, namely, the distributed unit (DU) and the mobile terminal (MT). Through the MT, the IAB node connects to an upstream IAB node. By the DU, the IAB node connects to CPEs and the MTs of downstream IAB-nodes. I.e., the IAB-MT is responsible for the backhaul communication to the parent IAB-DU. The IAB-DU is responsible for both UE access, as well as for backhaul to the child IAB-MT.

In the initial discussions on IAB, simultaneous transmission and reception were not considered, i.e., only one of the DU or the MT sub-units of the IAB node could work at a time slot. However, to reduce the latency of backhaul traffic and to improve the throughput, it will be preferable that the IAB-MT and IAB-DU of one IAB node could be receiving or transmitting simultaneously. For this reason, it is beneficial to provide methods that support simultaneous transmission and reception.

With this background, in this thesis, we will be concentrating on the potentials and challenges of simultaneous transmission/reception in IAB networks. The thesis will study different methods of simultaneous transmission/reception and their effect on the performance of dense IAB networks. We will consider not only the end-to-end performance but also the interference and hardware challenges.

The outline of this MSc thesis is as follows

- Literature study on publications related to mm-wave communications, backhauling and few existing publications on IAB.
- Review the 3GPP recent agreements on simultaneous transmission/reception in IAB networks.
- Work on IAB network performance:
  - Identify realistic channel models for mmWave mostly line-of-sight backhauling scenarios.
  - Identifying the appropriate simultaneous transmission/reception schemes in IAB networks.
  - Developing simulations to evaluate the effect of simultaneous transmission/reception in IAB networks.
  - Performance comparisons between IAB and non-IAB networks, with and without simultaneous transmission/reception.

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