Capacity and Energy Efficiency Tradeoff for Cellular Networks with Base Station Sleeping and Scheduling

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The rapid and tremendous growth of the worldwide development in information and communication technology (ICT) has the potential to be really a major contributor to global energy consumption and CO₂ emissions [1]. Recent surveys publish that ICT is responsible for up to 10 % of the world energy consumption which is mainly consumed by mobile radio networks alone and 2 % contribution to the global CO₂. But on other side, with increasing demand for broadband services, there is a genuine need for denser networks and in this context increased energy prices are expected to constitute a significant challenge in near future [2]. Therefore, energy efficiency considerations recently gained attention in order to reduce CO₂ emissions and minimize energy consumption. Furthermore, it is important to assess network energy efficiency from operators’ point of view, since energy costs are increasing and providing ubiquitous high speed mobile access may scale up the operators operational expenditure [3].

Consequently, energy efficiency has been emerged as one of the highly desirable characteristic of existing and future generation cellular networks, in addition to the traditional spectral efficiency, reliability and Quality of Service (QoS) requirements. In order to improve the energy efficiency of base stations (BSs), several techniques are currently under consideration, such as, improved power amplifier technology, use of renewable energy sources, deployment of relays, power control and power saving protocols such as BS sleeping and cell-zooming. Amongst the listed techniques, BS sleeping has been recognized as a promising approach that allow energy savings by switching underutilized BSs to sleep mode while maintaining the required coverage and quality of service of suffering users in sleeping cells.

In this work the performance of BS sleeping is characterized considering the impact of state-of-the-art user association and channel aware scheduling schemes. Firstly, we derive mean access probability which is the chance of getting a channel from the active set of BSs considering greedy and round robin scheduling schemes. Based on this, we derive the statistics of the received signal and interference at sleeping cell user considering the Maximum mean access probability (MMAP) based association. Then, feasibility of BS sleeping and cell-zooming is quantified by increasing the transmit power of the neighbouring BS to which a sleeping cell user gets associated.

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REFERENCES