Bachelor Thesis Ideas

Title: Energy-optimal uplink scheduling under energy-constrained NB-IoT and LTE-M operation

In real-world applications such as oil and gas pipeline monitoring, environmental sensing in forests or mountainous areas, remote infrastructure monitoring for bridges and railways, and smart agriculture in off-grid regions, sensing nodes must transmit data directly to the network without local infrastructure or regular maintenance.

In these scenarios, neither continuous power nor local connectivity such as WiFi or LoRa gateways is available, and periodic battery replacement is often impractical or too costly. As a result, the device must operate with a strictly limited amount of stored energy, for example in a small capacitor, while NB-IoT and LTE-M uplink communication still require enough continuous energy for attach and successful transmission.

This thesis therefore focuses on how uplink scheduling can be optimized for energy-constrained nodes in order to maximize successful transmissions and minimize wasteful energy use.

- Study uplink behavior under limited stored energy on nRF9151.
- Quantify minimum energy required for successful transmission in NB-IoT and LTE-M.
- Compare both protocols under the same energy constraints to identify when each is more efficient.
- Design simple energy-aware scheduling policies to avoid failed and wasteful transmissions.

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