

# Wireless & The IoT

Lab 3: The low-power [potential] of emerging cellular IoT technologies

## Introduction

The purpose of today's lab design assignment is to gain some understanding of the power profile and communications capability tradeoff for existing and emerging cellular-based IoT connectivity. It's a bit less lab-y #ThanksCOVID, but hopefully will be an interesting exercise.

## The Assignment

We are following-on with last week's application, only now we're zooming in on the performance of one individual sensor. For a refresher, the communication profile:

- Each device will send a 1 kB request once every 15 minutes, 24 hours a day.
- Let us also assume that once per month, you will update device firmware (a 10 MB operation).

Your task is to figure out how much energy your sensor will spend on communication over the lifetime of its operation. To make this a bit easier, we're just going to consider the energy spent on communication related activities, that is, you can assume that the platform does no sensing and has no application to run other than just waking and sending data that is ready following the schedule above. Specifically, you should consider the following three major energy needs:

- Energy during firmware-update event      This is primarily a downlink communication
- Energy during data-send event              This is primarily an uplink communication
- Energy during idle                              What will cause your device to wake every 15m?  
[You may use an integrated, or separate timer]

Your device may choose to use any of the cellular communication approaches we have discussed (2G, 3G, 4G, LTE-M, NB-IoT), however you should discuss *very briefly* why you chose that technology for your device. You must also choose radio hardware to use. As a final step, what is one example of a consumer-grade battery solution (i.e. 1 AA, 3 AAA's, a D cell, 2 CR2032's, etc) that could power your device for its 6 month lifetime?

## Some References

Where to find power numbers? Datasheets! One chipset you might choose, check out §4.2.3

[https://www.mouser.com/pdfDocs/SARA-R5\\_DataSheet\\_UBX-19016638.pdf](https://www.mouser.com/pdfDocs/SARA-R5_DataSheet_UBX-19016638.pdf)

Empirical analysis of power modes on real hardware:

<https://www.digikey.com/en/articles/how-to-enable-power-saving-modes-of-nb-iot-and-cat-m>

Release 13 Spec [Includes CAT M1, CAT NB1]:

[https://www.etsi.org/deliver/etsi\\_ts/124000\\_124099/124008/13.07.00\\_60/ts\\_124008v130700p.pdf](https://www.etsi.org/deliver/etsi_ts/124000_124099/124008/13.07.00_60/ts_124008v130700p.pdf)

Release 14 Spec [Includes CAT M2, CAT NB2]:

[https://www.etsi.org/deliver/etsi\\_ts/145000\\_145099/145022/14.00.00\\_60/ts\\_145022v140000p.pdf](https://www.etsi.org/deliver/etsi_ts/145000_145099/145022/14.00.00_60/ts_145022v140000p.pdf)

## What to submit?

Please use this document as a template, add your responses directly, and export it as a PDF to Gradescope. This is a hard problem, with lots of subtle details. Folks are encouraged to collaborate as much as you like with others. If you work with others, please put everyone's name who worked together below. I believe I have also configured Gradescope to allow "group submission," so please submit to Gradescope as a group.

(your name(S) here)

Q1: