

Quantifying the tiny-Small design of the SmolPhone

a smartphone with energy constraints

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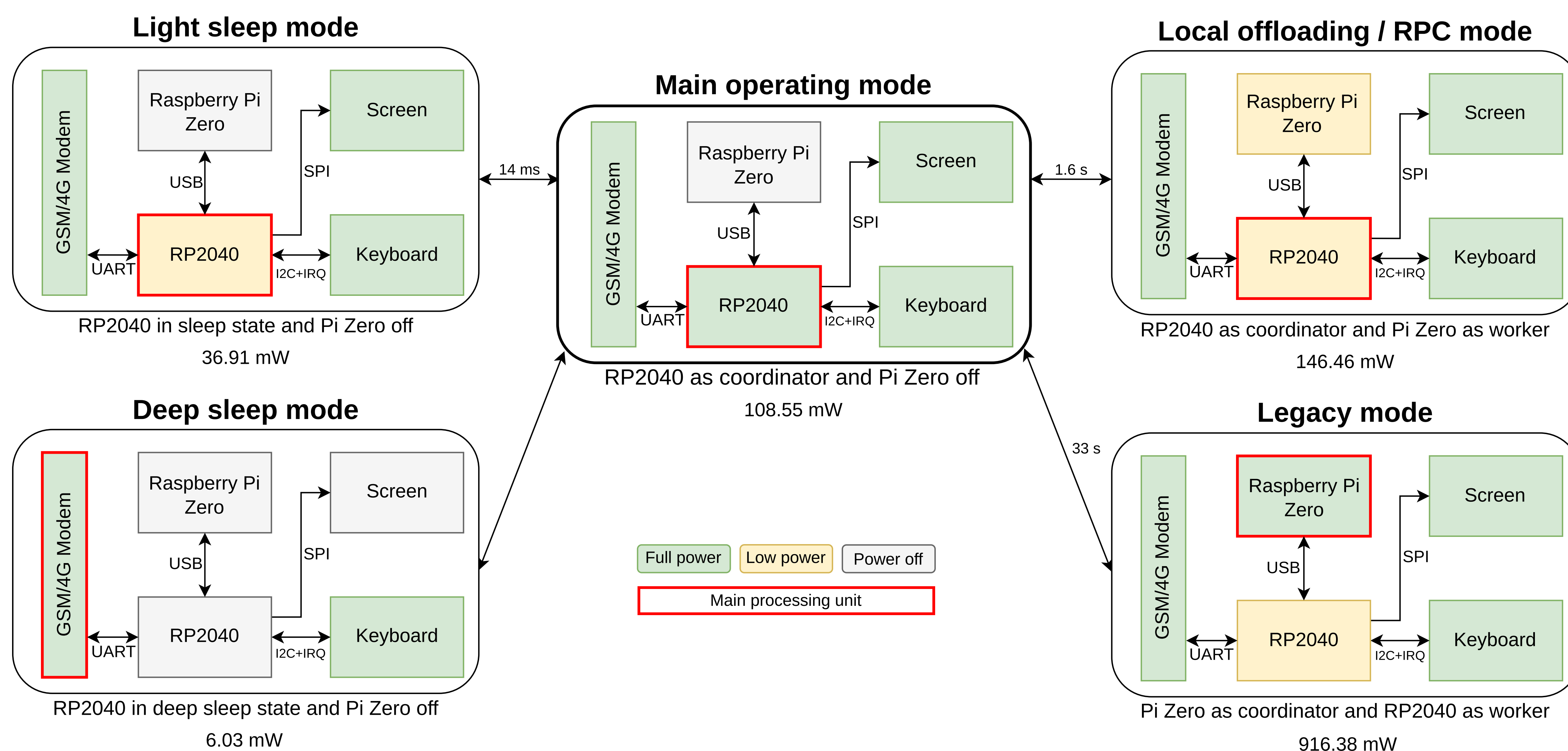
Sustainable Computing, Mobile Computing, Frugal Design

SmolPhone [1]: action research on low-tech in IT

Explores and quantifies different design for SmartPhones.

The **tiny-Small design**: heterogeneous computing architecture to optimize energy consumption.

- a **tiny low-power microcontroller (MCU)** → simple and dedicated applications.
- a **Small processor (CPU)** → Linux-based or computation-heavy applications.



Usage modes

Mode	Main unit	Typical usage	Exemple applications
Main	MCU	Dedicated applications	epub reader, navigation, text messaging, calls
Light sleep	MCU	Idle	clock
Deep sleep	Modem	Hibernation	N/A
Local offloading	MCU	Compute-intensive RPC	video player, camera
Legacy	CPU	Linux applications to be run	Linux games, Linux clients

- Frequently used applications able to run purely on the MCU
- Performance critical code called using RPC when needed.
- Any other application run on CPU's Linux.

First tiny-Small prototype

Hardware:

- MCU → Raspberry 2040 (RP2040)
- CPU → Raspberry Pi Zero (PiZ)
- Display → memory LCD display

Software:

- Main operating mode → Rust + Slint
- Local offloading → BareBox bootloader
- Legacy mode → Raspberry Pi OS Lite (w/o wireless connectivity)

Bibliography

[1] J. Paturel, C. Quinson, M. Quinson, and S. Rokicki, "SmolPhone: a smartphone with energy limits," in *IGSC 2023 - 14th International Green and Sustainable Computing*, Oct. 2023, p. 4–5. [Online]. Available: <https://inria.hal.science/hal-04156447>

Experimental evaluation

- **Power consumption** → busy work using matrix multiplication
- **Switch time** → cycling modes, GPIO high when switching to next mode

Power consumption + switch time reported in the main figure.

Values include screen consumption:

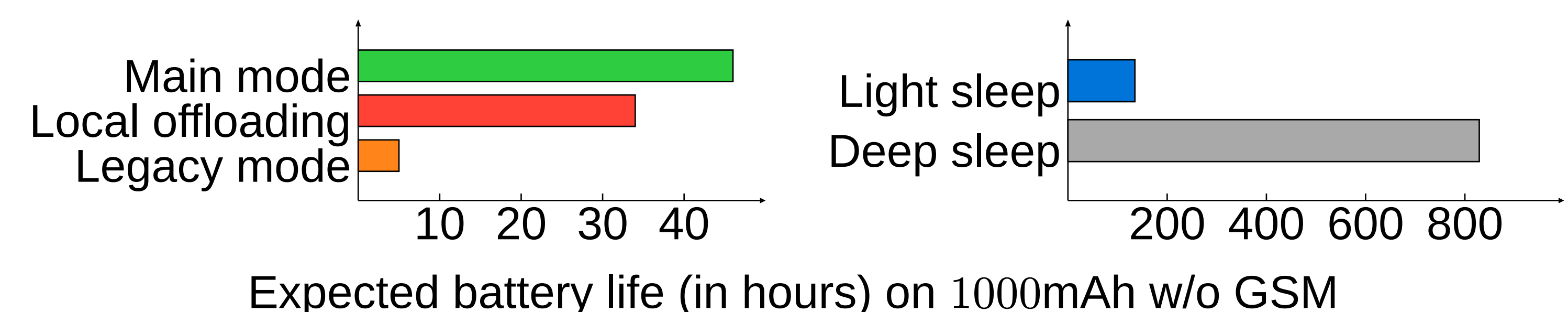
- 0.44 mW average
- 0.86 mW when drawing

No GSM modem/WiFi chip/keyboard were included in experiments.

Conclusion

Combining MCU and CPU:

- dramatically reduces power consumption of basic applications.
- **and** allows the use of resource hungry applications.



Future work

- Extending prototype with LTE Cat1 modem for GSM/LTE connectivity
- Measurements of the energy saving modes for the modem
- Basic applications (agenda, texting, epub reader, OpenStreetMap, ...)
- Measurements in "real life" settings with full hardware prototype
- Finish and test the port of Uxn environment to hardware