

Continuous Sensing on Mobile Phones with LittleRock

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Motivation

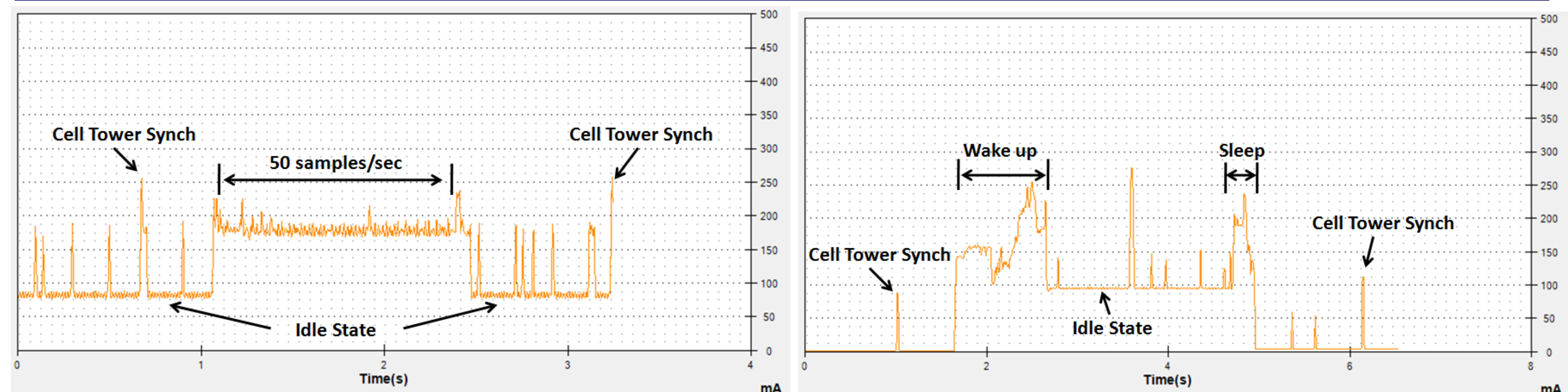
Current status:

- Modern phones have multiple sensors
- On demand sensing –apps actively read sensor data.

Continuous sensing:

- Senses activity on and around phone
- Continuously update user context
- Enables rich context aware user-centric apps

Problem



- Main processor remains active to read sensors
- Proc. ~600mW, sensor (accelerometer) ~0.56mW
- High energy overhead

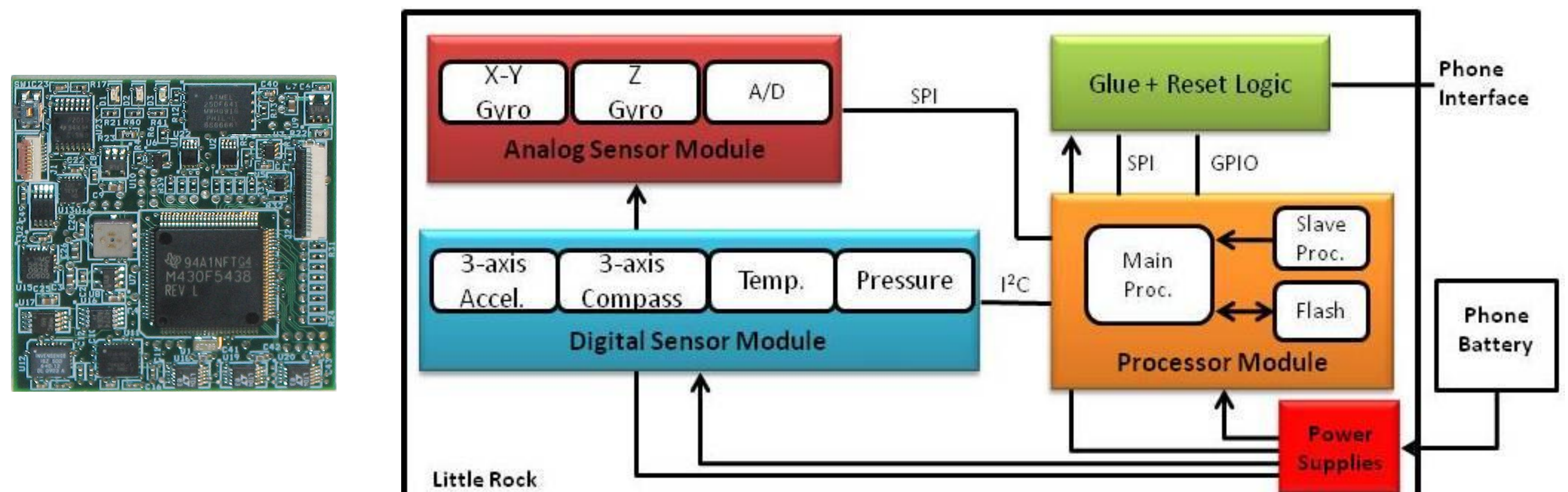
- Large sleep & wakeup times
- Wakeup + sleep time ~1.2s
- Proc. can't sleep during periodic sampling

Goal: Enable low-power continuous sensing

Solution

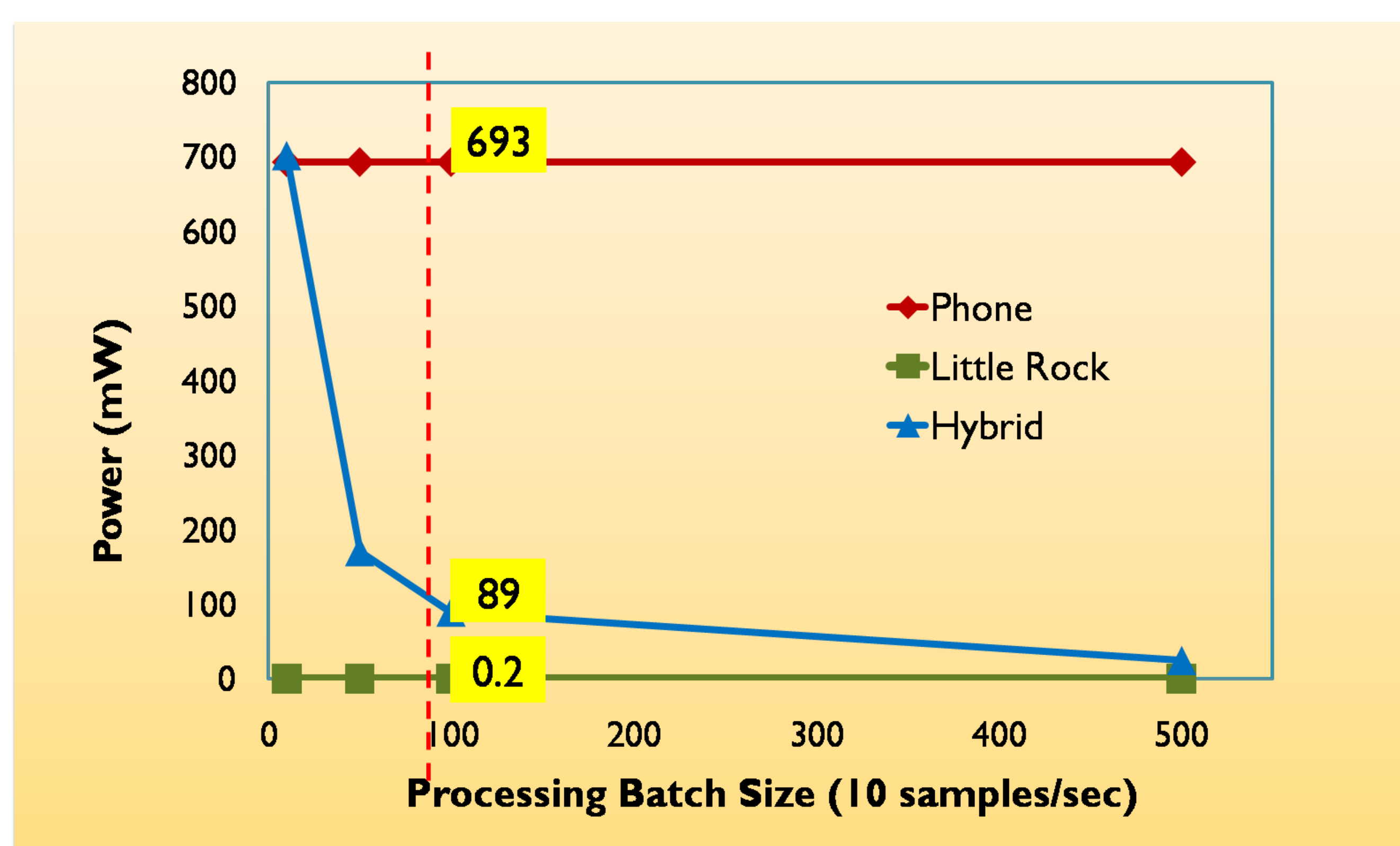
- Offload sensing & low-level processing to a low power processor
 - Power optimized design to meet slow periodic activity
 - Sample and process sensors while main proc. is sleeping
- Event-driven interaction
 - Turns phone on/off
 - Interrupts the phone
- Orders of magnitude power efficient for lightweight sensing

LittleRock Prototype



- MSP430 low power processor – 256kB Flash, 16kB RAM, 18Mhz max clock
- Sensors – 3D accelerometer, 3D compass, 3D gyro, temperature, pressure, touch
- Power consumption - sleep: 150 μ W, active: 20mW (proc. @ 16MHz)
- Other features – programmable from phone, extensible

Step Counting App Performance



- Pedometer app. : LittleRock vs. HTC Touch
- LittleRock solution > 1000 more energy efficient

Applications Enabled

- Context Aware Apps
 - Adjust ringtone based on location & background noise
 - User intent recognition for search
 - Make UI larger when running
- Novel UIs
 - Touch/motion based UI
 - Single-step interaction
 - Post tagging: log sampled sound on “tag now”
- Services
 - Always-available low-power location
 - Type of user location (meeting, home, car)
 - Phone as a “wellness sensor”
 - Level & type of user activity