A simple choice

How to deal with door codes?

- Remember them
- Use Reminders app built-in geofencing
- Download a geofencing app
- Learn geofencing, understand the limits, overcome them with engineering, and build an entire app on top of that before making a talk about it

Push the limits of Geofencing

From proof of concept to app

NSSpain XI

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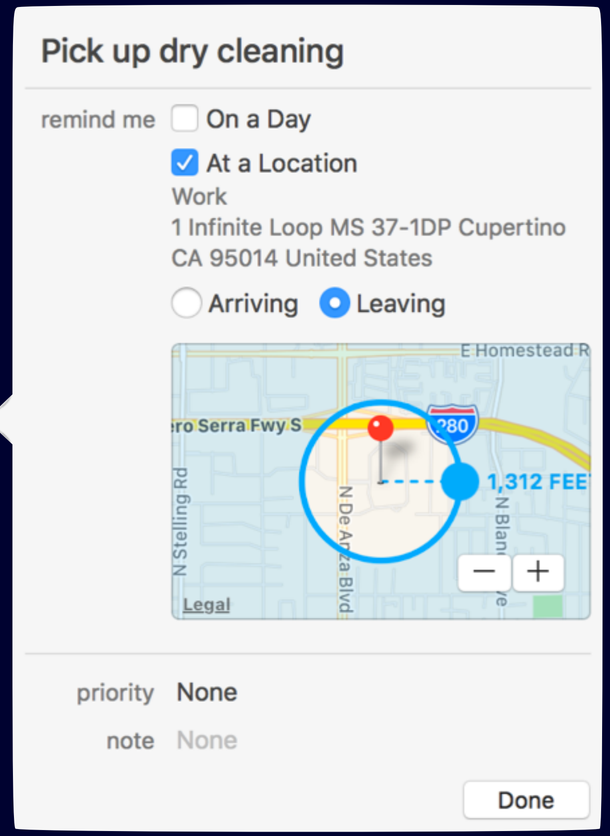
Geofencing is monitoring when your phone leaves or enters predefined regions

Concept of regions

Circular	Beacon
Center coordinate Radius (≥100m)	UUID Major/minor versions

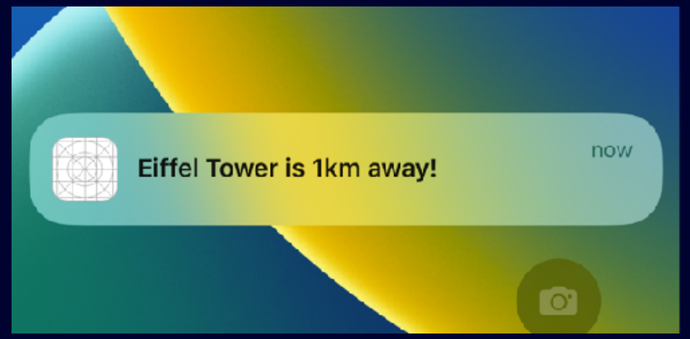
onEntry / onExit booleans

Identifier



First geofenced notification
Using UserNotifications

- `UNLocationNotificationTrigger` for the win?
  - Initialize with a region and a repeat boolean
  - Requires *when in use* location authorization
- But with limitations:
  - Unregister/Register for any payload change…
  - No control on the actual notification sending…



Diving into Core Location

Meet region monitoring

- Start or Stop monitoring CLRegion

```
manager.startMonitoring(for: region)
```

```
manager.stopMonitoring(for: region)
```

- Events trigger your delegate methods

```
func locationManager(_, didEnterRegion: _)
```

```
func locationManager(_, didExitRegion: _)
```

- Still only require *when in use* location permission

Geofencing tidbits

The devil hides in the details

- You must have full accuracy permission on location
  - Also check if your device is compatible with `isMonitoringAvailable(for:)`

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  - You app might be launched in background to deal with monitoring events

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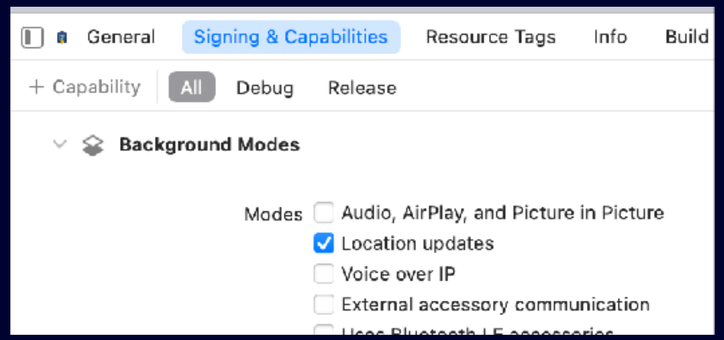
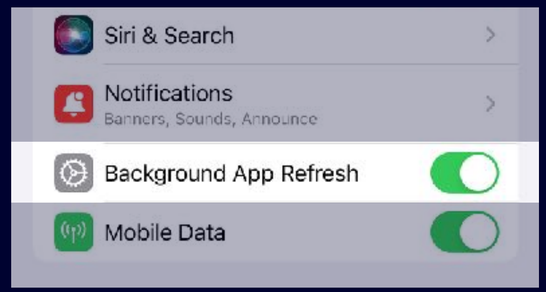
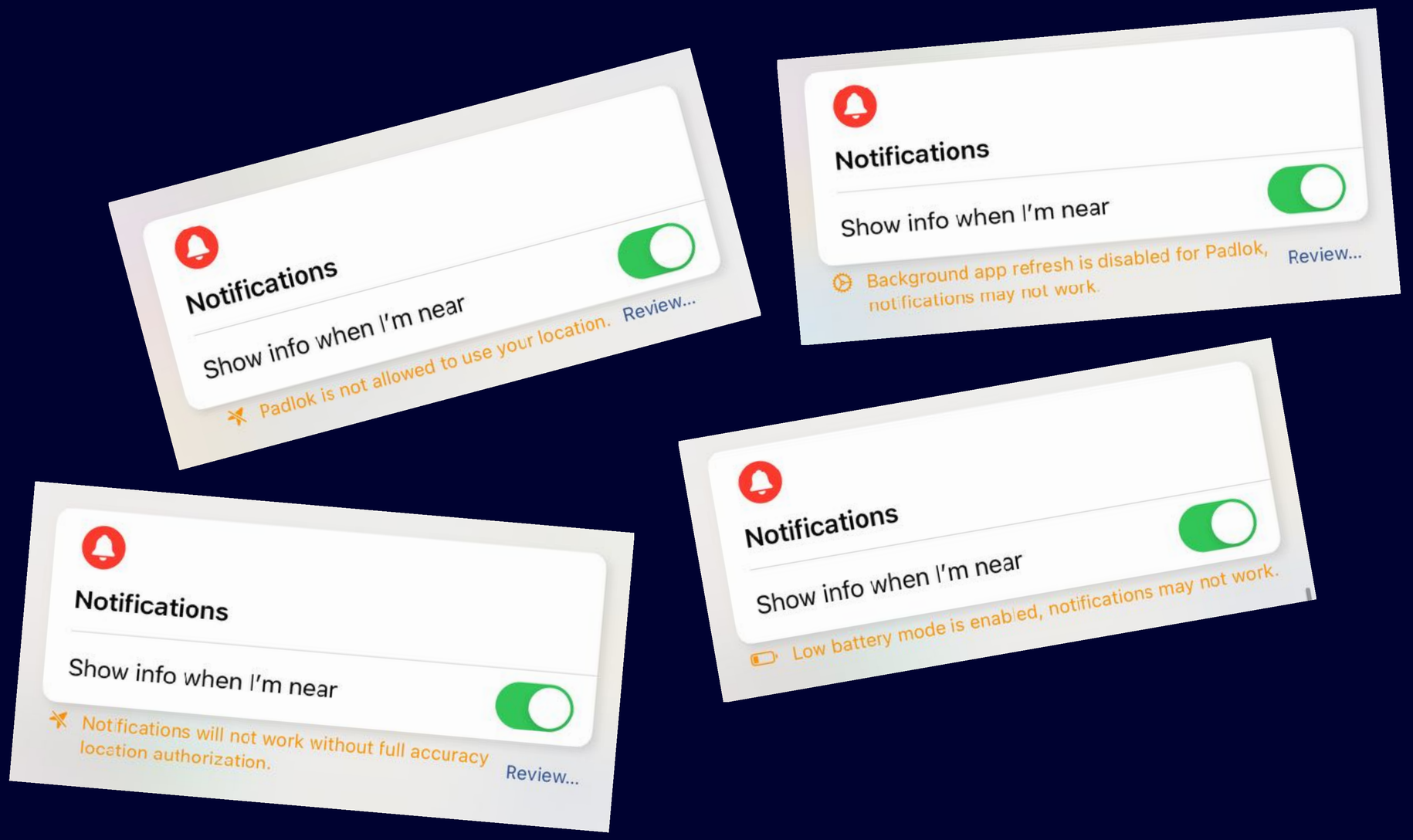
- You must have full accuracy permission on location
  - Also check if your device is compatible with `isMonitoringAvailable(for:)`
- Setup your CLLocationManagerDelegate as soon as possible
  - You app might be launched in background to deal with monitoring events
- Terminated app won’t start unless location background modes are enabled





No workaround? Warn your users

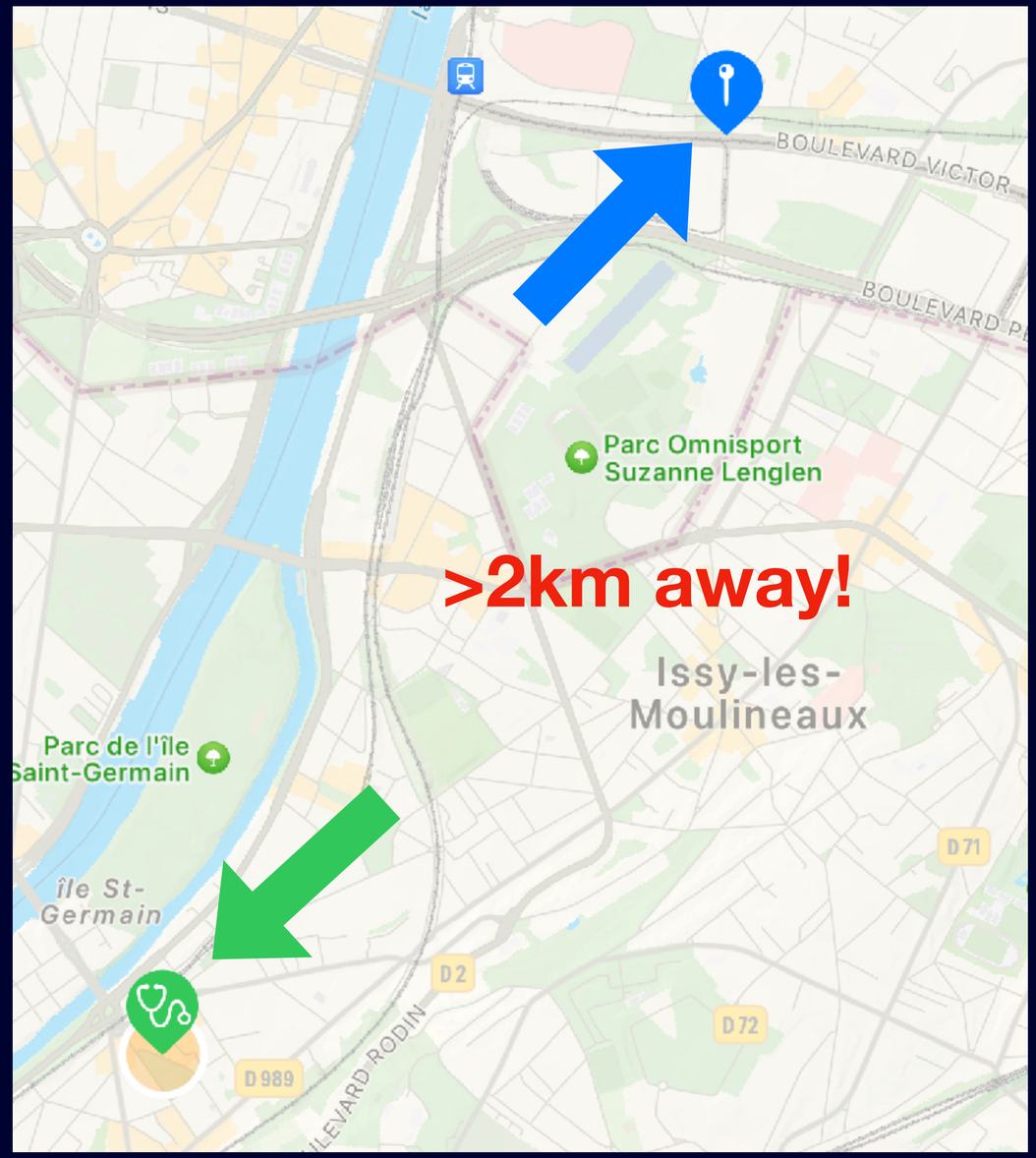


Precision…

A true story

- Geofencing does not rely on satellite navigation

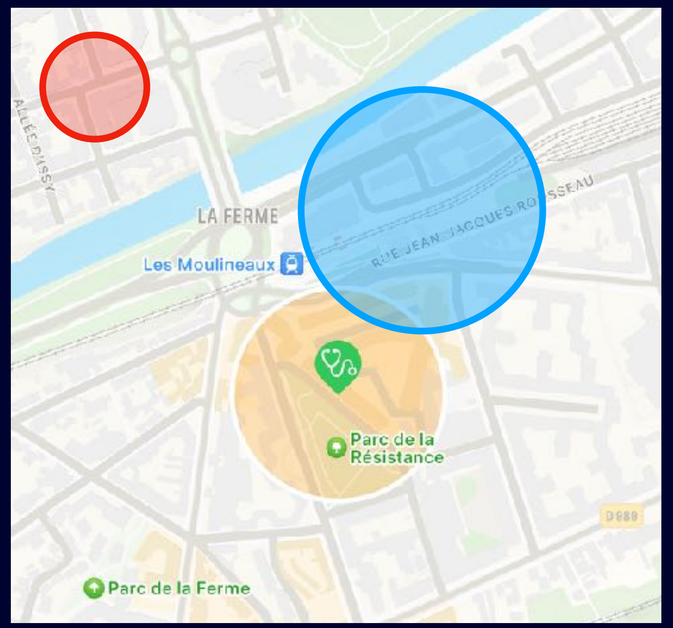
Expect false positives!



Precision…

Prevent false positives

- When entering/leaving region, we don’t have access to the position
- We can access it with `CLLocationManager.requestLocation()`
  - But requires « Always » location permission



- Take into account the given location accuracy!

Precision…

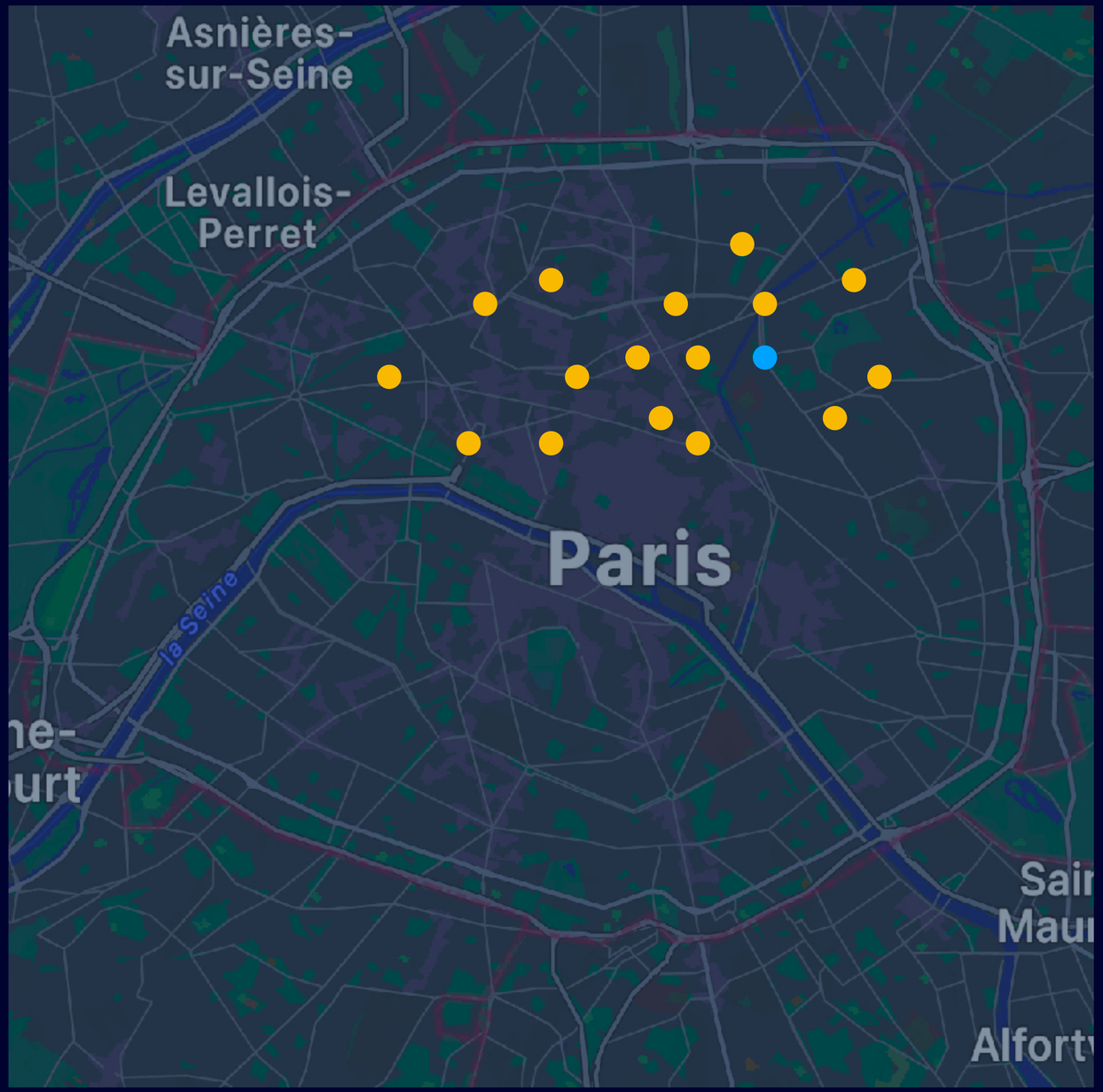
Going below the 100m radius

- Get multiple location events
  - `CLLocationManager.startUpdatingLocation()`
- Think about battery consumption!
  - `desiredAccuracy` & `distanceFilter`
  - `stopUpdatingLocation()`

Region budget

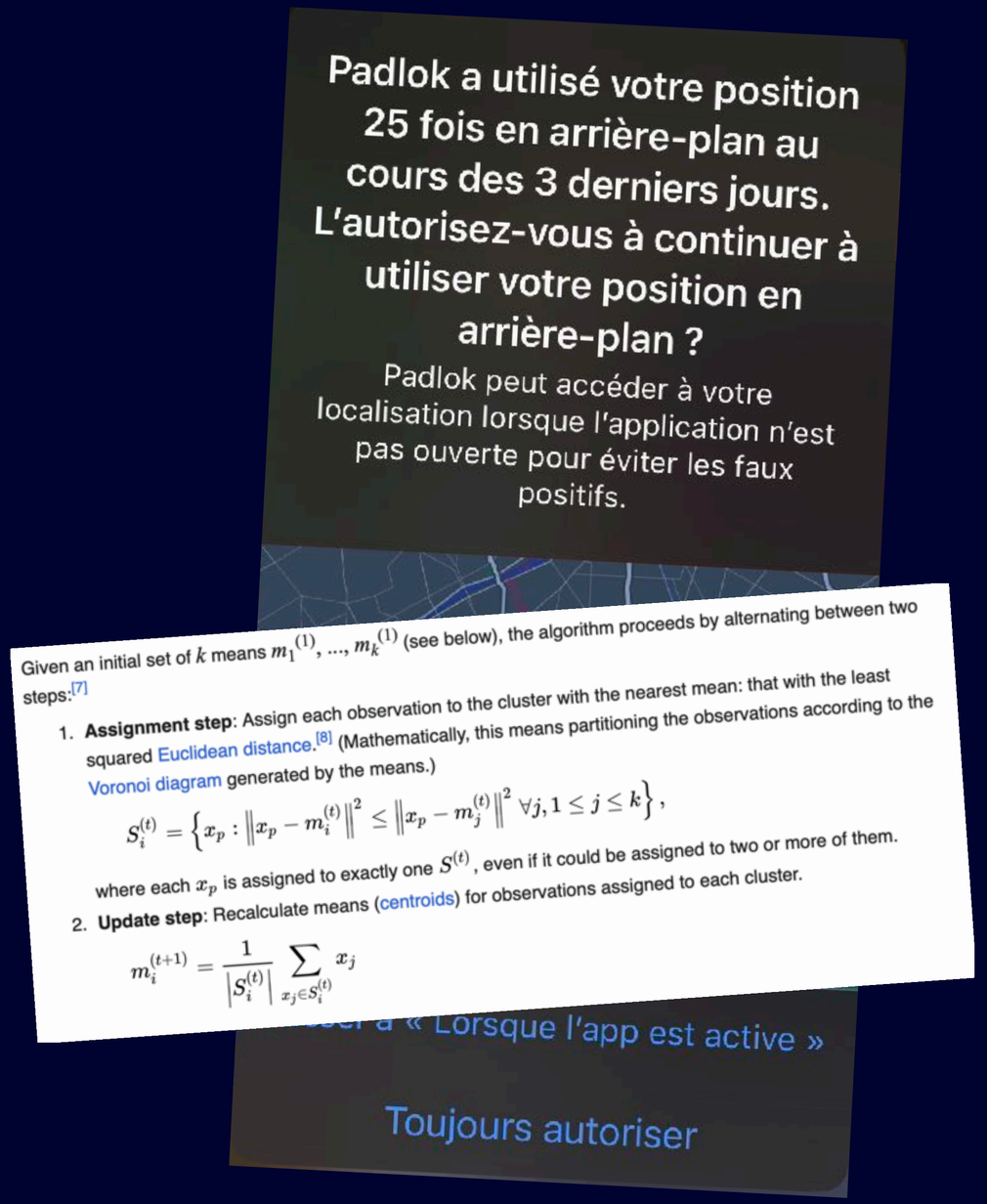
≤ 20 regions per app…

- Concept of syncing
  - Get current location
  - Register closest regions
- Repeat…
  - Get new location
  - Unregister; Register regions



~~Significant Location Change?~~

~~Region clustering?~~



Given an initial set of k means $m_1^{(1)}, \ldots, m_k^{(1)}$ (see below), the algorithm proceeds by alternating between two steps:[7]

1. **Assignment step**: Assign each observation to the cluster with the nearest mean: that with the least squared Euclidean distance.[8] (Mathematically, this means partitioning the observations according to the Voronoi diagram generated by the means.)

$$S_i^{(t)} = \left\{ x_p : \left\| x_p - m_i^{(t)} \right\|^2 \leq \left\| x_p - m_j^{(t)} \right\|^2 \forall j, 1 \leq j \leq k \right\},$$

   where each x_p is assigned to exactly one $S^{(t)}$, even if it could be assigned to two or more of them.

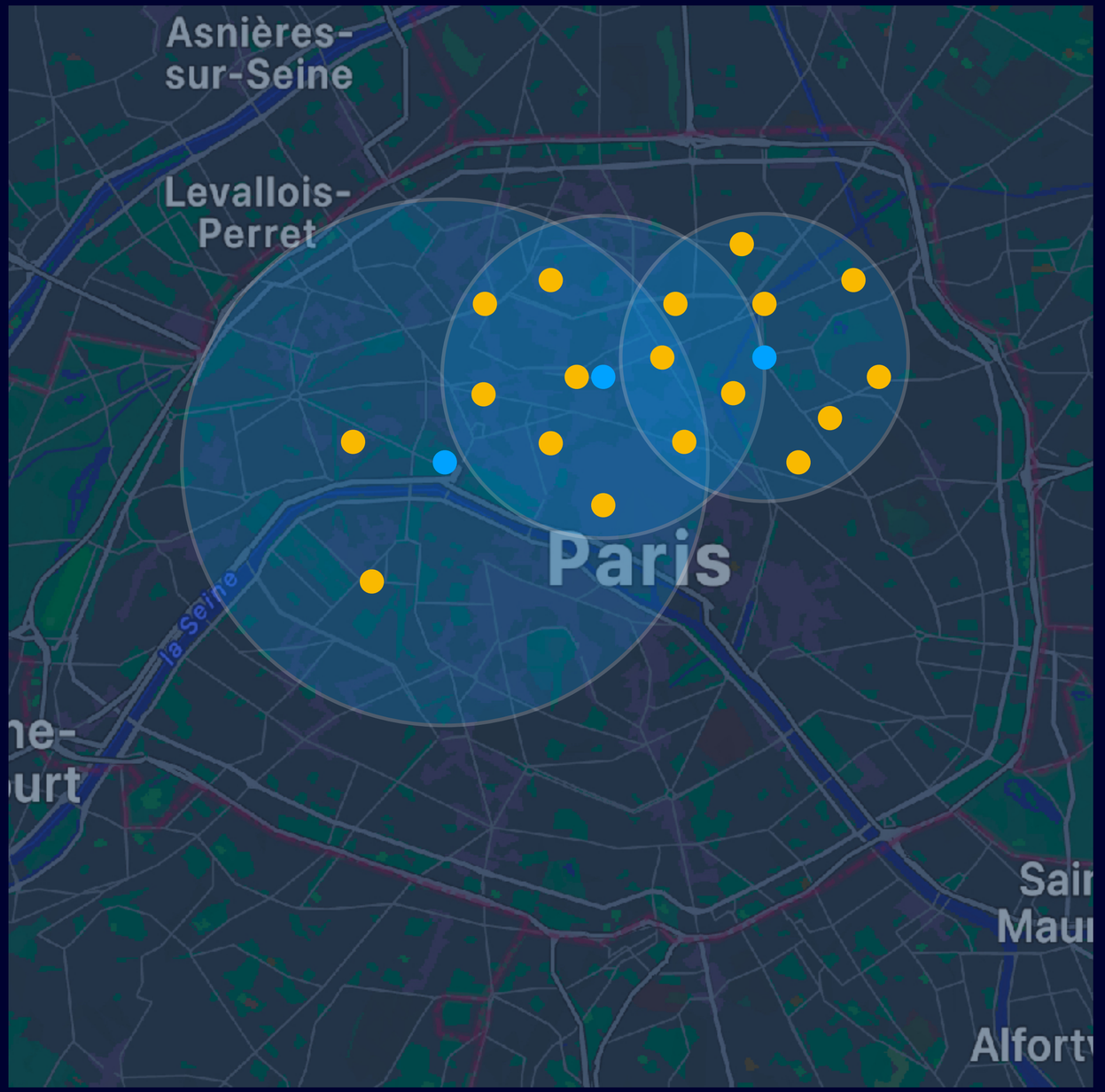
2. **Update step**: Recalculate means (centroids) for observations assigned to each cluster.

$$m_i^{(t+1)} = \frac{1}{\left| S_i^{(t)} \right|} \sum_{x_j \in S_i^{(t)}} x_j$$

Region budget

≤ 20 regions per app…

- Use 19 regions out of 20
- Enclose them with the 20th
- When exiting the outer region
  - Fetch location
  - Sync
  - Repeat!



Deprecated?

Meet the new CLMonitor

Deprecating CLLocationManager monitor

CLLocationManager Monitoring API deprecated	**CLMonitor** new
iOS 5+ / macOS 10.8+	iOS 17+ / macOS 14+
Delegation	AsyncSequence
No state	**Current state access**
~100 meters precision	
20 regions hard limit	

https://padlok.app

Thank you!

Slides:

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