Core Location Best Practices

Privacy and power

Session 716

Brad Jensen Apple Inc

The Schedule

The Schedule

Major Features

The Schedule
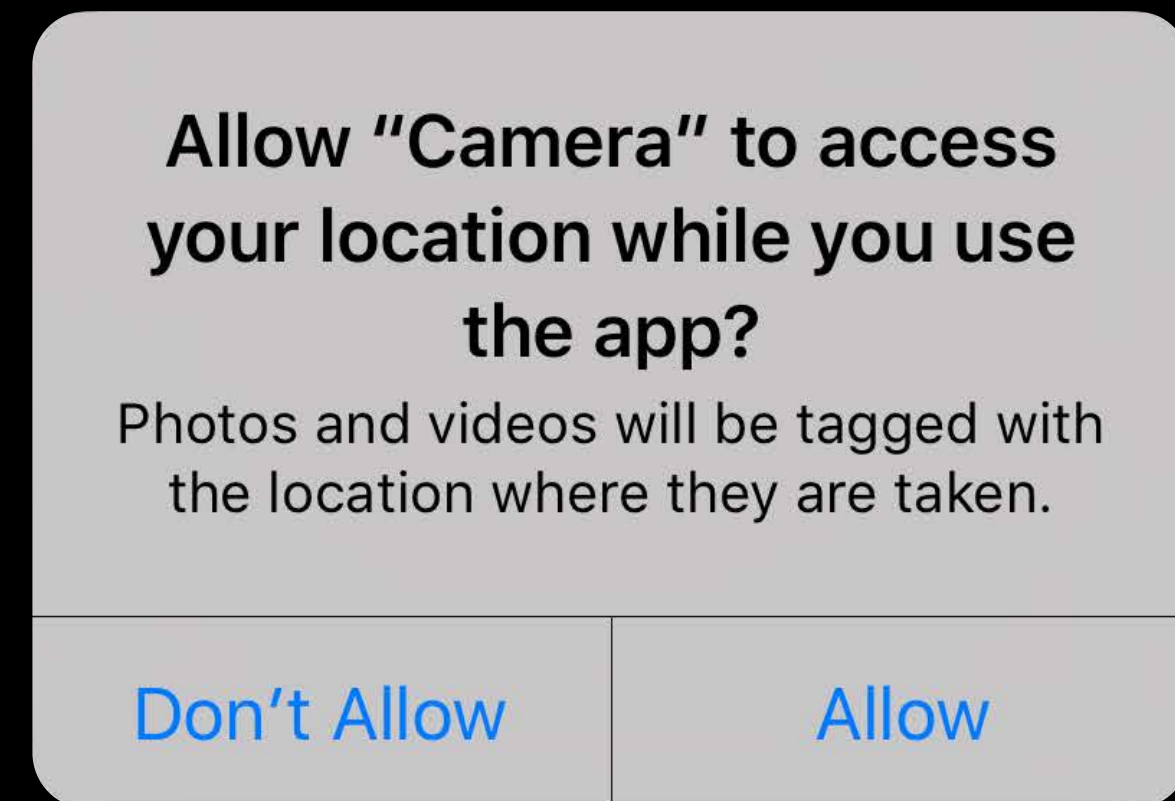
Major Features

Best Practices

Major Features

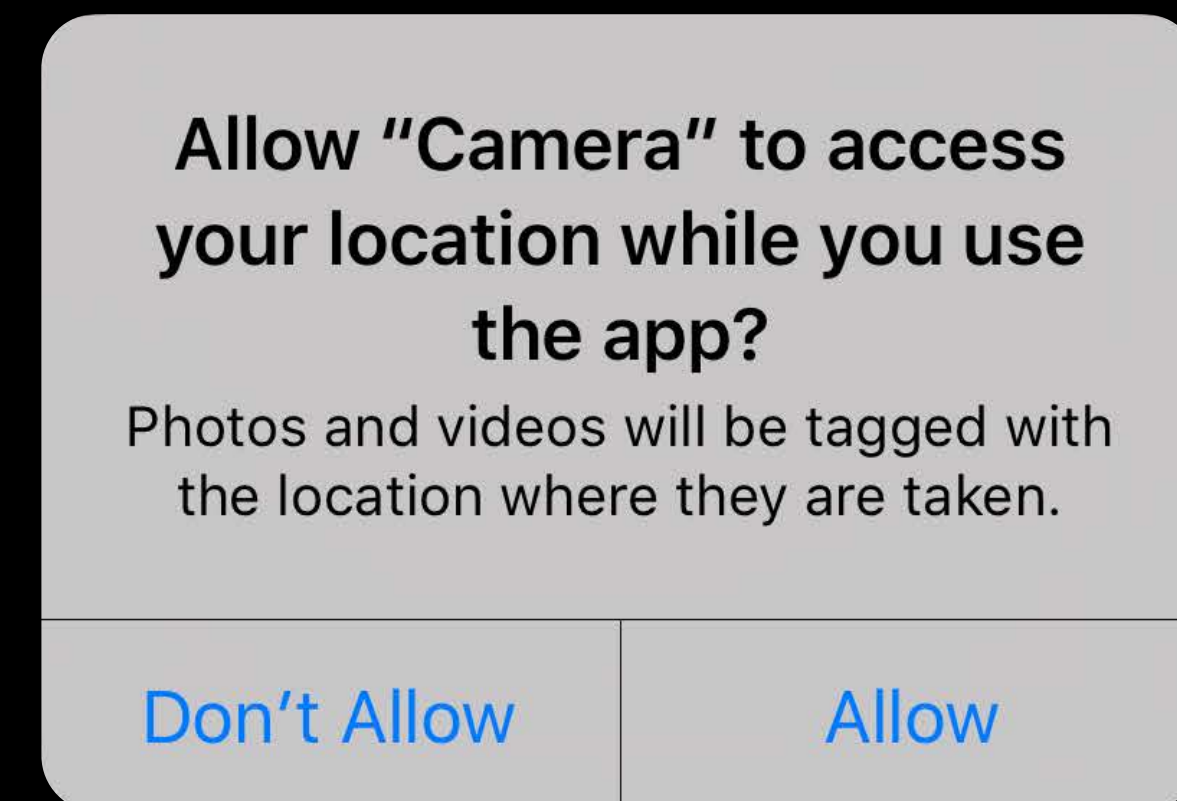# Authorization

Authorization

Required to access location

Authorization

Required to access location

Allow "Camera" to access your location while you use the app?

Photos and videos will be tagged with the location where they are taken.

| Don't Allow | Allow |

Authorization

Required to access location

When-in-use

Allow "Camera" to access your location while you use the app?

Photos and videos will be tagged with the location where they are taken.

| Don't Allow | Allow |

Authorization

Required to access location

When-in-use

- `requestWhenInUseAuthorization`

Allow "Camera" to access your location while you use the app?

Photos and videos will be tagged with the location where they are taken.

Don't Allow   Allow

Authorization

Required to access location

When-in-use

- `requestWhenInUseAuthorization`

Always

Allow "Camera" to access your location while you use the app?

Photos and videos will be tagged with the location where they are taken.
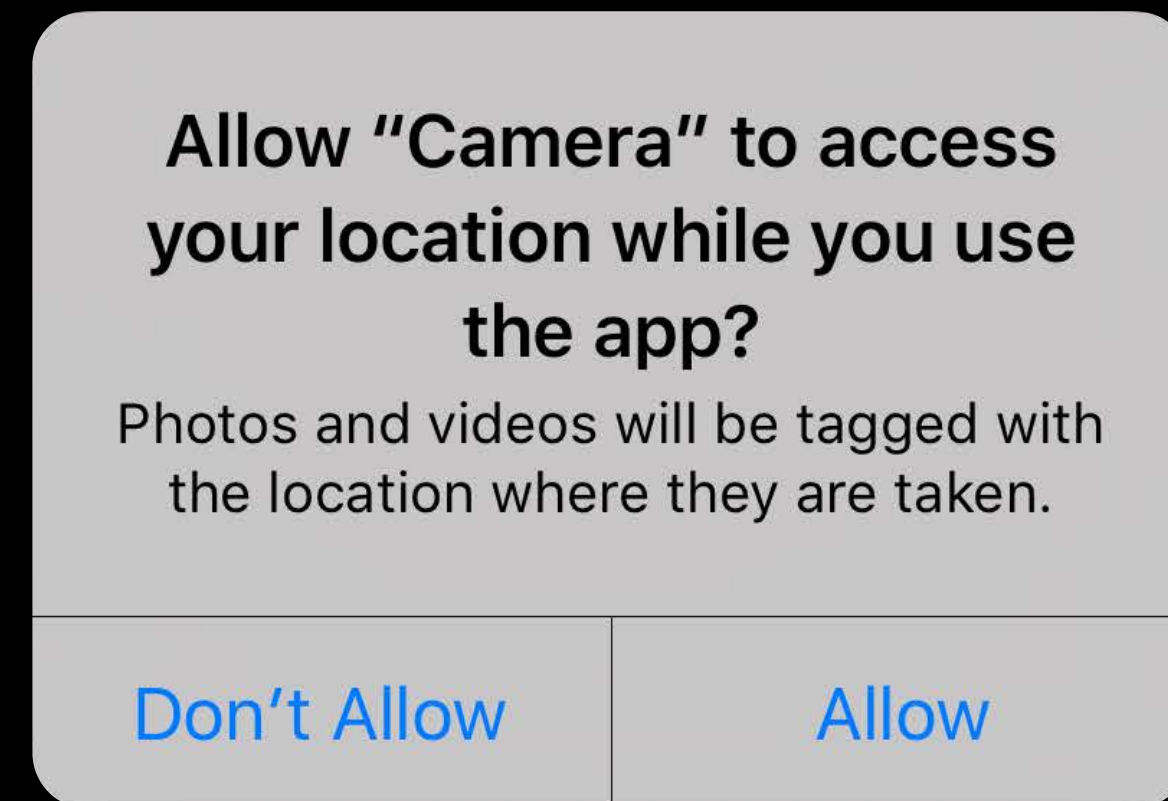
| Don't Allow | Allow |

Authorization

Required to access location

When-in-use

- `requestWhenInUseAuthorization`

Always

- `requestAlwaysAuthorization`

Allow "Camera" to access your location while you use the app?

Photos and videos will be tagged with the location where they are taken.

Don't Allow   Allow

Authorization

Required to access location

When-in-use

- `requestWhenInUseAuthorization`

Always

- `requestAlwaysAuthorization`
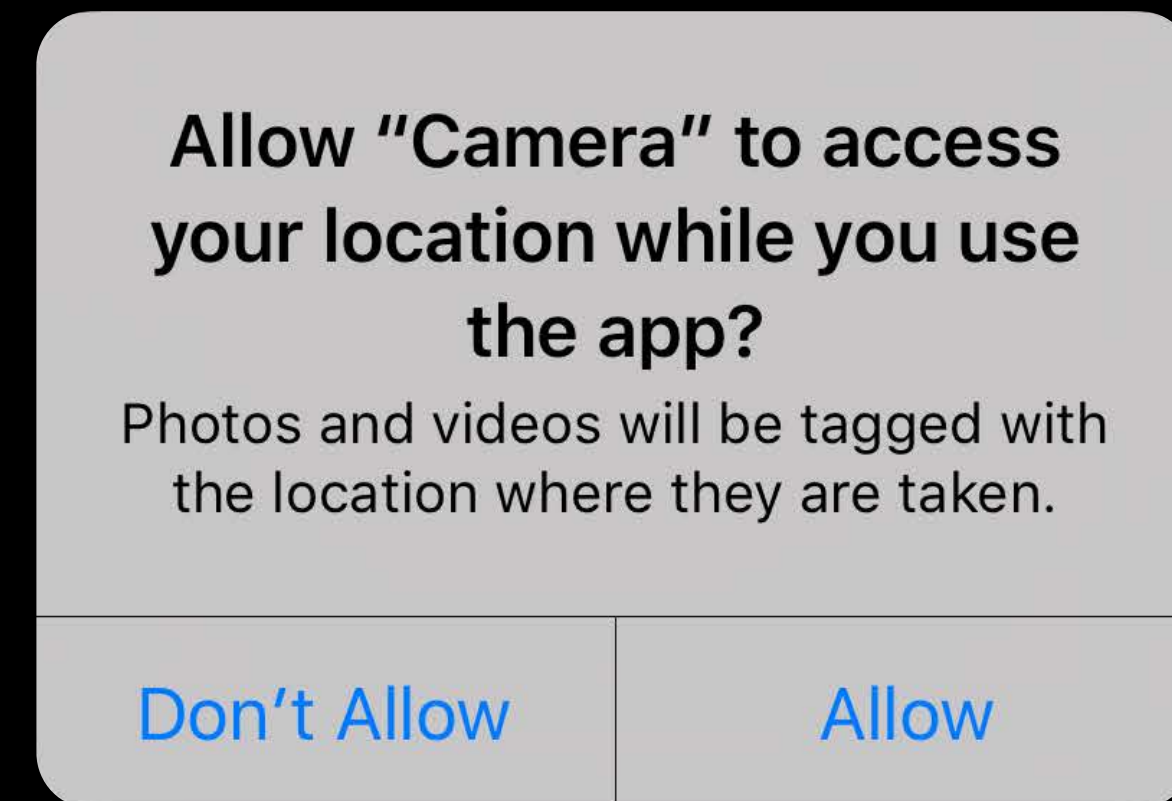
Allow "Camera" to access
your location while you use
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Photos and videos will be tagged with
the location where they are taken.
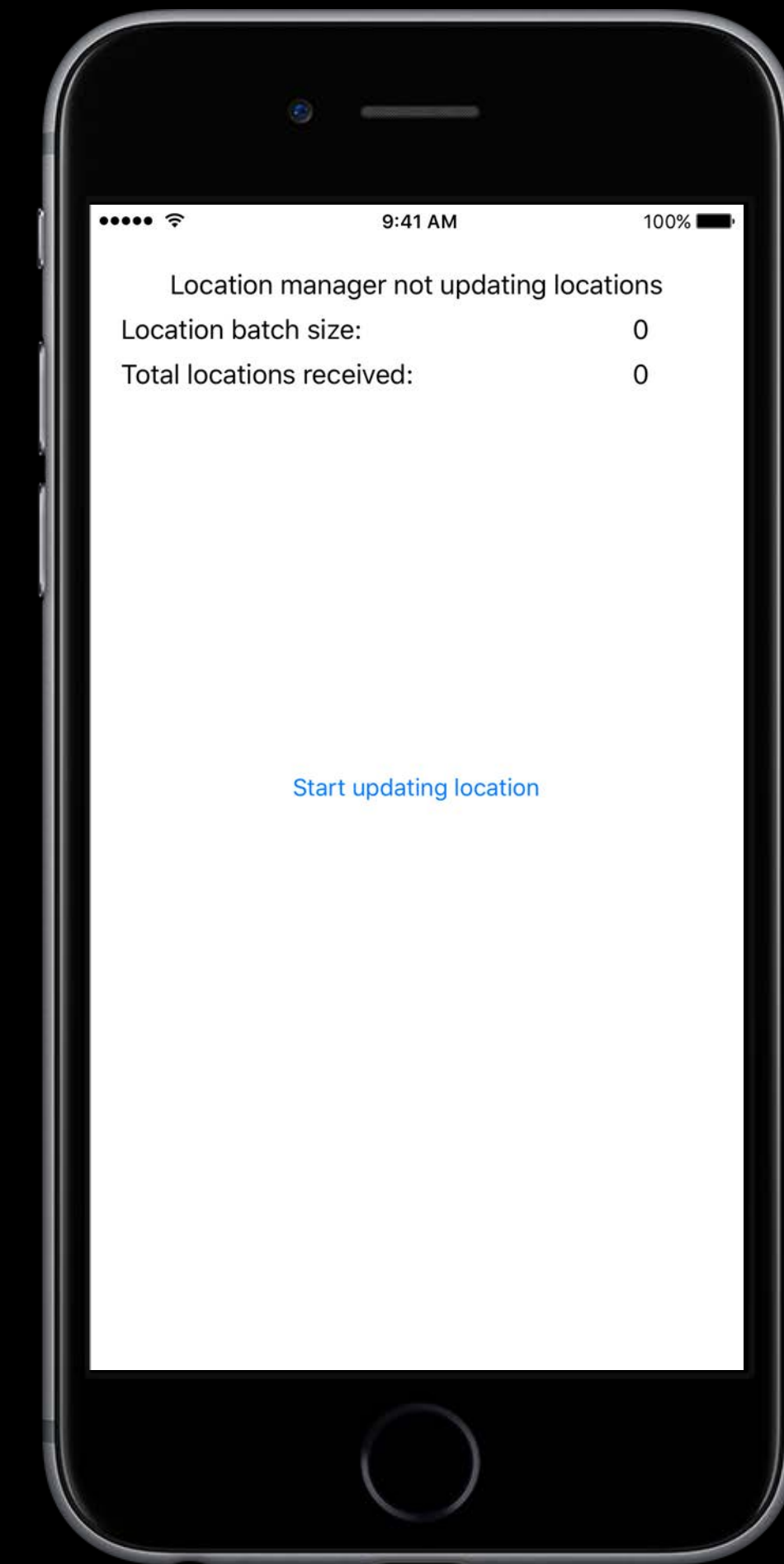
Don't Allow | Allow

| Privacy - Location When In Use Usage Description | String | Location authorization is required to display your position on a map |
| Privacy - Location Always Usage Description | String | Location authorization is required to automatically journal your day |

When-in-use Authorization

When-in-use Authorization

Foreground

When-in-use Authorization

Foreground

Blue bar

When-in-use Authorization

Foreground

Blue bar

WatchConnectivity

Standard Location

Standard Location

Single location

- `requestLocation`

Standard Location

Single location

- `requestLocation`

Continuous location

- `startUpdatingLocation`

Standard Location

Single location

- `requestLocation`

Continuous location

- `startUpdatingLocation`

- `stopUpdatingLocation`

Standard Location

Single location

- `requestLocation`

Continuous location

- `startUpdatingLocation`

- `stopUpdatingLocation`

Features

Standard Location

Single location

- `requestLocation`

Continuous location

- `startUpdatingLocation`

- `stopUpdatingLocation`

Features

- Deferred updates

Standard Location

Single location

- `requestLocation`

Continuous location

- `startUpdatingLocation`

- `stopUpdatingLocation`

Features

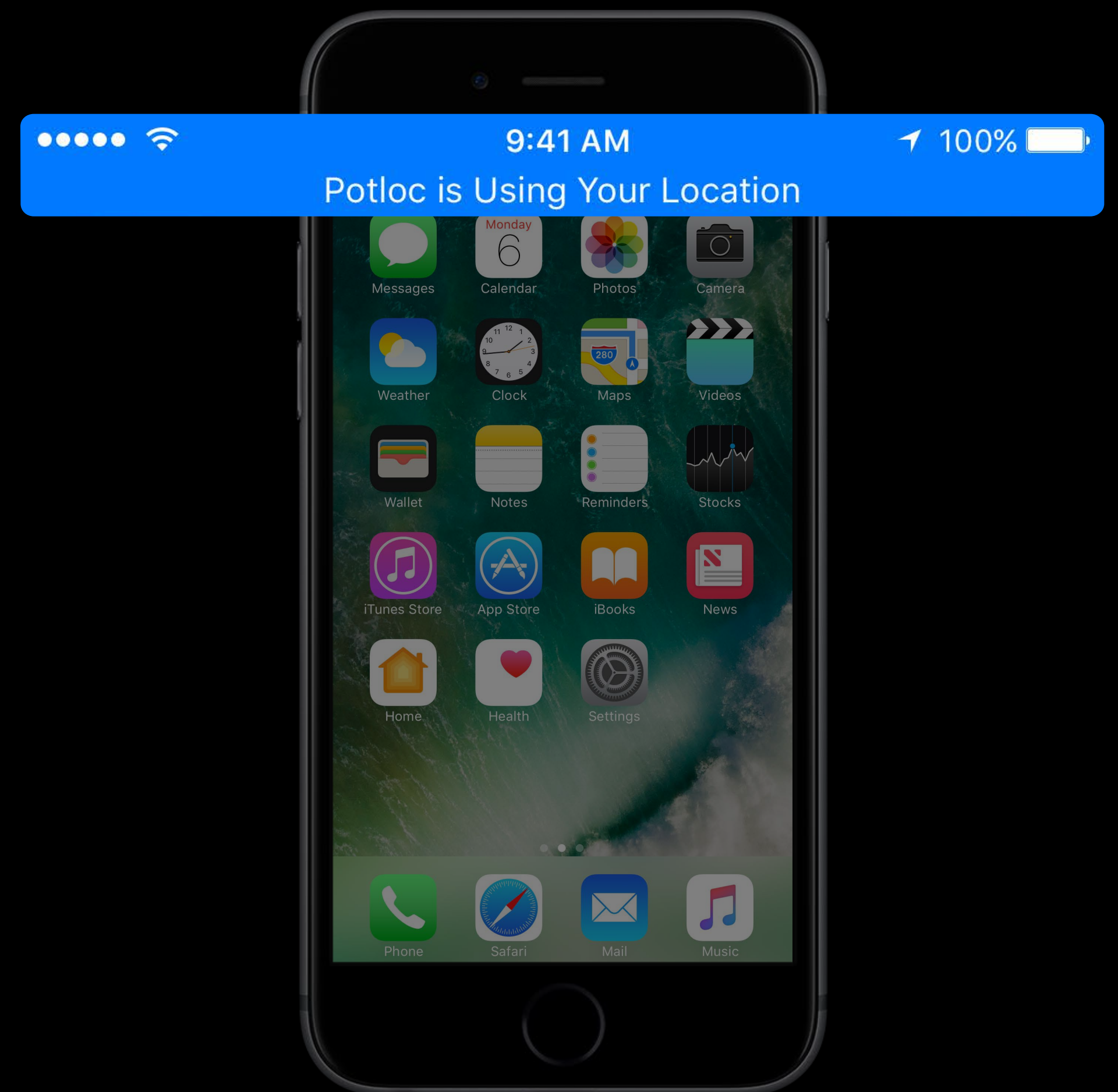- Deferred updates

- Automatic pausing

Continuous Location in the Background

Continuous Location in the Background

Location updates and app continue running

Continuous Location in the Background

Location updates and app continue running

When-in-use authorized apps get a blue bar

Continuous Location in the Background

Location updates and app continue running

When-in-use authorized apps get a blue bar

Stop when done

Continuous Location in the Background

Location updates and app continue running

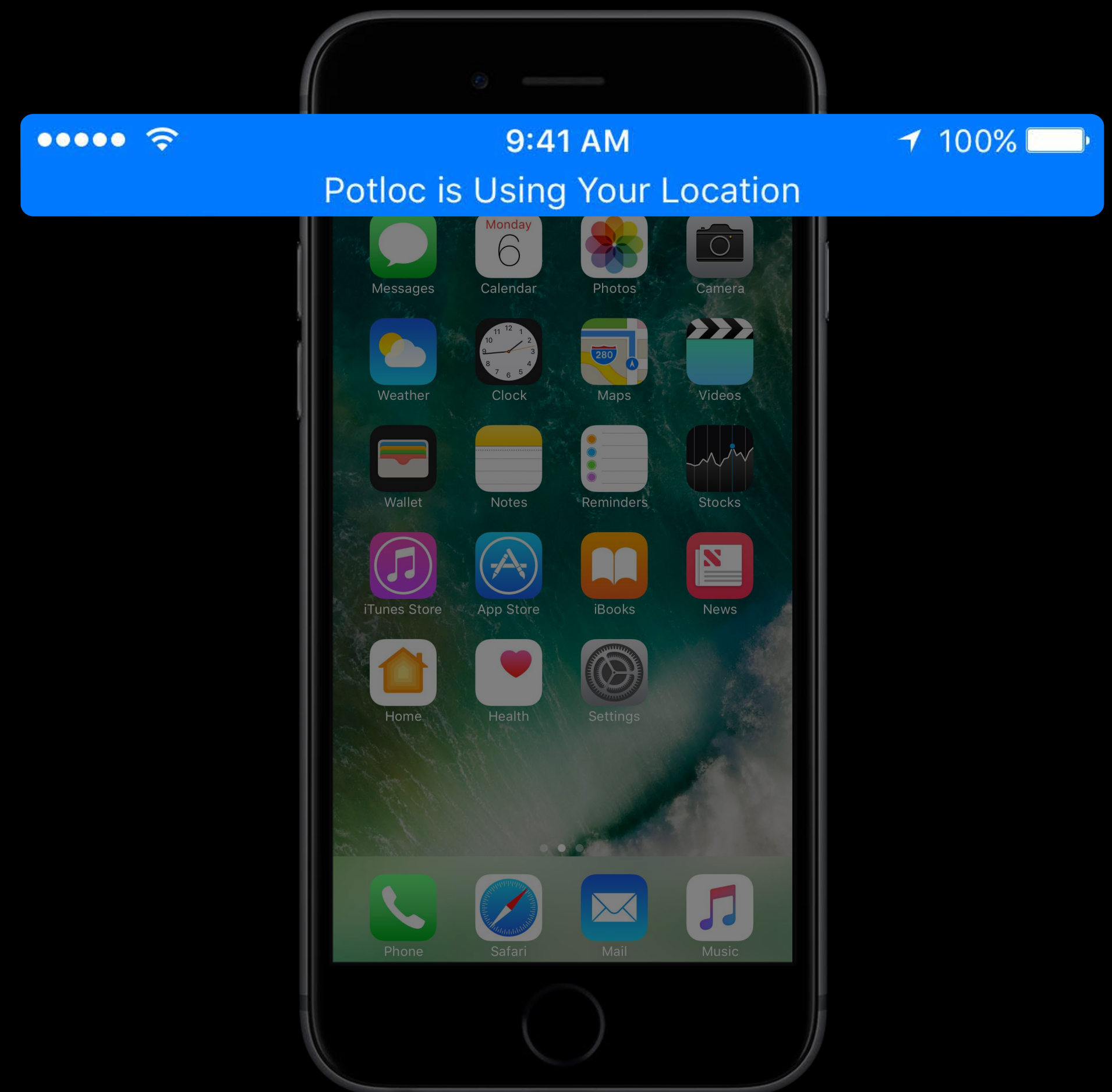When-in-use authorized apps get a blue bar

Stop when done

Requirements

Continuous Location in the Background

Location updates and app continue running

When-in-use authorized apps get a blue bar

Stop when done

Requirements

• Enable background location in information property list

Background Modes ON

Modes:
☐ Audio, AirPlay and Picture in Picture
☑ Location updates
☐ Voice over IP
☐ Newsstand downloads
☐ External accessory communication
☐ Uses Bluetooth LE accessories
☐ Acts as a Bluetooth LE accessory
☐ Background fetch
☐ Remote notifications

Steps: ✓ Add the "Required Background Modes" key to your info plist file
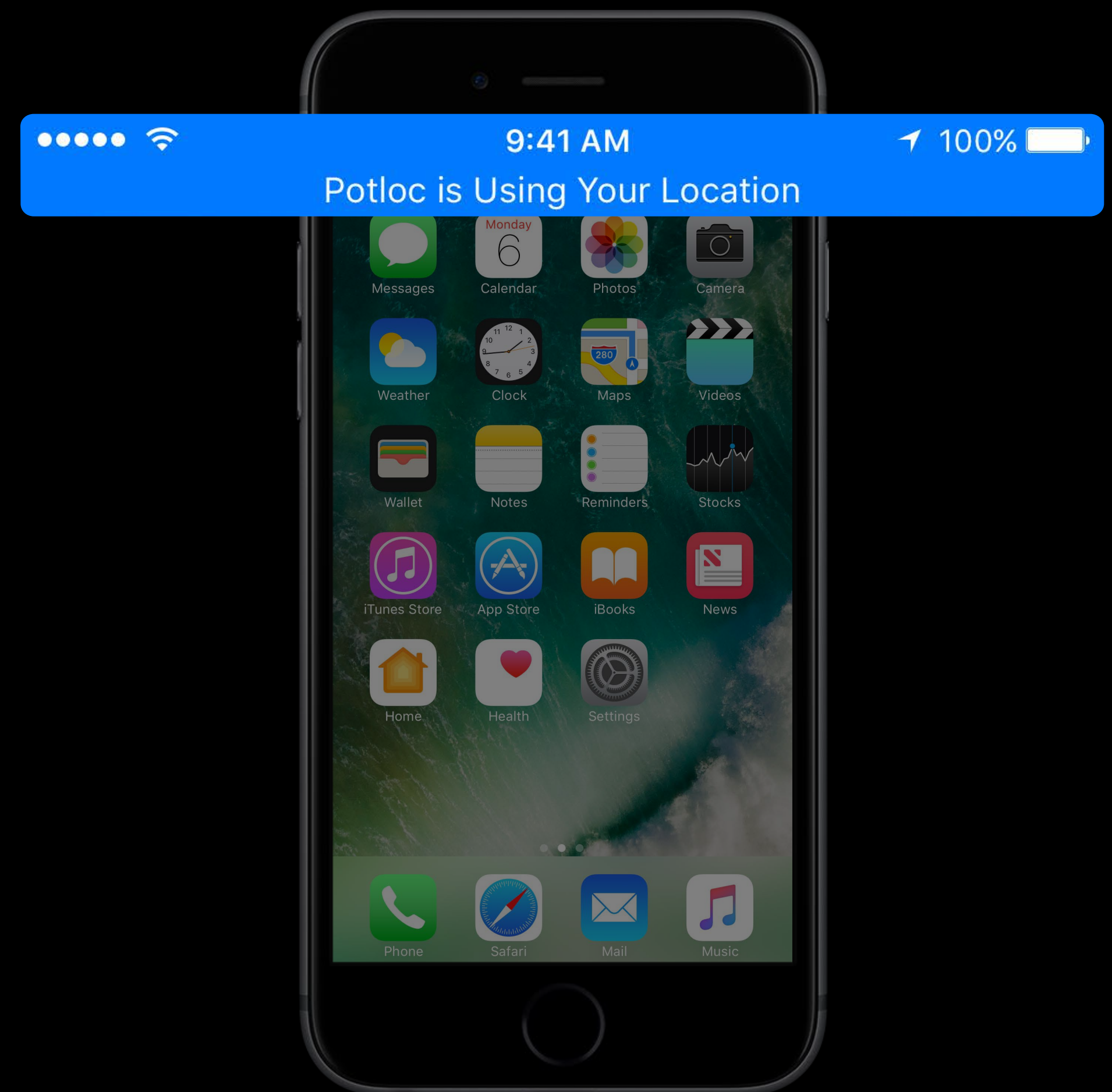
Continuous Location in the Background

Location updates and app continue running

When-in-use authorized apps get a blue bar

Stop when done

Requirements

- Enable background location in information property list

- Set `allowsBackgroundLocationUpdates`

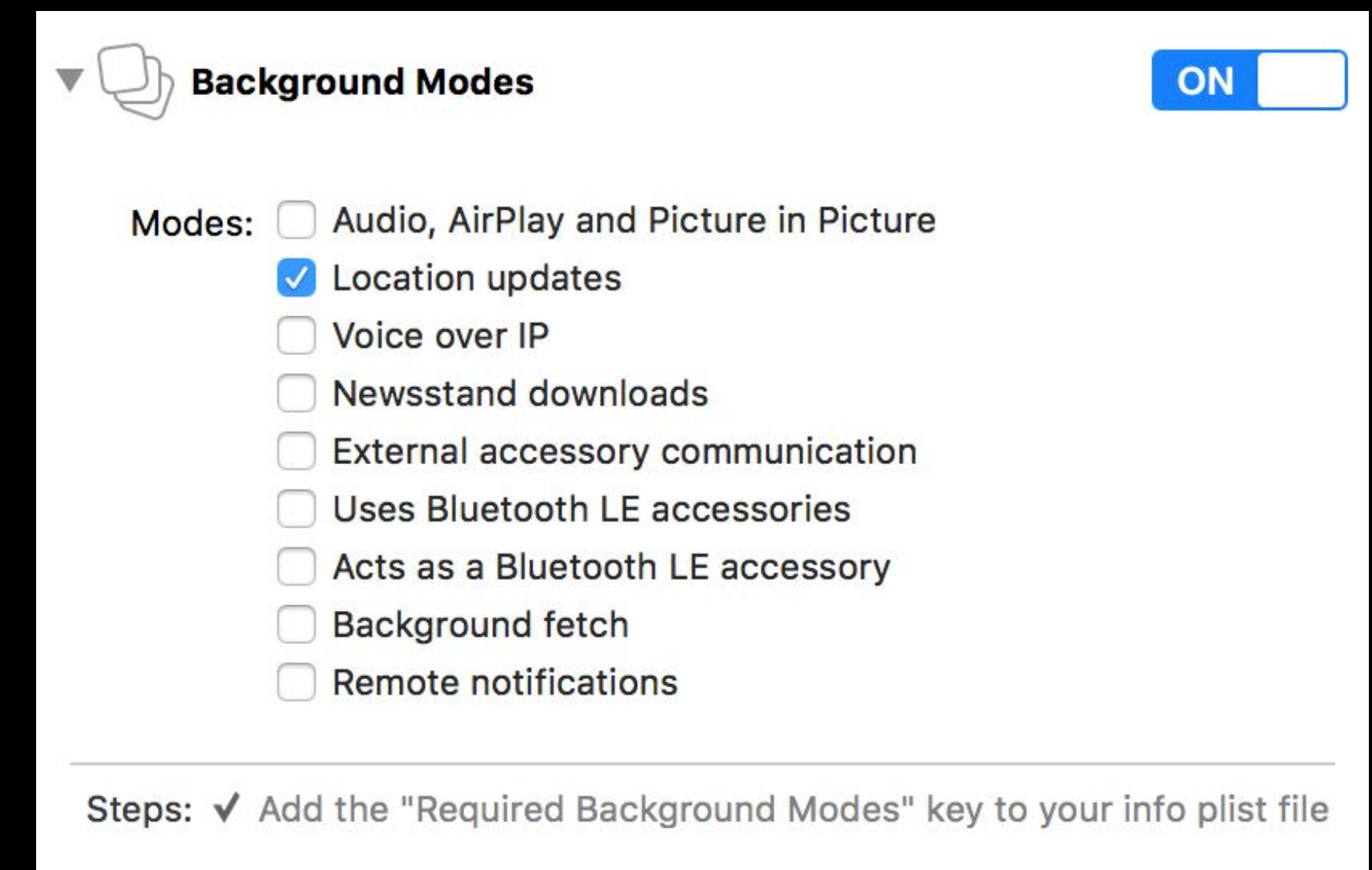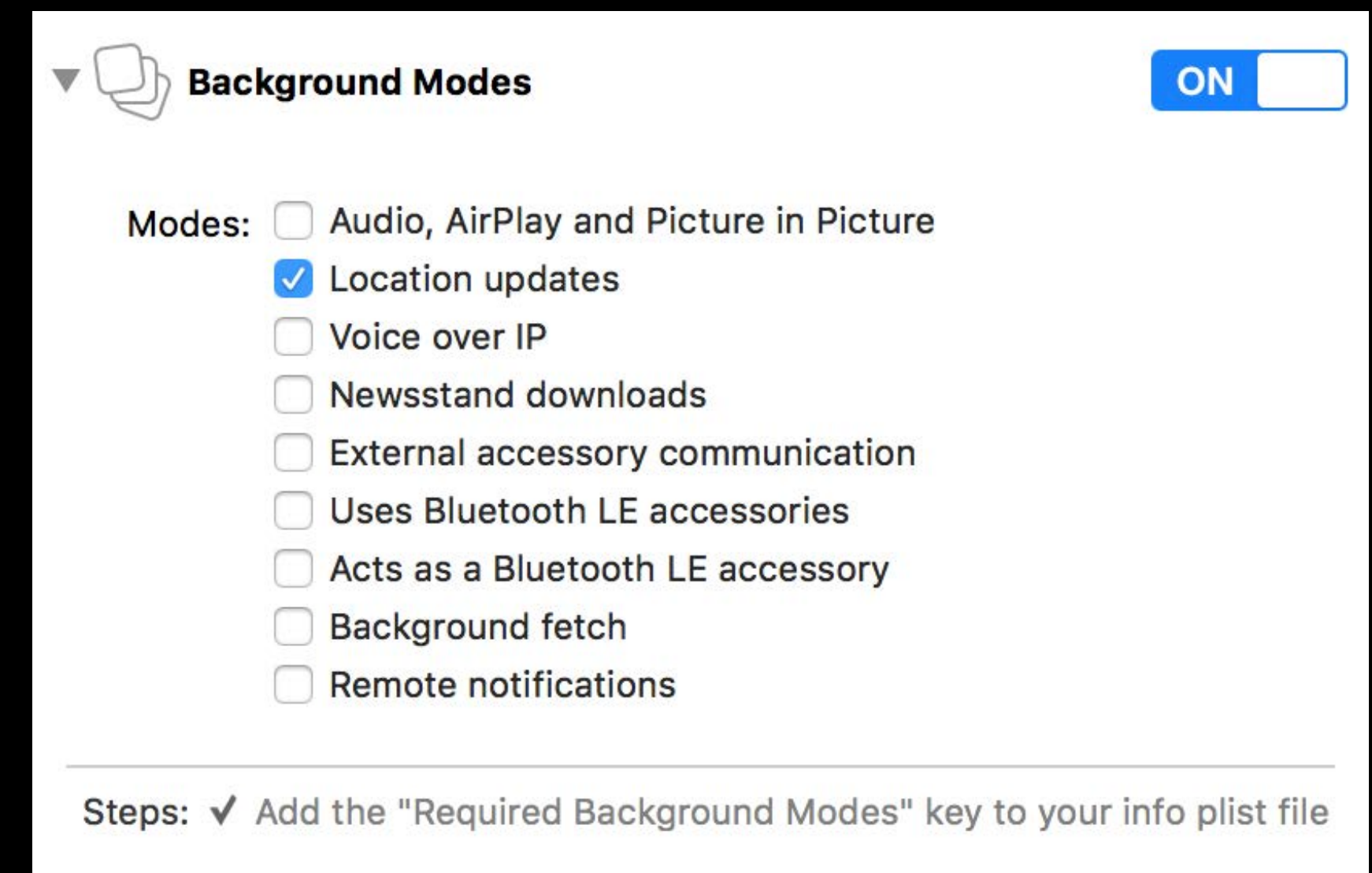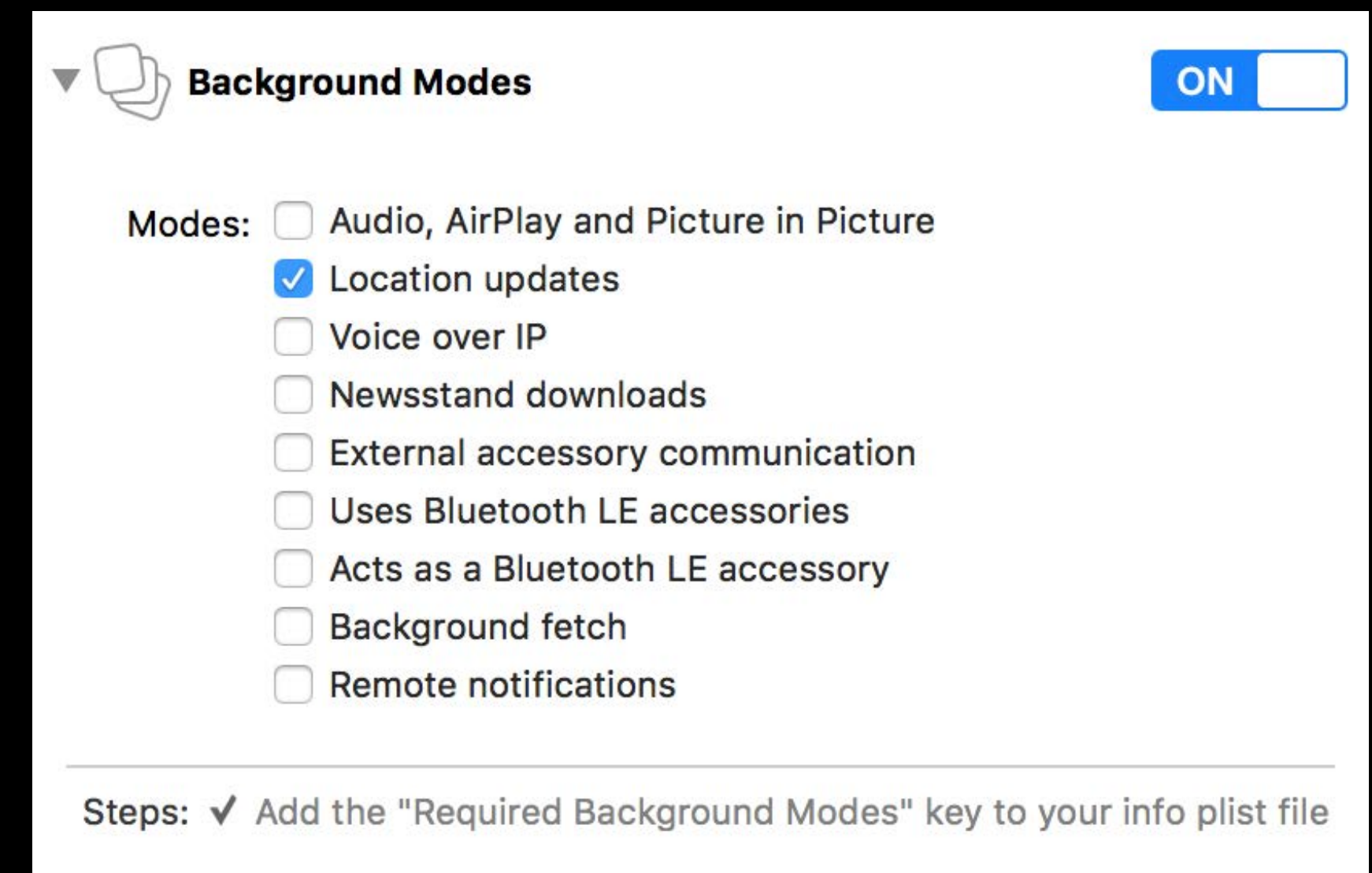# Continuous Location in the Background

Location updates and app continue running

When-in-use authorized apps get a blue bar

Stop when done

Requirements

- Enable background location in information property list

- Set `allowsBackgroundLocationUpdates`

- Start continuous location updates in foreground

▼ 🗇 **Background Modes**   `ON`

Modes: ☐ Audio, AirPlay and Picture in Picture
        ☑ Location updates
        ☐ Voice over IP
        ☐ Newsstand downloads
        ☐ External accessory communication
        ☐ Uses Bluetooth LE accessories
        ☐ Acts as a Bluetooth LE accessory
        ☐ Background fetch
        ☐ Remote notifications

Steps: ✓ Add the "Required Background Modes" key to your info plist file

Standard Location in the Background

Standard Location in the Background

Start in background

Standard Location in the Background

Start in background

Always authorization

Standard Location in the Background

Start in background

Always authorization

No extra runtime

Region Monitoring

Region Monitoring

Monitor for specific locations

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Two variants

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Two variants

- Circular Region

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Two variants

- Circular Region

- Beacon Region

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Two variants

- Circular Region

- Beacon Region

Limited resource

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Two variants

- Circular Region

- Beacon Region

Limited resource

Start with `startMonitoring(for:)`

Region Monitoring

Monitor for specific locations

Continues when app is suspended

Two variants

- Circular Region

- Beacon Region

Limited resource

Start with `startMonitoring(for:)`

Stop with `stopMonitoring(for:)`

Region Monitoring

Triggers

Region Monitoring
Triggers

Notifications

- `UNLocationNotificationTrigger`

Region Monitoring

Triggers

Notifications

- `UNLocationNotificationTrigger`

Region Monitoring
Triggers

Notifications

- `UNLocationNotificationTrigger`

HomeKit

- `HMLocationEvent`

Region Monitoring
Triggers

Notifications

- `UNLocationNotificationTrigger`

HomeKit

- `HMLocationEvent`

When-in-use authorization

Pacific Heights   Wednesday 9:00AM

Beacon Ranging

Beacon Ranging

UUID, major ID, and minor ID

Beacon Ranging

UUID, major ID, and minor ID

Range to beacons

Beacon Ranging

UUID, major ID, and minor ID

Range to beacons

No extra runtime

Aside

https://developer.apple.com/ibeacon/

Works with Apple iBeacon

Artwork and Specifications

Download the resources for developing or manufacturing hardware that integrates iBeacon technology using the iBeacon Proximity Specification. Once you accept the iBeacon license agreement, you'll receive:

- Works with Apple iBeacon Badges
- Works with Apple iBeacon Guidelines
- Proximity Beacon Specification

Download Artwork and Specifications

Significant Location Change Monitoring

Significant Location Change Monitoring

Monitor for large changes in location

Significant Location Change Monitoring

Monitor for large changes in location

Useful, but niche

Significant Location Change Monitoring

Monitor for large changes in location

Useful, but niche

Consider Visit Monitoring

Visit Monitoring

Visit Monitoring

Monitor for places of interest to the user

Visit Monitoring

Monitor for places of interest to the user

Suitable for all-day use

Visit Monitoring

Monitor for places of interest to the user

Suitable for all-day use

Continues when app is suspended

Visit Monitoring

Monitor for places of interest to the user

Suitable for all-day use

Continues when app is suspended

Start with `startMonitoringVisits`

Visit Monitoring

Monitor for places of interest to the user

Suitable for all-day use

Continues when app is suspended

Start with `startMonitoringVisits`

Stop with `stopMonitoringVisits`

Geocoding

Geocoding

Address to coordinates

Geocoding

Address to coordinates

Coordinates to address

Geocoding

Address to coordinates

Coordinates to address

Authorization is not required

Geocoding

Address to coordinates

Coordinates to address

Authorization is not required

Rate limiting

Geocoding

Address to coordinates

Coordinates to address

Authorization is not required

Rate limiting

- Cache results

Geocoding

Address to coordinates

Coordinates to address

Authorization is not required

Rate limiting

- Cache results

- One request per user action

Which Authorization Level?

Which Authorization Level?

	When-in-use	Always

Which Authorization Level?

	When-in-use	Always
Standard Location	✓	✓
Background Location Session	✓	✓
Beacon Ranging	✓	✓

Which Authorization Level?

	When-in-use	Always
Standard Location	✓	✓
Background Location Session	✓	✓
Beacon Ranging	✓	✓
Region Monitoring		✓
Visit Monitoring		✓
Significant Location Change Monitoring		✓

Availability

Availability

Standard Location

Background Location Session

Beacon Ranging

Region Monitoring

Visit Monitoring

Significant Location Change Monitoring

Geocoding

Availability

	iOS
Standard Location	✓
Background Location Session	✓
Beacon Ranging	✓
Region Monitoring	✓
Visit Monitoring	✓
Significant Location Change Monitoring	✓
Geocoding	✓

Availability

	iOS	macOS
Standard Location	✓	✓
Background Location Session	✓	N/A
Beacon Ranging	✓	
Region Monitoring	✓	Circular Regions
Visit Monitoring	✓	
Significant Location Change Monitoring	✓	✓
Geocoding	✓	✓

Availability

	iOS	macOS	watchOS
Standard Location	✓	✓	✓
Background Location Session	✓	N/A	
Beacon Ranging	✓		
Region Monitoring	✓	Circular Regions	
Visit Monitoring	✓		
Significant Location Change Monitoring	✓	✓	
Geocoding	✓	✓	✓

Availability

	iOS	macOS	watchOS	tvOS
Standard Location	✓	✓	✓	Single Location
Background Location Session	✓	N/A		
Beacon Ranging	✓			
Region Monitoring	✓	Circular Regions		
Visit Monitoring	✓			
Significant Location Change Monitoring	✓	✓		
Geocoding	✓	✓	✓	✓

Availability

	iOS	macOS	watchOS	tvOS
Standard Location	✓	✓	✓	Single Location
Background Location Session	✓	N/A		
Beacon Ranging	✓			
Region Monitoring	✓	Circular Regions		
Visit Monitoring	✓			
Significant Location Change Monitoring	✓	✓		
Geocoding	✓	✓	✓	✓

Best Practices

Privacy

Privacy

The most important part

Privacy

The most important part

You must respect the user's privacy

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The most important part

You must respect the user's privacy

You must respect the user's privacy

Privacy

The most important part

You must respect the user's privacy

You must respect the user's privacy

Don't ask for more than you need

Privacy

The most important part

You must respect the user's privacy

You must respect the user's privacy

Don't ask for more than you need

Make it clear

Privacy
Continued

Privacy
Continued

Anonymize server queries

Privacy
Continued

Anonymize server queries

Use file protection

Power

Power

Core Location's power cost is highly variable

Power

Core Location's power cost is highly variable

Users like their batteries

Power

Core Location's power cost is highly variable

Users like their batteries

Design with power in mind

Power

Core Location's power cost is highly variable

Users like their batteries

Design with power in mind

Using the right API matters
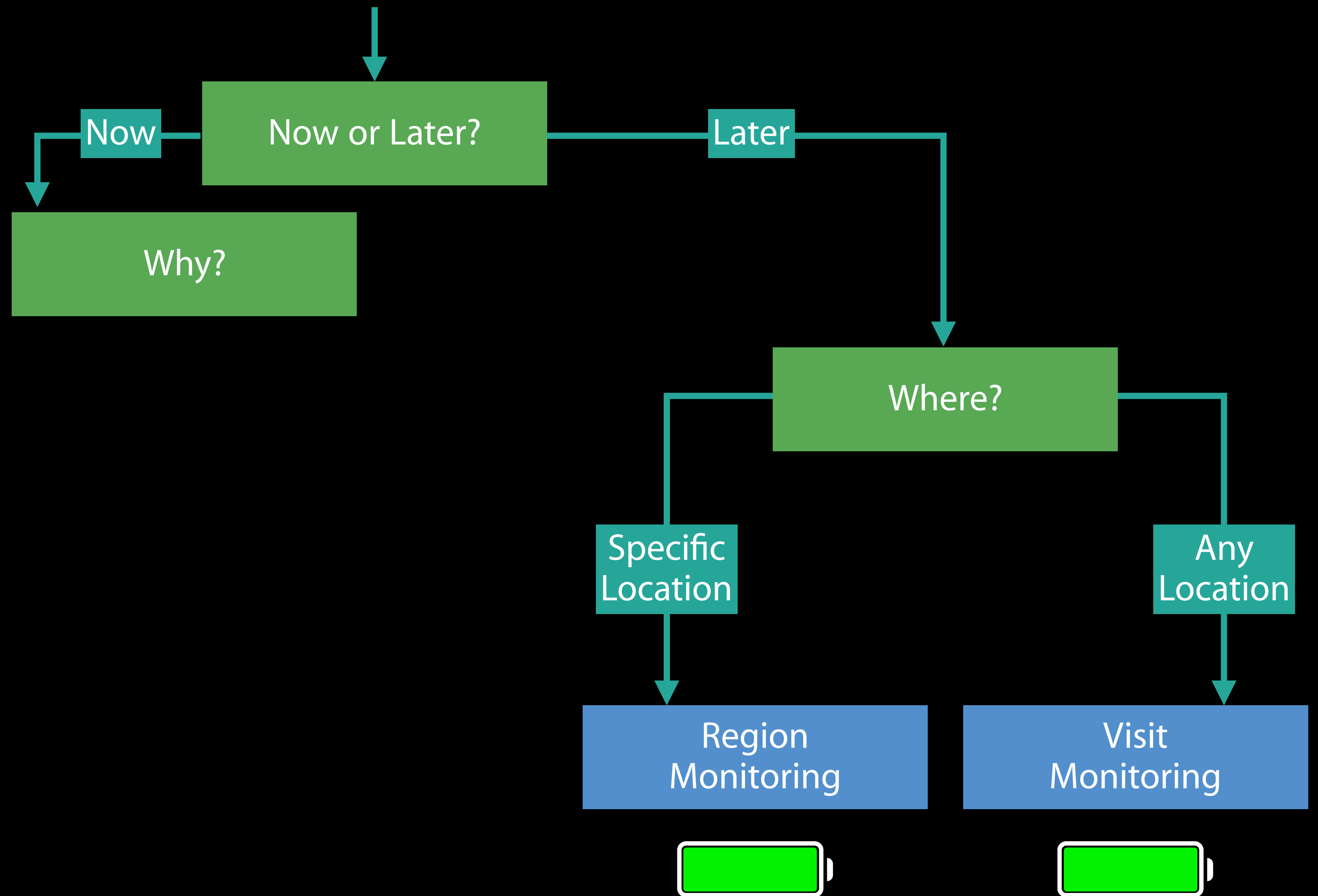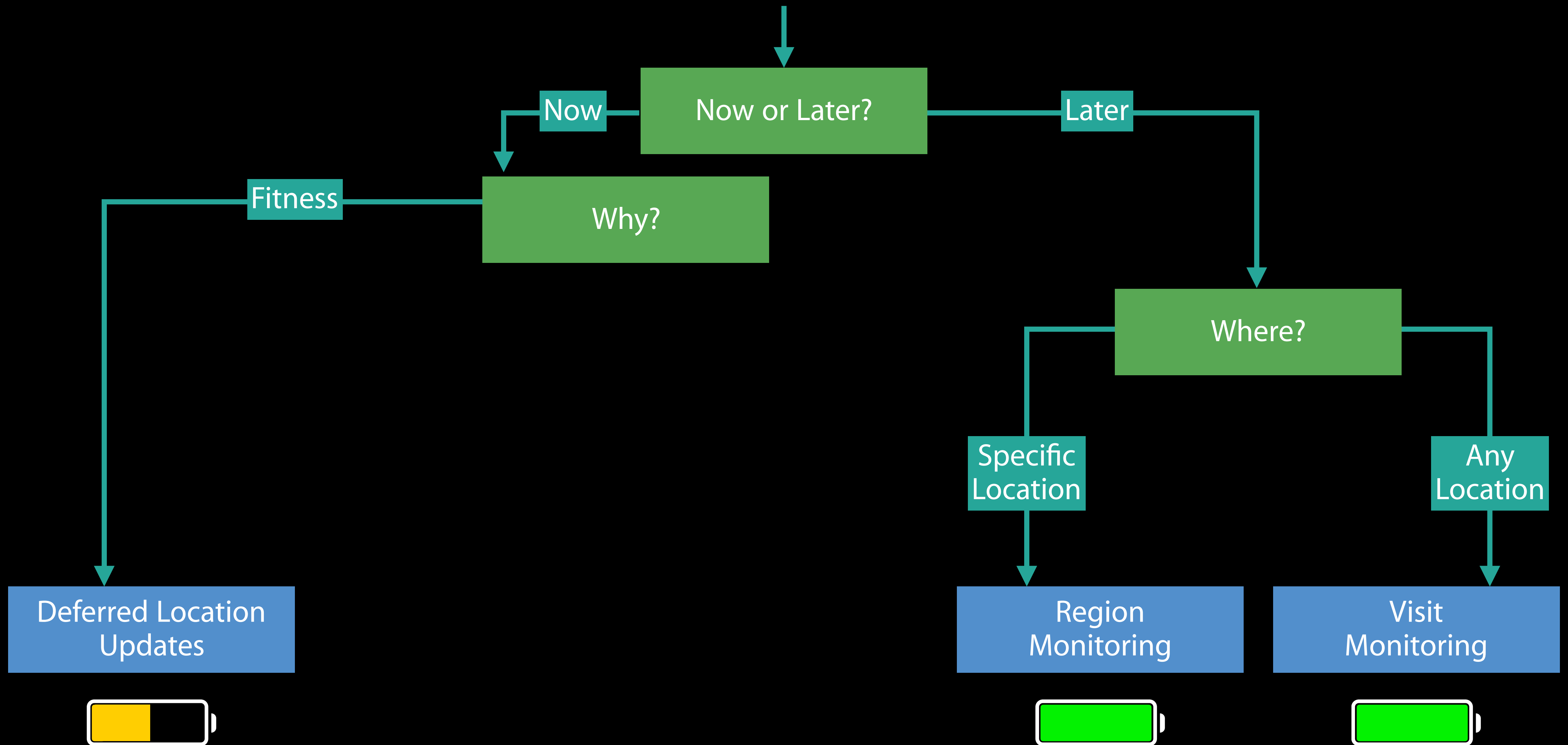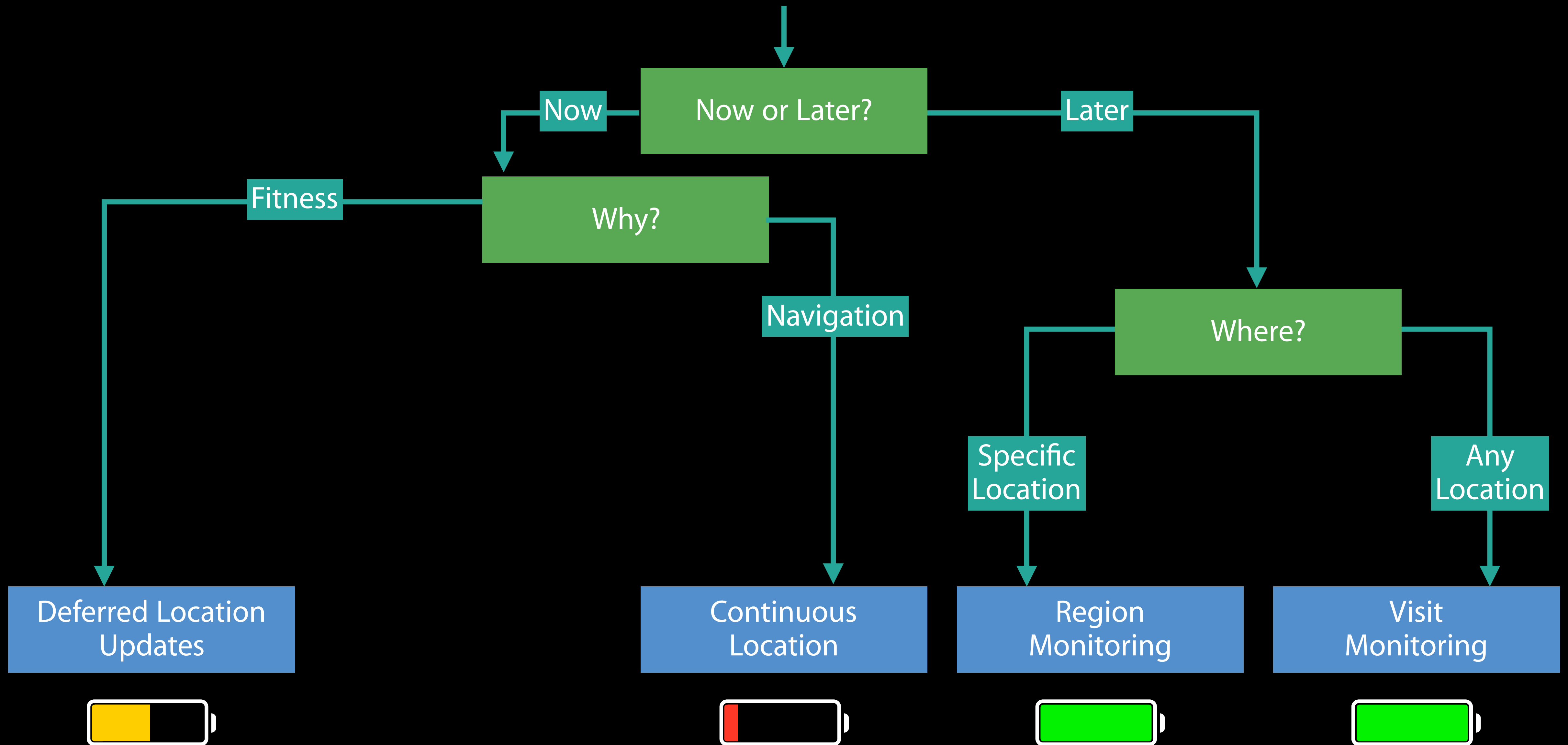
Which API?

Which API?

Now or Later?

Which API?

```
                    │
                    ▼
        ┌───────────────────┐                    ┌────────┐
        │   Now or Later?   │────────────────────│ Later  │
        └───────────────────┘                    └────────┘
                                                      │
                                                      ▼
                                          ┌───────────────────┐
                              ┌───────────│      Where?       │───────────┐
                              │           └───────────────────┘           │
                              ▼                                           ▼
                      ┌──────────┐                              ┌──────────┐
                      │ Specific │                              │   Any    │
                      │ Location │                              │ Location │
                      └──────────┘                              └──────────┘
                           │                                         │
                           ▼                                         ▼
              ┌─────────────────────┐                 ┌─────────────────────┐
              │       Region        │                 │        Visit        │
              │     Monitoring      │                 │     Monitoring      │
              └─────────────────────┘                 └─────────────────────┘
                    [battery]                                [battery]
```

Which API?

Now or Later?

Now → Why?

Later → Where?

Specific Location → Region Monitoring

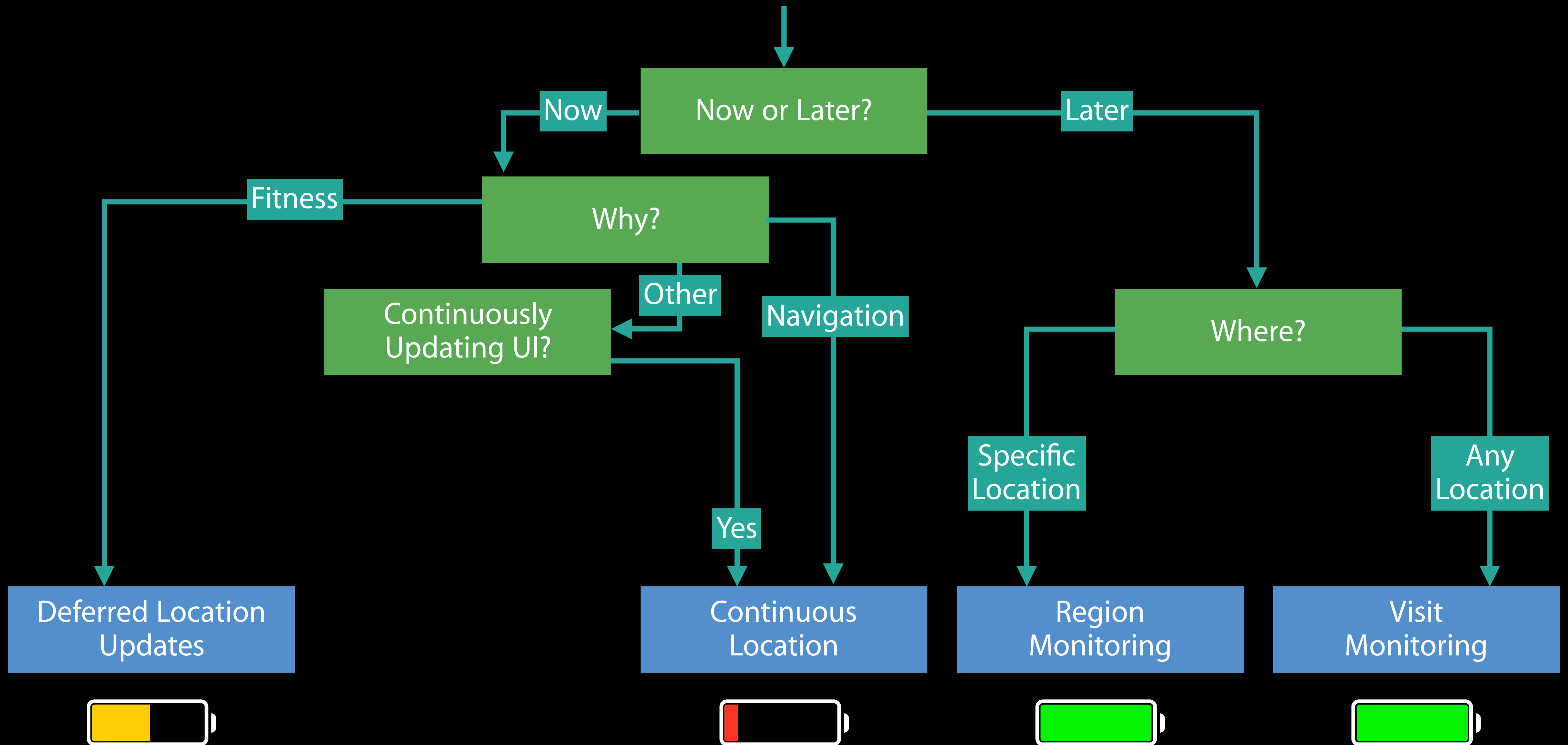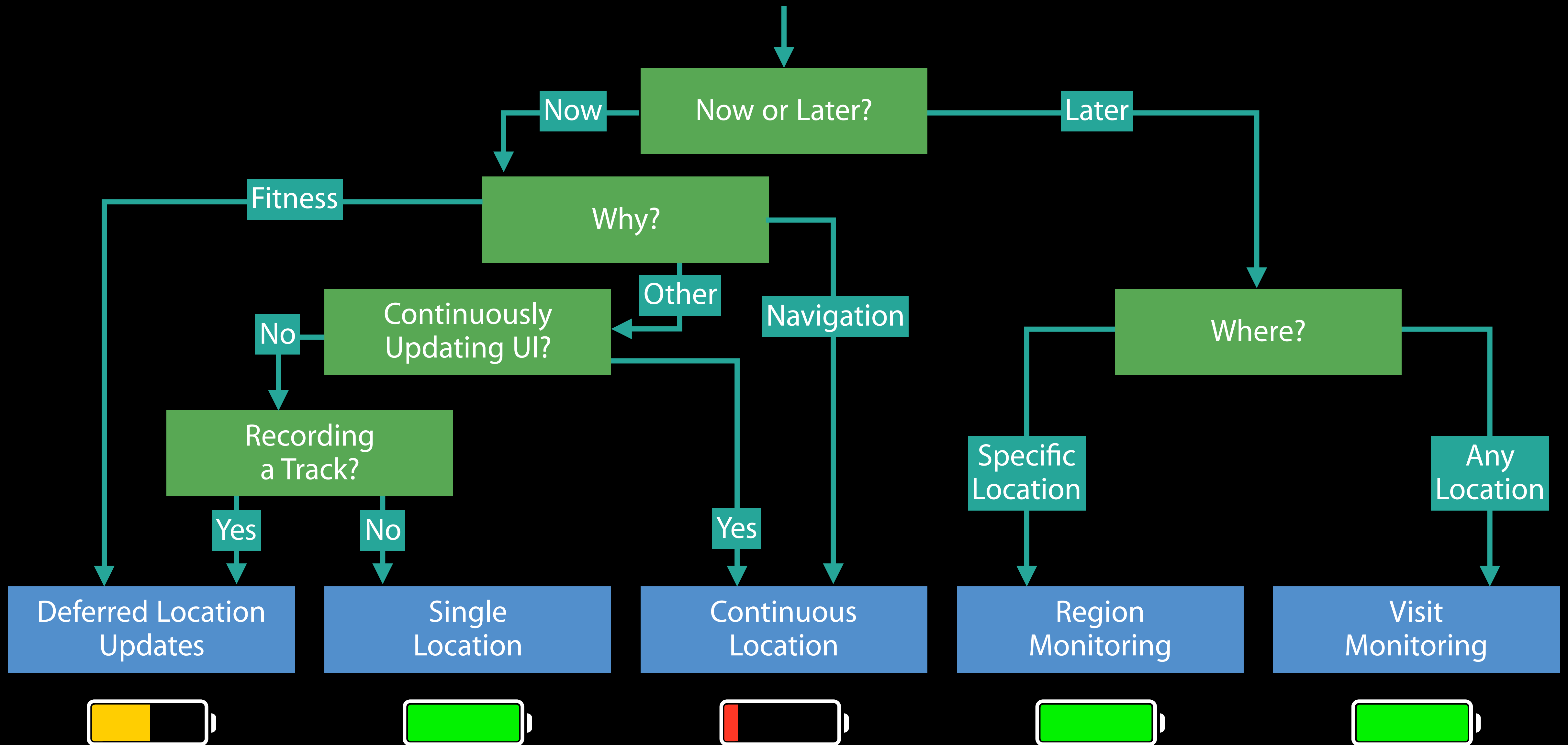Any Location → Visit Monitoring
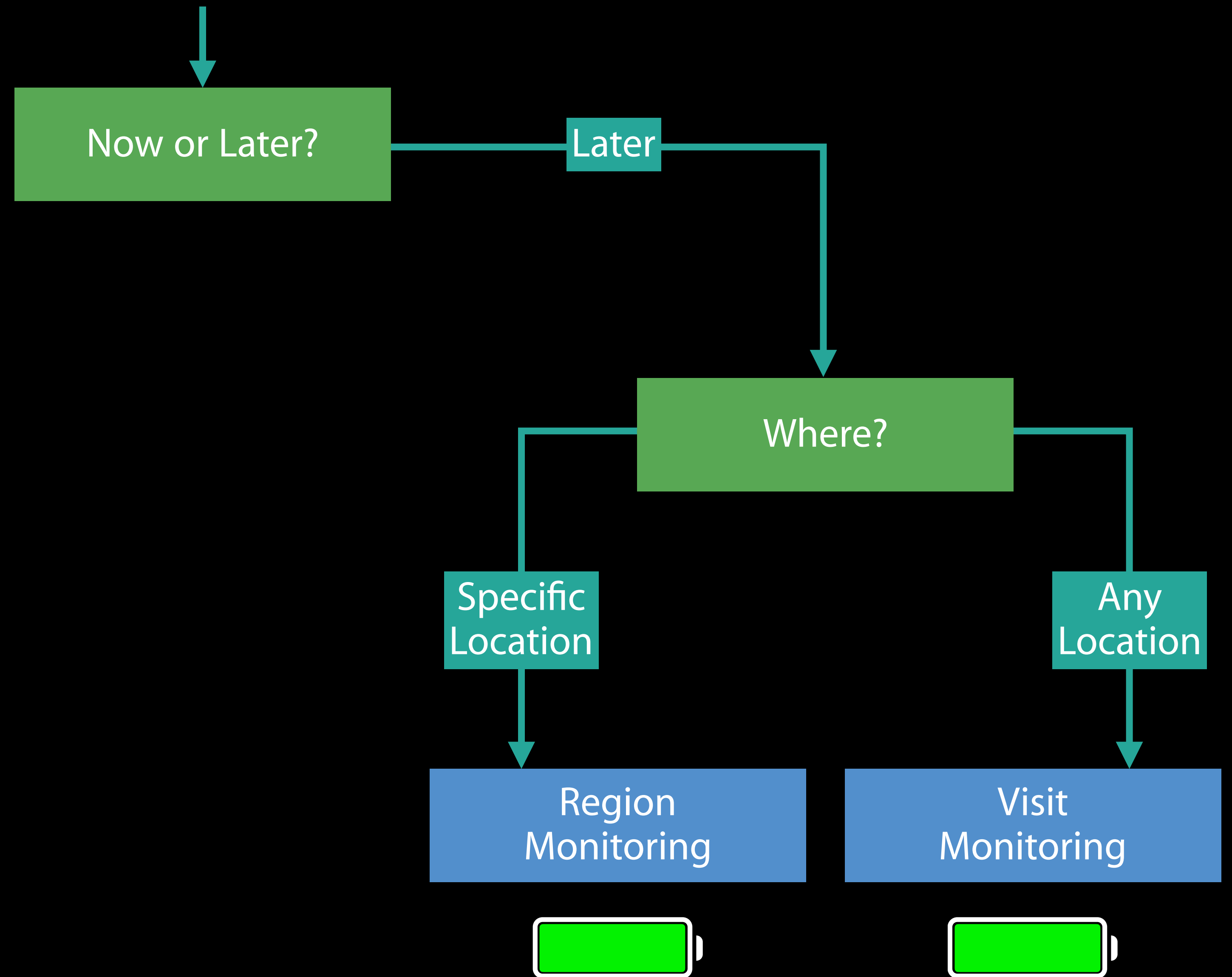
Which API?

Which API?

Which API?

Authorization

Best practices

Authorization

Best practices

Use when-in-use authorization when possible

Authorization

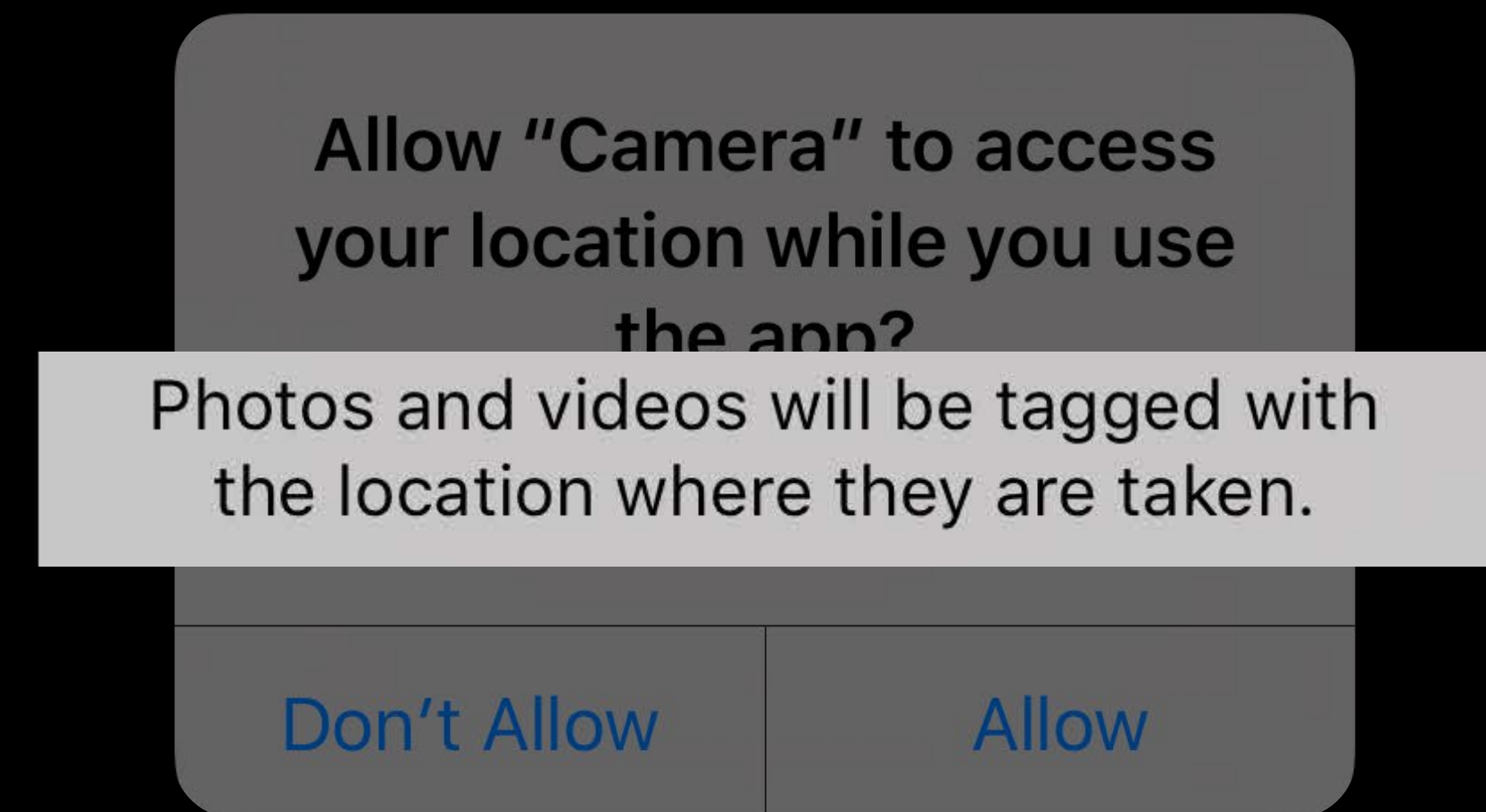## Best practices

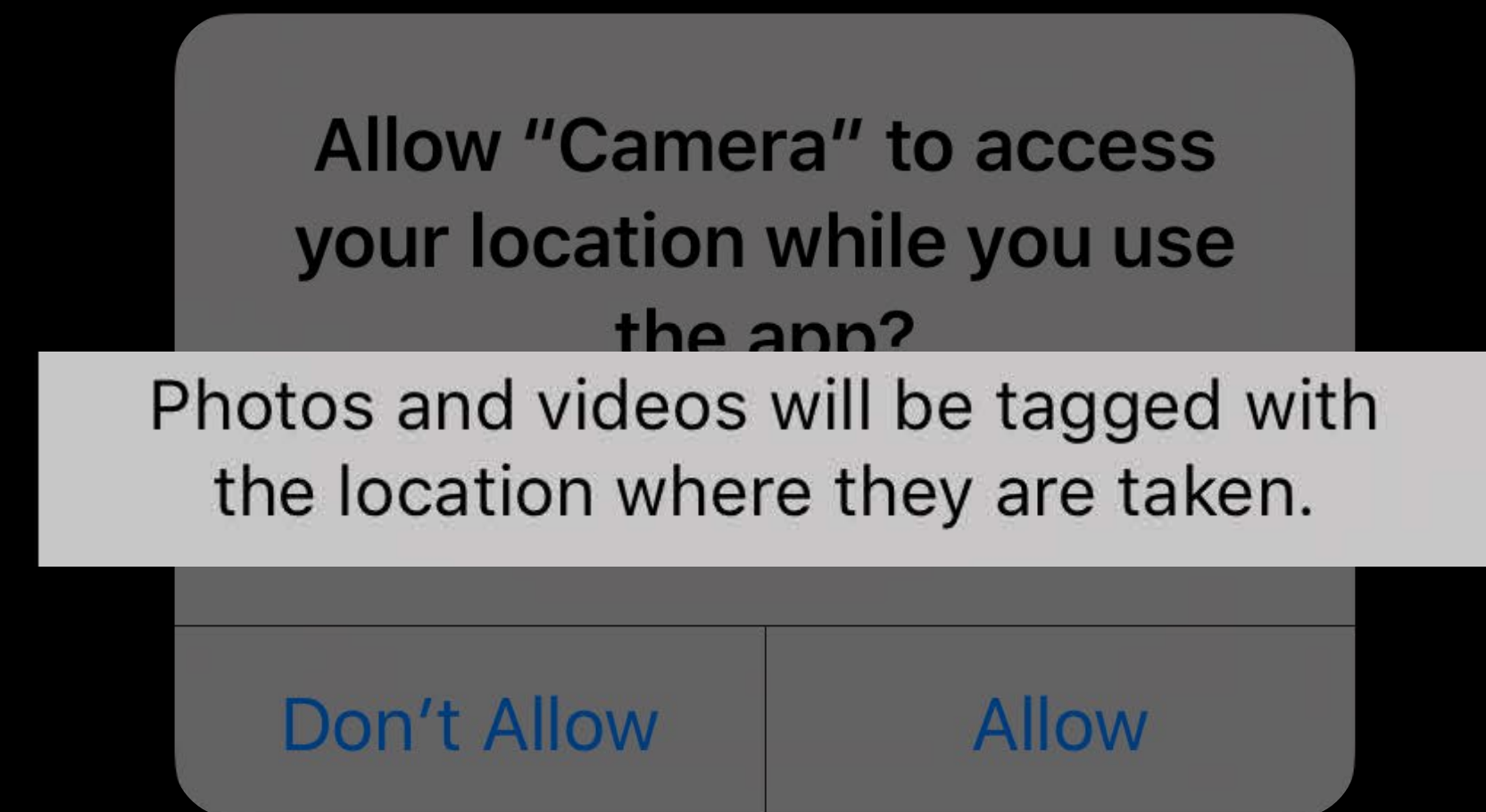Use when-in-use authorization when possible

Communicate

Authorization

Best practices

Use when-in-use authorization when possible

Communicate

Allow "Camera" to access
your location while you use
the app?

Photos and videos will be tagged with
the location where they are taken.

Don't Allow   Allow

Authorization

Best practices

Use when-in-use authorization when possible

Communicate

Direct users to settings

- `UIApplicationOpenSettingsURLString`

Allow "Camera" to access
your location while you use
the app?

Photos and videos will be tagged with
the location where they are taken.

Don't Allow   Allow

Authorization

Best practices

Use when-in-use authorization when possible

Communicate

Direct users to settings

- `UIApplicationOpenSettingsURLString`
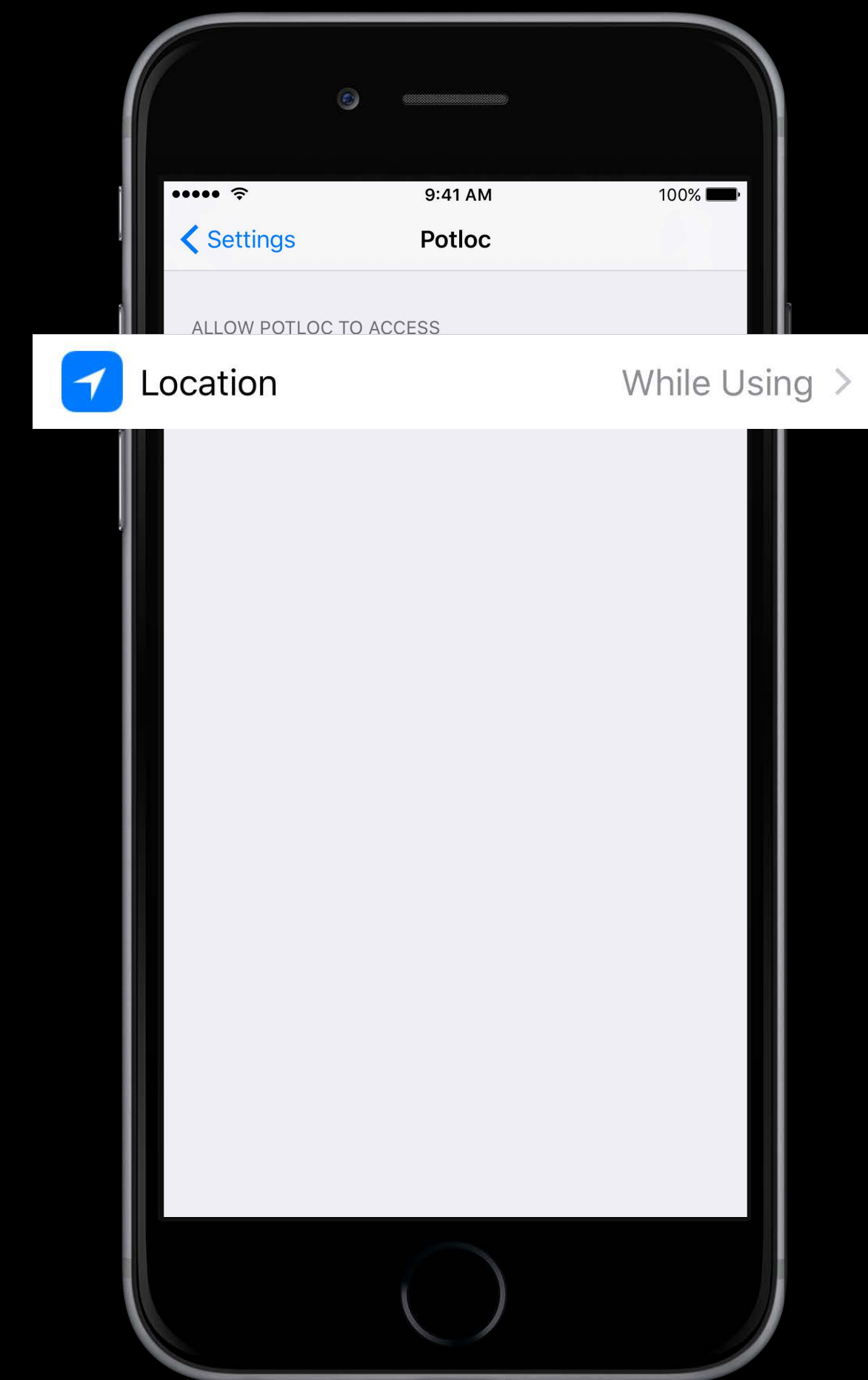
Threading

Best practices

Threading

Best practices

`CLLocationManager` requires a runloop

Threading
Best practices

`CLLocationManager` requires a runloop

You can use `CLLocationManager` on the main thread

Threading
Best practices

`CLLocationManager` requires a runloop

You can use `CLLocationManager` on the main thread

Interact with `CLLocationManager` from the thread it was created on

```swift
// Requesting authorization

func requestAuthorization() {
    let manager = CLLocationManager()
    manager.requestWhenInUseAuthorization()
}
```

```swift
// Requesting authorization

func requestAuthorization() {

    let manager = CLLocationManager()

    manager.requestWhenInUseAuthorization()

}
```

```swift
// Requesting authorization

class LocationAuthorizationRequester {

    static let manager = CLLocationManager()


    func requestAuthorization() {

        LocationAuthorizationRequester.manager.requestWhenInUseAuthorization()

    }

}
```

```swift
// Requesting authorization

class LocationAuthorizationRequester {
    static let manager = CLLocationManager()


    func requestAuthorization() {

        LocationAuthorizationRequester.manager.requestWhenInUseAuthorization()

    }

}
```

```swift
// Requesting authorization

class LocationAuthorizationRequester {

    static let manager = CLLocationManager()


    func requestAuthorization() {

        LocationAuthorizationRequester.manager.requestWhenInUseAuthorization()

    }

}
```

```swift
// Requesting authorization

class ViewController: UIViewController {

    let manager = CLLocationManager()


    func requestAuthorization() {

        self.manager.requestWhenInUseAuthorization()

    }


    // ...
}
```

```swift
// Requesting authorization

class ViewController: UIViewController {

    let manager = CLLocationManager()


    func requestAuthorization() {

        self.manager.requestWhenInUseAuthorization()

    }


    // ...
}
```

```swift
// Requesting authorization

class ViewController: UIViewController {

    let manager = CLLocationManager()


    func requestAuthorization() {

        self.manager.requestWhenInUseAuthorization()

    }


    // ...
}
```

Standard Location

Best practices

Standard Location

Best practices

Use `requestLocation`

Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Enable automatic pausing

Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Enable automatic pausing

Use deferred location updates
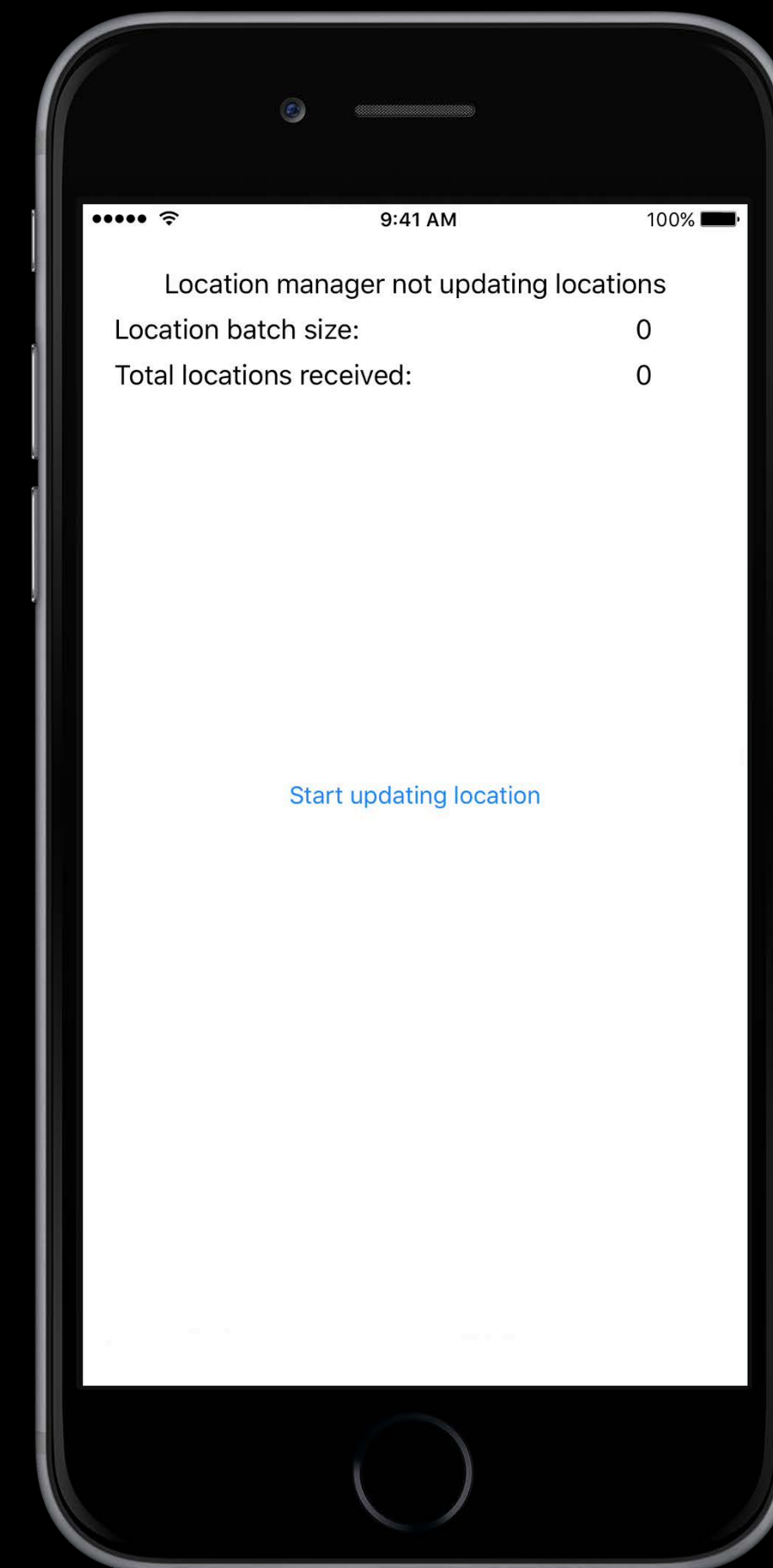
Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Enable automatic pausing

Use deferred location updates

Energy Log Instrument

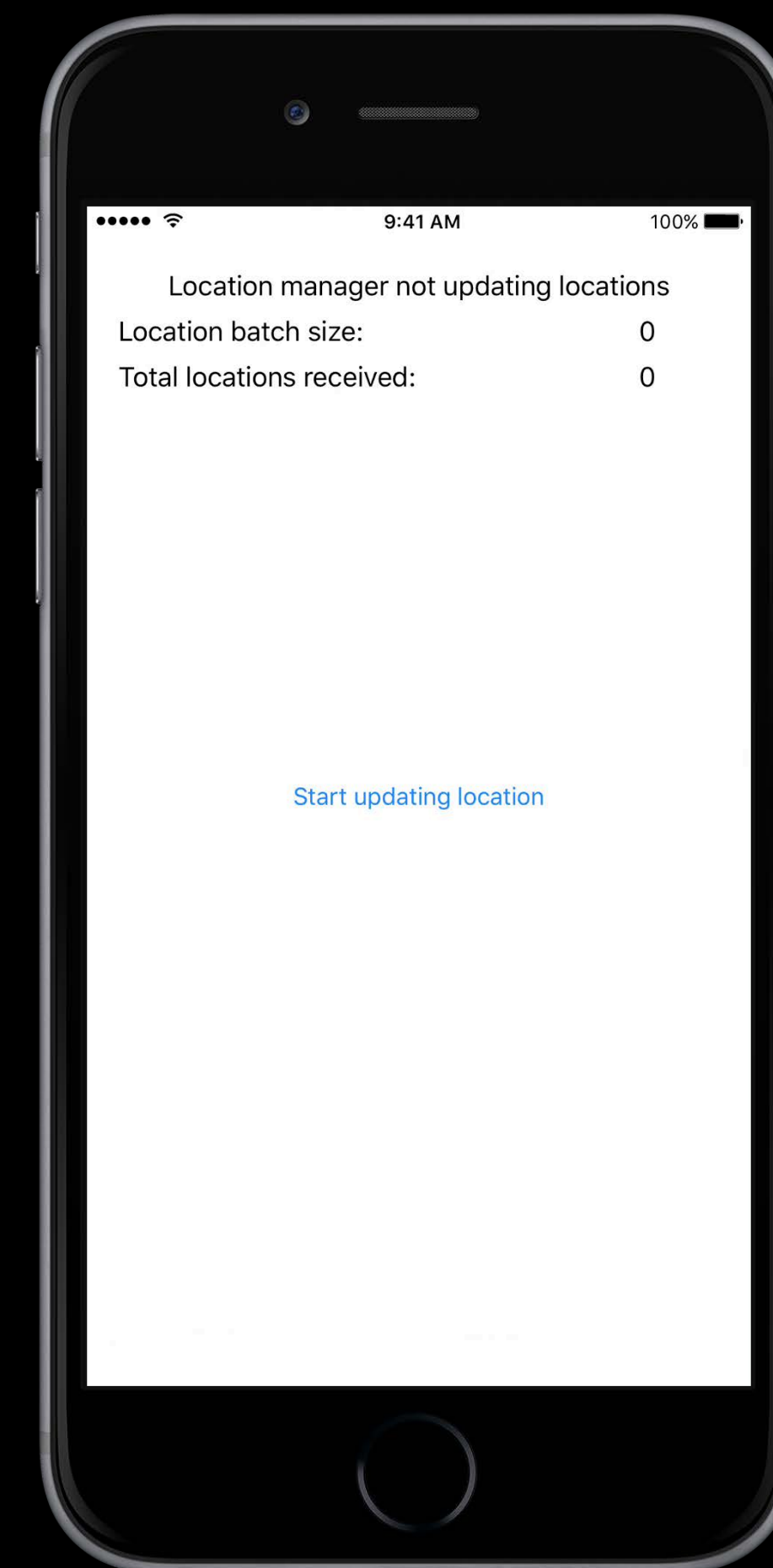# Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Enable automatic pausing

Use deferred location updates

Energy Log Instrument

Set `allowsBackgroundLocationUpdates`

Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Enable automatic pausing

Use deferred location updates

Energy Log Instrument

Set `allowsBackgroundLocationUpdates`

Standard Location

Best practices

Use `requestLocation`

Set `desiredAccuracy` property

Enable automatic pausing

Use deferred location updates

Energy Log Instrument

Set `allowsBackgroundLocationUpdates`

Location manager not updating locations

Location batch size:	0
Total locations received:	0

Start updating location

Monitoring APIs

Best practices

Monitoring APIs

Best practices

Use a single `CLLocationManager`

Monitoring APIs

Best practices

Use a single `CLLocationManager`

Monitoring continues until explicitly stopped

Monitoring APIs

Best practices

Use a single `CLLocationManager`

Monitoring continues until explicitly stopped

Stop monitoring on launch if you're unsure of your state
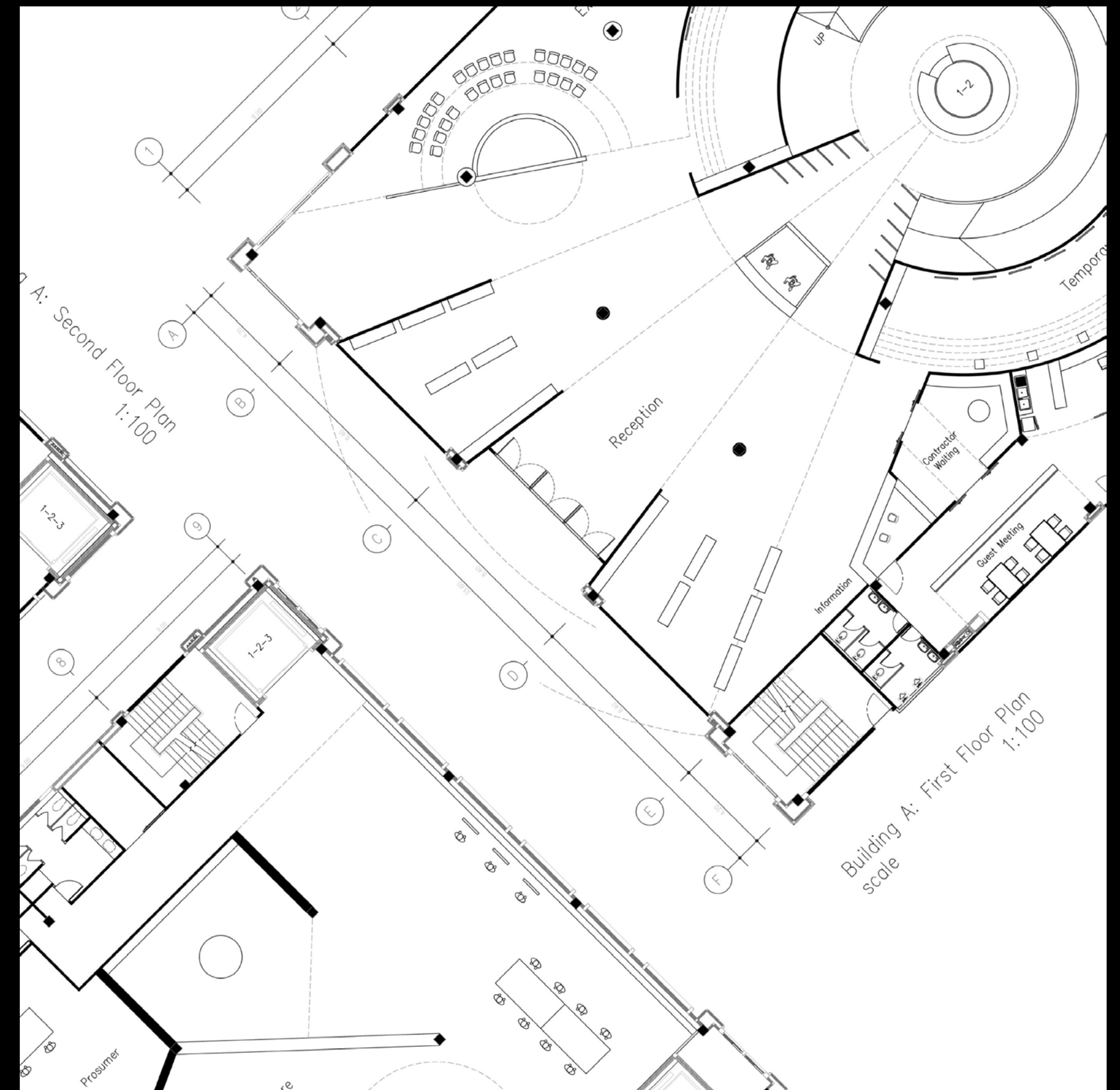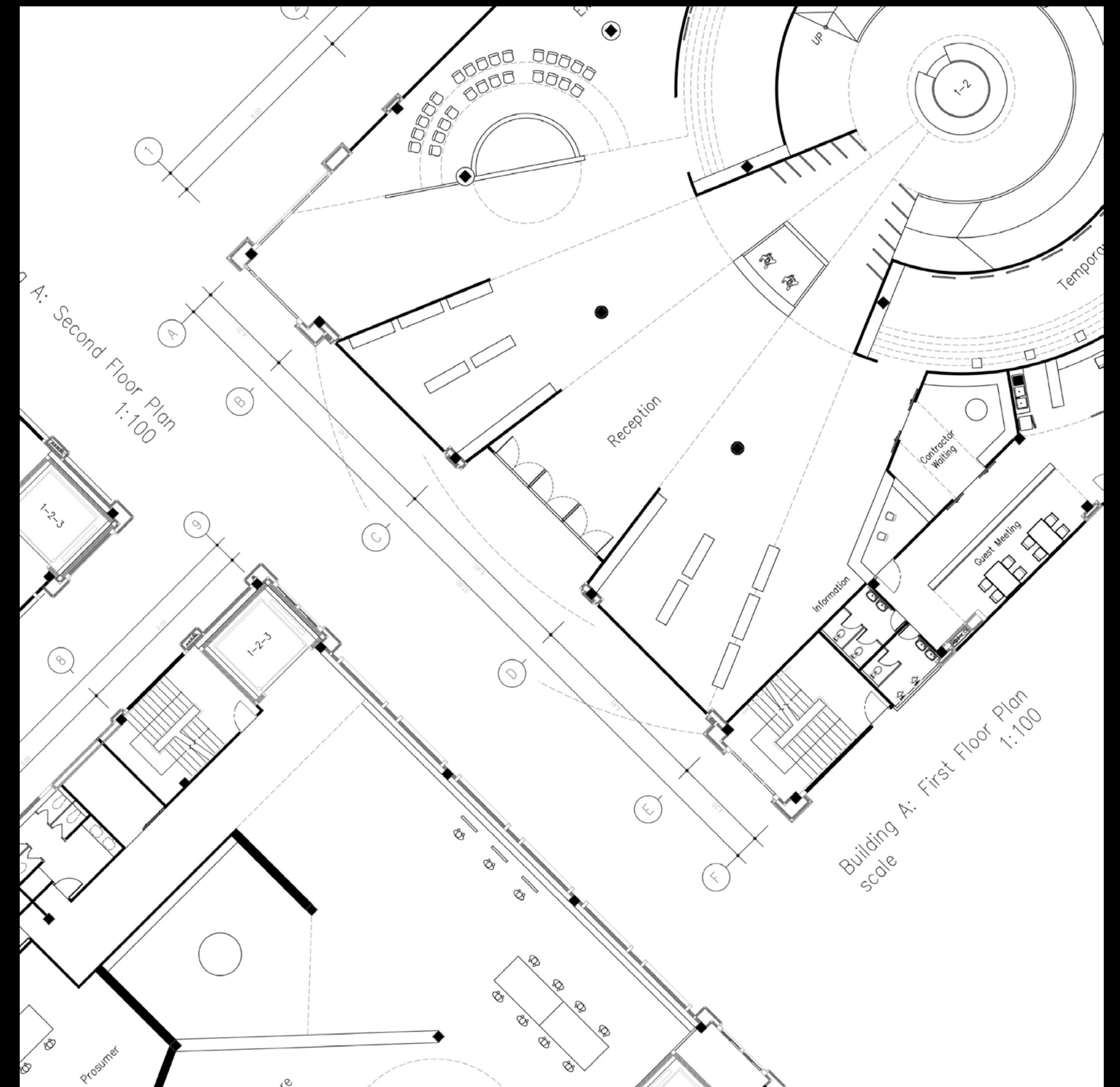
Monitoring APIs
Best practices

Use a single `CLLocationManager`

Monitoring continues until explicitly stopped

Stop monitoring on launch if you're unsure of your state

```swift
let manager = CLLocationManager()
manager.stopMonitoringVisits()
manager.stopMonitoringSignificantLocationChanges()
for region in manager.monitoredRegions {
    manager.stopMonitoring(for: region)
}
```
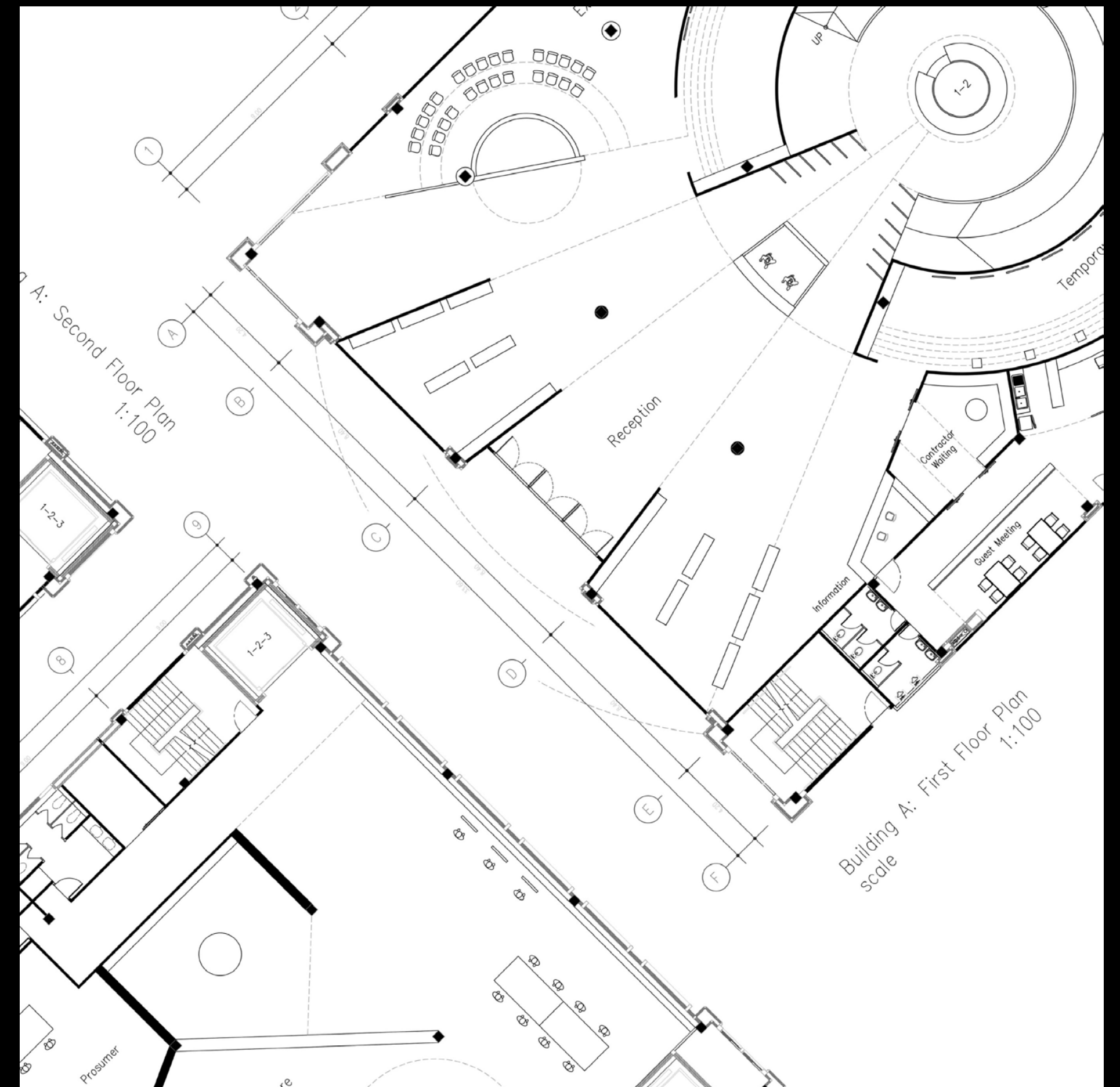
Indoor Location

Indoor Location

Automatic

Indoor Location

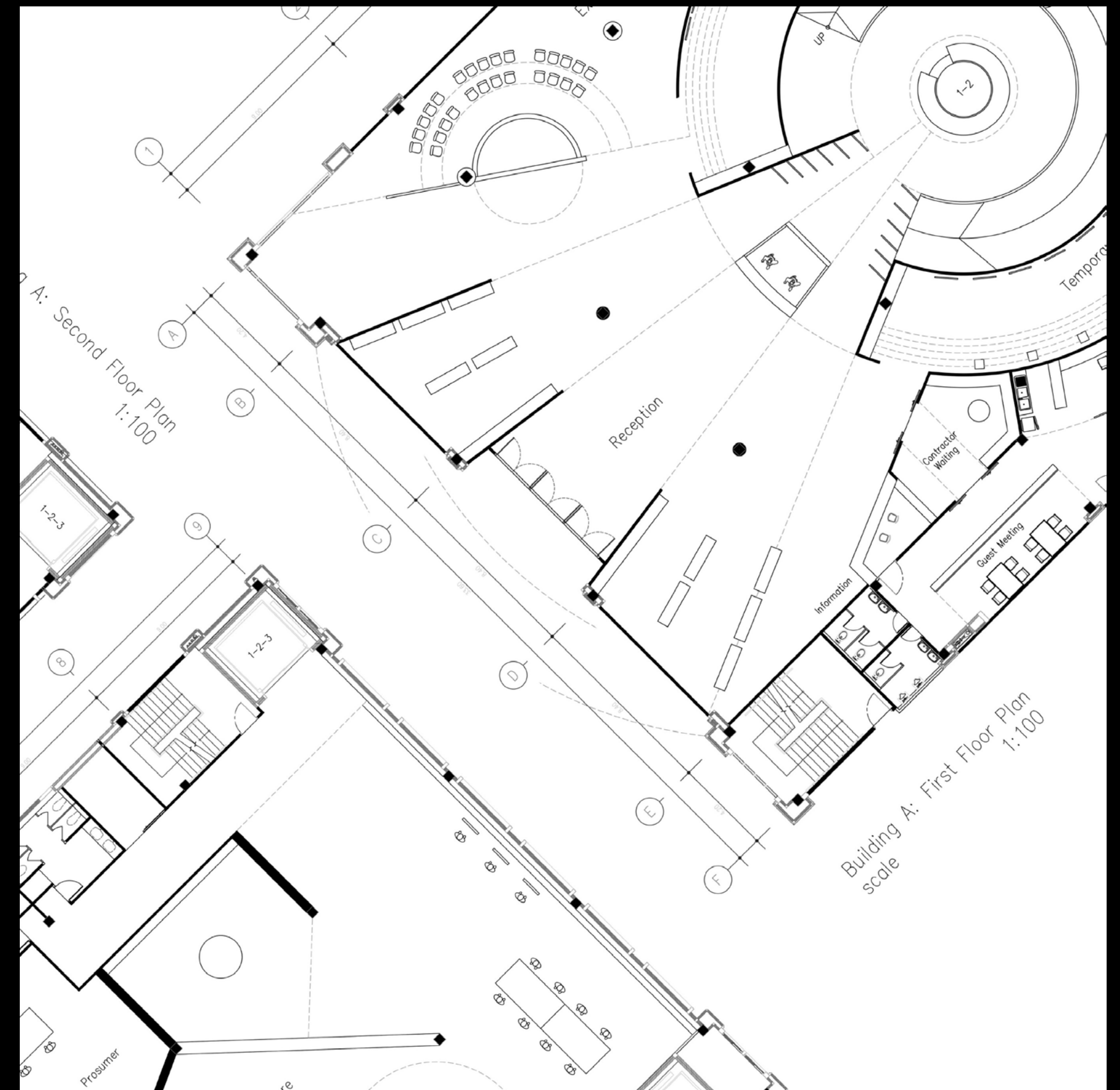Automatic

mapsconnect.apple.com

Indoor Location

Automatic

mapsconnect.apple.com

Beacon region monitoring

watchOS

watchOS

iPhone automatically assists

watchOS

iPhone automatically assists

When-in-use authorization

watchOS

iPhone automatically assists

When-in-use authorization

`startUpdatingLocation` is available*

*`startUpdatingLocation` will be available in a future seed

watchOS

iPhone automatically assists

When-in-use authorization

`startUpdatingLocation` is available*

*`startUpdatingLocation` will be available in a future seed

Building Great Workout Apps   Pacific Heights   Friday 11:00AM

macOS

macOS

Always authorization

macOS

Always authorization

Automatic prompting

macOS

Always authorization

Automatic prompting

Use `requestLocation`

tvOS

tvOS

You have

- Single location
- Geocoding
- MapKit

tvOS

You have

- Single location

- Geocoding

- MapKit

Respect the user's privacy

Best Practices

Best Practices

Respect the user's privacy

Best Practices

Respect the user's privacy

Conserve power

Best Practices

Respect the user's privacy

Conserve power

Use the right API

Best Practices

Respect the user's privacy

Conserve power

Use the right API

Look at Potloc

More Information

https://developer.apple.com/wwdc16/716

Related Sessions

What's New in watchOS 3	Presidio	Tuesday 5:00PM
Introduction to Notifications	Pacific Heights	Wednesday 9:00AM
Building Great Workout Apps	Pacific Heights	Friday 11:00AM

Labs

Core Location Lab	Frameworks Lab C	Friday 12:30PM
Notifications Lab	Graphics, Games and Media Lab B	Friday 9:00AM
HomeKit Lab	Frameworks Lab A	Friday 11:30AM