# Beacon Notifications with Locly

Locly tries to deliver location based notifications as reliably as possible across all platforms, yet due to constraints imposed by mobile platforms this can sometimes prove difficult. This document aims to explain the process in which the locly app delivers notifications and gives some useful tips on how to maximise the reliability of location based notifications.

## Terminology & Detection Lifecycle

It's important to explain some of the terminology used when referencing beacon devices and how they trigger notifications.

**Beacon:** An iBeacon is defined as a bluetooth device with a UUID, major number and minor number. Together these three items form an id to which content and notifications can be pinned to

**Region:** A region is a collection of iBeacon devices which have the same UUID. The device only allows a finite amount of regions that can be listened to at any one time.

Beacon detection generates four different types of events which form a beacon lifecycle. They are…
1. Enter a region
2. Enter a beacon
3. Exit a beacon
4. Exit a region
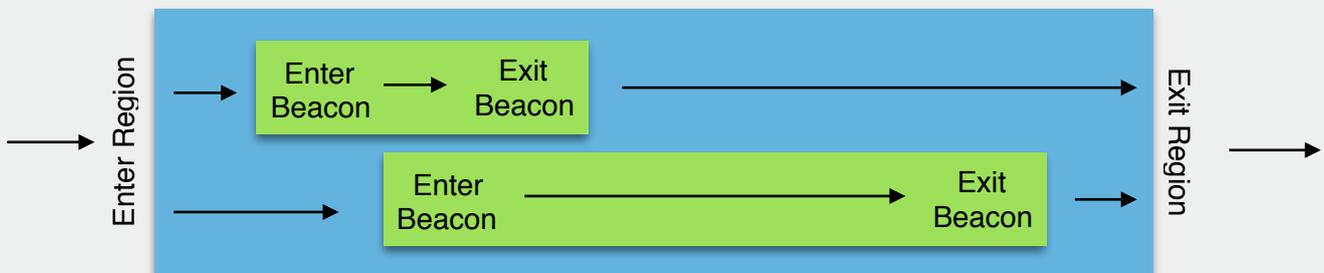


Entering and exiting a region is always twinned with the state of a beacon changing. Whilst in a region the visible beacons within it may change but as far as the device is concerned you're still within the same region. The device can be in multiple regions at the same time.

In addition to the 4 events in the beacon lifecycle, when the app is in the foreground it is able to **range** beacons. Ranging actively scans for beacon devices every second and returns the devices that it sees.

# Notification Triggering

Notifications can be fired on any of the beacon events as mentioned in the detection lifecycle. The behaviour of when and how quickly these notifications are fired depends on whether the device is running the app in the foreground or background and also on the platform that it's using (iOS or Android).

When creating a notification on the Locly platform you're given the option of when you want the notification to trigger. This option reflects the different stages in the beacon detection lifecycle.
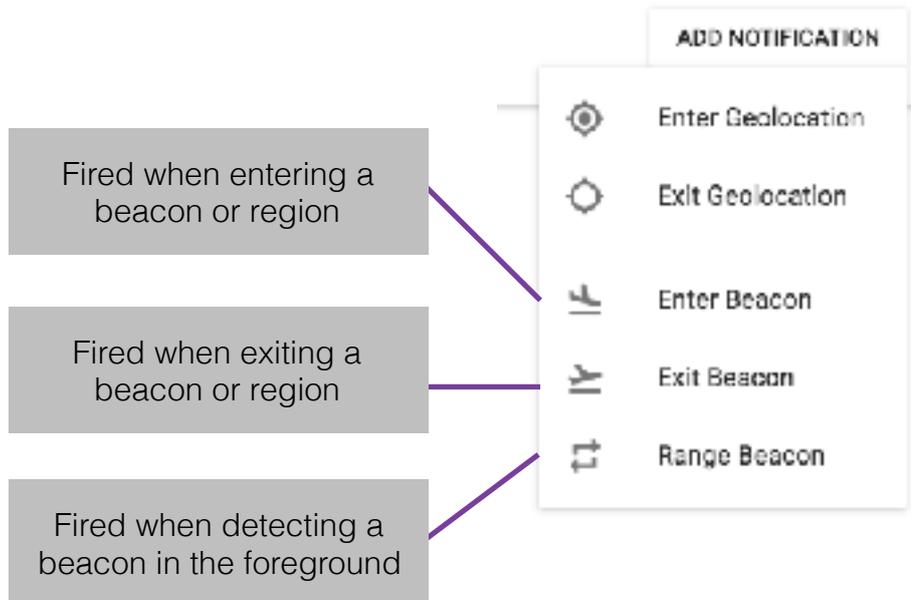


Once you've created your notification you can choose whether to trigger the notification on region or beacon detection. To indicate the different between these you simply need to omit or include the beacon major and minor numbers. The platform takes care of handling the different detection modes from here.



*Region detection*                                *Beacon detection*

In addition to what event you want your notification to trigger on, you're able to choose if you want it to display. For example whilst the app is in the foreground, background or both. In addition to this because beacon events can often be spurious as the user traverses between beacons and regions the locly platform also provides a way to throttle repeat notifications by imposing a minimum time between re-showing notifications.

Triggering when the app is in the foreground / background

Preventing duplicate notifications for at least 60 seconds

Trigger when app is in Foreground
Trigger when app is in Background

After firing suppress for the following seconds

60
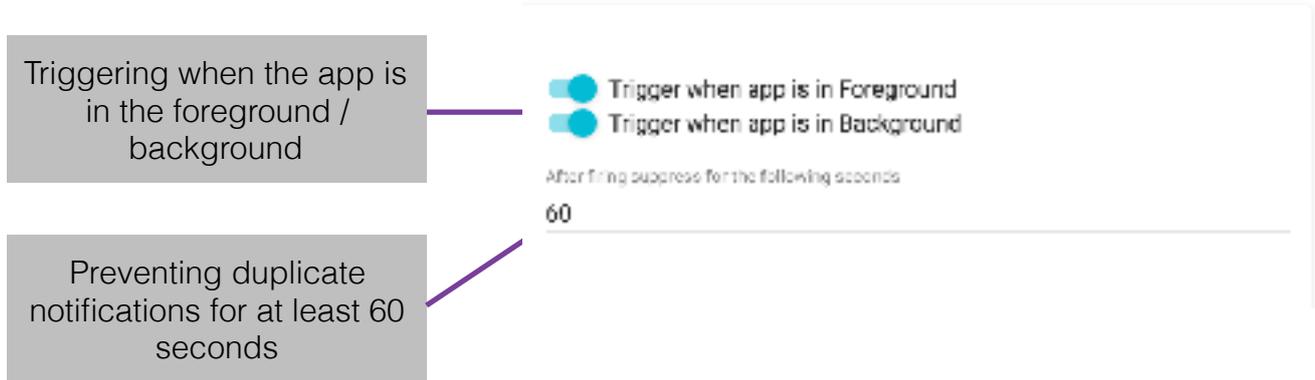
# Foreground App Events

When the Locly app is running in the foreground, OS imposed restrictions are relaxed compared to when running in the background. This means that on both iOS and Android location based notifications will be delivered with maximum reliability and both platforms have very similar implementations. The app will receive all lifecycle events and thus all notifications can be delivered.

## Typical timings

- **Enter Region:** Immediate
- **Enter Beacon:** Immediate
- **Ranging Beacon**: Once per second
- **Exit Beacon:** Up to 10 seconds
- **Exit Region:** Up to 10 seconds

When the app is running in the foreground the notification is delivered as an overlay within the app rather than in the devices notification tray. When creating the notification you can customise how long the notification should remain open and also how long to wait before automatically opening the notifications linked item. This is done in the Foreground Behaviour section of the notification screen

The user can dismiss the notification manually or it will be dismissed after 10 seconds automatically

Foreground Behaviour

Automatically close notification after seconds (0=disabled)

10

Automatically open link after seconds (0=disabled)

0

If set the notification will display a countdown bar for the given time and then automatically open the notifications link

# Background App Events

There are numerous restrictions imposed by the OS when running in the background. This can limit the reliability of which notifications are delivered and when. The OS will wake the Locly app when the active regions change (Entering or exiting a region) but not when entering or exiting an individual beacon. You can distill the behaviour as below…

- **Enter a region:** Triggered
- **Enter a beacon:** Triggered if this beacon awoke the device through the enter region trigger
- **Exit a beacon:** Triggered if the beacon awoke the device through the enter region trigger, or the device was in the foreground when it entered the region and it detected the beacon during this time
- **Exit a region:** Triggered

Whilst in the background each mobile platform imposes delays on triggering Enter and Exit events (*more details for each platform below*) which means this it is quite possible for a device to physically enter and exit a region or exit and re-enter a region without ever being awoken to that fact. If you're relying on closely based beacons to trigger notifications it's important to keep this in mind. More information tips and information about this is provided in the *Maximising Reliability* section
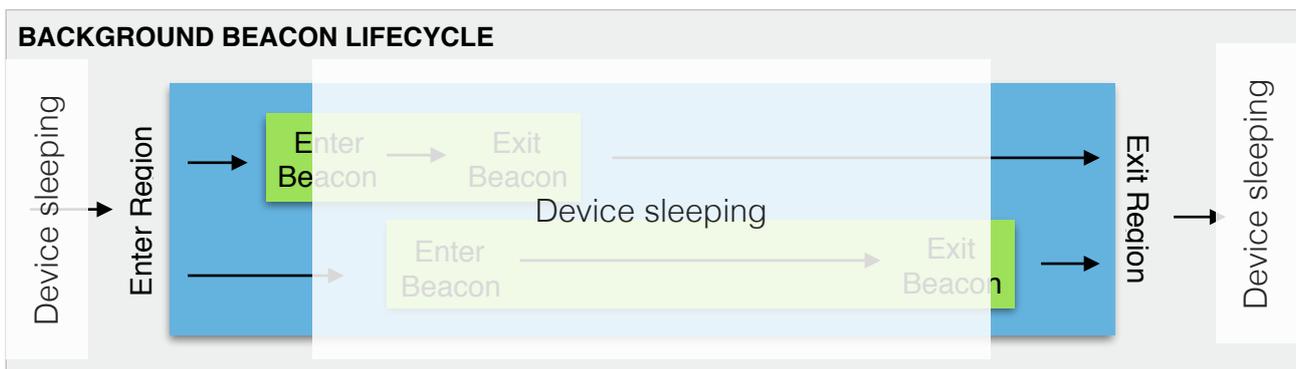


## Background App Events : iOS

iOS will only wake the Locly app when the active regions change and will allow the app to execute for roughly 5 seconds.

It's worth noting that iOS only actively monitors 10 regions in the background. These 10 regions are shared between all apps on the device and are re-prioritised by the last app that was active. If the Locly app has not been launched for some time or has never been launched iOS may not wake the app in a timely fashion or at all.

## Typical timings

- **Enter Region:** Up to 15 seconds
- **Enter Beacon:** Up to 15 seconds
- **Exit Beacon:** Up to 15 minutes depending on battery level

• **Exit Region:** Up to 15 minutes depending on battery level

To receive beacon notifications after restarting the device you will need to be outside the region for up to 15 minutes. iOS holds this 15 minute grace period to silently check if the device is already in a region. After the grace period notifications will fire with the typical timings.

# Background App Events : Android

Android only wakes the Locly app when the active region changes. The regularity of typical event timings on android are somewhat more complicated than on iOS. The main factor deciding this is whether the device can see any other beacon devices. We can define `any other beacon devices` as any Bluetooth Low Energy devices transmitting as per the iBeacon specification. These maybe beacons in different regions as to what the Locly app is listening to or they may be in one of the regions the Locly app is listening to.

We can split the detection types into two main categories:
1. **First Beacon (FB) detection:** This occurs when the device can see no beacon devices whatsoever. When detecting the first beacon the app will be awoken almost immediately.
2. **Second Beacon (SB) detection:** This occurs when the device can already see a Bluetooth Low Energy beacon device and sees another. This detection is done on a periodic scan interval. This periodic scan interval by default is set to 5 minutes which provides a great balance between performance and battery consumption.

If required the Second Beacon scan interval can be reduced as low as 10 seconds at the expense of battery. At present this can be set within the App JSON by changing the `ibeacon.androidBackgroundBetweenScanPeriodSecs` value to `10` for example. It's worth noting that although the app tries to scan once every 10 seconds Android might prolong this period when it's set so low and thus detection may still take 60-100 seconds.

## Typical timings

• **Enter Region:**
  • **First Beacon detection:** Immediate
  • **Second Beacon detection:** Up to 5 minutes or the configured value
• **Enter Beacon:**
  • **First Beacon detection:** Immediate
  • **Second Beacon detection:** Up to 5 minutes or the configured value
• **Exit Beacon:** Up to 5 minutes
• **Exit Region:** Up to 5 minutes

On Android the Locly App runs a service in the background to monitor for beacon events. For the most part this service is kept silently and consistently running, however some user actions can make Android kill the service and prevent it from restarting automatically. The events that can effect this service are:

• **The user goes to the task switcher and swipes an app off the screen:** scanning will attempt to resume shortly however some devices prevent this. In those cases the service will restart when the device is charged or restarted or the Locly app is opened. On some devices using less than android 5.0 scanning will only resume when the app is re-opened
• **The operating system terminates an app due to low memory:** scanning will resume when the device is charged, restarted or the Locly app is opened
• **The user goes to Settings -> Applications and requests a force stop:** scanning will only resume when the app is opened

On some devices with older bluetooth chipsets (e.g. the original Nexus 4) there can be a 10 minute delay between the device starting and the service being able to re-detect beacons.

# Maximising reliability

## Region Phasing

To maximise the reliability of delivering notifications it's recommended that you phase the regions where you want notifications delivered. This ensures that the app will be woken up when crossing each region boundary. This is demonstrated in the diagram below, whereby the app will be able to deliver notifications when crossing the boundaries of Region A, B or C.

If the app is providing richer beacon content when the app is open, it's possible to have multiple beacons in the same region whilst only waking the app on the boundaries. This is demonstrated by the two overlapping Region C's.



**REGION PHASING**

Region A — Region B

Notification

Region C — Overlapping regions. No notification — Region C
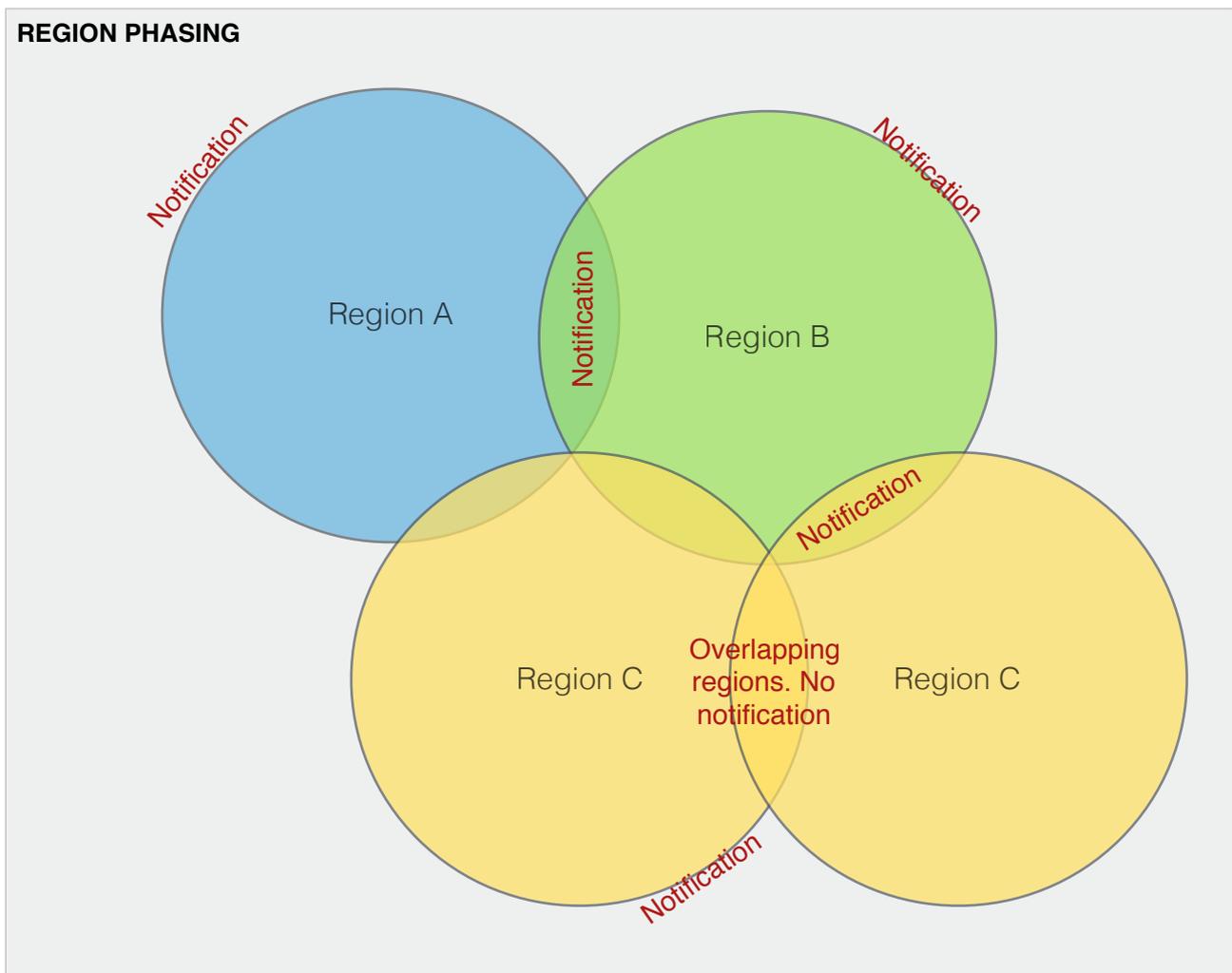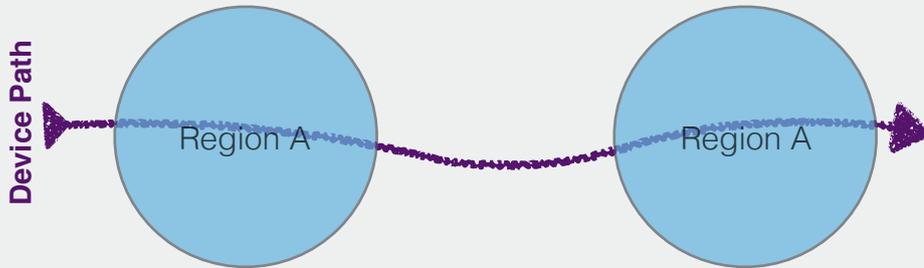
## Region spacing

Whilst scanning in the background there is a longer delay between detecting region events. This can lead to some instances whereby the device moves between regions but never shows notifications. To prevent this you should ensure that devices dwell for an adequate amount of time in a region or dwell outside of a region for an adequate amount of time. Some examples with example solutions are provided below
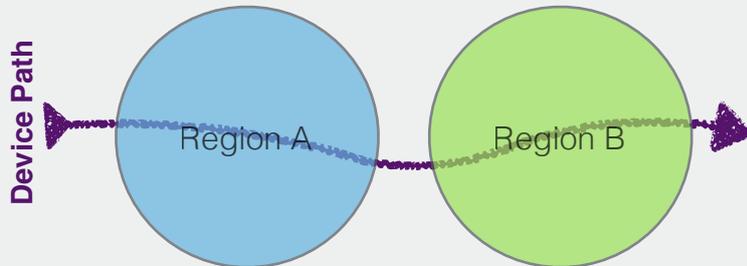
**REGION SPACING**
**Problem:** The user exits a region and re-enters a region without seeing a notification
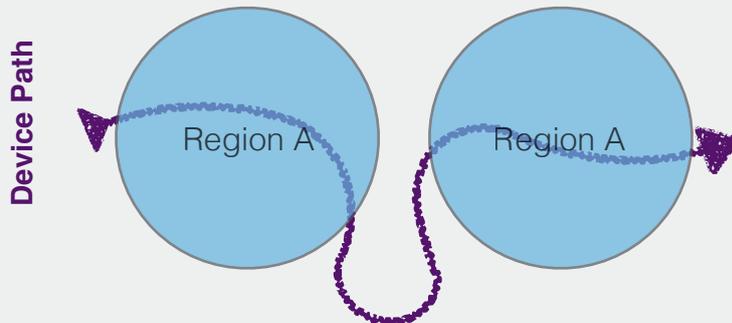
Device Path

Region A

Region A

Notification never fires
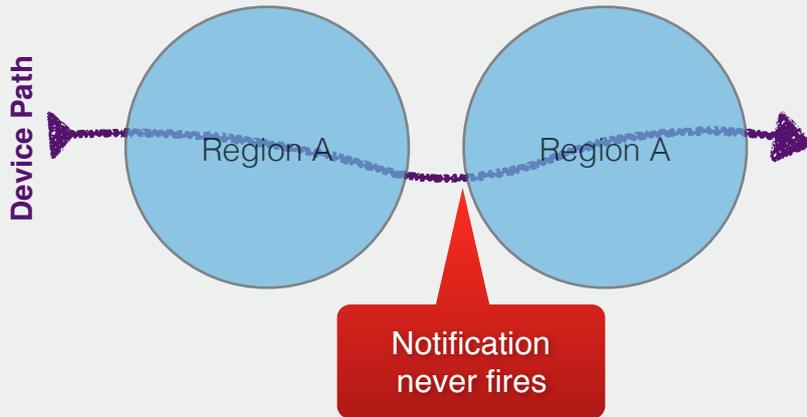
**Solution 1:** Increase distance between beacons

Device Path

Region A

Region A

**Solution 2:** Use two regions

Device Path

Region A

Region B

**Solution 3:** Increase the users dwell time outside region

Device Path

Region A

Region A

**REGION SPACING**
**Problem:** The user doesn't dwell in a region long enough

Device Path

Region A

Notification never fires
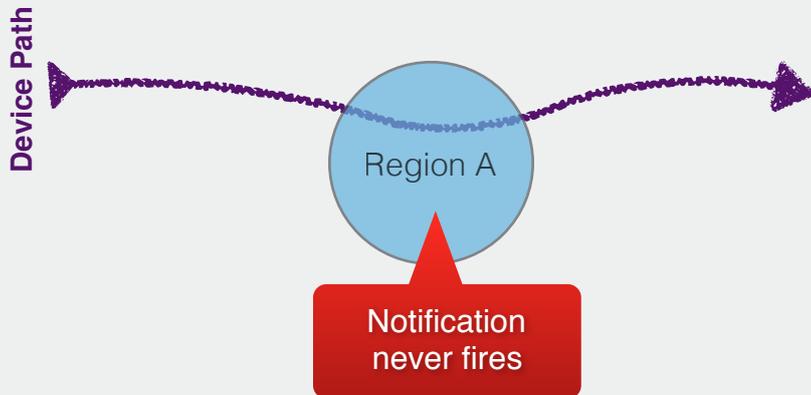
**Solution 1:** Increase the region size with multiple beacons

Device Path

Region A    Region A
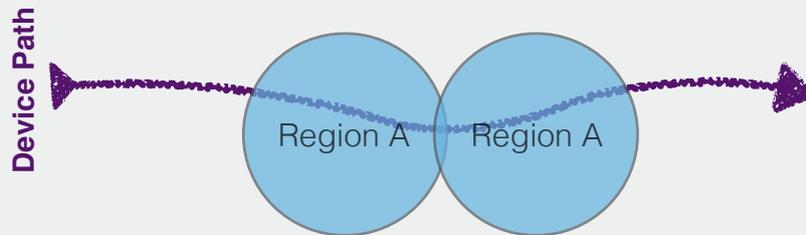
**Solution 2:** Use a combination of regions. 1 to deliver foreground app content, another for the background notification

Device Path

Region B    Region A    Region B
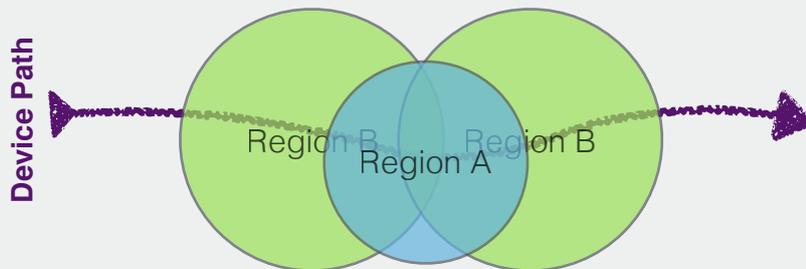
**Solution 3:** Increase the time the user dwells in region

Device Path

Region A    Free Coffee