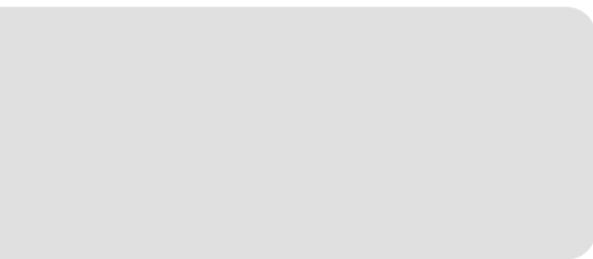




Google
Developers



Beyond the Blue Dot

New features in Android Location

Waleed Kadous, Jaikumar Ganesh

Team Leads, Android Location



Plan

- What's changed?
- Deep Dive on the New Stuff
- Looking Ahead





What's changed?

Growing Importance of Location



New Type of App: Contextual Apps



Location-using cards: 21

The stack of cards shows a progression of content from top to bottom:

- Stamps nearby
- Attractions nearby
- Nearby events
- Oakland Raiders vs. Cleveland...
O.Co Coliseum (Oakland Raiders)
in 3 days
Sports
- Prince Royce
The Warfield
tomorrow
Concerts
- Festival Weekend for Come Out...
SOMArts Cultural Center
Dec 1, noon
Fairs/Festivals

All cards: 28+

Happy Birthday!

You are 1,262,304,000 seconds young today.

Conrad Kent
birthday today

[Wish happy birthday](#)
[View contact](#)

News related to a story you read earlier

Democratic convention:
Obama arena speech
venue moved
Source: BBC News - 27 minutes ago

[Read full story](#)

Boarding pass: UA 1051
Sequence: 63, Premier access

Passenger
John Smith

Terminal	Gate	Seat	Group
3	1	31B	6

[View email](#)

Trip to Italy
Continue your research

Italy by Train
A beginner's guide to train travel in Italy, including trains between Rome, Venice ...
[trips2italy.com](#)

Things to do in Italy
Rental Bike Venice, Colosseum, Pantheon, Trevi Fountain, St Peter's Basilica...
[lonelyplanet.com](#)

[Explore more](#)

Virgin America
flight 25

Status: **Delayed** / Mon, 29 Oct 2012

Depart New York
JFK 12:30 PM (12:00 PM)
Terminal 2, Gate 54B

Arrive San Francisco
SFO 1:56 PM (1:31 PM)
Terminal 4

[Navigate to JFK / 32 min](#)
[View email](#)

Final 10/22/2012 9

Cardinals 0 Giants

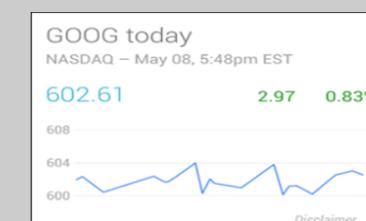
[Recap & Highlights](#)
[Box score](#)

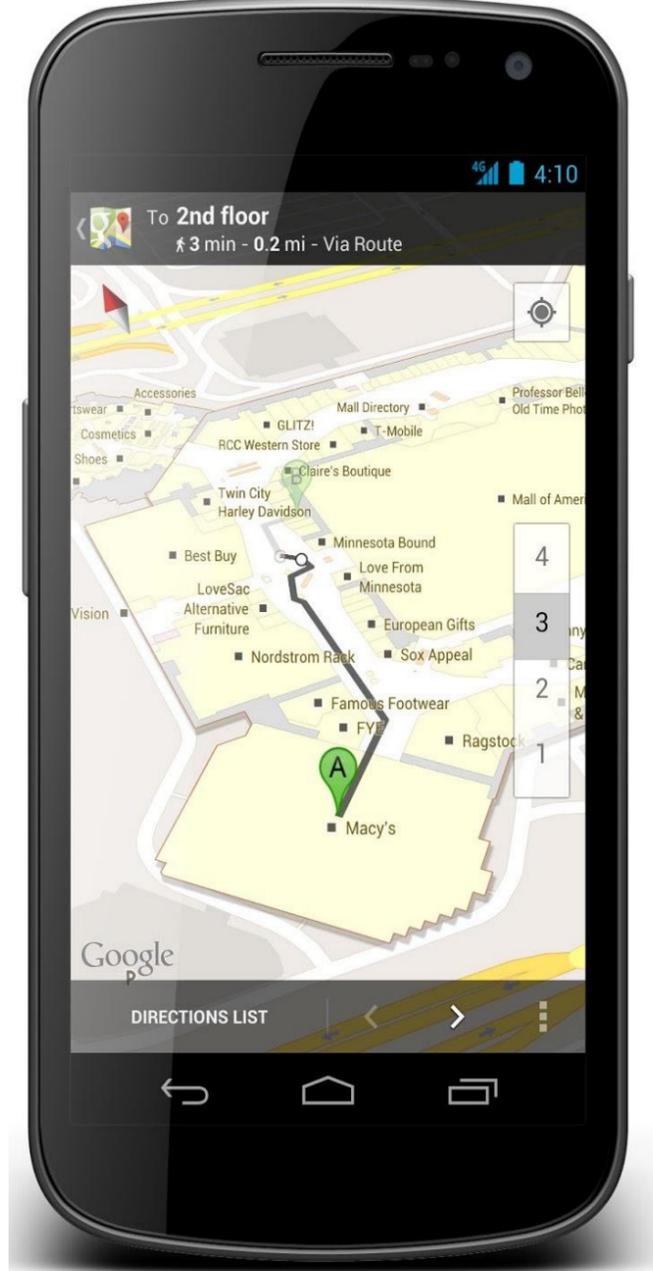
Package shipped
5.26pm Thursday August 10

Iron Man 2 (Three-Disc Blu-ray/DVD Combo)
Prometheus (Blu-ray/ DVD + Digital Copy)...

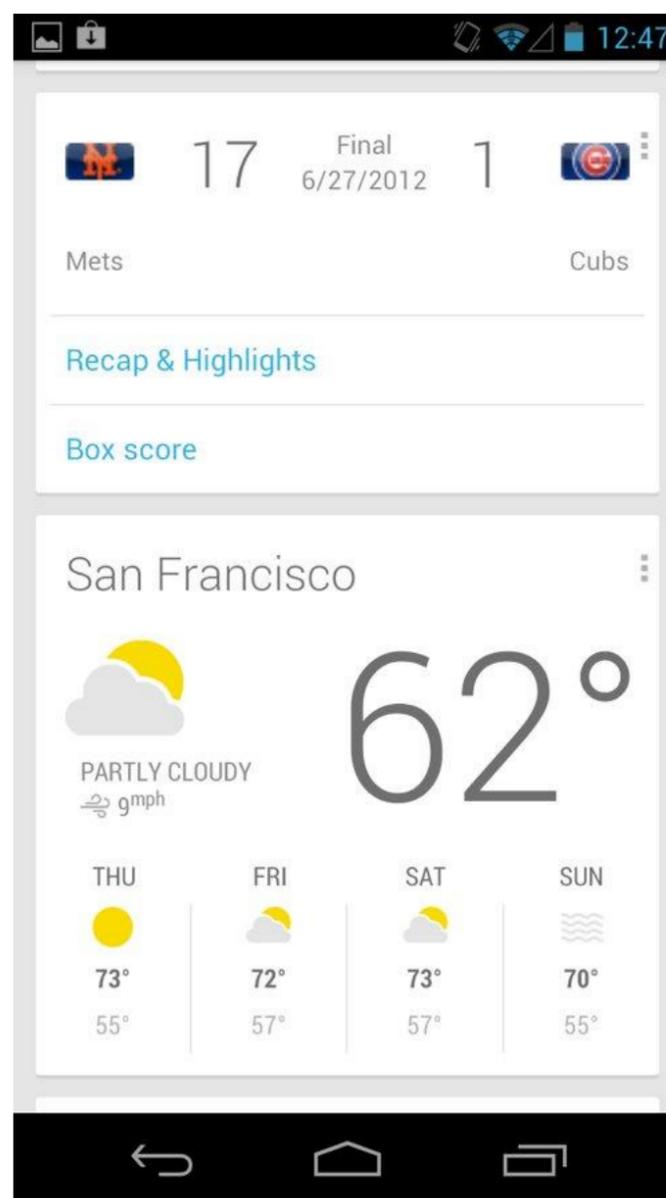
From: The Business Card Shop
UPS Standard Delivery

[Track Package](#)
[View email](#)





VS



requirements?

On when?

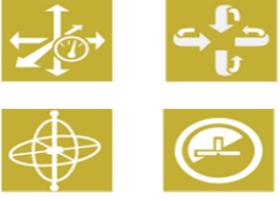
Power?

Real-time vs historical?

Accuracy?

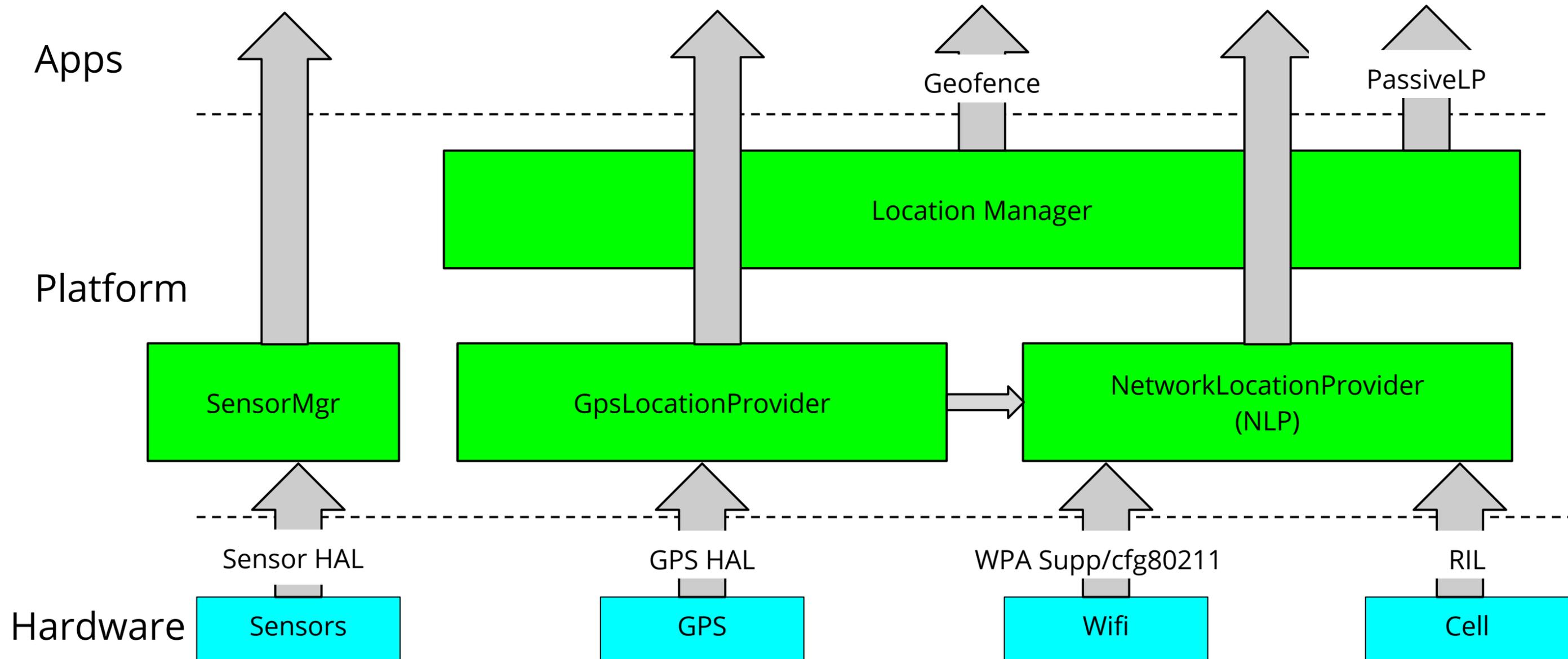


Complexity

	 GPS	 WiFi	 Cell	 Sensors
Power				
Accuracy				
Coverage				



Current State Of Platform APIs



Location Strategies

Flow for obtaining user location

Here's the typical flow of procedures for obtaining the user location:

1. Start application.
2. Sometime later, start listening for updates from desired location providers.
3. Maintain a "current best estimate" of location by filtering out new, but less accurate fixes.
4. Stop listening for location updates.
5. Take advantage of the last best location estimate.

Figure 1 demonstrates this model in a timeline that visualizes the period in which an application is listening for location updates and the events that occur during that time.

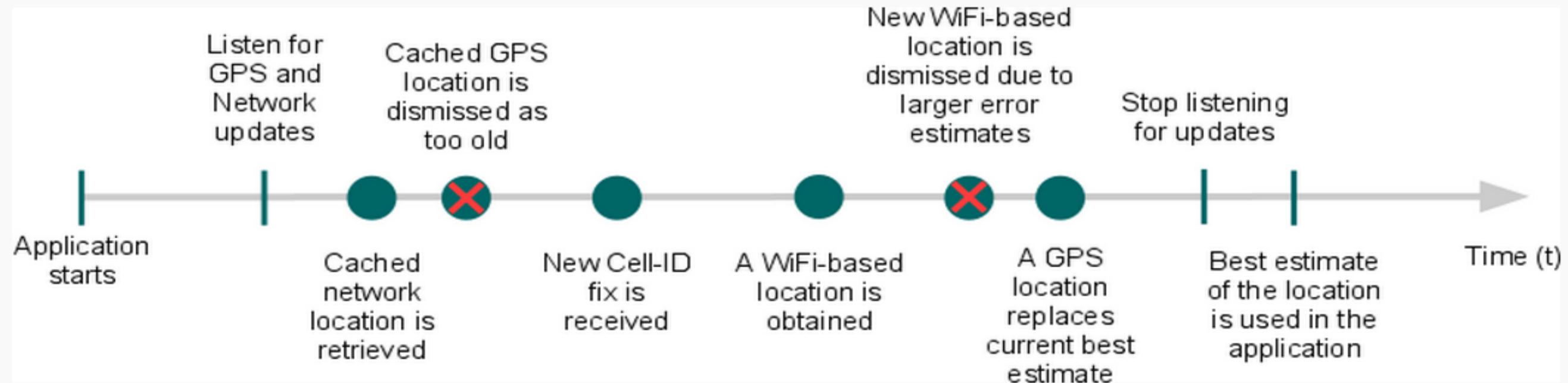


Figure 1. A timeline representing the window in which an application listens for location updates.



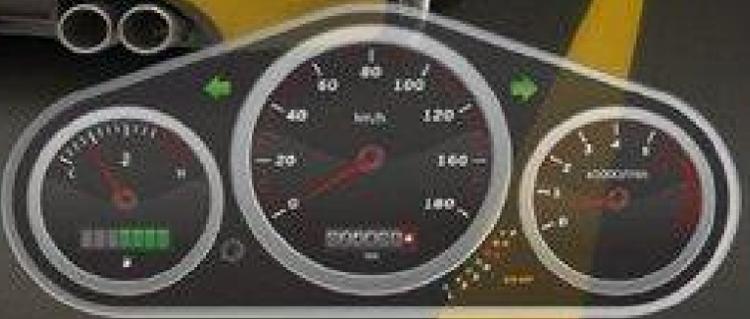
Sensors?

	 GPS	 WiFi	 Cell	 Sensors
Power				
Accuracy				
Coverage				



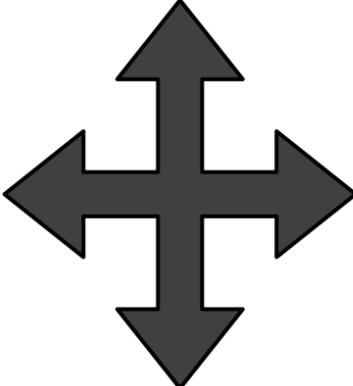


FM-1
TEMP
60.0° C
TOP
155 MPH
LAP
35.00 MIN

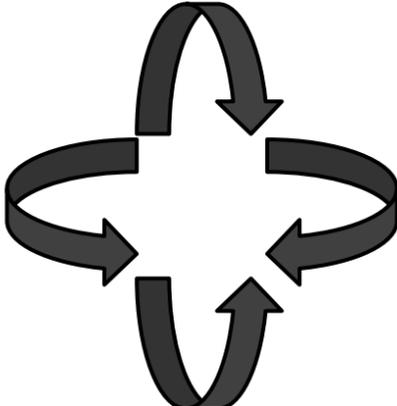


Sensors

Accelerometer



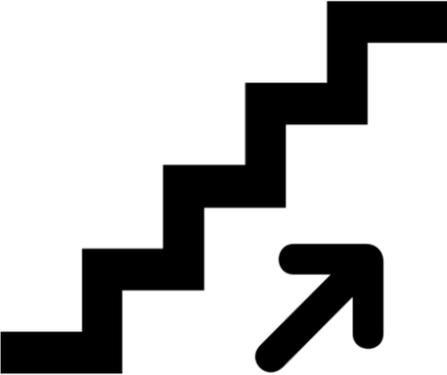
Gyro



Compass



Barometer



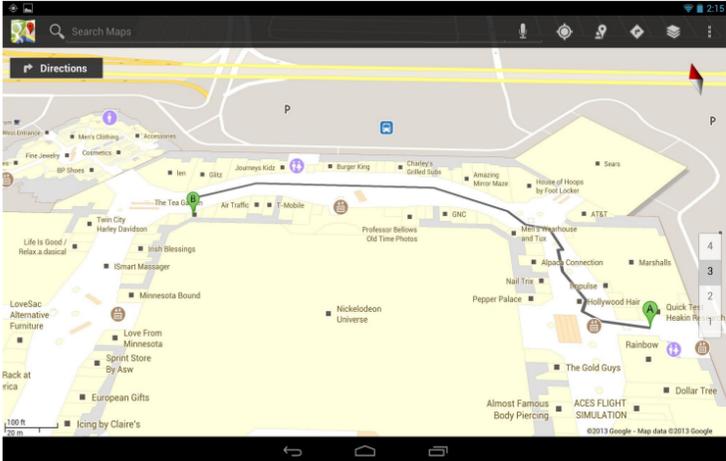
Save Power



Detect Activity



Indoor location



Animations

- High Quality indoor location with sensors
- Underlying wifi jumpiness



Goals of the Changes

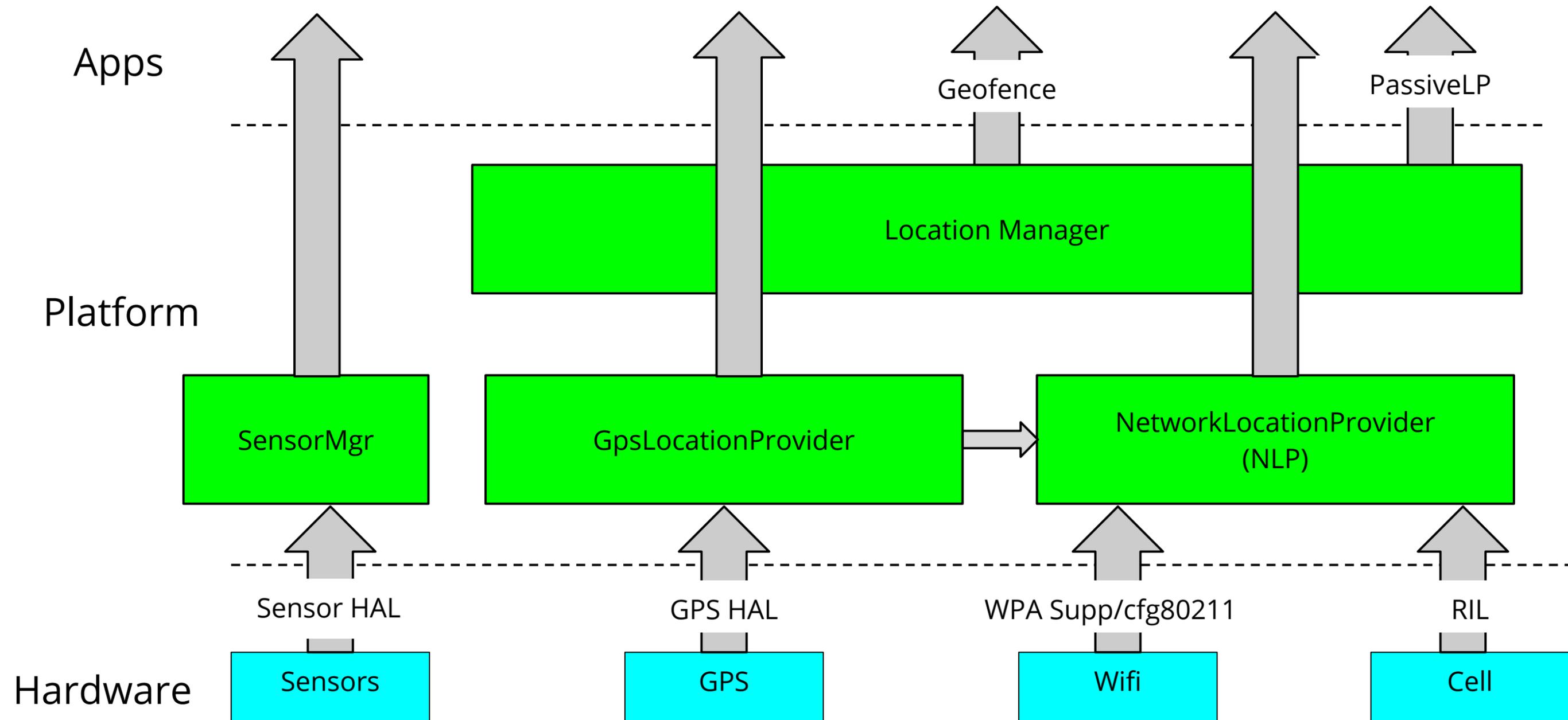
- Reduce Power
- Improve accuracy
- Simplify the APIs
- Expose cool new features
- *and* make it available on most Android devices.



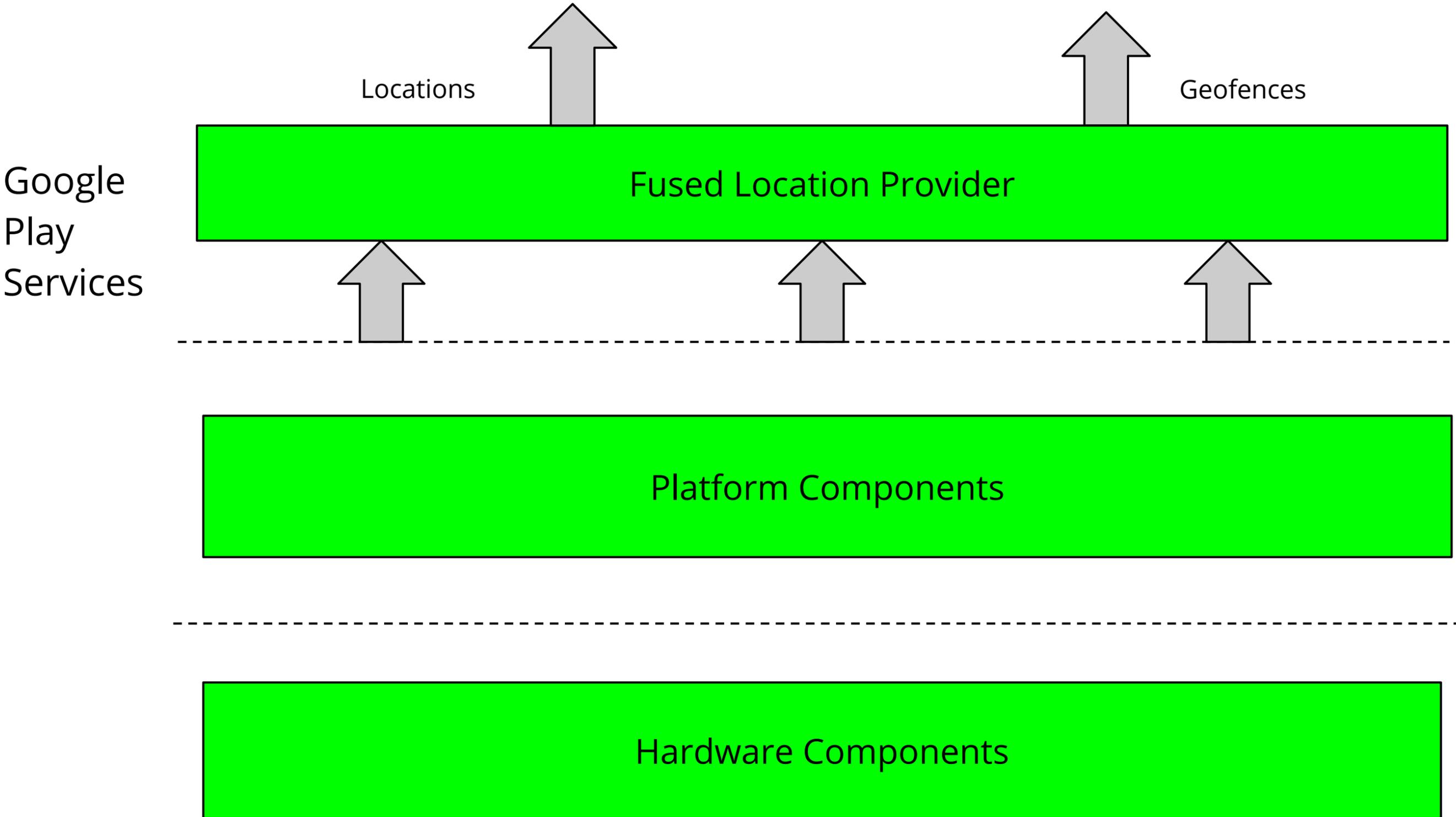


Deep Dive

Fused Location Provider - From This ...



... To This



Fused Location Provider

Animations



Fused Location Provider - Closer Look At The APIs

- Listeners vs Pending Intent
- Foreground vs Background



Fused Location Provider - Closer Look At The APIs

```
mLocationClient = new LocationClient(...)  
mLocationClient.connect();  
  
// public void onConnected(Bundle bundle)  
  
// Get the latest known location. Useful when you need location quickly.  
Location location = mLocationClient.getLastLocation();  
  
// Create location request.  
LocationRequest locationRequest = LocationRequest.create()  
    .setInterval(5000).setPriority(LocationRequest.PRIORITY_HIGH_ACCURACY);
```



Fused Location Provider - Closer Look At The APIs

```
LocationListener mLocationListener = new LocationListener() {  
    @Override  
    public void onLocationChanged(Location location) {  
        Log.i(TAG, "Received a new location " + location);  
    }  
};  
  
// Request updates.  
mLocationClient.requestLocationUpdates(locationRequest, mLocationListener);
```



Fused Location Provider - Closer Look At The APIs

```
PendingIntent mIntent = PendingIntent.getService(...);

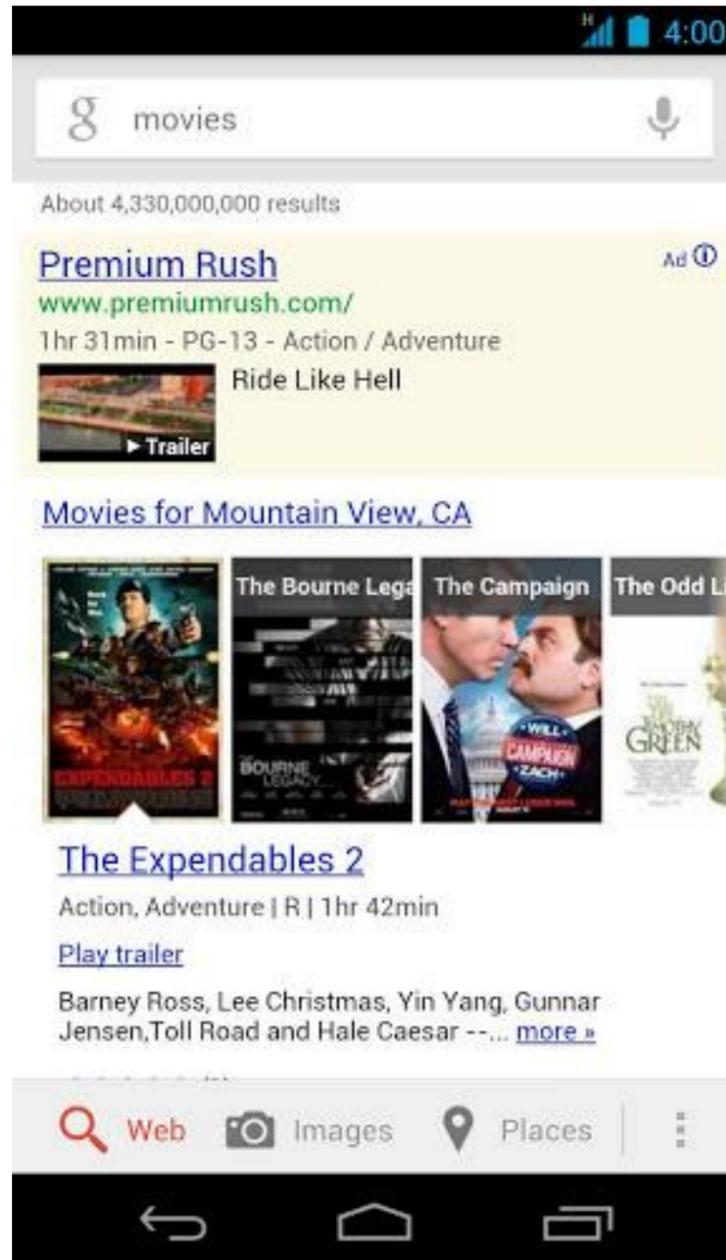
mLocationClient.requestLocationUpdates(locationRequest, mIntent);

public void onHandleIntent(Intent intent) {
    String action = intent.getAction();
    if (ACTION_LOCATION.equals(action)) {
        Location location = intent.getParcelableExtra(...)
    }
}
```

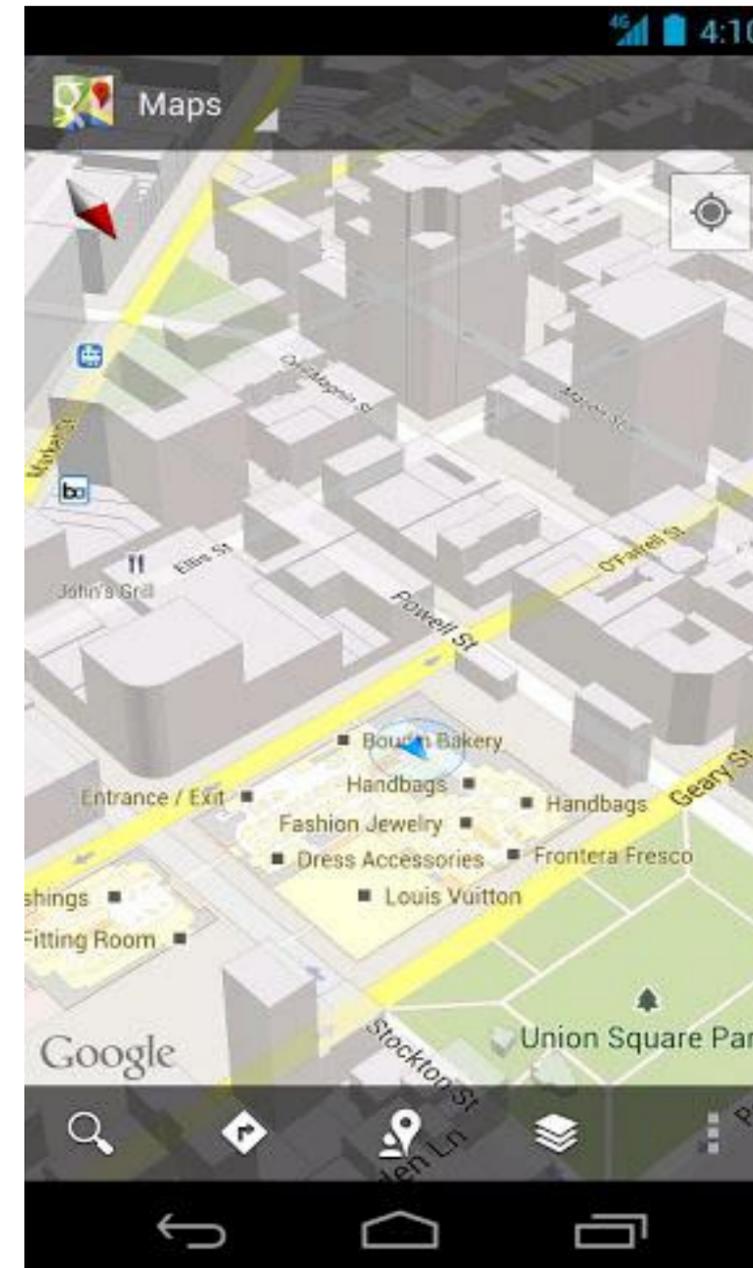


Fused Location Provider

getLastLocation()



LocationRequest APIs



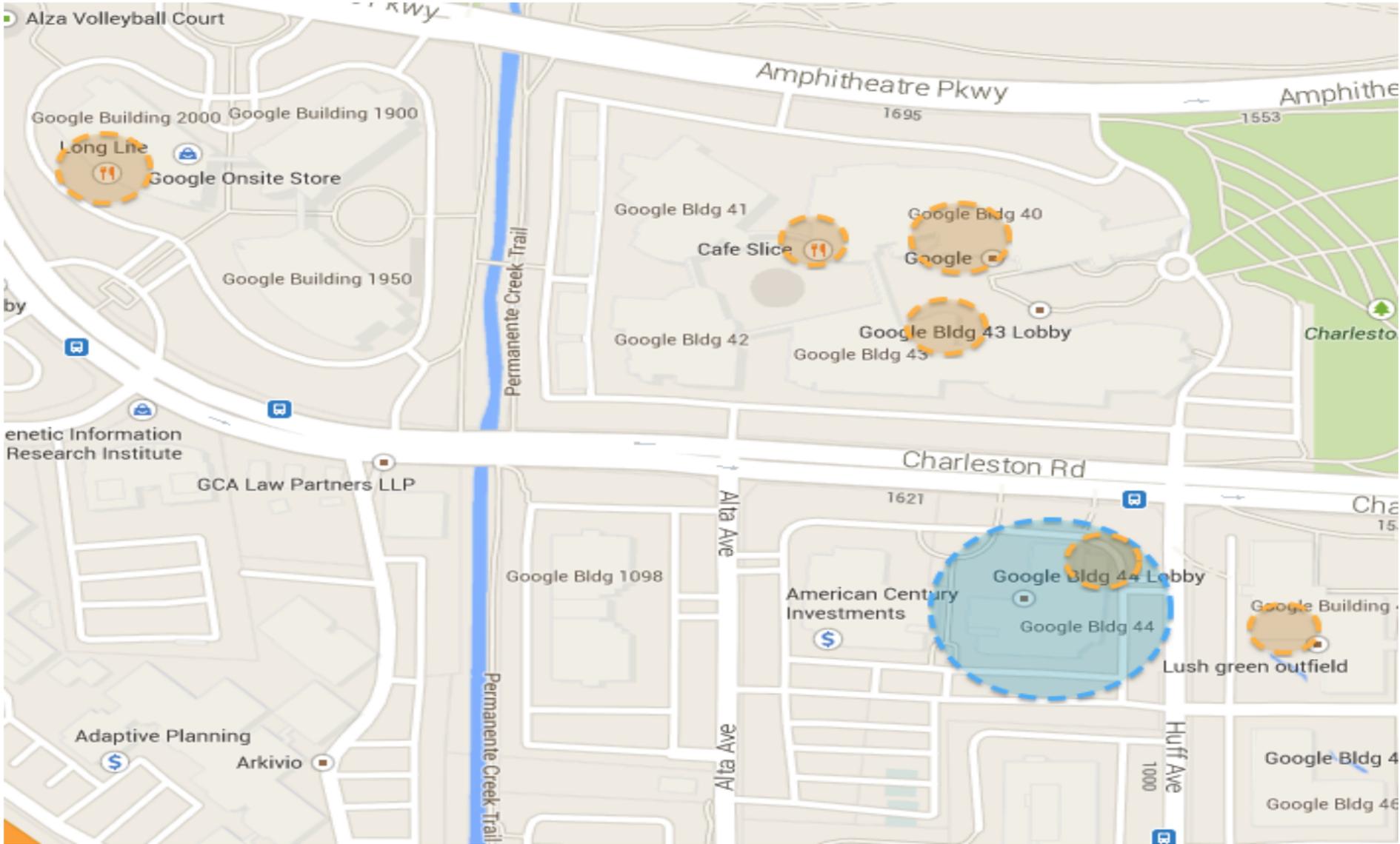
Fused Location Provider: Priority options

Galaxy Nexus (over multiple tests)

Priority	Typical Interval	Battery Drain per Hour (%)	Accuracy*
HIGH_ACCURACY	5 seconds	7.25%	~10 meters
BALANCED_POWER	20 seconds	0.6%	~40 meters
NO_POWER	N/A	small	~1 mile?



Geofencing



Geofencing- Demo

- Demo app with Mocked Location
- Zillow with Mocked Location



Geofencing - Closer Look At The APIs

```
mLocationClient = new LocationClient(...)  
mLocationClient.connect(); - Entry point for Location and Geofence APIs  
  
public void onConnected(Bundle bundle) {  
    Geofence geofence = new Geofence.Builder().setRequestId(stringId)  
        .setTransitionTypes(transitionTypes)  
        .setCircularRegion(getLatitude(), getLongitude(), getRadius())  
        .setExpirationDuration(expiration).build();  
  
    mLocationClient.addGeofences(List<Geofences> geofences,  
        PendingIntent intent, ...);  
}
```



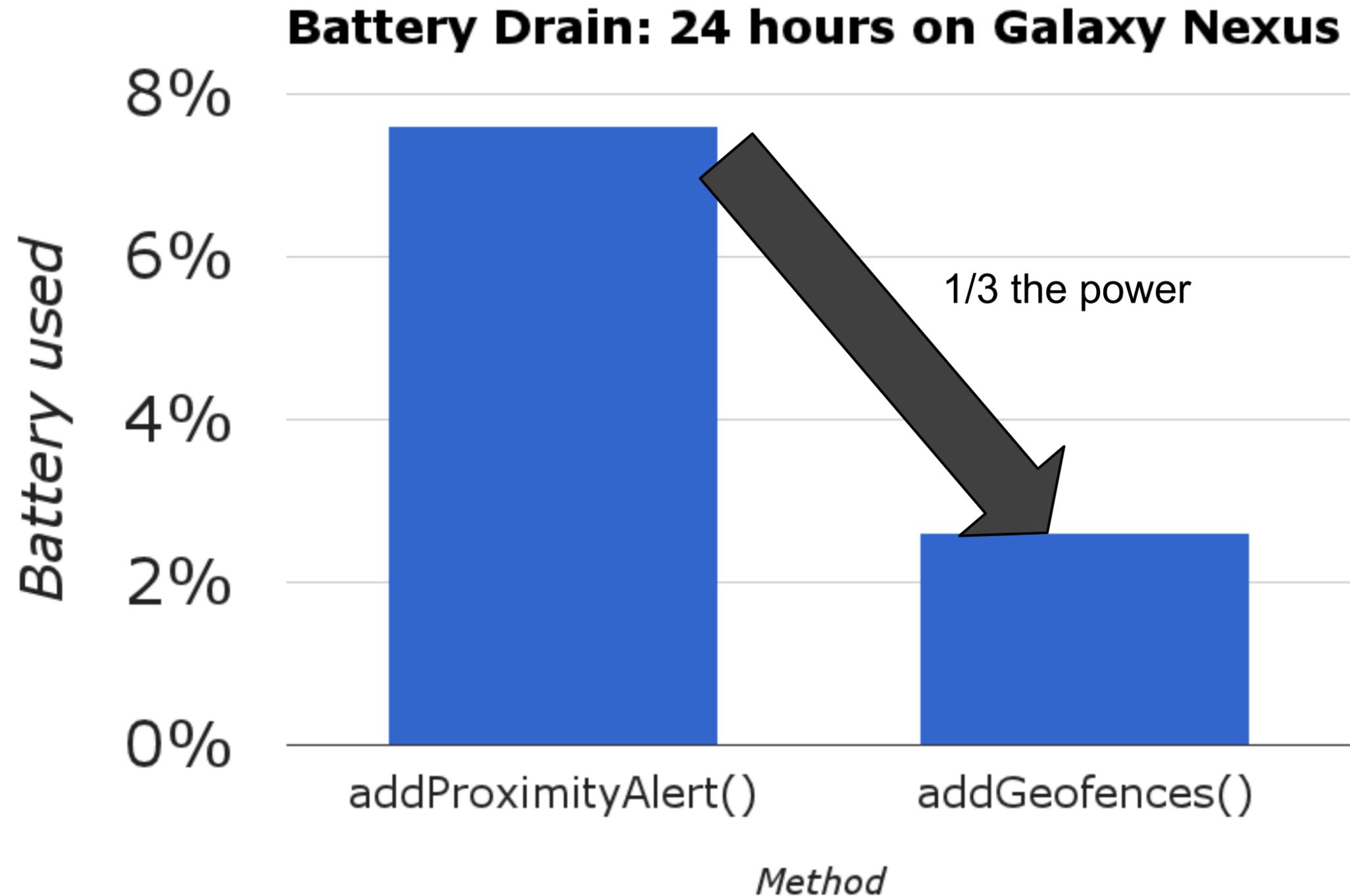
Geofencing - Closer Look At The APIs

```
public void onReceive(Context context, Intent intent) {
    String action = intent.getAction();
    if (GeofenceActivity.ACTION_GEOFENCE.equals(action)) {
        // This is an intent that indicates geofence transition.
        handleGeofenceCrossed(context, intent);
    }
}

private void handleGeofenceCrossed(Context context, Intent intent) {
    int transition = LocationClient.getGeofenceTransition(intent);
    List<Geofence> crossedGeofences = LocationClient.getTriggeringGeofences(intent);
}
```



Geofencing - addProximityAlert() vs addGeofences()

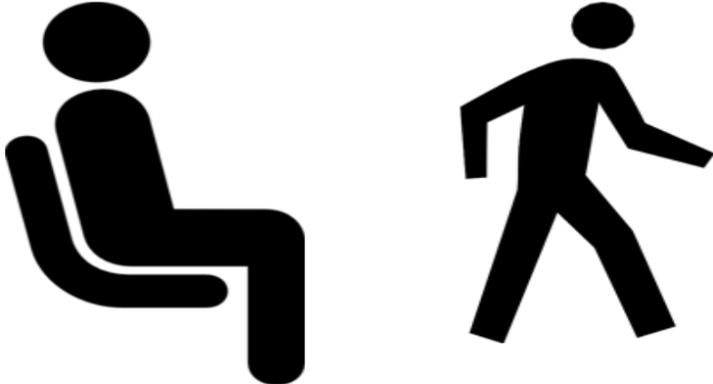


Geofencing - Power Management

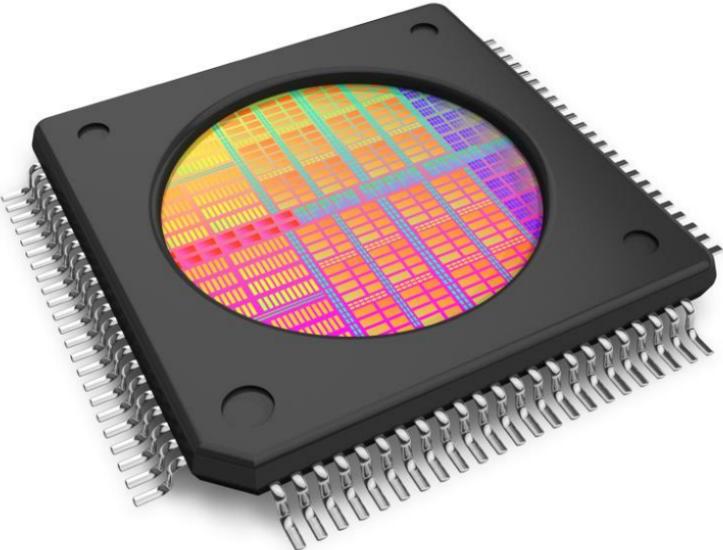
User versus Geofence Location



User state



Doing things in Hardware



Activity Recognition

Detect the user's activity using sensor data



Vehicle



On Foot



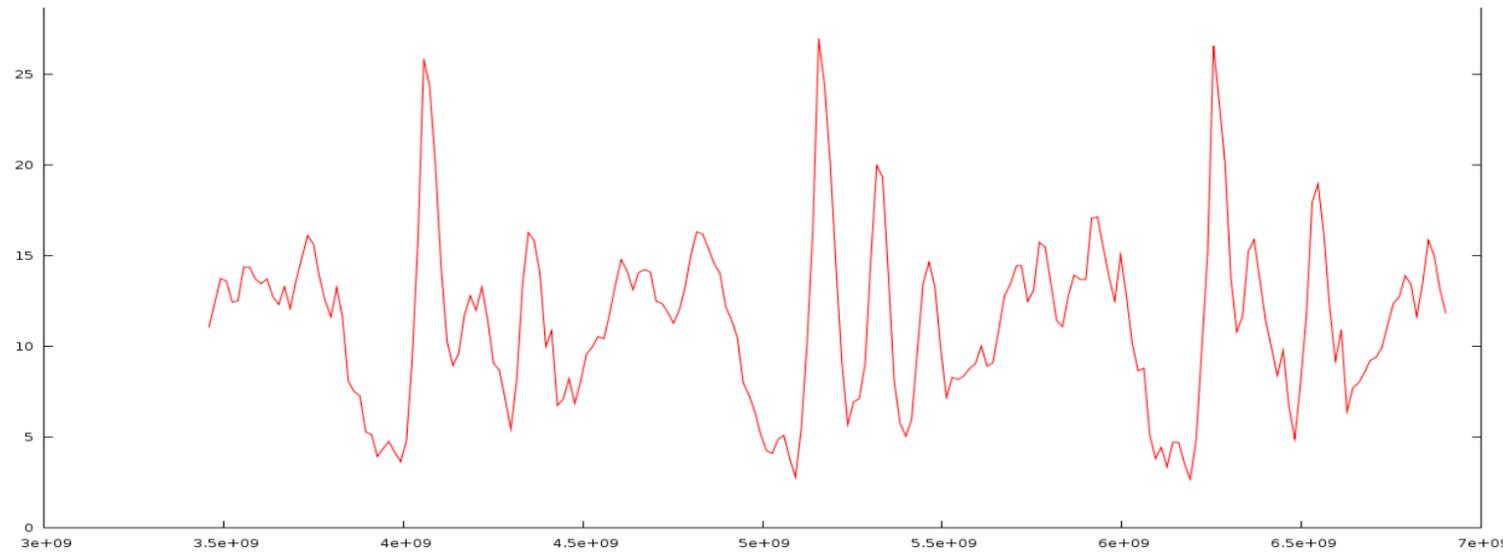
Still



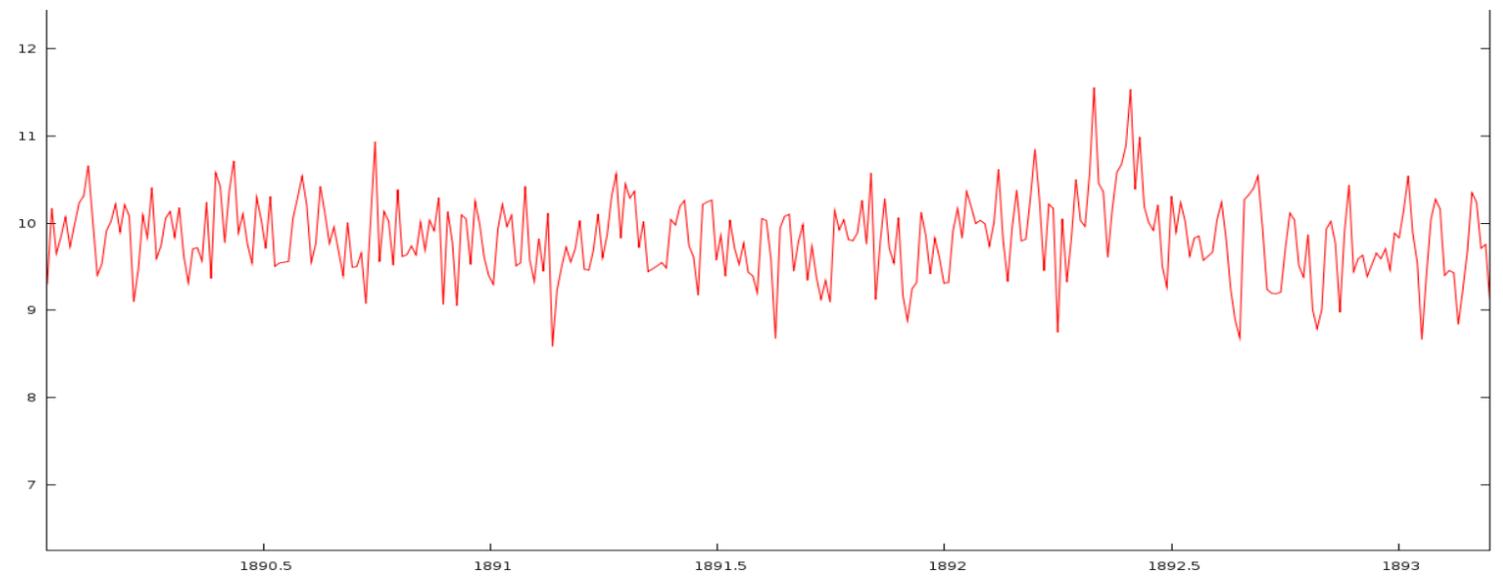
On Bicycle



Activity Recognition - "How Does It Work ?"



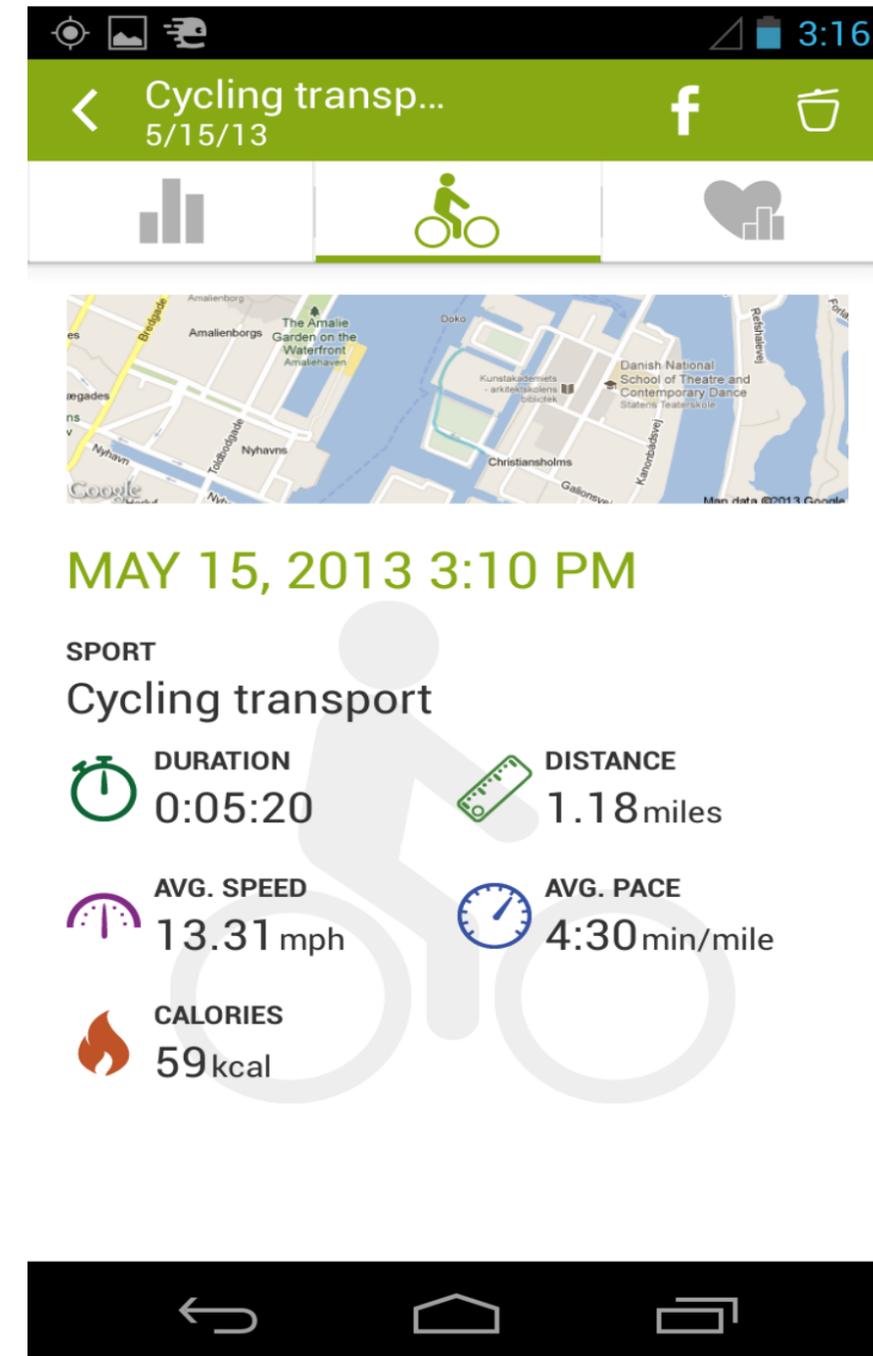
The user is walking



The user is in a car



Activity Recognition - Endomondo



Activity Recognition - Moves App Demo



Activity Recognition - Closer Look At The APIs

```
ActivityRecognitionClient mActivityClient = new ActivityRecognitionClient(...);  
mActivityClient.connect();
```

```
// Called when a connection to the ActivityRecognitionService has been established.
```

```
public void onConnected(Bundle connectionHint) {  
    mActivityClient.requestActivityUpdates(30000, callbackIntent);  
}
```

```
/**
```

```
* public void requestActivityUpdates (long detectionIntervalMillis,  
*     PendingIntent callbackIntent)
```

```
*/
```



Activity Recognition - Closer Look At The APIs

```
protected void onHandleIntent(Intent intent) {  
    if (ActivityRecognitionResult.hasResult(intent)) {  
        ActivityRecognitionResult result =  
            ActivityRecognitionResult.extractResult(intent);  
        DetectedActivity activity = result.getMostProbableActivity();  
    }  
}  
  
// DetectedActivity - IN_VEHICLE, ON_BICYCLE, ON_FOOT, STILL, TILTING  
// Detected Activities have associated probabilities.  
// Apps would need to use new ACTIVITY_RECOGNITION permission
```



Making It Available Everywhere

- All new APIs available today
 - Fused Location Provider
 - Activity Recognition
 - Geofencing
- App built with Client library

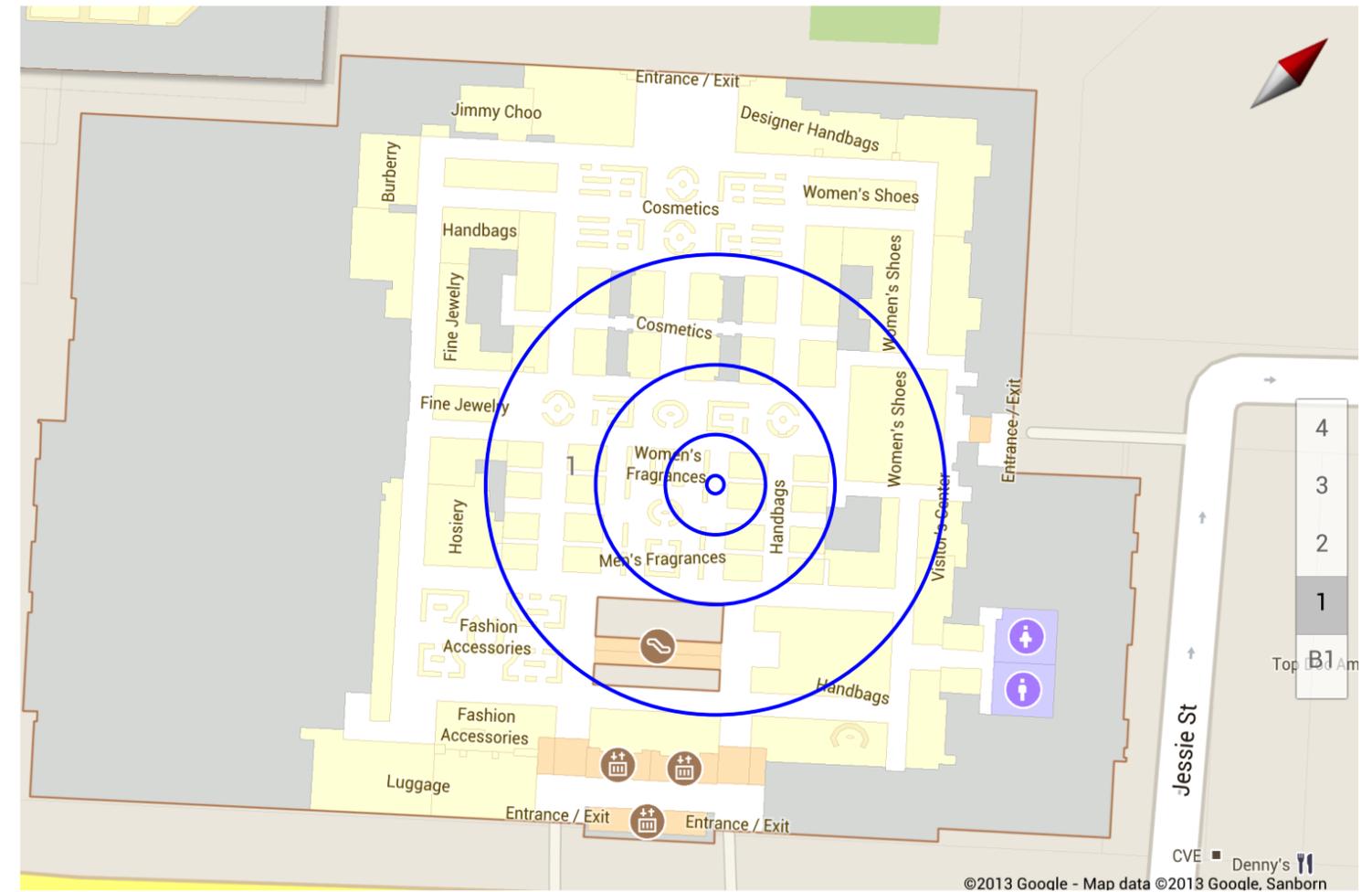




What's next

Improvements

- Improving accuracy
- Reducing power
 - Working with the hardware vendors
- Better coverage



Key Takeaways

- Our focus is on improving power, accuracy, coverage, simplicity and coolness.
- New and improved APIs
 - Fused Location Provider: simpler, lower power and more accurate
 - Geofencing
 - Activity Recognition: just darn cool
 - *all available today in Google Play Services*
- Adding more features soon!
- Can you make your app smarter by using location and context (like activity)?



Thank You

On behalf of the entire Android location team at Google

Feedback

Code Lab - May 17, 11:15 am - 1:15, Room 9





Google

Developers