Location & Maps

Location Services

Mobile applications can benefit from being location-aware

Allow applications to determine & manipulate location

Using Location Information

Find stores near the user's current location

Direct a user from a current to a particular store

Define a geofence

Initiate action when user enters or exits the geofence

Location

Represents a position on the Earth

A Location instance consists of:

Latitude, longitude, timestamp and, optionally, accuracy, altitude, speed, and bearing

LocationProvider

Represents a location data source

Actual data may come from

GPS satellites

Cell phone towers

WiFi access points

LocationProvider Types

Network – WiFi and cell tower

GPS - Satellite

Passive – Piggyback on the readings requested by other applications

Network Provider

Determines location based on cell tower and WiFi access points

Requires either

android.permission.!
ACCESS_COARSE_LOCATION

android.permission.!
ACCESS_FINE_LOCATION

GPS Provider

Determines location using satellites

Requires

android.permission.!
ACCESS_FINE_LOCATION

Passive provider

Returns locations generated by other providers

Requires

android.permission.!
ACCESS_FINE_LOCATION

LocationProvider

Different LocationProviders offer different tradeoffs between cost, accuracy, availability & timeliness

Provider Tradeoffs

GPS – expensive, accurate, slower, available outdoors

Network - cheaper, less accurate, faster, availability varies

Passive – cheapest, fastest, not always available

LocationManager

System service for accessing location data

```
getSystemService(!
        Context.LOCATION_SERVICE)
```

LocationManager

Determine the last known user location

Register for location updates

Register to receive Intents when the device nears or moves away from a given geographic area

LocationListener

Defines callback methods that are called when Location or LocationProvider status changes

LocationListener

```
void onLocationChanged(!
                Location location)
void onProviderDisabled(!
                String provider)
void onProviderEnabled(!
                String provider)
void onStatusChanged(!
            String provider, !
            int status, !
            Bundle extras)
```

Obtaining Location

Start listening for updates from location providers

Maintain a "current best estimate" of location

When estimate is “good enough”, stop listening for location updates

Use best location estimate

Determining Best Location

Several factors to consider

Measurement time

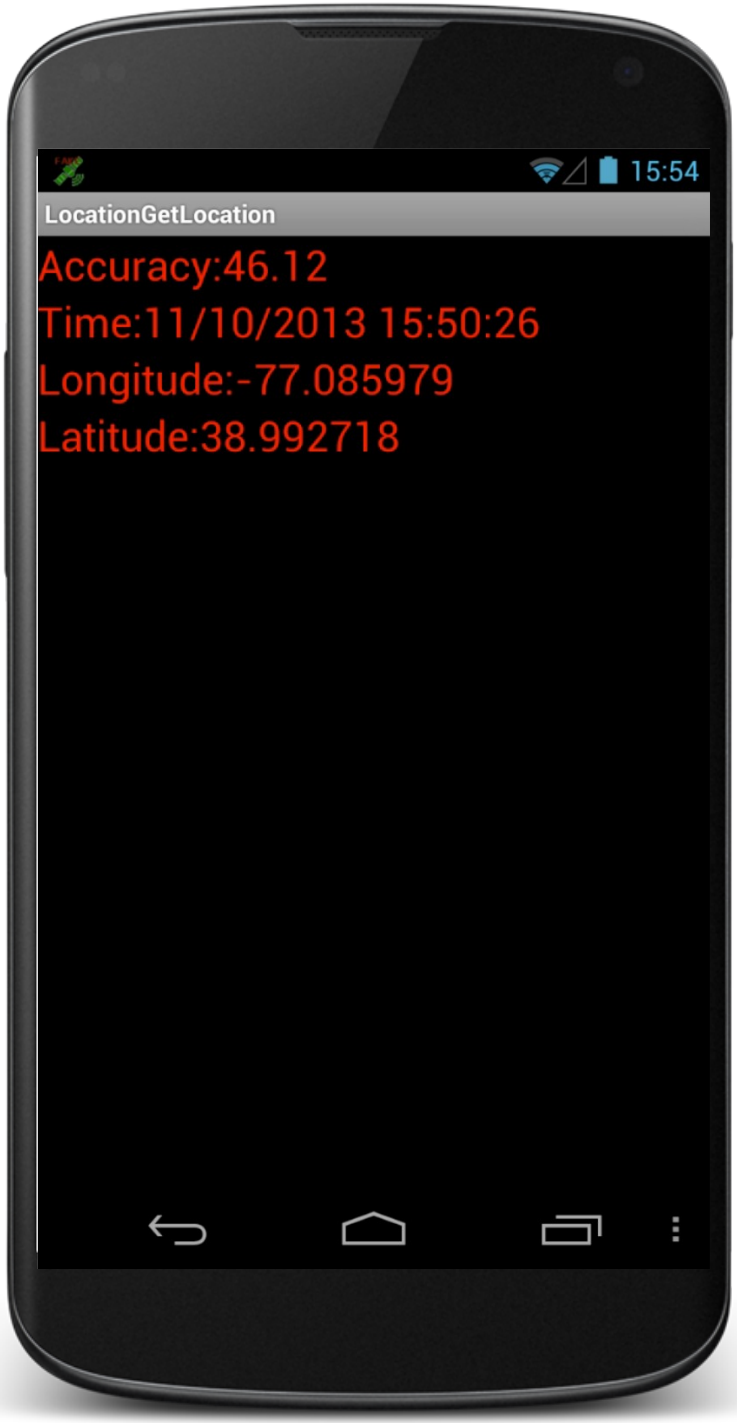
Accuracy

power needs

LocationGetLocation

Application acquires and displays the last known locations from all providers

If necessary, acquires and displays new readings from all providers


15:54
LocationGetLocation
Accuracy:46.12
Time:11/10/2013 15:50:26
Longitude:-77.085979
Latitude:38.992718

LocationGetLocation

```
// Acquire reference to the LocationManager
if (null == (mLocationManager = (LocationManager) getSystemService(Context.LOCATION_SERVICE)))
    finish();

// Get best last location measurement
mBestReading = bestLastKnownLocation(MIN_LAST_READ_ACCURACY, FIVE_MIN);

// Display last reading information
if (null != mBestReading) {

    updateDisplay(mBestReading);

} else {

    mAccuracyView.setText("No Initial Reading Available");

}
```

LocationGetLocation

```
mLocationListener = new LocationListener() {

    // Called back when location changes

    public void onLocationChanged(Location location) {

        ensureColor();

        // Determine whether new location is better than current best
        // estimate

        if (null == mBestReading
                || location.getAccuracy() < mBestReading.getAccuracy()) {

            // Update best estimate
            mBestReading = location;

            // Update display
            updateDisplay(location);

            if (mBestReading.getAccuracy() < MIN_ACCURACY)
                mLocationManager.removeUpdates(mLocationListener);

        }
    }
```

LocationGetLocation

```
@Override
protected void onResume() {
    super.onResume();

    // Determine whether initial reading is
    // "good enough". If not, register for
    // further location updates

    if (null == mBestReading
            || mBestReading.getAccuracy() > MIN_LAST_READ_ACCURACY
            || mBestReading.getTime() < System.currentTimeMillis()
                    - TWO_MIN) {

        // Register for network location updates
        if (null != mLocationManager
                .getProvider(LocationManager.NETWORK_PROVIDER)) {
            mLocationManager.requestLocationUpdates(
                    LocationManager.NETWORK_PROVIDER, POLLING_FREQ,
                    MIN_DISTANCE, mLocationListener);
        }

        // Register for GPS location updates
        if (null != mLocationManager
                .getProvider(LocationManager.GPS_PROVIDER)) {
            mLocationManager.requestLocationUpdates(
                    LocationManager.GPS_PROVIDER, POLLING_FREQ,
                    MIN_DISTANCE, mLocationListener);
        }

        // Schedule a runnable to unregister location listeners
        Executors.newScheduledThreadPool(1).schedule(new Runnable() {
```

LocationGet

```
@Override
protected void onResume() {
    super.onResume();

    // Determine whether initial reading is
    // "good enough". If not, register for
    // further location updates

    if (null == mBestReading
            || mBestReading.getAccuracy() > MIN_LAST_READ_ACCURACY
            || mBestReading.getTime() < System.currentTimeMillis()
                    - TWO_MIN) {

        // Register for network location updates
        if (null != mLocationManager
                .getProvider(LocationManager.NETWORK_PROVIDER)) {
            mLocationManager.requestLocationUpdates(
                    LocationManager.NETWORK_PROVIDER, POLLING_FREQ,
                    MIN_DISTANCE, mLocationListener);
        }

        // Register for GPS location updates
        if (null != mLocationManager
                .getProvider(LocationManager.GPS_PROVIDER)) {
            mLocationManager.requestLocationUpdates(
                    LocationManager.GPS_PROVIDER, POLLING_FREQ,
                    MIN_DISTANCE, mLocationListener);
        }

        // Schedule a runnable to unregister location listeners
        Executors.newScheduledThreadPool(1).schedule(new Runnable() {

            @Override
            public void run() {

                Log.i(TAG, "location updates cancelled");

                mLocationManager.removeUpdates(mLocationListener);

            }
        }, MEASURE_TIME, TimeUnit.MILLISECONDS);
    }
}
```

```
// Get the last known location from all providers
// return best reading that is as accurate as minAccuracy and
// was taken no longer then minAge milliseconds ago. If none,
// return null.

private Location bestLastKnownLocation(float minAccuracy, long maxAge) {

    Location bestResult = null;
    float bestAccuracy = Float.MAX_VALUE;
    long bestAge = Long.MIN_VALUE;

    List<String> matchingProviders = mLocationManager.getAllProviders();

    for (String provider : matchingProviders) {

        Location location = mLocationManager.getLastKnownLocation(provider);

        if (location != null) {

            float accuracy = location.getAccuracy();
            long time = location.getTime();

            if (accuracy < bestAccuracy) {

                bestResult = location;
                bestAccuracy = accuracy;
                bestAge = time;

            }
        }
    }

    // Return best reading or null
    if (bestAccuracy > minAccuracy
            || (System.currentTimeMillis() - bestAge) > maxAge) {
        return null;
    } else {
        return bestResult;
    }
}
```

Loc

```java
// Get the last known location from all providers
// return best reading that is as accurate as minAccuracy and
// was taken no longer then minAge milliseconds ago. If none,
// return null.

private Location bestLastKnownLocation(float minAccuracy, long maxAge) {

    Location bestResult = null;
    float bestAccuracy = Float.MAX_VALUE;
    long bestAge = Long.MIN_VALUE;

    List<String> matchingProviders = mLocationManager.getAllProviders();

    for (String provider : matchingProviders) {

        Location location = mLocationManager.getLastKnownLocation(provider);

        if (location != null) {

            float accuracy = location.getAccuracy();
            long time = location.getTime();

            if (accuracy < bestAccuracy) {

                bestResult = location;
                bestAccuracy = accuracy;
                bestAge = time;

            }
        }
    }

    // Return best reading or null
    if (bestAccuracy > minAccuracy
            || (System.currentTimeMillis() - bestAge) > maxAge) {
        return null;
    } else {
        return bestResult;
    }
}
```

Battery Saving Tips

Always check last known measurement

Return updates as infrequently as possible. Limit measurement time

Use the least accurate measurement necessary

Turn off updates in onPause()

Maps

A visual representation of area

Android provides Mapping support through the Google Maps Android v2 API

Map Types

Normal: traditional road map

Satellite – Aerial photograph

Hybrid – Satellite + road map

Terrain – Topographic details

Customizing the Map

Change the camera position

Add Markers & ground overlays

Respond to gestures

Indicate the user’s current Location

Some Map Classes

GoogleMap

MapFragment

Camera

Marker

Setting up a Maps Application

Set up the Google Play services SDK

Obtain an API key

Specify settings in Application Manifest

Add map to project

See: https://developers.google.com/maps/documentation/android/start

Map Permissions

```
<uses-permission android:name=!
  "android.permission.INTERNET"/>
<uses-permission android:name=!
   "android.permission.ACCESS_NETWORK_STATE"/>
```

Map Permissions

```
<uses-permission android:name= !
  "android.permission.WRITE_EXTERNAL_STORAGE"/>

<uses-permission android:name=!
        "com.google.android.providers.!
                gsf.permission.READ_GSERVICES"/>
```

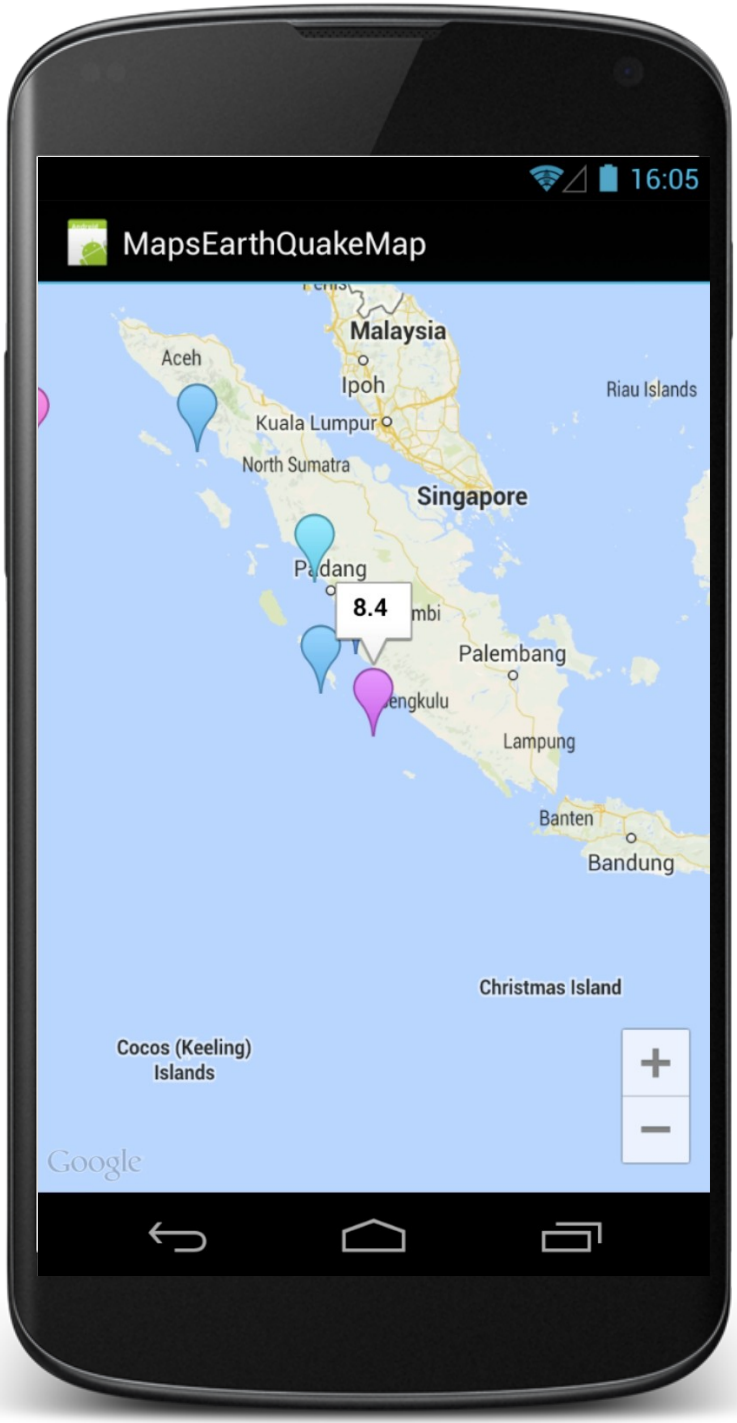
Map Permissions

```
<uses-permission android:name=!
  "android.permission.ACCESS_COARSE_LOCATION"/>
<uses-permission android:name=!
  "android.permission.ACCESS_FINE_LOCATION"/>
```

MapEarthQuakeMap

This application acquires earthquake data from a server

Then it displays the data on a map, using clickable markers


16:05
MapsEarthQuakeMap
Malaysia
Aceh
Ipoh
Riau Islands
Kuala Lumpur
North Sumatra
Singapore
Padang
8.4
Palembang
Lampung
Banten
Bandung
Christmas Island
Cocos (Keeling) Islands
Google

MapEarthQuakeMap

```
// The Map Object
private GoogleMap mMap;

// URL for getting the earthquake
// replace with your own user name

private final static String UNAME = "aporter";
private final static String URL = "http://api.geonames.org/earthquakesJSON?north=44.1&south=-9.9&east=-22.4&west=55.2&username="
        + UNAME;

public static final String TAG = "MapsEarthquakeMapActivity";

// Set up UI and get earthquake data
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);

    setContentView(R.layout.main);

    new HttpGetTask().execute(URL);

}
```

MapEarthQuakeMap

```
private class HttpGetTask extends
        AsyncTask<String, Void, List<EarthQuakeRec>> {

    AndroidHttpClient mClient = AndroidHttpClient.newInstance("");

    @Override
    protected List<EarthQuakeRec> doInBackground(String... params) {

        HttpGet request = new HttpGet(params[0]);
        JSONResponseHandler responseHandler = new JSONResponseHandler();

        try {

            // Get Earthquake data in JSON format
            // Parse data into a list of EarthQuakeRecs

            return mClient.execute(request, responseHandler);

        } catch (ClientProtocolException e) {
            Log.i(TAG, "ClientProtocolException");
        } catch (IOException e) {
            Log.i(TAG, "IOException");
        }

        return null;

    }
```

MapEarthQuakeMap

```
@Override
protected void onPostExecute(List<EarthQuakeRec> result) {

    // Get Map Object
    mMap = ((MapFragment) getFragmentManager().findFragmentById(
            R.id.map)).getMap();

    if (null != mMap) {

        // Add a marker for every earthquake

        for (EarthQuakeRec rec : result) {

            // Add a new marker for this earthquake
            mMap.addMarker(new MarkerOptions()

                    // Set the Marker's position
                    .position(new LatLng(rec.getLat(), rec.getLng()))

                    // Set the title of the Marker's information window
                    .title(String.valueOf(rec.getMagnitude()))

                    // Set the color for the Marker
                    .icon(BitmapDescriptorFactory
                            .defaultMarker(getMarkerColor(rec
                                    .getMagnitude()))));

        }

        // Center the map
        // Should compute map center from the actual data

        mMap.moveCamera(CameraUpdateFactory.newLatLng(new LatLng(
                CAMERA_LAT, CAMERA_LNG)));

    }
```

```
        if (null != mMap) {

            // Add a marker for every earthquake

            for (EarthQuakeRec rec : result) {

                // Add a new marker for this earthquake
                mMap.addMarker(new MarkerOptions()

                        // Set the Marker's position
                        .position(new LatLng(rec.getLat(), rec.getLng()))

                        // Set the title of the Marker's information window
                        .title(String.valueOf(rec.getMagnitude()))

                        // Set the color for the Marker
                        .icon(BitmapDescriptorFactory
                                .defaultMarker(getMarkerColor(rec
                                        .getMagnitude()))));

            }

            // Center the map
            // Should compute map center from the actual data

            mMap.moveCamera(CameraUpdateFactory.newLatLng(new LatLng(
                    CAMERA_LAT, CAMERA_LNG)));

        }

        if (null != mClient)
            mClient.close();

    }
```