CMSC436: Programming Handheld Systems

Fall 2017

The BroadcastReceiver Class

Today’s Topics

The BroadcastReceiver Class

Registration

Broadcast

Processing

BroadcastReceiver

Base class for components that receive and react to events

BroadcastReceiver

BroadcastReceivers register to receive events in which they are interested

BroadcastReceiver

When Events occur at runtime they are represented as Intents

Those Intents are then broadcast to the system

BroadcastReceiver

Android routes the Intents to BroadcastReceivers that have registered to receive them

BroadcastReceivers receive the Intent via a call to onReceive()

Typical Use Case

Register BroadcastReceivers

Broadcast an Intent

Android delivers Intent to registered recipients by calling their onReceive() method

Event handled in onReceive()

Registering for Intents

- BroadcastReceivers can register in two ways
    - Statically, in AndroidManifest.XML
    - Dynamically, by calling a registerReceiver() method

Static Registration

Put <receiver> and <intent-filter> tags in AndroidManifest.xml

<Receiver> Tag Format

```
<receiver
        android:enabled=["true" | "false"]
        android:exported=["true" | "false"]
        android:icon="drawable resource"
        android:label="string resource"
        android:name="string"
        android:permission="string"
        android:process="string" >
    . . .
</receiver>
```

Intent Filter

Specify <intent-filter> tag within a <receiver>

Static Registration

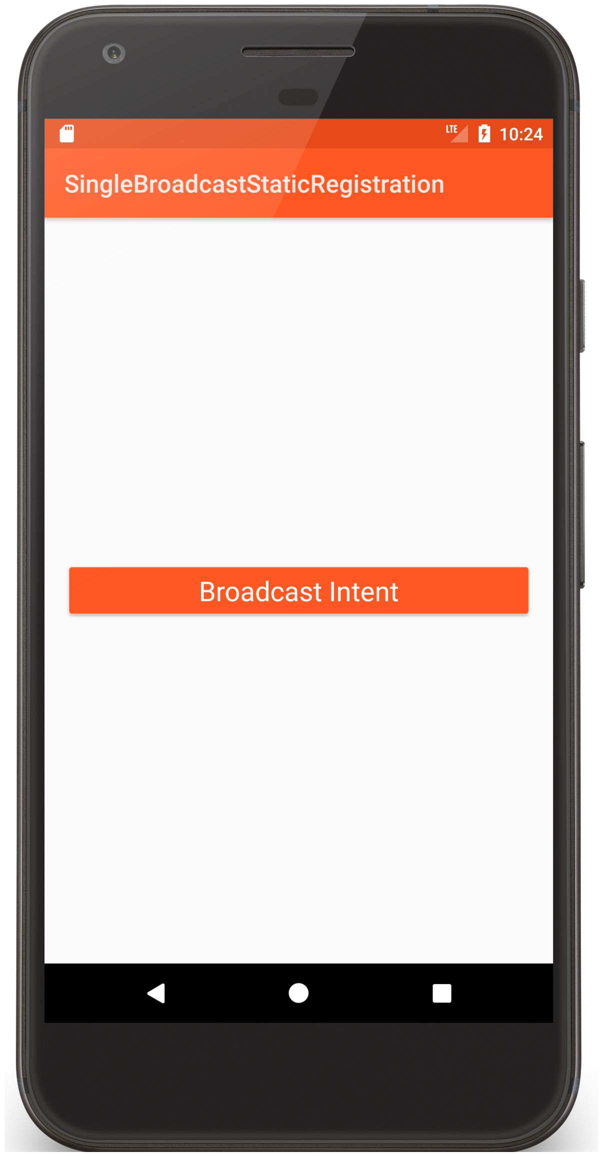
Receivers can be registered in AndroidManifest.xml

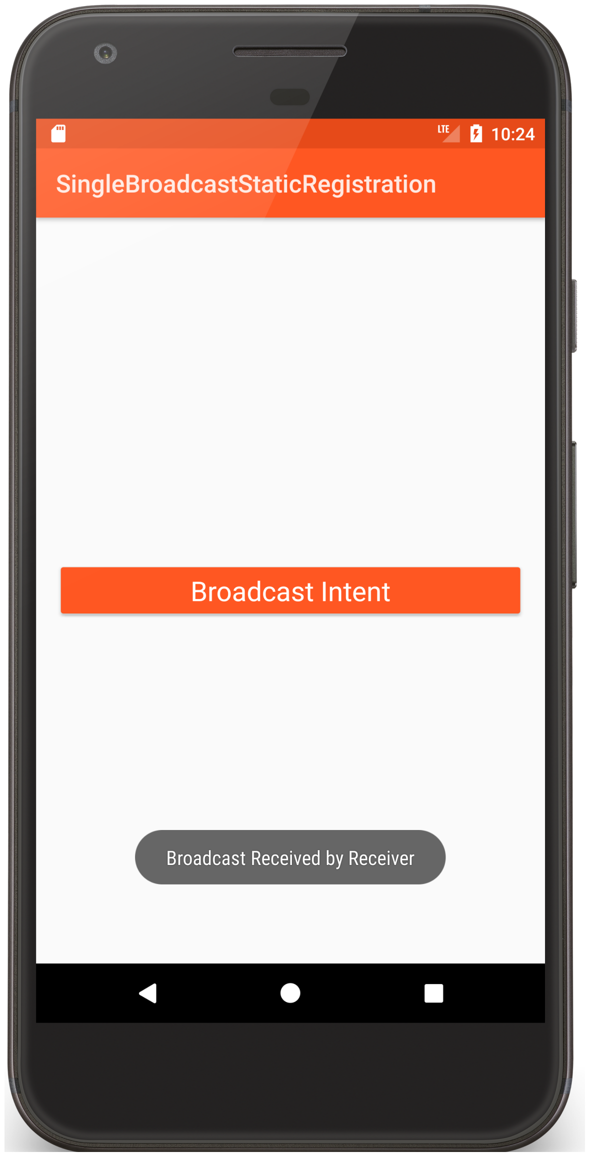
Will be woken to receive broadcasts, if needed

From API 26 or higher, statically registered receivers cannot receive most implicit intents

See: https://developer.android.com/guide/components/broadcast-exceptions.html

BcastRec
SinBcast
StatReg





Broadcast Received by Receiver

```
<receiver
      android:name=".Receiver"
      android:exported="false"
      android:permission="android.permission.VIBRATE">
       <intent-filter>
           <action android:name="course.examples.broadcastreceiver.
                                 singlebroadcaststaticregistration.SHOW_TOAST" />
       </intent-filter>
  </receiver>
```

```
public class SimpleBroadcastActivity extends Activity {
   private static final String CUSTOM_INTENT =
"course.examples.broadcastreceiver.
                                        singlebroadcaststaticregistration.SHOW_TOAST";
   …
   public void onClick(@SuppressWarnings("unused") View v) {
      Log.i(TAG, "Broadcast sent");
      Intent intent = new Intent(CUSTOM_INTENT);
      intent.setPackage("course.examples.broadcastreceiver.
                                                       singlebroadcaststaticregistration");
      sendBroadcast(intent, Manifest.permission.VIBRATE);
   }
}
```

```java
public class Receiver extends BroadcastReceiver {
   @SuppressWarnings("FieldCanBeLocal")
   private final String TAG = "Receiver";
   public void onReceive(Context context, Intent intent) {
      Log.i(TAG, "Broadcast Received");
      Vibrator v = (Vibrator) context
            .getSystemService(Context.VIBRATOR_SERVICE);
      v.vibrate(500);
      Toast.makeText(context, "Broadcast Received by Receiver",
                                                   Toast.LENGTH_LONG).show();
   }
}
```

Dynamic Registration

Create an IntentFilter

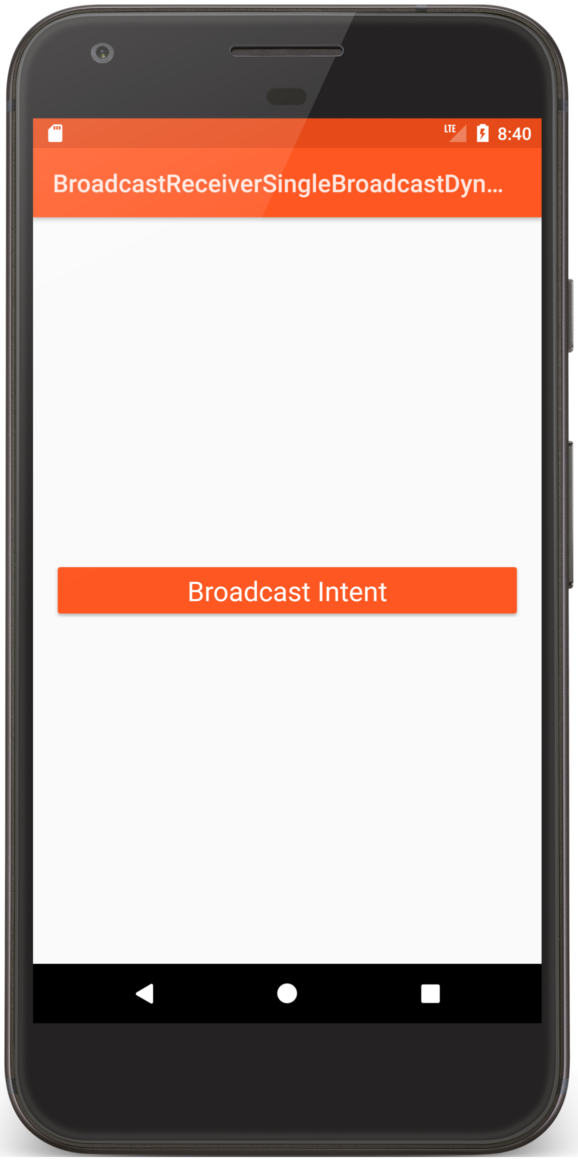
Create a BroadcastReceiver

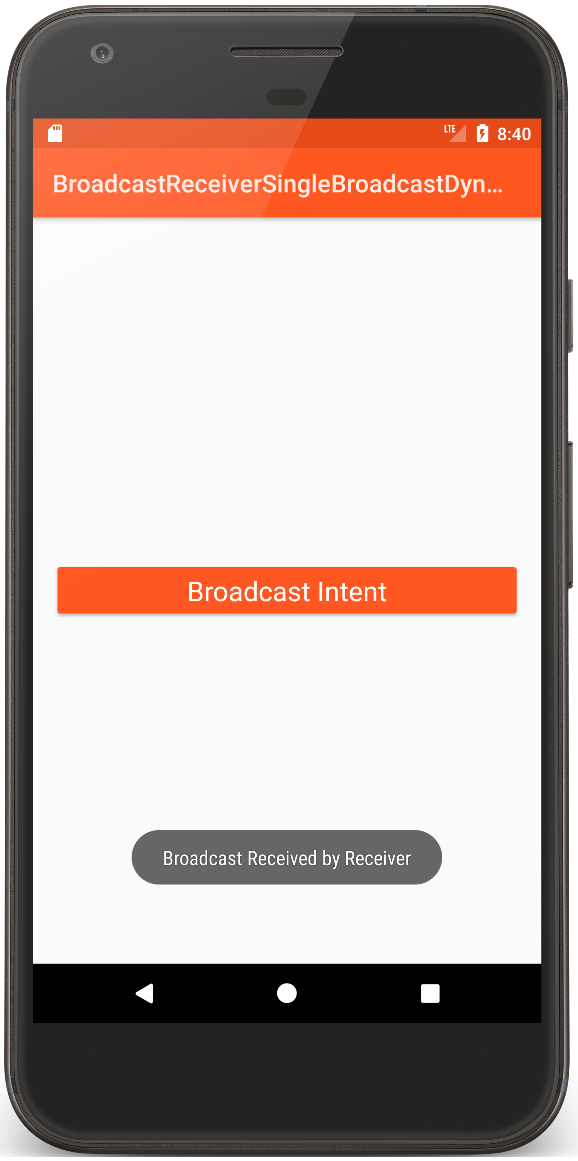
Register BroadcastReceiver using registerReceiver()

- LocalBroadcastManager
- Context

Call unRegisterReceiver() to unregister BroadcastReceiver

BcastRec
SinBcast
DynReg



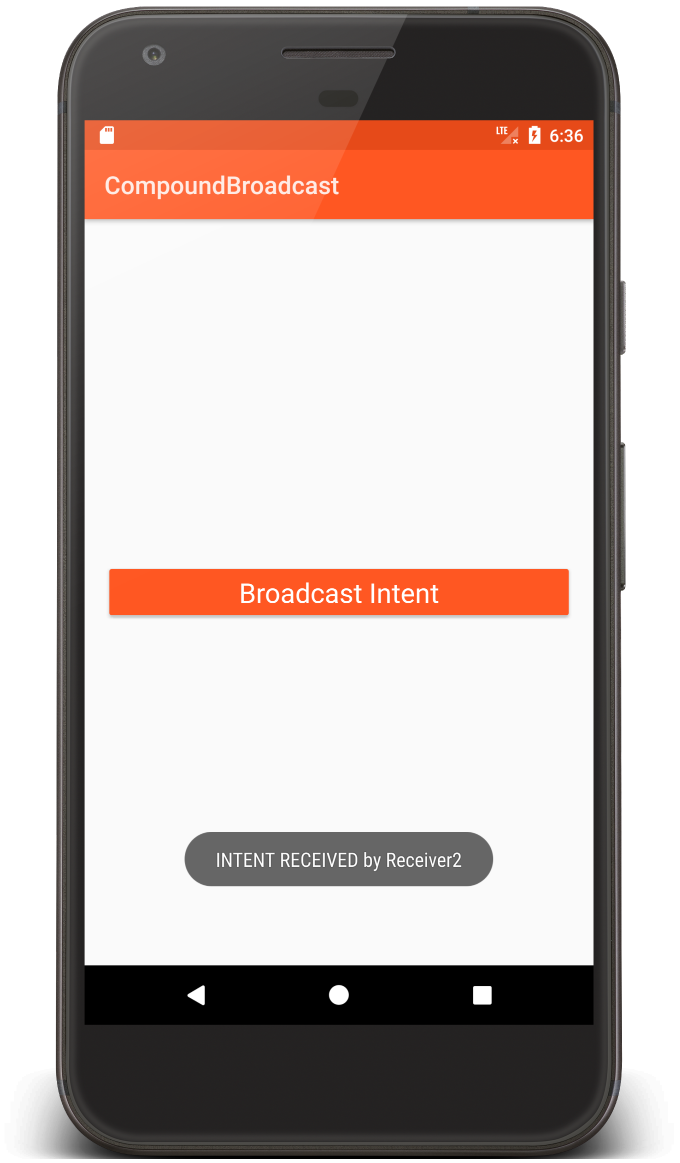


Broadcast Received by Receiver

```
public class SingleBroadcastActivity extends Activity {

    private static final String CUSTOM_INTENT = … ;
    private final IntentFilter intentFilter = new IntentFilter(CUSTOM_INTENT);
    private final Receiver receiver = new Receiver();
    private LocalBroadcastManager mBroadcastMgr;

    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);

        mBroadcastMgr = LocalBroadcastManager
                .getInstance(getApplicationContext());
        setContentView(R.layout.main);
    }
```

```
// Called when Button is clicked
public void onClick(@SuppressWarnings("unused") View v) {
    mBroadcastMgr.sendBroadcast(new Intent(CUSTOM_INTENT));
}

protected void onStart() {
    super.onStart();
    mBroadcastMgr.registerReceiver(receiver, intentFilter);
}

protected void onStop() {
    mBroadcastMgr.unregisterReceiver(receiver);
    super.onStop();
}
```

BcastRec
CompBcast



INTENT RECEIVED by Receiver2

```
   private static final String CUSTOM_INTENT = …
   private final Receiver1 mReceiver1 = new Receiver1();
   private final IntentFilter mIntentFilter = new IntentFilter(CUSTOM_INTENT);
   …
   public void onClick(View v) {
      Intent intent = new Intent(CUSTOM_INTENT)
            .setPackage("course.examples.broadcastreceiver.compoundbroadcast);
      sendBroadcast(intent, Manifest.permission.VIBRATE);
   }
   protected void onStart() {
      super.onStart();
      registerReceiver(mReceiver1, mIntentFilter);
   }
   protected void onStop() {
      unregisterReceiver(mReceiver1);
      super.onStop();
   }
}
```

```
…
    <receiver
        android:name=".Receiver3"
        android:exported="false">
        <intent-filter>
            <action android:name=”… .SHOW_TOAST" />
        </intent-filter>
    </receiver>
    <receiver
        android:name=".Receiver2"
        android:exported="false">
        <intent-filter>
            <action android:name=”… .SHOW_TOAST" />
        </intent-filter>
    </receiver>
…
```

Event Broadcast

- Multiple broadcast methods supported
- Normal vs. Ordered
  - Normal: processing order undefined
  - Ordered: sequential processing in priority order

Some Debugging Tips

Log extra Intent resolution information

```
Intent.setFlag(FLAG_DEBUG_LOG_RESOLUTION)
```

List registered BroadcastReceivers

Dynamically registered

```
% adb shell dumpsys  activity b
```

Statically registered

```
% adb shell dumpsys  package
```

Event Delivery

Intents are delivered to Receiver by calling onReceive(Context, Intent)

- The Context in which the receiver is running
- The Intent that was broadcast

Event Handling in onReceive()

Hosting process has high priority while onReceive() is executing

onReceive() runs on the main Thread

So onReceive should be short-lived

Event Handling in onReceive()

Note: If event handling is lengthy, consider starting a Service, rather than performing complete operation in onReceive()

Will cover this later in the course

Event Handling in onReceive()

Receiver is not considered valid once onReceive() returns

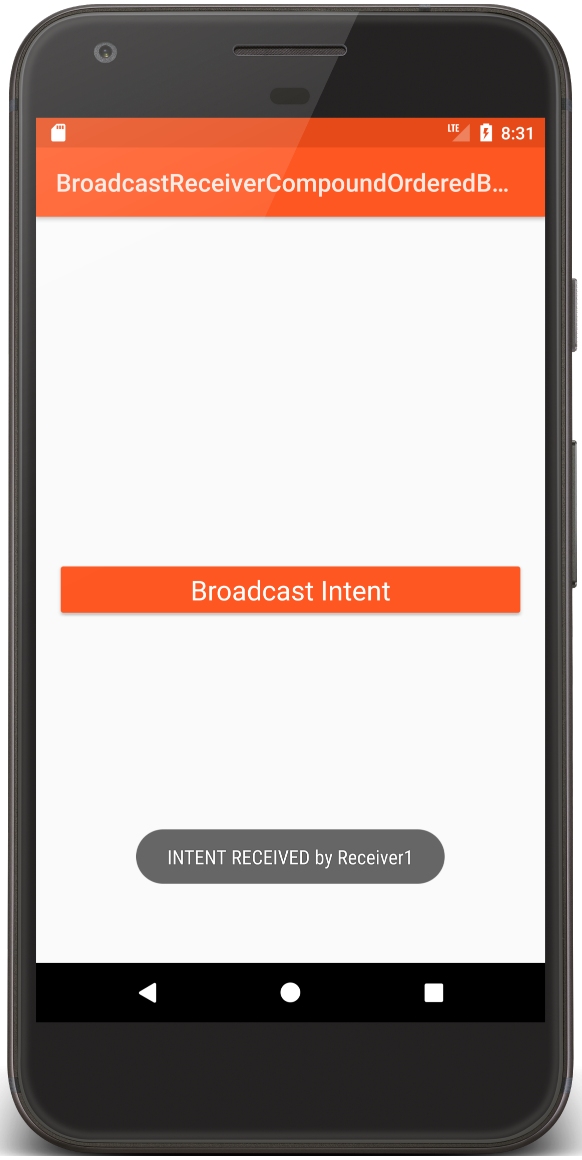
Normally, BroadcastReceivers can’t start asynchronous operations

- e.g., showing a dialog, starting an Activity via startActivityForResult()

Ordered Broadcasts

```
// send Intent to BroadcastReceivers in priority order

void sendOrderedBroadcast (Intent intent,  String receiverPermission)

// send Intent to BroadcastReceivers in priority order. Includes multiple
// parameters for greater control

void sendOrderedBroadcast (Intent intent,
                           String receiverPermission,
                           BroadcastReceiver resultReceiver,
                           Handler scheduler,
                           int initialCode,
                           String initialData,
                           Bundle initialExtras)
```

BcastRec
CompOrd
Bcast



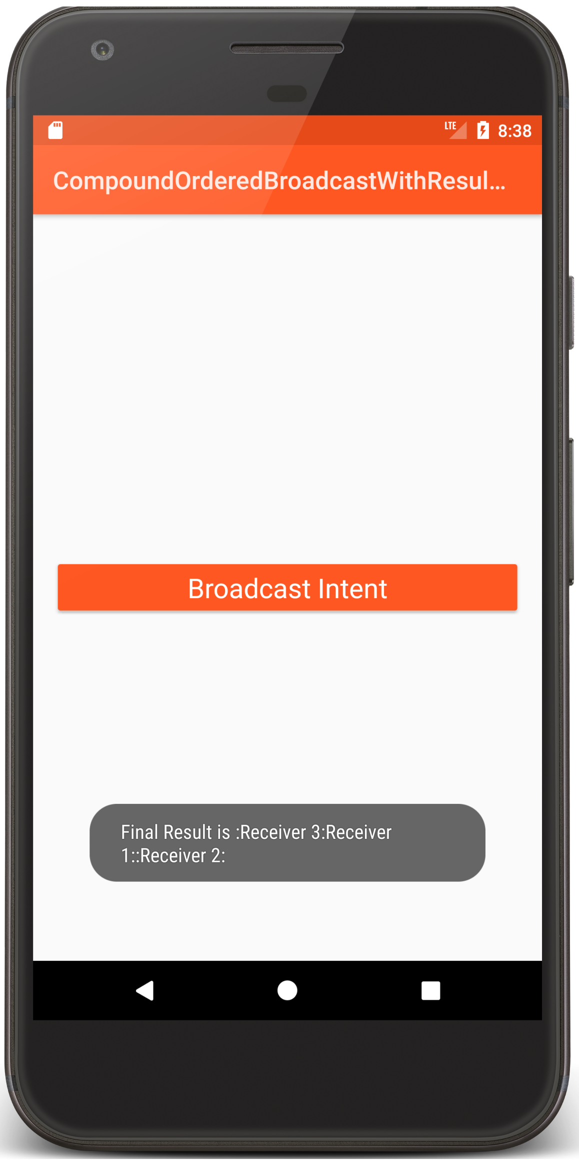
INTENT RECEIVED by Receiver1

```
<receiver
   android:name=".Receiver2"
   android:exported="false">
   <intent-filter android:priority="1">
      <action android:name=”...SHOW_TOAST" />
   </intent-filter>
</receiver>
<receiver
   android:name=".Receiver3"
   android:exported="false">
   <intent-filter android:priority="10">
      <action android:name=”...SHOW_TOAST" />
   </intent-filter>
</receiver>
```

```
public void onClick(View v) {
  sendOrderedBroadcast(new Intent(CUSTOM_INTENT)
          .setPackage("course.examples.broadcastreceiver.compoundorderedbroadcast"),
           android.Manifest.permission.VIBRATE);
}

protected void onStart() {
     super.onStart();
     IntentFilter intentFilter = new IntentFilter(CUSTOM_INTENT);
     intentFilter.setPriority(3);
     registerReceiver(mReceiver, intentFilter);
  }

protected void onStop() {
  unregisterReceiver(mReceiver);
  super.onStop();
}
```

```
public class Receiver1 extends BroadcastReceiver {
  private final String TAG = "Receiver1";
  public void onReceive(Context context, Intent intent) {
    Log.i(TAG, "INTENT RECEIVED");
    if (isOrderedBroadcast()) {
      Log.i(TAG, "Calling abortBroadcast()");
      abortBroadcast();
    }
    …
  }
}
```

BcastRecCompOrd
BcastWithResRec



Final Result is :Receiver 3:Receiver 1::Receiver 2:

```
public void onClick(View v) {
   sendOrderedBroadcast(new Intent(CUSTOM_INTENT)
         .setPackage("course.examples.broadcastreceiver.resultreceiver"),
         null,
         new BroadcastReceiver() {
            public void onReceive(Context context, Intent intent) {
               Toast.makeText(context,"Final Result is " + getResultData(),
                     Toast.LENGTH_LONG).show();
            }
         }, null, 0, null, null);
}
```

```
public class Receiver3 extends BroadcastReceiver {
  …
  public void onReceive(Context context, Intent intent) {
    Log.i(TAG, "INTENT RECEIVED by Receiver3");

    String tmp = getResultData() == null ? "" : getResultData();
    setResultData(tmp + ":Receiver 3");
  }
}
```

Long-Running Operations

After onReceive() exits, system can kill BroadcastReceiver

Don’t’ start long-running Threads from onReceive()

Options

- Call goAsync()
- Schedule a JobService with JobScheduler. (Will discuss Services later in course)

```
public class Receiver extends BroadcastReceiver {
   public void onReceive(final Context context, final Intent intent) {
      …
      final PendingResult pendingResult = goAsync();
      new Thread(new Runnable() {
         public void run() {
            try { /* long-running operation */}
            …
          }
            // Must call finish() so the BroadcastReceiver can be recycled.
           pendingResult.finish();
         }

      }).start();
     …
```

Notes

BroadcastReceiver’s original design has changed to improve security, performance and UX

- Prefer LocalBroadcastManager to Context
- Prefer Context registration over Manifest registration
- Don’t put sensitive info in implicit Intents you broadcast
- Don’t start Activities from onReceive()

Next Time

User Notifications