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CMSC436: Programming
Handheld Systems
The BroadcastReceiver Class
Today’s Topics

The BroadcastReceiver Class
Registering for events
Broadcasting events
Processing events
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 BroadcastReceiver to receive specific events
When event occurs, broadcast an Intent
Android delivers Intent to registered recipients by calling their onReceive() method
Event handled in onReceive()
Registering for Intents

Broadcast Receivers 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" />

...
Intent Filter

Specify `<intent-filter>` tag within a `<receiver>`
See lecture on Intent class
Static Registration

Receivers can be registered in AndroidManifest.xml
Will be woken to receive broadcasts, if needed
In API 26+, statically registered receivers cannot receive most implicit intents
BcastRec
SinBcast
StatReg
<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>
class SimpleBroadcastActivity : Activity() {
    ... 
    private const val CUSTOM_INTENT = "course.examples.broadcastreceiver.
                                                singlebroadcaststaticregistration.SHOW_TOAST"

    ... 
    fun onClick(view: View) {
        Log.i(TAG, "Broadcast sent")
        val intent = Intent(CUSTOM_INTENT)
        intent.setPackage("course.examples.broadcastreceiver.
                                        singlebroadcaststaticregistration")
        sendBroadcast(intent, Manifest.permission.VIBRATE)
    }
}
Receiver.kt

class Receiver : BroadcastReceiver() {
    override fun onReceive(context: Context, intent: Intent) {
        Log.i(TAG, "Broadcast Received")
        val vibrator = context.getSystemService(Context.VIBRATOR_SERVICE) as Vibrator
        vibrator.vibrate(VibrationEffect.createOneShot(500,
            VibrationEffect.DEFAULT_AMPLITUDE))
        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
class SingleBroadcastActivity : Activity() {
    companion object {
        private const val CUSTOM_INTENT = "course.examples.broadcastreceiver.
                                         singlebroadcastdynamicregistration.SHOW_TOAST"
    }
    private val intentFilter = IntentFilter(CUSTOM_INTENT)
    private val receiver = Receiver()
    private lateinit var mBroadcastMgr: LocalBroadcastManager

    public override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)

        mBroadcastMgr = LocalBroadcastManager.getInstance(applicationContext)
        setContentView(R.layout.main)
    }
}
// Called when Button is clicked
fun onClick(v: View) {
    mBroadcastMgr.sendBroadcast(
        Intent(CUSTOM_INTENT).setFlags(Intent.FLAG_DEBUG_LOG_RESOLUTION))
}

override fun onStart() {
    super.onStart()
    mBroadcastMgr.registerReceiver(receiver, intentFilter)
}

override fun onStop() {
    mBroadcastMgr.unregisterReceiver(receiver)
    super.onStop()
}
BcastRec
CompBcast

Broadcast Intent
private const val CUSTOM_INTENT = "course.examples.broadcastreceiver.
  compoundbroadcast.SHOW_TOAST"

private val mIntentFilter = IntentFilter(CUSTOM_INTENT)

... onClick(v: View) {
    val intent = Intent(CUSTOM_INTENT).
    .setPackage(packageName)
    .setFlags(Intent.FLAG_DEBUG_LOG_RESOLUTION)
    sendBroadcast(intent, Manifest.permission.VIBRATE)
}
override fun onStart() {
    super.onStart()
    registerReceiver(mReceiver1, mIntentFilter)
}

override fun onStop() {
    unregisterReceiver(mReceiver1)
    super.onStop()
}
AndroidManifest.xml

<receiver
    android:name=".Receiver3"
    android:exported="false">
    <intent-filter>
        <action android:name="course.examples.broadcastreceiver.
                    compoundbroadcast.SHOW_TOAST" />
    </intent-filter>
</receiver>

<receiver
    android:name=".Receiver2"
    android:exported="false">
    <intent-filter>
        <action android:name="course.examples.broadcastreceiver.
                    compoundbroadcast.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 BroadcastReceiver 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 the Service class later in the course
Event Handling in `onReceive()`

`BroadcastReceiver` is not considered valid once `onReceive()` returns

Normally, `BroadcastReceivers` can’t start asynchronous operations

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

Why not?
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)
<receiver
    android:name=".Receiver2"
    android:exported="false">
    <intent-filter android:priority="1">
        <action android:name="course.examples.BroadcastReceiver.
            compoundorderedbroadcast.SHOW_TOAST" />
    </intent-filter>
</receiver>

<receiver
    android:name=".Receiver3"
    android:exported="false">
    <intent-filter android:priority="10">
        <action android:name="course.examples.BroadcastReceiver.
            compoundorderedbroadcast.SHOW_TOAST" />
    </intent-filter>
</receiver>
fun onClick(v: View) {
    sendOrderedBroadcast(
        Intent(CUSTOM_INTENT).setPackage(packageName).setFlags(
            Intent.FLAG_DEBUG_LOG_RESOLUTION,
            android.Manifest.permission.VIBRATE)
    )
}

override fun onStart() {
    super.onStart()
    val intentFilter = IntentFilter(CUSTOM_INTENT)
    intentFilter.priority = 3
    registerReceiver(mReceiver, intentFilter)
}

override fun onStop() {
    unregisterReceiver(mReceiver)
    super.onStop()
}
class Receiver1 : BroadcastReceiver() {
    ...
    override fun onReceive(context: Context, intent: Intent) {
        Log.i(TAG, "INTENT RECEIVED")

        if (isOrderedBroadcast) {
            Log.i(TAG, "Calling abortBroadcast()")
            abortBroadcast()
        }
    }
}
BcastRecCompOrd
BcastWithResRec
fun onClick(v: View) {
    sendOrderedBroadcast(Intent(CUSTOM_INTENT).setPackage(packageName),
            null, object : BroadcastReceiver() {
        override fun onReceive(context: Context, intent: Intent) {
            Toast.makeText(context, "Final Result is $resultData",
                    Toast.LENGTH_LONG).show()
        }
    }, null, 0, null, null)
}
Receiver3.kt

class Receiver3 : BroadcastReceiver() {

    override fun onReceive(context: Context, intent: Intent) {

        Log.i(TAG, "INTENT RECEIVED by Receiver3")

        val tmp = if (resultData == null) "" else resultData
        resultData = "$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)
goAsync()

BroadcastReceiver is generally valid only until onReceive() exits

Use goAsync() to allow asynchronous processing from onReceive()

Method returns an object of PendingResult

Receiver considered alive until PendingResult.finish()
BcastRecGoAsync
override fun onReceive(context: Context, intent: Intent) {
    Log.i(TAG, "Broadcast Received")

    val pendingResult = goAsync()

    GlobalScope.launch(context = Dispatchers.Main) {
        delay(7000)
        Toast.makeText(context, "Broadcast Received by Receiver", Toast.LENGTH_LONG).show()
        pendingResult.finish()
    }
}
Additional 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
Example Applications

BcastRecSinBcastStatReg
BcastRecSinBcastDynReg
BcastRecCompBcast
BcastRecCompOrdBcast
BcastRecCompOrdBcastWithResRec
BcastRecGoAsync