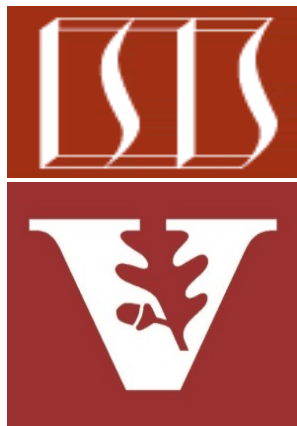


Android Intent Resolution & Filtering

(Part 2)



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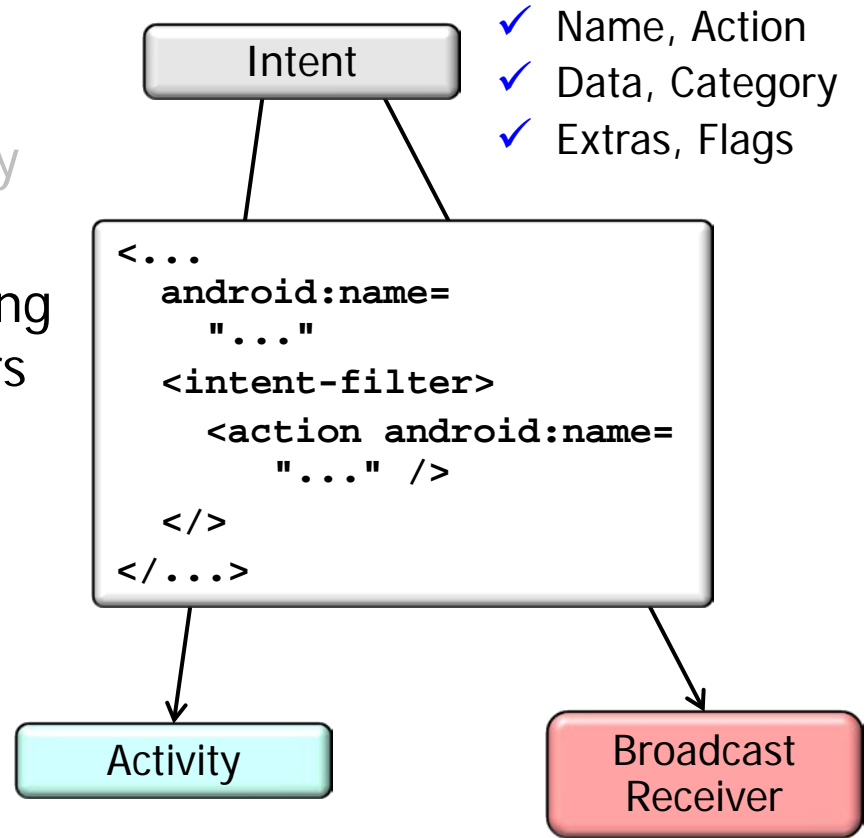
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Vanderbilt University
Nashville, Tennessee, USA



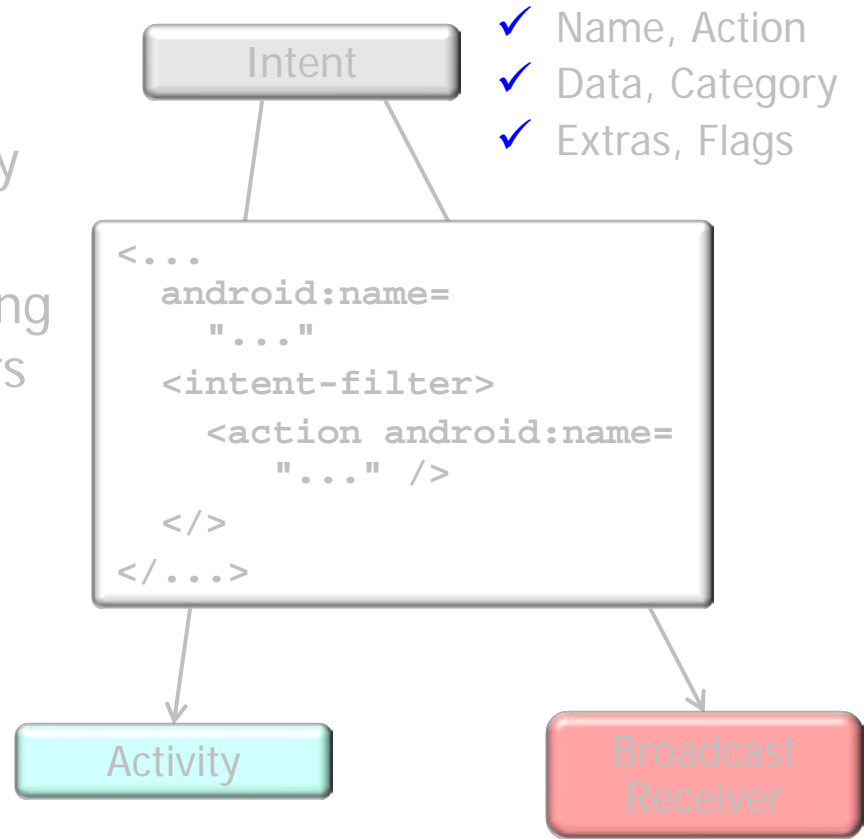
Learning Objectives in this Part of the Lesson

1. Understand the purpose of the AndroidManifest.xml file
2. Recognize the structure & functionality of elements in AndroidManifest.xml
3. Know how a component is started using implicit intent resolution & intent filters



Learning Objectives in this Part of the Lesson

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We cover both activity & receiver components here, with emphasis on activities

Types of Intents

Types of Intents

- There are two types of intents in Android



Types of Intents

- An *explicit* intent is delivered to its named target component

name: EmailHandler
action: ACTION_SEND
uri: mailto:billg@microsoft.com

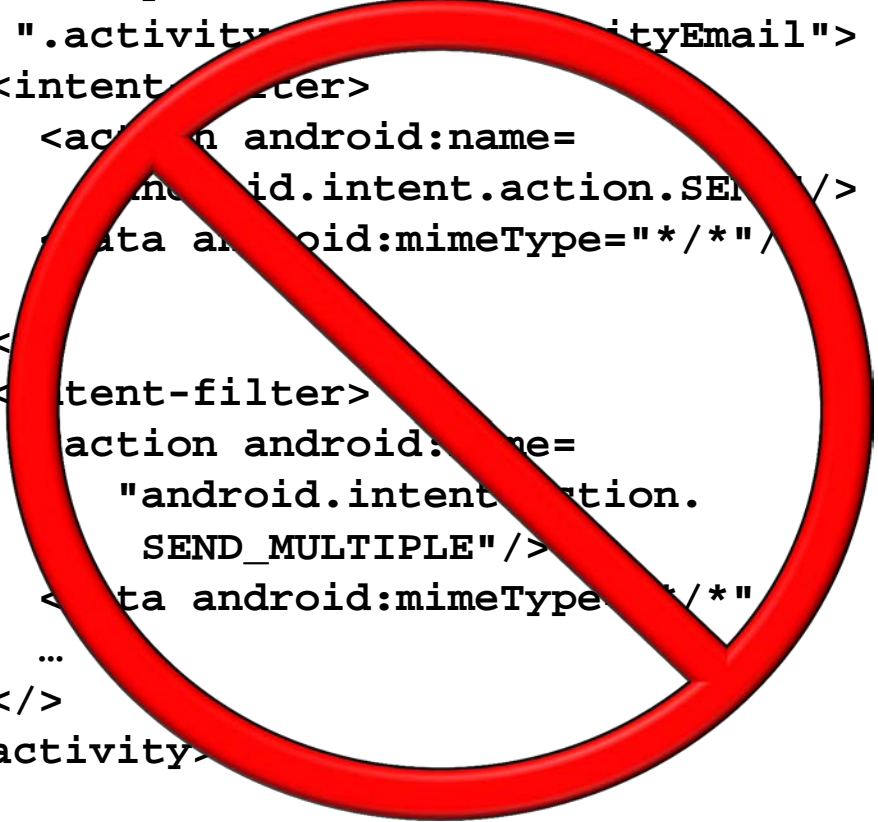


Types of Intents

- An *explicit* intent is delivered to its named target component
- Filters in AndroidManifest.xml are not consulted

name: EmailHandler
action: ACTION_SEND
uri: mailto:billg@microsoft.com

```
<activity android:name=
    ".activity.EmailActivity" > ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND" />
        <data android:mimeType="*/*" />
    </intent-filter>
    <action android:name=
        "android.intent.action.
        SEND_MULTIPLE" />
    <data android:mimeType="*/*"
    ...
    </>
</activity>
```



Types of Intents

- Conversely, an *implicit* intent has no named target component

action: ACTION_SEND
uri: mailto:billg@microsoft.com



action: ACTION_VIEW
uri: /sdcard/images/billg.jpeg



Types of Intents

- Conversely, an *implicit* intent has no named target component

action: ACTION_SEND
uri: mailto:billg@microsoft.com



action: ACTION_VIEW
uri: /sdcard/images/billg.jpeg

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*/>

    ...
</...>
<intent-filter>
    <action android:name=
        "android.intent.action.
        SEND_MULTIPLE"/>
    <data android:mimeType="*/*/>

    ...
</...>
</...>
```

Implicit intents partake in a filtering process involving AndroidManifest.xml files

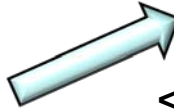
Types of Intents

- Conversely, an *implicit* intent has no named target component
- An implicit intent is delivered to a component *only* if a filter matches

action: ACTION_SEND
uri: mailto:billg@microsoft.com

action: ACTION_VIEW
uri: /sdcard/images/billg.jpeg

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*/>
        ...
    </...>
    <intent-filter>
        <action android:name=
            "android.intent.action.
            SEND_MULTIPLE"/>
        <data android:mimeType="*/*/>
        ...
    </...>
</...>
```



All fields in an implicit intent must match with the corresponding intent filter

Overview of Intent Filtering & Intent Resolution

Overview of Intent Filtering & Intent Resolution

- Intent filters describe which types of intents a component can handle

<intent-filter>

SYNTAX:

```
<intent-filter android:icon="drawable resource"
              android:label="string resource"
              android:priority="integer" >
    . . .
</intent-filter>
```

CONTAINED IN:

```
<activity>
<activity-alias>
<service>
<receiver>
```

MUST CONTAIN:

```
<action>
```

CAN CONTAIN:

```
<category>
<data>
```

DESCRIPTION:

Specifies the types of intents that an activity, service, or broadcast receiver can respond to. An intent filter declares the capabilities of its parent component — what an activity or service can do and what types of broadcasts a receiver can handle. It opens the component to receiving intents of the advertised type, while filtering out those that are not meaningful for the component.

Most of the contents of the filter are described by its `<action>`, `<category>`, and `<data>` subelements.

For a more detailed discussion of filters, see the separate [Intents and Intent Filters](#) document, as well as the [Intents Filters](#) section in the introduction.

ATTRIBUTES:

`android:icon`

An icon that represents the parent activity, service, or broadcast receiver when that component is presented to the user as having the capability described by the filter.

This attribute must be set as a reference to a drawable resource containing the image definition. The default value is the icon set by the parent component's `icon` attribute. If the parent does not specify an icon, the default is the icon set by the `<application>` element.

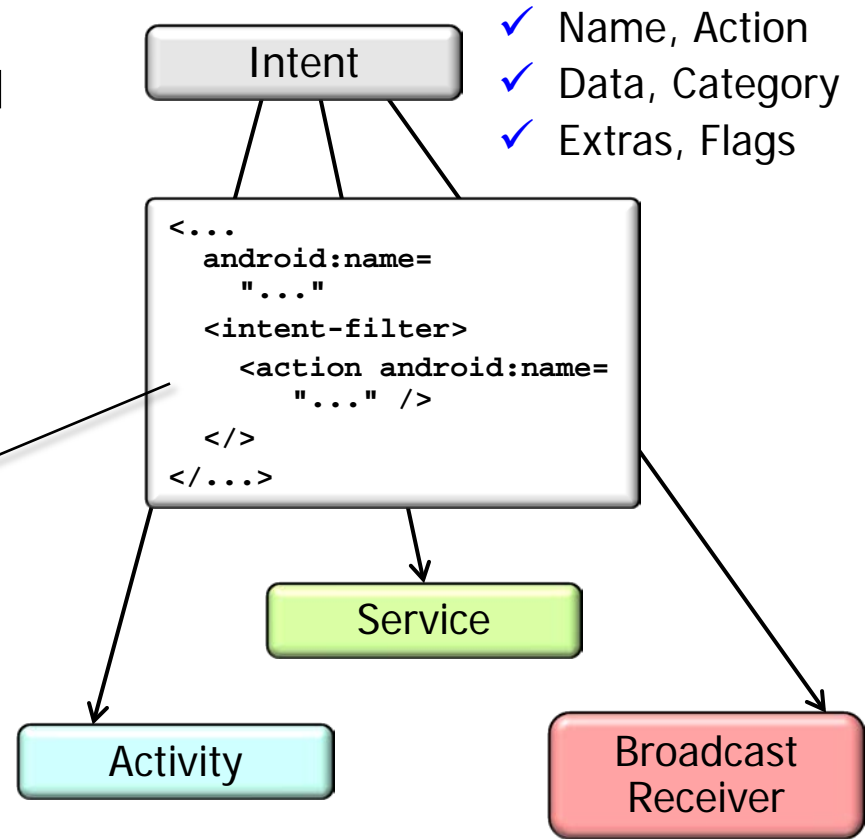
See developer.android.com/guide/topics/manifest/intent-filter-element.html

Overview of Intent Filtering & Intent Resolution

- Intent filters “glue” together loosely-coupled components that are accessed via intents



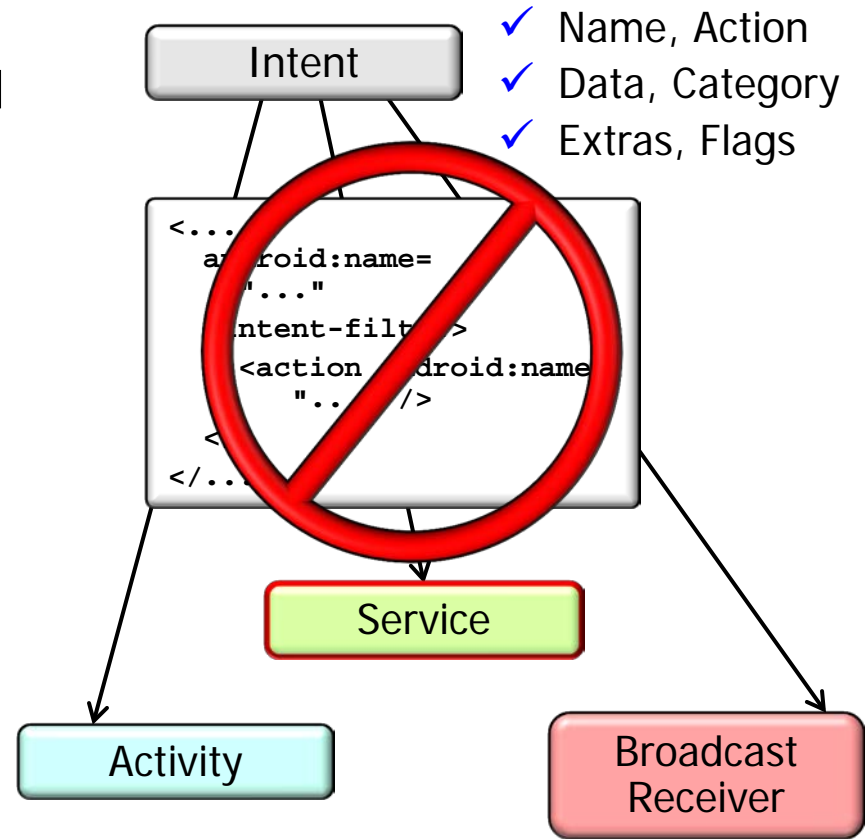
The Activity Manager Service uses intent filters to match intent fields against filtering criteria



See developer.android.com/guide/components/intents-filters.html

Overview of Intent Filtering & Intent Resolution

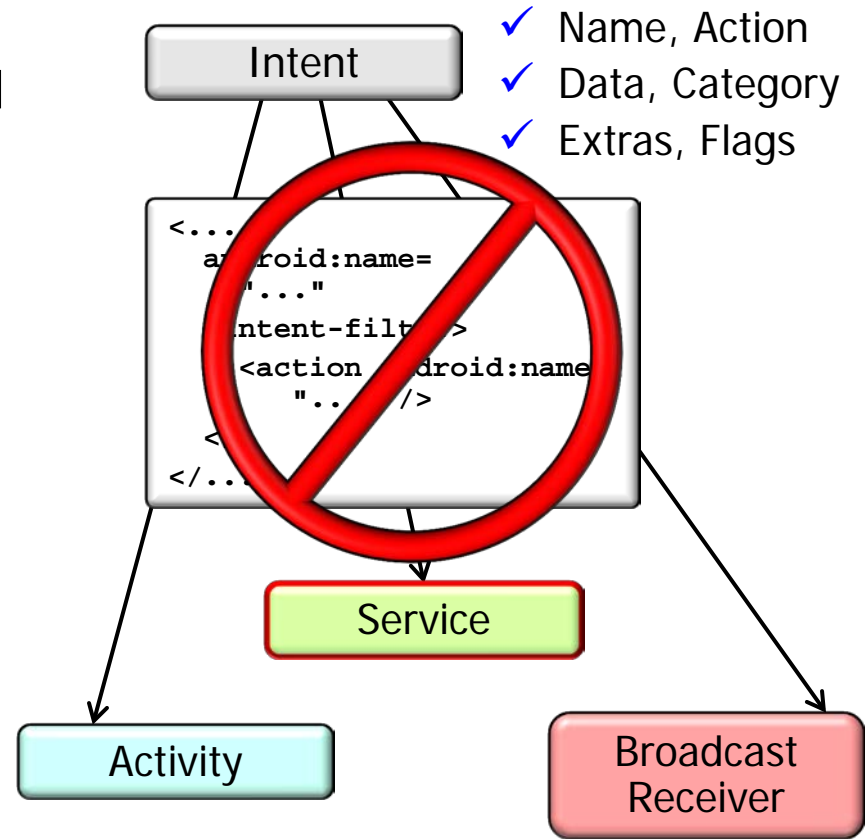
- Intent filters “glue” together loosely-coupled components that are accessed via intents
- To ensure an app is secure, always use an explicit intent when starting a Service & do not declare intent filters for services



See developer.android.com/guide/components/intents-filters.html#Types

Overview of Intent Filtering & Intent Resolution

- Intent filters “glue” together loosely-coupled components that are accessed via intents
- To ensure an app is secure, always use an explicit intent when starting a Service & do not declare intent filters for services
- Android now throws an exception if `bindService()` is called with an implicit intent



Overview of Intent Filtering & Intent Resolution

- Intent filter fields reflect the action, data, & category fields of an intent

```
<activity android:name="..."> ...  
  <intent-filter>  
    <action android:name="android.intent.action.MAIN" />  
    <data android:mimeType="*/*" />  
    <category android:name="android.intent.category.DEFAULT" />  
  </intent-filter>  
</activity>
```

An implicit intent is tested against the filter in all three areas – all must pass to be delivered

Extras & flags play no part in resolving which component receives an intent

Overview of Intent Filtering & Intent Resolution

- Intent filter fields reflect the action, data, & category fields of an intent
- e.g., ComposeActivityEmail matches the SEND action for any type of data

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*/>
        <category android:name=
            "android.intent.category.DEFAULT"/>
    </...> ...
    </activity>
```

See [packages/apps/Email/AndroidManifest.xml](https://android.googlesource.com/packages/apps/Email/AndroidManifest.xml)

Overview of Intent Filtering & Intent Resolution

- These components can have one or more intent filters

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*/>
        ...
    </...>
    <intent-filter>
        <action android:name=
            "android.intent.action.
            SEND_MULTIPLE"/>
        <data android:mimeType="*/*/>
        ...
    </...>
</activity>
```

Overview of Intent Filtering & Intent Resolution

- These components can have one or more intent filters
- Each filter describes a set of intents the component is willing to receive

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*/>
        ...
    </...>
    <intent-filter>
        <action android:name=
            "android.intent.action.
            SEND_MULTIPLE"/>
        <data android:mimeType="*/*/>
        ...
    </...>
</activity>
```

Overview of Intent Filtering & Intent Resolution

- These components can have one or more intent filters
- Each filter describes a set of intents the component is willing to receive

Handles SEND actions with any type of attachment

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*"/>
        ...
    </...>
    <intent-filter>
        <action android:name=
            "android.intent.action.
            SEND_MULTIPLE"/>
        <data android:mimeType="*/*"/>
        ...
    </...>
</activity>
```

Overview of Intent Filtering & Intent Resolution

- These components can have one or more intent filters
- Each filter describes a set of intents the component is willing to receive

Also handles SEND_MULTIPLE actions with any type of attachment

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
    <intent-filter>
        <action android:name=
            "android.intent.action.SEND"/>
        <data android:mimeType="*/*/>
        ...
    </...>
    <intent-filter>
        <action android:name=
            "android.intent.action.
            SEND_MULTIPLE"/>
        <data android:mimeType="*/*/>
        ...
    </...>
</activity>
```

Types of Intent Handlers

Types of Intent Handlers

- There are two types of intent handler components in Android



Types of Intent Handlers

- There are two types of intent handler components in Android

- **Statically configured**

- Specified declaratively in AndroidManifest.xml file

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
<intent-filter>
    <action android:name=
        "android.intent.action.SEND"/>
    <data android:mimeType="*/*/>
</...>
</activity>
```


Types of Intent Handlers

- There are two types of intent handler components in Android

- Statically configured**

- Specified declaratively in AndroidManifest.xml file

```
<activity android:name=
    ".activity.ComposeActivityEmail"> ...
  <intent-filter>
    <action android:name=
      "android.intent.action.SEND"/>
    <data android:mimeType="*/*/>
  </...>
</activity>
```

Activity receives ACTION_SEND intent for any type of data

See [packages/apps/Email/AndroidManifest.xml](https://developer.android.com/reference/packages/apps/Email/AndroidManifest.xml)

Types of Intent Handlers

- There are two types of intent handler components in Android

- Statically configured

- Dynamically configured**

- Programmatically specified in Java code

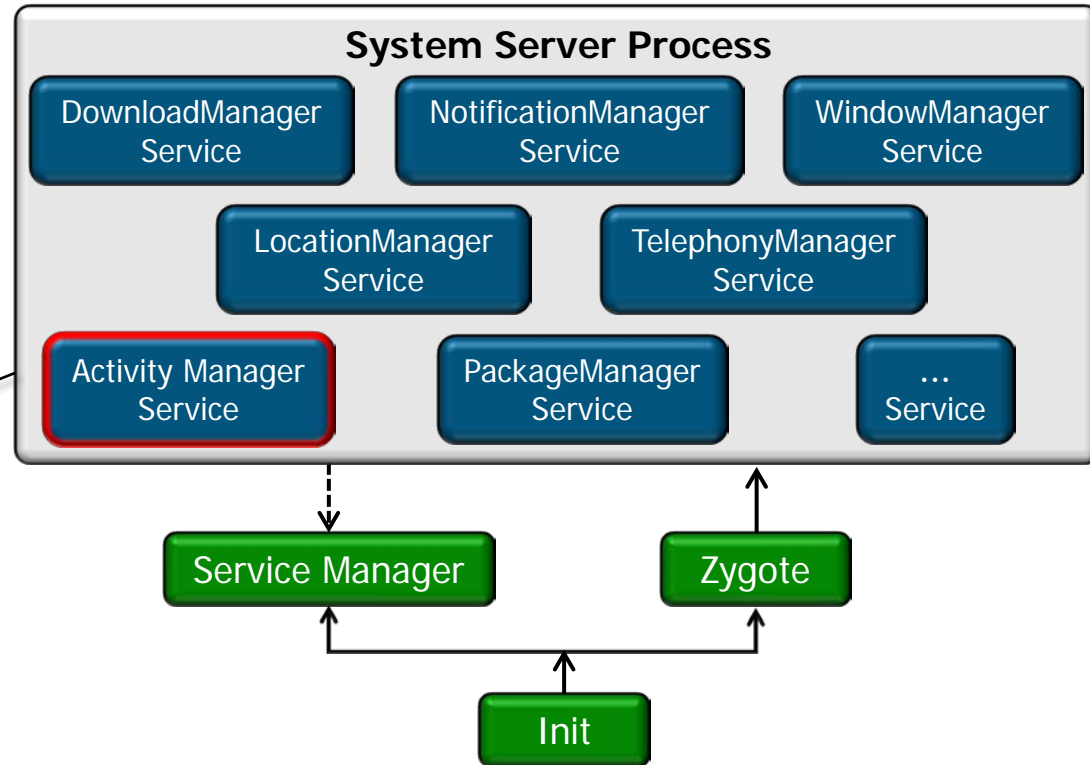
```
final BroadcastReceiver mReceiver =  
    new SendBroadcastReceiver();  
...  
IntentFilter intentFilter =  
    new IntentFilter  
        (Intent.ACTION_SEND);  
intentFilter.setType("*/*");  
...  
registerReceiver(mReceiver,  
                intentFilter);
```

Receiver receives ACTION_SEND intent for any type of data

The BroadcastReceiver component is covered in an upcoming lesson

Types of Intent Handlers

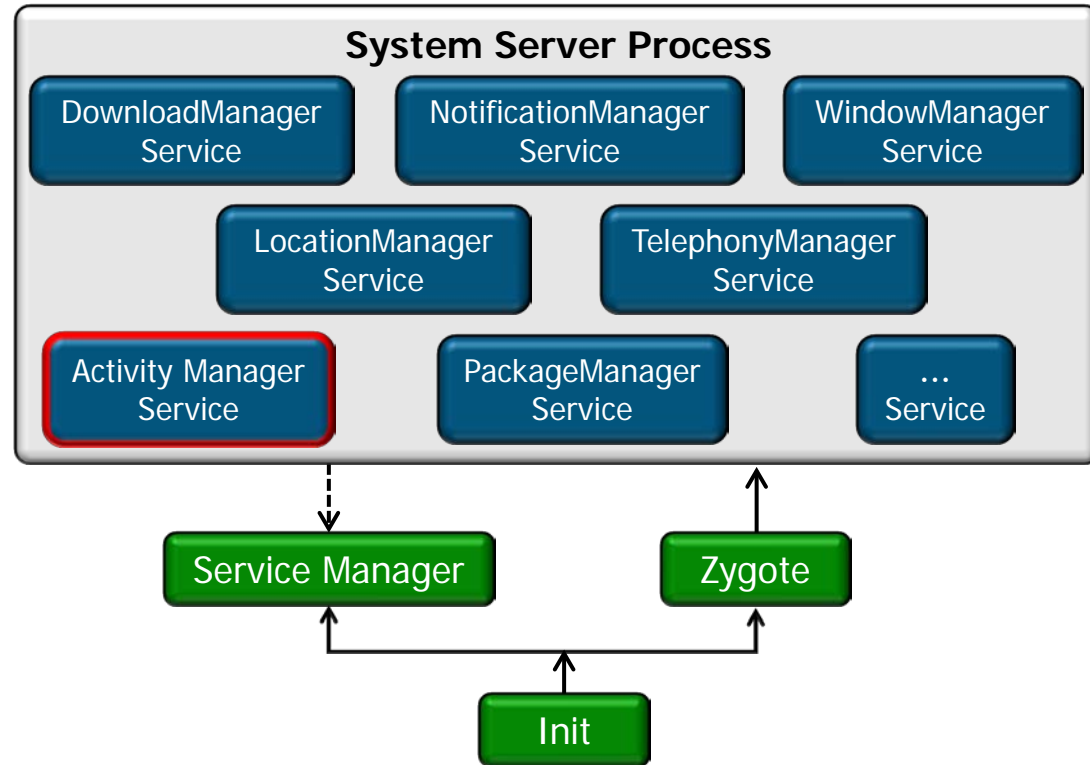
- The Activity Manager Service filters events & dispatches them to the intent handlers



The Activity Manager Service plays the role of a "router" of intents on an Android device

Types of Intent Handlers

- The Activity Manager Service filters events & dispatches them to the intent handlers



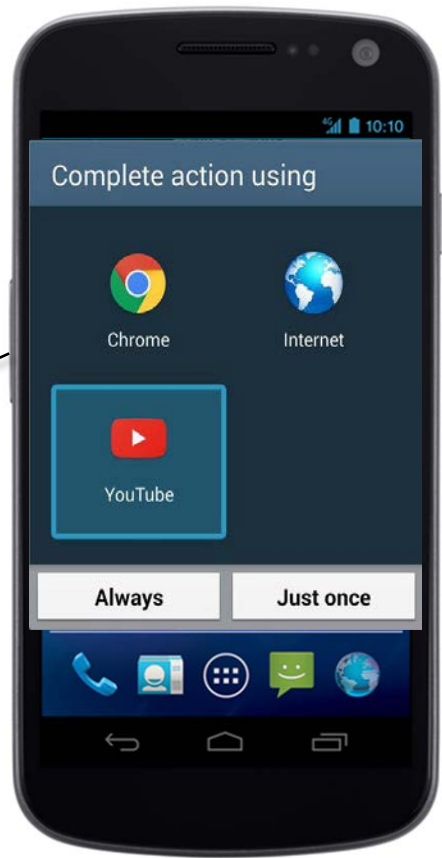
Despite its name, the Activity Manager Service handles other components

Implicit Intents Can Match Multiple Activities

Implicit Intents Can Match Multiple Activities

- An implicit intent may match the intent filters of *multiple* activities

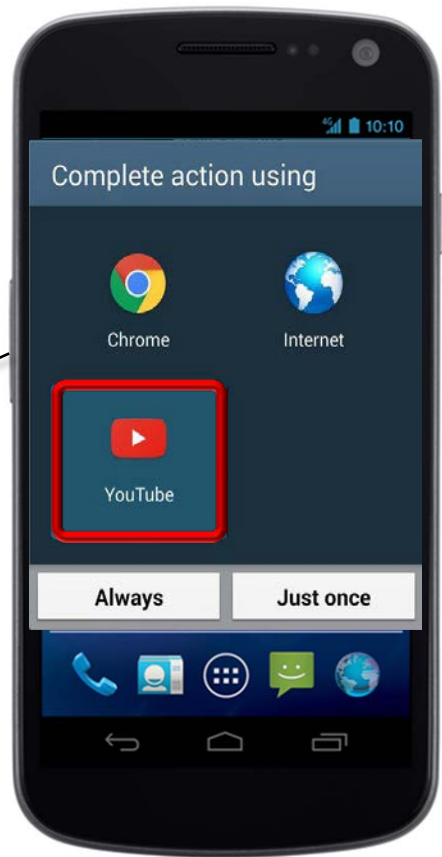
There are multiple ways of watching a video at a URL



Implicit Intents Can Match Multiple Activities

- An implicit intent may match the intent filters of *multiple* activities

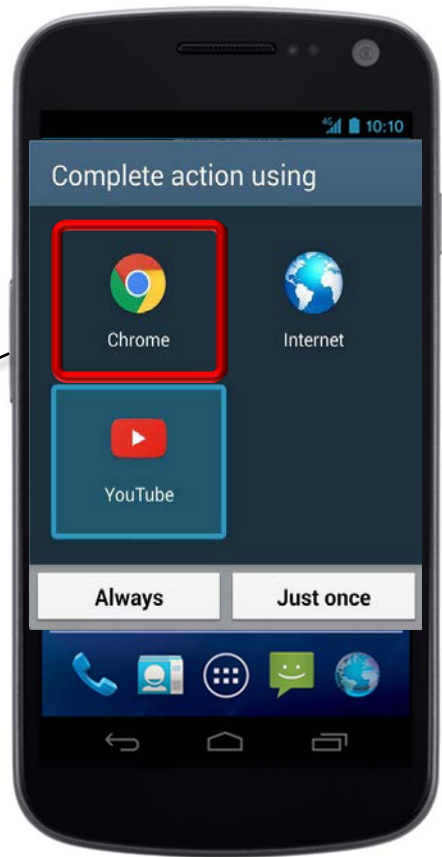
There are multiple ways of watching a video at a URL



Implicit Intents Can Match Multiple Activities

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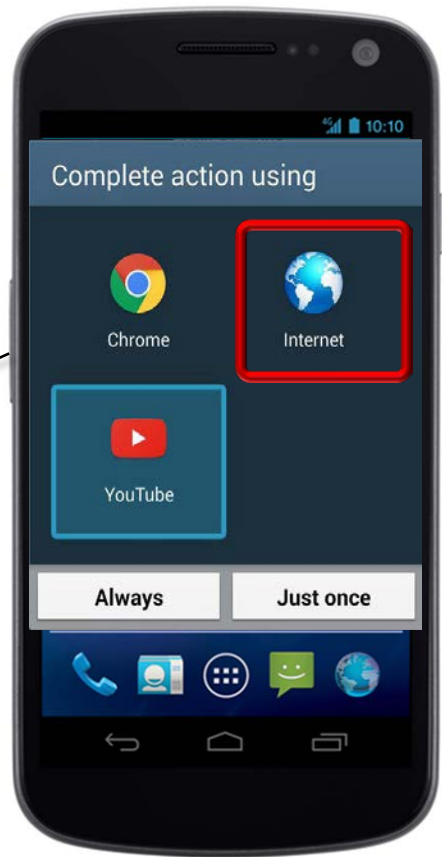
There are multiple ways of watching a video at a URL



Implicit Intents Can Match Multiple Activities

- An implicit intent may match the intent filters of *multiple* activities

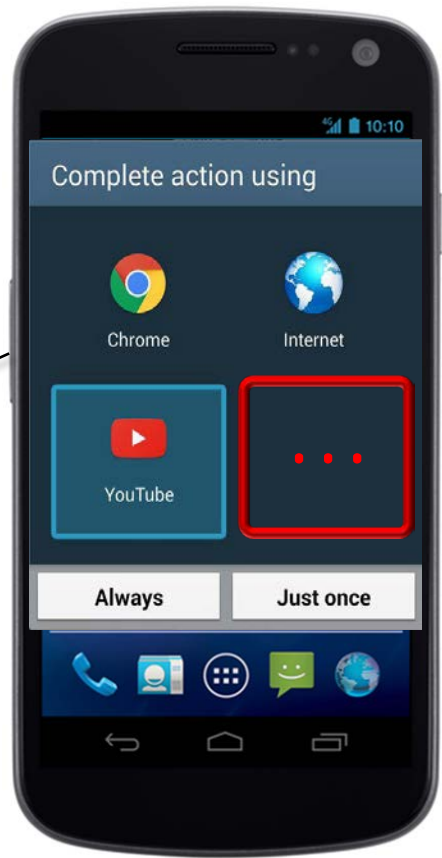
There are multiple ways of watching a video at a URL



Implicit Intents Can Match Multiple Activities

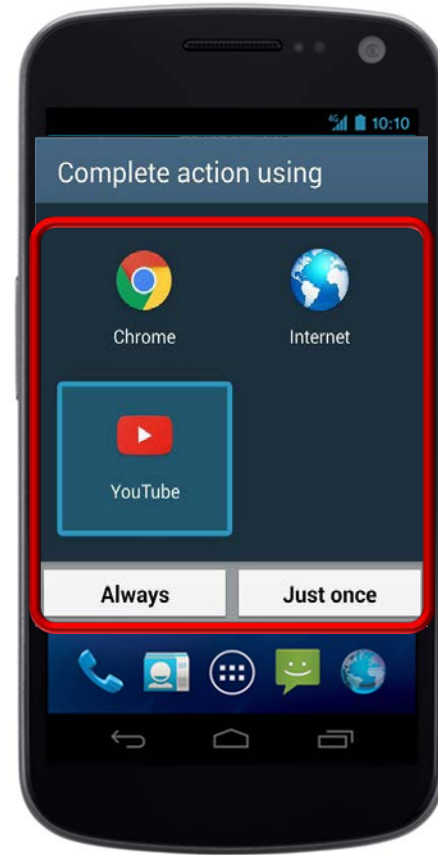
- An implicit intent may match the intent filters of *multiple* activities

There are multiple ways of watching a video at a URL



Implicit Intents Can Match Multiple Activities

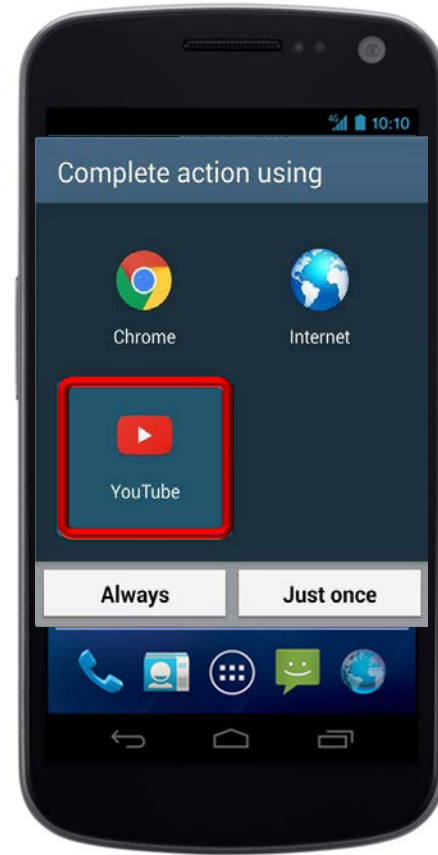
- An implicit intent may match the intent filters of *multiple* activities
- If there's more than one match, a “Chooser dialog” is display that enables users to do several things



See developer.android.com/guide/components/intents-filters.html#ForceChooser

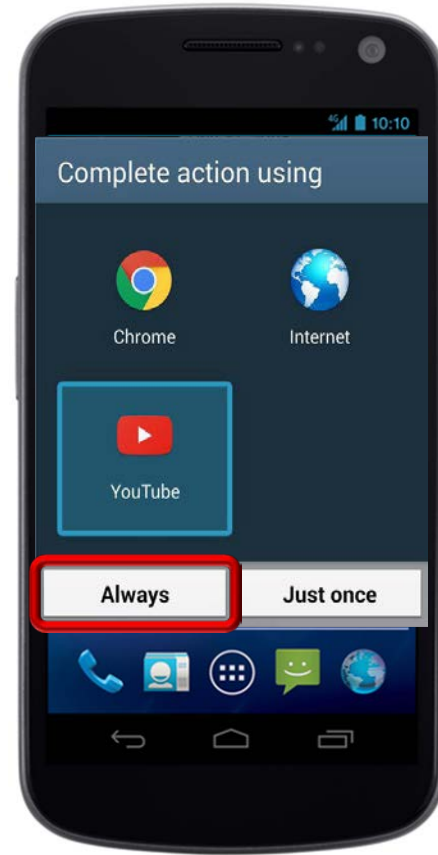
Implicit Intents Can Match Multiple Activities

- An implicit intent may match the intent filters of *multiple* activities
- If there's more than one match, a “Chooser dialog” is displayed that enables users to do several things
 - Select the app to handle the intent



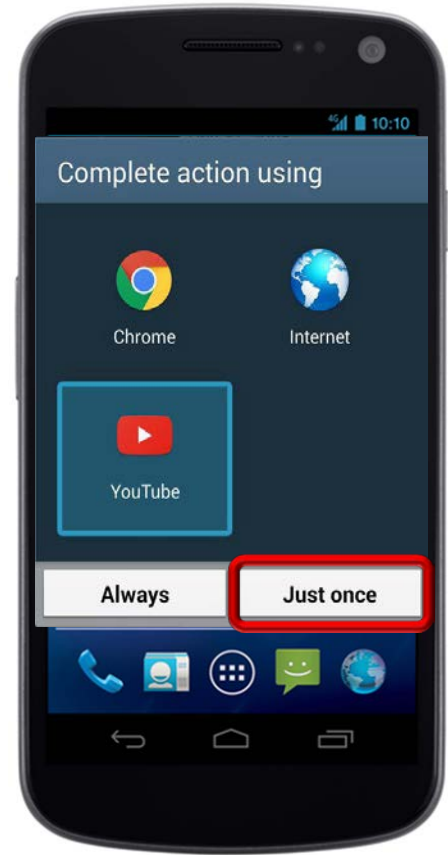
Implicit Intents Can Match Multiple Activities

- An implicit intent may match the intent filters of *multiple* activities
- If there's more than one match, a “Chooser dialog” is display that enables users to do several things
 - Select the app to handle the intent
 - Make that app the default choice for future intent resolutions



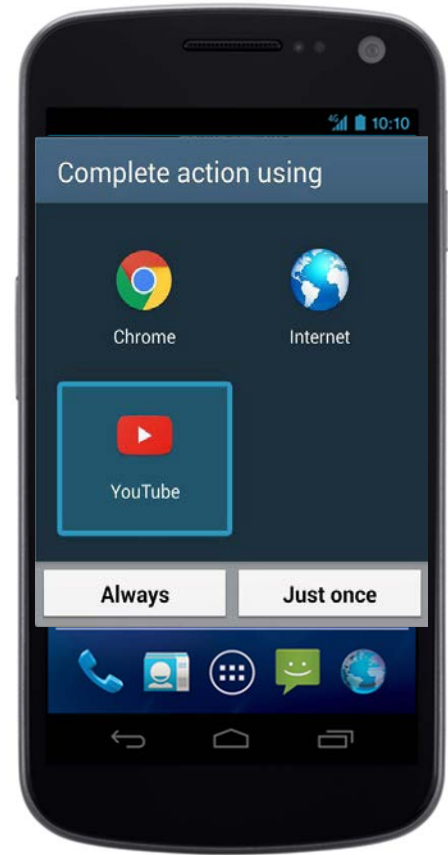
Implicit Intents Can Match Multiple Activities

- An implicit intent may match the intent filters of *multiple* activities
- If there's more than one match, a “Chooser dialog” is displayed that enables users to do several things
 - Select the app to handle the intent
 - Make that app the default choice for future intent resolutions
 - Select it just this one time & re-prompt the user in the future



Implicit Intents Can Match Multiple Activities

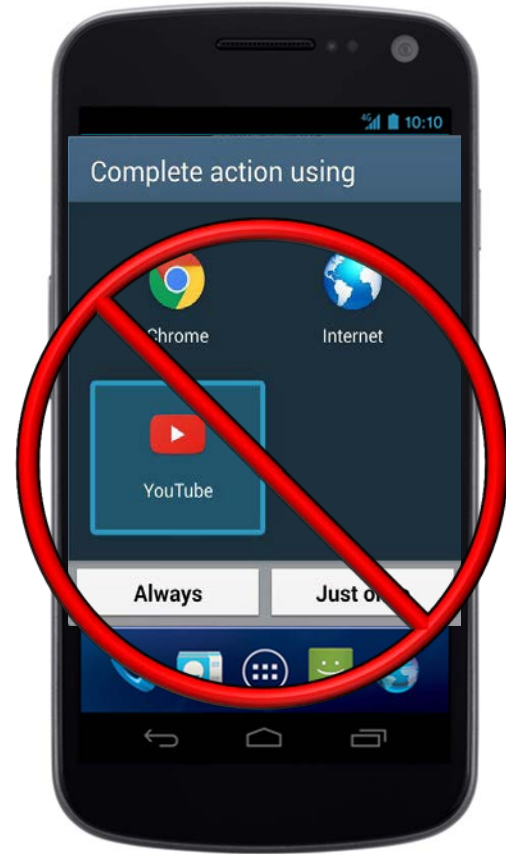
- This example shows why starting a Service with an implicit intent is a security hazard



See developer.android.com/about/versions/android-5.0-changes.html#BindService

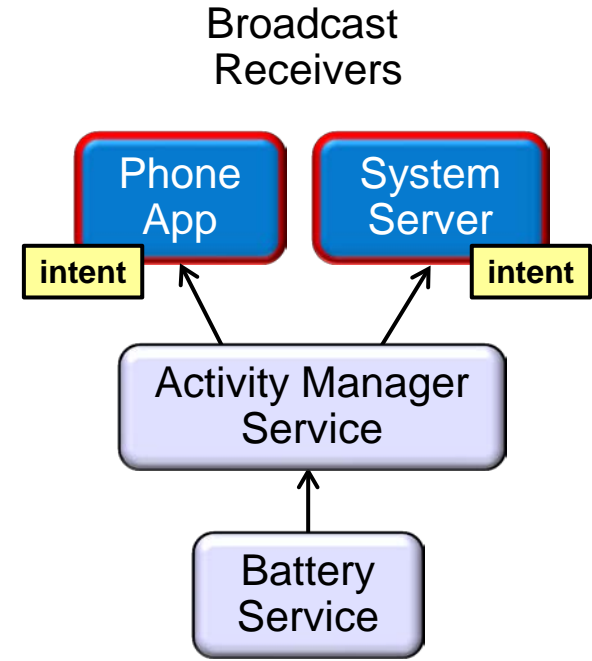
Implicit Intents Can Match Multiple Activities

- This example shows why starting a Service with an implicit intent is a security hazard
- i.e., unlike activities, the user can't see which service starts if several service intent filters match the intent



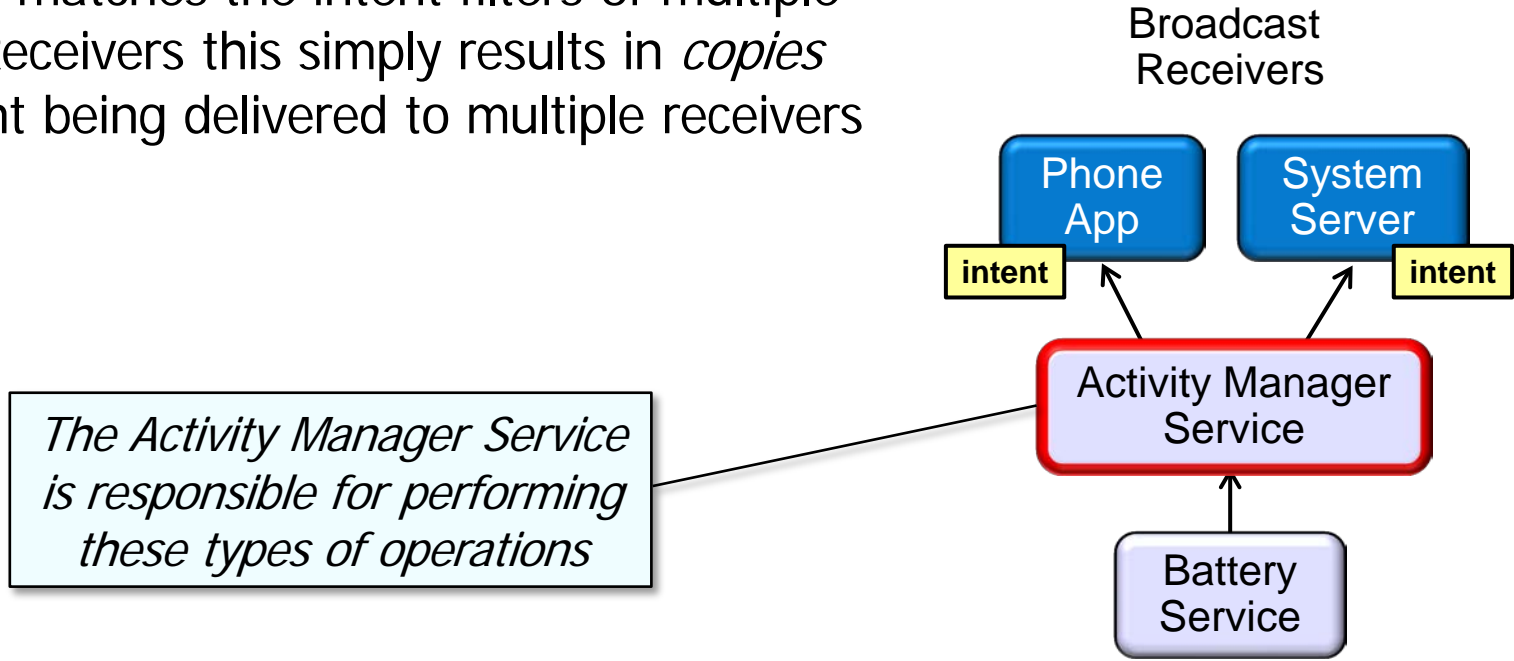
Implicit Intents Can Match Multiple Activities

- If an intent matches the intent filters of multiple BroadcastReceivers this simply results in *copies* of the intent being delivered to multiple receivers



Implicit Intents Can Match Multiple Activities

- If an intent matches the intent filters of multiple BroadcastReceivers this simply results in *copies* of the intent being delivered to multiple receivers



End of Android Intent Resolution & Filtering (Part 2)