Welcome

Understanding the Android Platform

Today's Overview

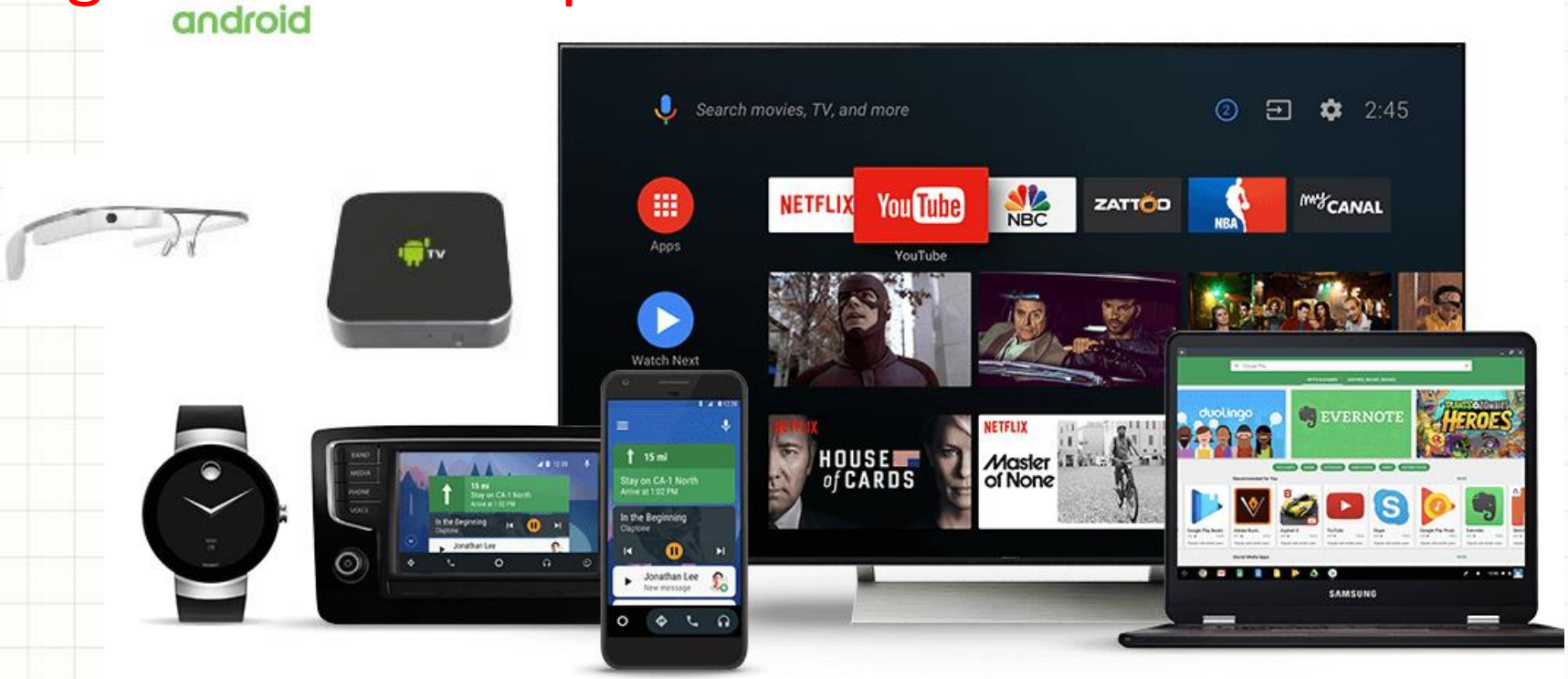
1. What is Android
2. Android System Architecture Overview
3. Android Application Architecture Overview
4. Function of Intent & IntentFilter

What is Android?

- Android is a software environment for mobile devices (not a hardware platform) that includes an operating system, middleware and key applications
- Android is not a particular device, or even class of devices. It is a platform that can be used and adapted to power different hardware configurations

Android Devices

- Mobile phones are the main class of Android powered devices, but it is currently used on electronic book readers, netbooks, tablets, glass and set-top boxes

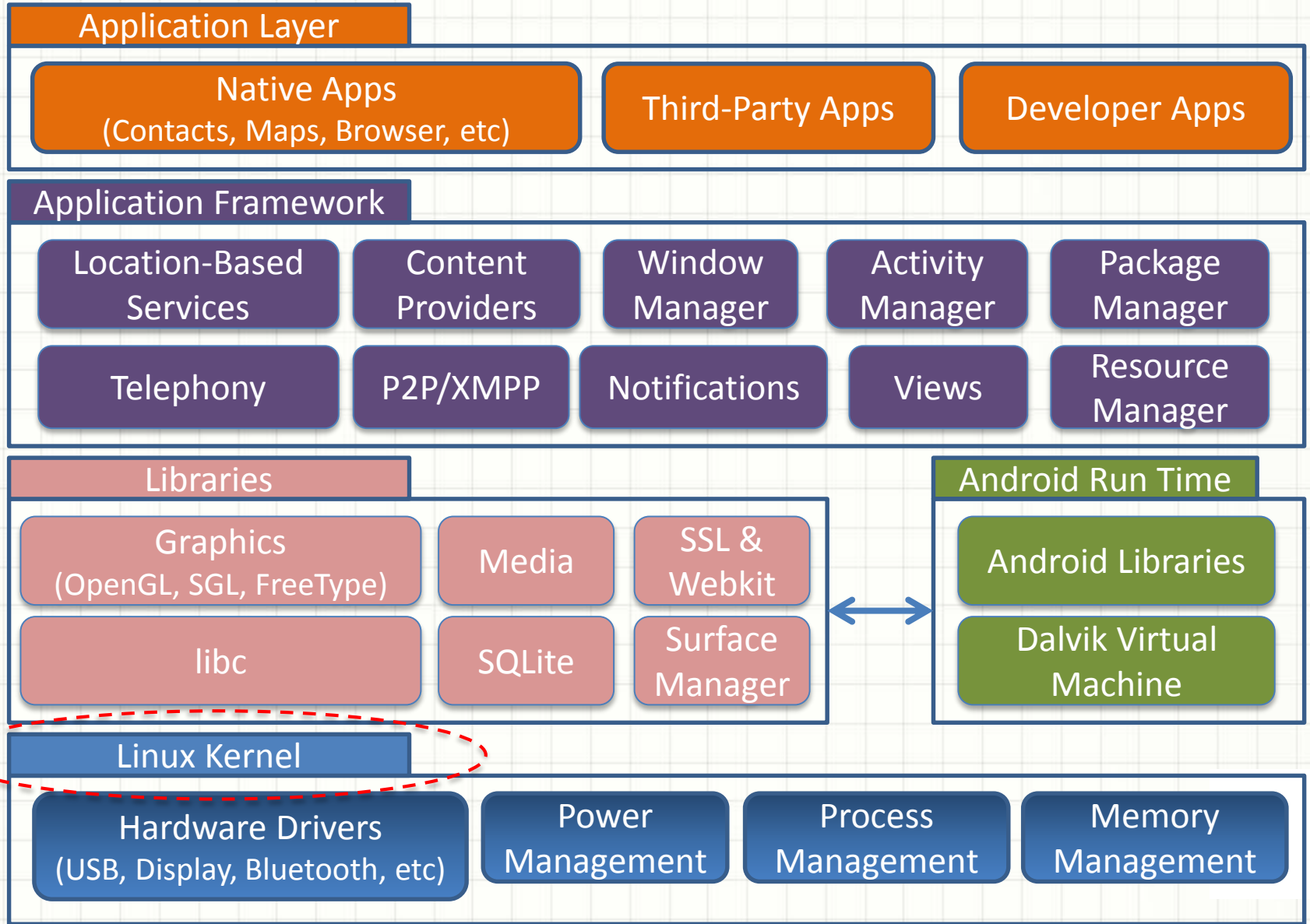


System Architecture Overview

Android System Architecture

- an Android system comprises 4 basic layers
  - Linux Kernel
  - Libraries & Android Runtime
  - Application Framework
  - Applications

Android System Architecture

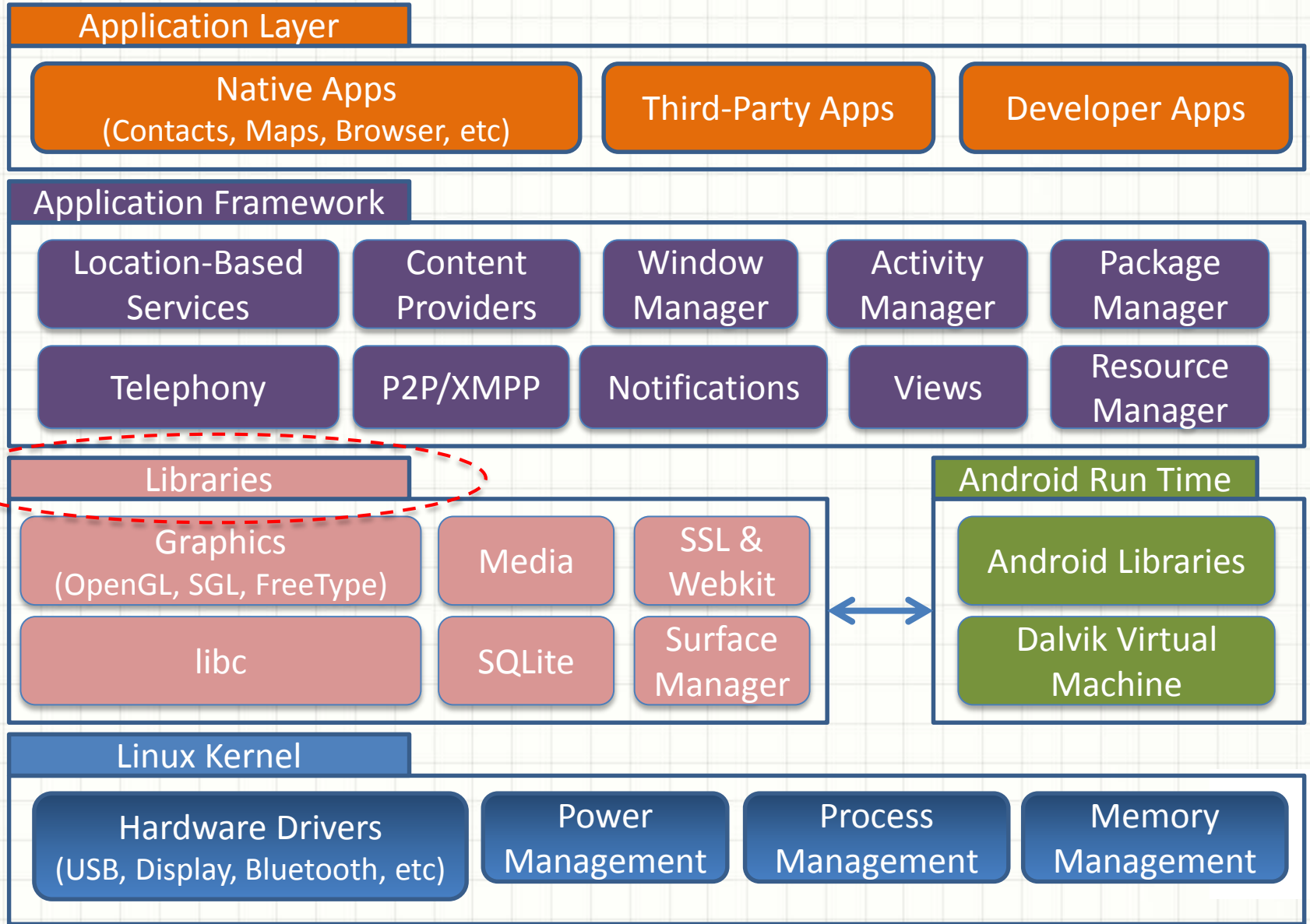


Android System Architecture

Linux Kernel

- Android relies on Linux for core system services such as security, memory management, process management, network stack, and driver model. The kernel also acts as an abstraction layer between the hardware and the rest of the software stack

Android System Architecture



Android System Architecture

Libraries

- Running on top of the kernel, Android includes
  - C/C++ core libraries

    such as libs and SSL
  - Media library

    for playback of audio and video media
  - Surface manager

    to provide display management

Android System Architecture

Libraries

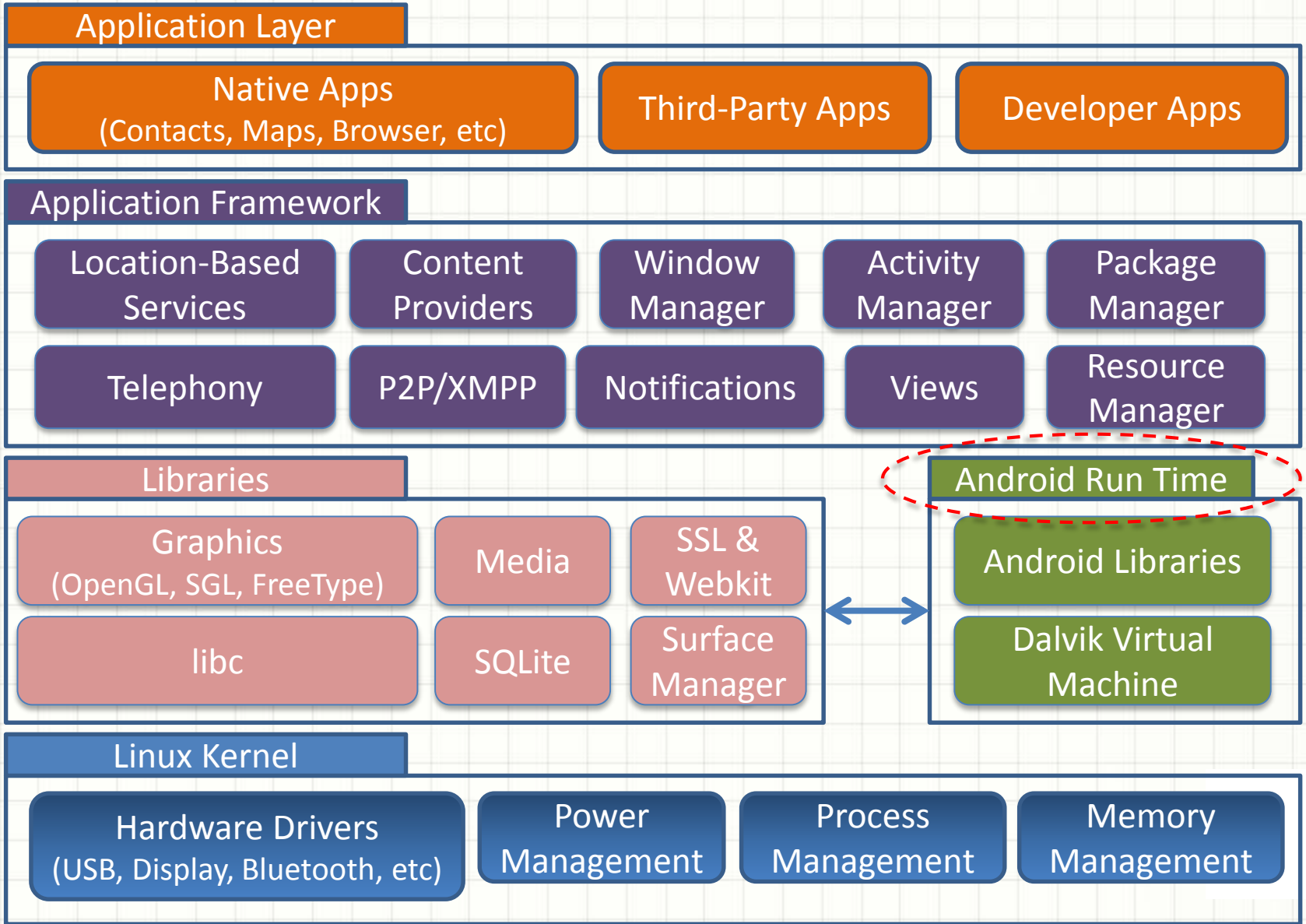
- Running on top of the kernel, Android includes
  - Graphics libraries

    include SGL and OpenGL for 2D and 3D graphics
  - SQLite

    for native database support
  - SSL and WebKit

    for integrated browser and Internet security

Android System Architecture



Android System Architecture

Android Run Time

- The Android run time is the engine that powers your applications and, along with the libraries, forms the basis for the application framework

Android System Architecture

Android Run Time

Including

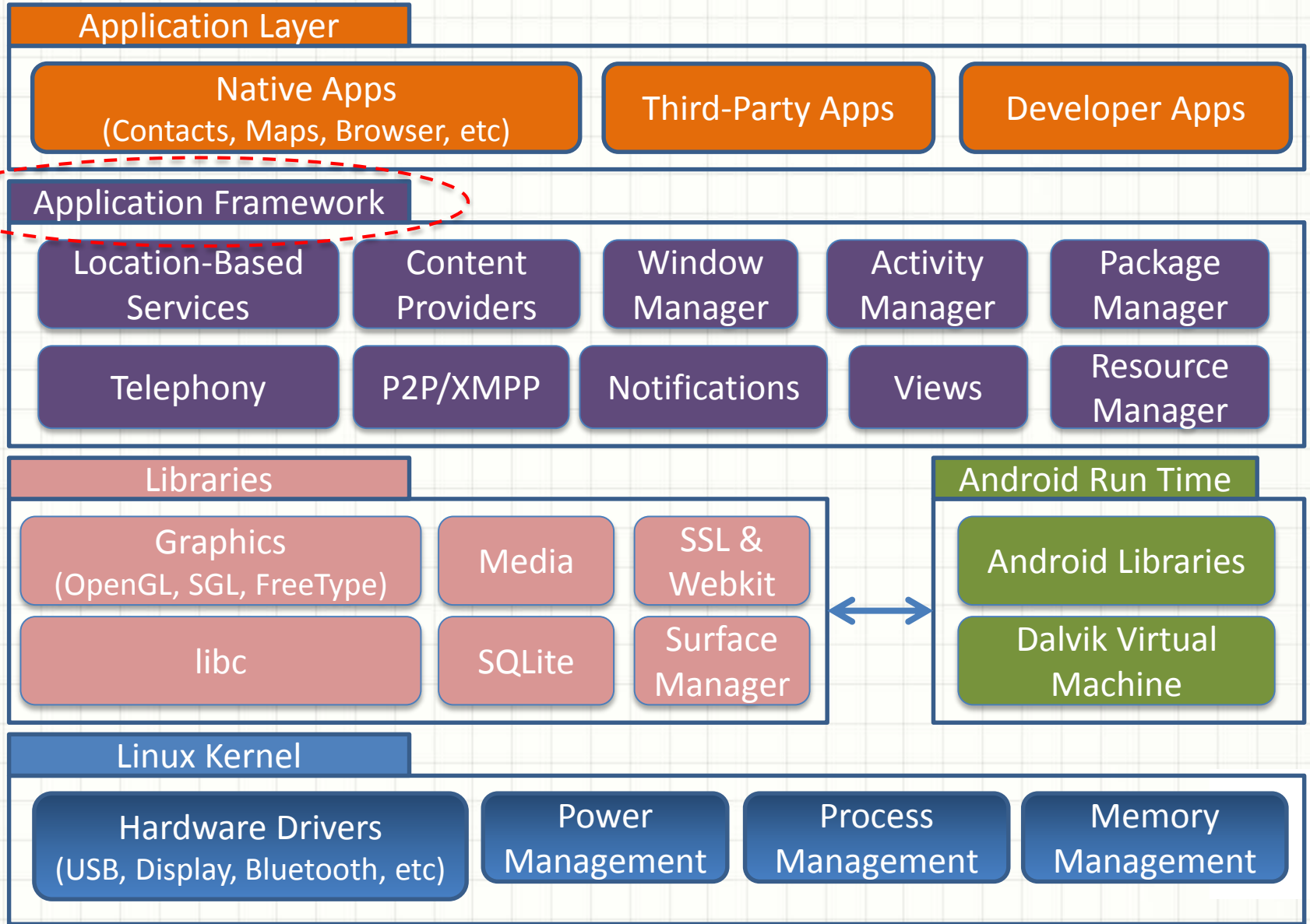
- Core libraries

  The core Android libraries provide most of the functionality available in core Java libraries as well as the Android-specific libraries

- Dalvik Virtual Machine

  Dalvik is a register-based virtual machine that's been optimized to ensure that a device can run multiple instances efficiently. It relies on the Linux kernel for threading and low-level memory management

Android System Architecture



Android System Architecture

Application Framework

- A set of high-level building blocks for creating apps
- It also provides a generic abstraction for hardware access and manages the user interface and application resources

Android System Architecture

Application Framework

The preinstalled framework on Android devices consists of the following components:

- Activity Manager

  manages the lifecycle of applications and maintains a shared activity stack for navigating within and among apps

- Views

  manages user interface elements (e.g. lists, text boxes, buttons, etc) and user interface-oriented event generation

Android System Architecture

Application Framework

- Notification Manager

  enables all applications to display custom alerts in the status bar

- Content Providers

  enable applications to access data from other applications (such as Contacts), or to share their own data

- Resource Manager

  providing access to non-code resources such as localized strings, graphics, and layout files

Android System Architecture

Application Framework

- Location Manager

  enables an Android device to be aware of its physical location

- Package Manager

  lets an app learn about other app packages that are currently installed on the device

- Telephony Manager

  handles making and receiving phone calls

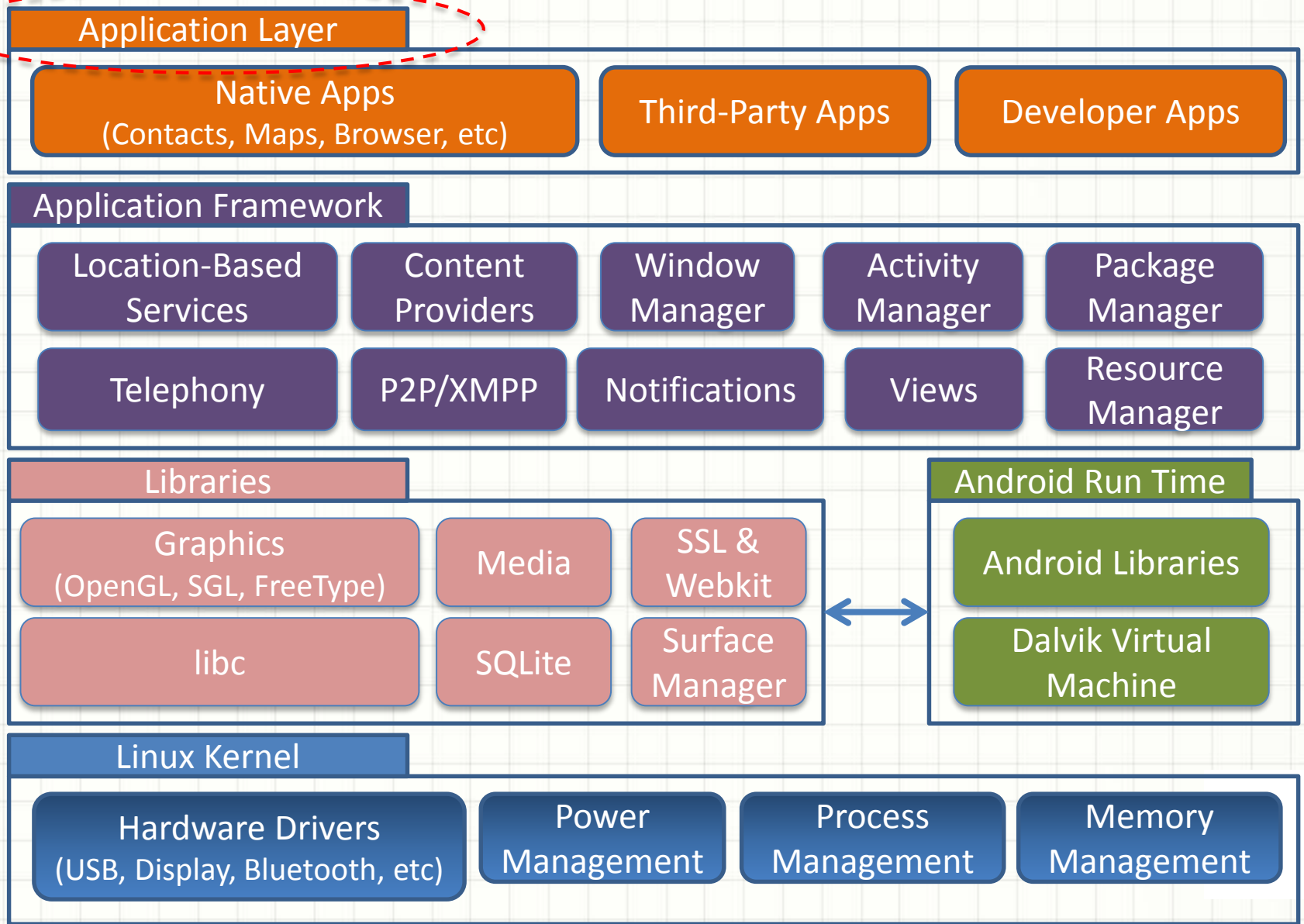
Android System Architecture

Application Framework

- Window Manager

  organizes the screen's real estate into windows, allocates drawing surfaces, and perform other window-related jobs

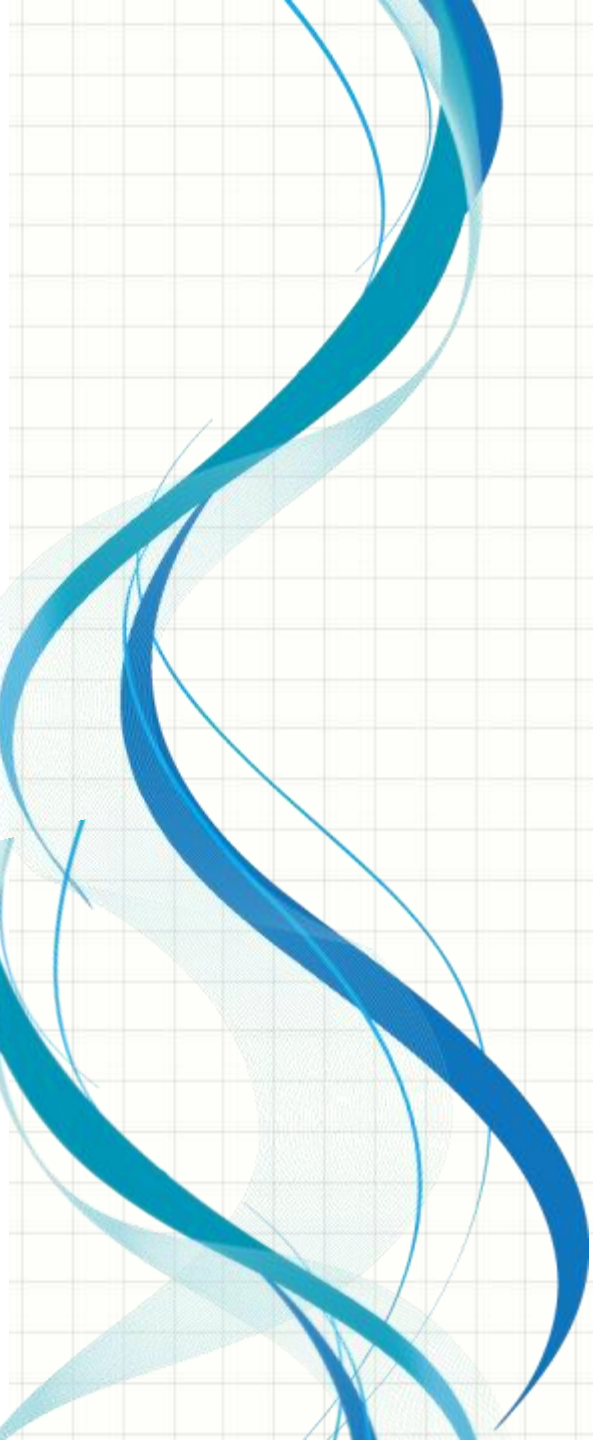
Android System Architecture



Android System Architecture

Application Layer

- Highest Layer in the Architecture
- All applications are written in Java programming language
- The application layer runs within the Android run time, using the classes and services made available from the application framework



Application Architecture Overview

Android Versions

- Android has gone through a number of updates since its first release on 2005. Since April 2009, each Android version has been developed under a codename based on a dessert item

ANDROID VERSION	CODENAME	API level
Android 1.5	Cupcake	3
Android 1.6	Donut	4
Android 2.0/2.1	Éclair	5 - 7
Android 2.2	Froyo	8

Android Versions

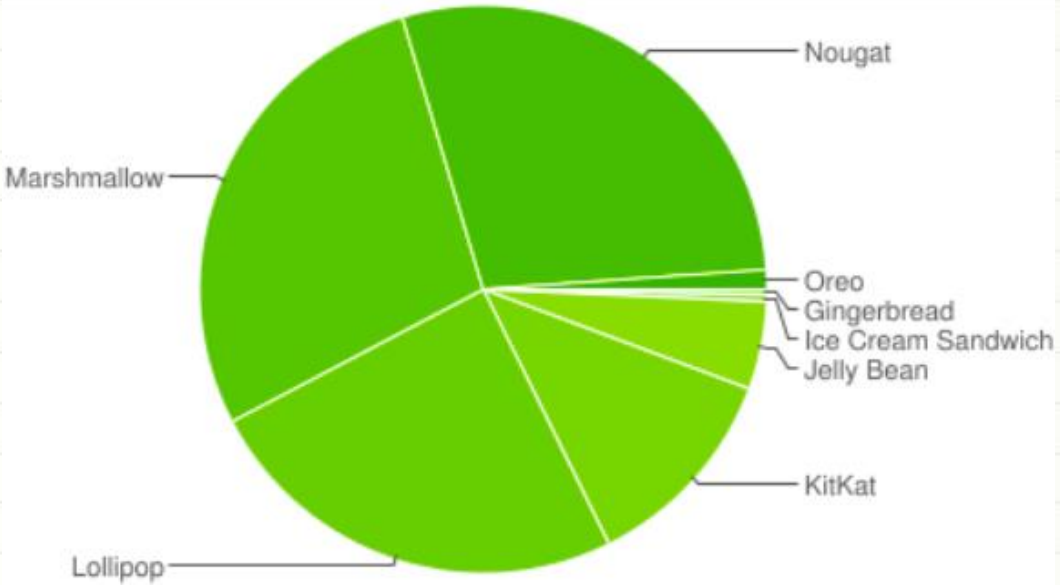
- Android has gone through a number of updates since its first release on 2005. Since April 2009, each Android version has been developed under a codename based on a dessert item

ANDROID VERSION	CODENAME	API level
Android 2.3	Gingerbread	9 - 10
Android 3.0	Honeycomb	11
Android 4.0/4.0.3	Ice cream Sandwich	14 - 15
Android 4.1/4.2/4.3	Jelly Bean	16 - 18
Android 4.4.2/4.4W	KitKat	19 - 20
Android 5.0/5.1	Lollipop	21 - 22
Android 6.0	Marshmallow	23
Android 7.0/7.1	Nougat	24 - 25
Android 8.0/8.1	Oreo	26 - 27

Platform Version Distribution

- The relative number of devices running a given version of the Android platform
- Data collected during a *7-day period ending on Feb 5, 2018.*

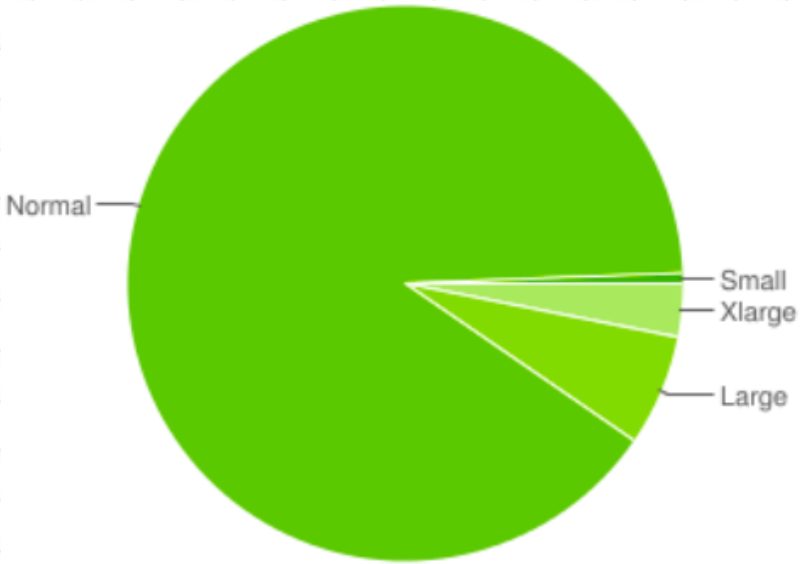
Version	Codename	API	Distribution
2.3.3 - 2.3.7	Gingerbread	10	0.3%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	0.4%
4.1.x	Jelly Bean	16	1.7%
4.2.x		17	2.6%
4.3		18	0.7%
4.4	KitKat	19	12.0%
5.0	Lollipop	21	5.4%
5.1		22	19.2%
6.0	Marshmallow	23	28.1%
7.0	Nougat	24	22.3%
7.1		25	6.2%
8.0	Oreo	26	0.8%
8.1		27	0.3%

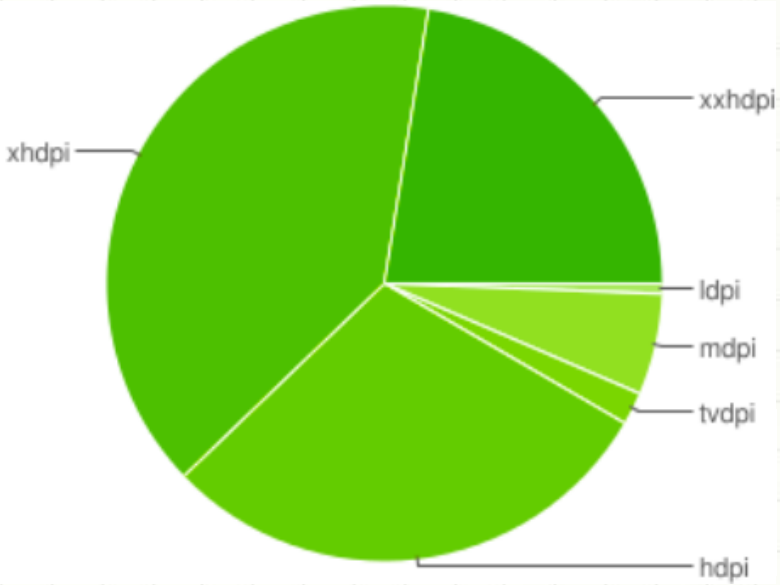


Screen Sizes and Densities

- Data collected during a *7-day period ending on Feb 5, 2018.*

	ldpi	mdpi	tvdpi	hdpi	xhdpi	xxhdpi	Total
Small	0.5%					0.1%	0.6%
Normal		1.1%	0.3%	28.5%	37.9%	22.0%	89.8%
Large	0.1%	2.8%	1.6%	0.4%	1.2%	0.4%	6.5%
Xlarge		2.0%		0.6%	0.5%		3.1%
Total	0.6%	5.9%	1.9%	29.5%	39.6%	22.5%	





Android Application Architecture

- The architecture of an Android app differs from desktop application architecture
- App architecture is based upon components that communicate with each other by using intents that are described by a manifest and are stored in an app package
- Application components are the essential building blocks of an Android application

Android Application Architecture

`Important!`

- Android apps do not have a single entry point (no C-style main() function, for example). Instead, apps use components that are instantiated and run as needed
- Each components exists as its own entity and plays a specific role—each one is a unique building block that helps define your application's overall behaviour.

Android Application Architecture

- There are four different types of application components
- Each type serves a distinct purpose and has a distinct lifecycle that defines how the component is created and destroyed.

Android Application Architecture

Here are the four types of application components:

- Activities
- Services
- Content Providers
- Broadcast Receivers

Android Application Components

Activities

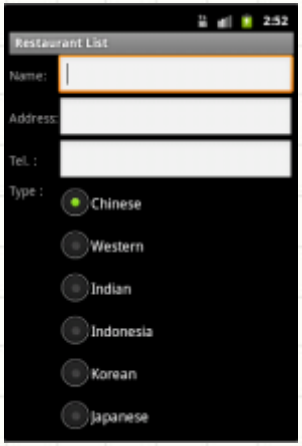
- An *activity* is implemented as a subclass of Activity
- An *activity* represents a single screen with a user interface (UI)

Android Application Components

Activities

- Example

  a restaurant list application might have one activity that shows a list of restaurants, another activity to display the restaurant detail, and another activity for show map location



Android Application Components

Activities

- Each activities is independent of the others. Different application can start any one of these activities
- Example

  A restaurant list app can start the map activity in the restaurant list app to show the location of the restaurant on Google map

Android Application Architecture

Here are the four types of application components:

- Activities
- Services
- Content Providers
- Broadcast Receivers

Android Application Components

Important!

Services

- A *service* is a component that runs in the background to perform long-running operations or to perform work for remote processes.
- A service does not provide a user interface

No Graphical User Interface!

Android Application Components

Services

- Example

  A service might play music in the background while the user is in a different application, or it might fetch data over the network without blocking user interaction with an activity

Android Application Architecture

Here are the four types of application components:

- Activities
- Services
- Content Providers
- Broadcast Receivers

Android Application Components

Broadcast Receivers

- A *broadcast receiver* is implemented as a subclass of BroadcastReceiver and each broadcast is delivered as an Intent object
- A *broadcast receiver* is a component that responds to system-wide broadcast announcements

Android Application Components

Broadcast Receivers

- Many broadcasts originate from the system
- Example

  A broadcast announcing that the screen has turned off, the battery is low, or a picture was captured

Android Application Components

Broadcast Receivers

- Apps can also initiate broadcasts
- Example

  An app may want to let other apps know that some data has finished downloading from the network to the device and is available now for usage

Android Application Architecture

Here are the four types of application components:

- Activities
- Services
- Content Providers
- Broadcast Receivers

Android Application Components

Content Providers

- A *content provider* is implemented as a subclass of ContentProvider and must implement a standard set of APIs that enable other applications to perform transactions
- A *content provider* manages a shared set of application data which is stored in the file system, an SQLite database, on the web, or any other persistent storage location the app can access

Android Application Components

Content Providers

- Through the content provider, other applications can query or even modify the data
- Example

  The Android system provides a content provider that manages the user's contact information. As such, any application with the proper permissions can query part of the content provider (such as ContactsContract.Data) to read and write information about a particular person

Intent & IntentFilter

Activating Components

- Three (activities, services, and broadcast receivers) of the four component types are activated by an asynchronous message called an *intent*
- Intents bind individual components to each other at runtime (you can think of them as the messengers that request an action from other components), whether the component belongs to your application or another

Intents

- Intent is basically a message that is passed between components (such as Activities, Services, Broadcast Receivers, and Content Providers)
- It is almost equivalent to parameters passed to API calls

Intents

- The fundamental differences between API calls and intents' way of invoking components are:
  - API calls are **synchronous** while intent-based invocations are **asynchronous**
  - API calls are **compile time** binding while intent-based calls are **run-time binding**

Intents

- An intent is created with an Intent object, which defines a message to activate either a specific component or a specific *type* of component
- Example

  An Activity can send an Intents to the Android system which starts another Activity

Intents

- There are separate mechanisms for delivering intents to each type of component (such as Activities, Services or Broadcast Receivers) :
  - An Intent object is passed to Context.startActivity() or Activity.startActivityForResult() to launch an activity

Example

```
Intent intend = new Intent(……..……);
startActivity(intend);
```

Intents

- There are separate mechanisms for delivering intents to each type of component:
  - An Intent object is passed to Context.startService() to initiate a service or deliver new instructions to an ongoing service. Similarly, an intent can be passed to Context.bindService() to establish a connection between the calling component and a target service

Intents

- There are separate mechanisms for delivering intents to each type of component:
  - Intent objects passed to any of the broadcast methods (such as Context.sendBroadcast(), Context.sendOrderedBroadcast(), or Context.sendStickyBroadcast()) are delivered to all interested broadcast receivers. Many kinds of broadcasts originate in system code

Intents

Intents can be classified as:

- Explicit Intents
- Implicit Intents

Explicit Intents

- Explicit Intents explicitly names the component which should be called by the Android system, by using the Java class as identifier
- It is made to work exactly like API calls

Explicit Intents

- The following shows an explicit Intent to start the associated class
- Example

```
Intent intend = new Intend(this, HelloWorld.class);
startActivity(intend);
```

- When run, this code snippet has the following consequences:
  - A new instance of HelloWorld is created
  - The instance is pushed on top of the current task's stack, which is the one the calling activity is in.
  - The activity is started and brought to the foreground.

Explicit Intents

- Example

  you want explicitly call the activity B from activity A and pass to it an array of integers:

```
int intArray[] = {1,2,3,4};
Intent in = new Intent(this, B.class);
in.putExtra("my_array", intArray);
startActivity(in);
```

  To read the information in activity B (in onCreate() method) you should use the following code:

```
Bundle extras = getIntent().getExtras();
int[] arrayInB = extras.getIntArray("my_array");
```

Intents

Intents can be classified as:

- Explicit Intents
- Implicit Intents

Implicit Intents

- Implicit Intents do not specify the Java class which should be called
- The Android system finds the best component for handling the intent. This is done by comparing the contents of Intent object with Intent Filters
- The comparison to Intent Filter is done with three elements of intent object namely action, data and category

Implicit Intents

- Example

  the following tells the Android system to view a webpage. Typically the web browser is registered to this Intent but other component could also register themself to this event

  ```
  Intent intent = new Intent(Intent.ACTION_VIEW,
  Uri.parse("http://www.sp.edu.sg"));
  ```

Intent Filters

- If an Intent is sent to the Android system, it will determine suitable applications for this Intent `Example: Settings application`
- If several components have been registered for this type of Intent, Android offers the users choice to open one of them `Web browser`
- This determination is based on IntentFilters. An IntentFilter specifies the types of Intent that an activity, service, or broadcast receiver can respond

Intent Filters

- Intent Filters describe the capability of the component (Activity, Service or Broadcast Receivers) to handle an implicit intent
- It specifies what an activity or service can do and what types of broadcasts a receiver can handle
- Components without intent filters cannot receive implicit intents, but can only handle explicit intents

Intent Filters

- IntentFilters are typically defined via the "AndroidManifest.xml" file.
  For BroadcastReceiver it is also possible to define them in coding
- An IntentFilters is defined by its category, action and data filters. It can also contain additional metadata

Intent Filters

- Example

  The following will register an Activity for the Intent which is triggered when someone wants to open a webpage

```
<activity android:name=".BrowserActivitiy" android:label="@string/app_name">
  <intent-filter>
    <action android:name="android.intent.action.VIEW" />
    <category android:name="android.intent.category.DEFAULT" />
    <data android:scheme="http"/>
  </intent-filter>
</activity>
```

Intent Filters

- Example

  The following shows how you could define an Intent receiver for the ACTION.SEND Intent

```
<activity android:name=".ActivityTest" android:label="@string/app_name">
  <intent-filter>
    <action android:name="android.intent.action.SEND" />
    <category android:name="android.intent.category.DEFAULT" />
    <data android:mimeType="text/plain" />
  </intent-filter>
</activity>
```

Intent Filters

- Example

  The following will register an Activity for the ACTION.SEND Intent for the “text/plain” mime type

```
<activity android:name=".ActivityTest" android:label="@string/app_name">
  <intent-filter>
    <action android:name="android.intent.action.SEND" />
    <category android:name="android.intent.category.DEFAULT" />
    <data android:mimeType="text/plain" />
  </intent-filter>
</activity>
```

END