An Introduction to Android

Michalis Katsarakis katsarakis@csd.uoc.gr
M.Sc. Student

Tutorial: hy439 & hy539 http://www.csd.uoc.gr/~hy439/
16 October 2012

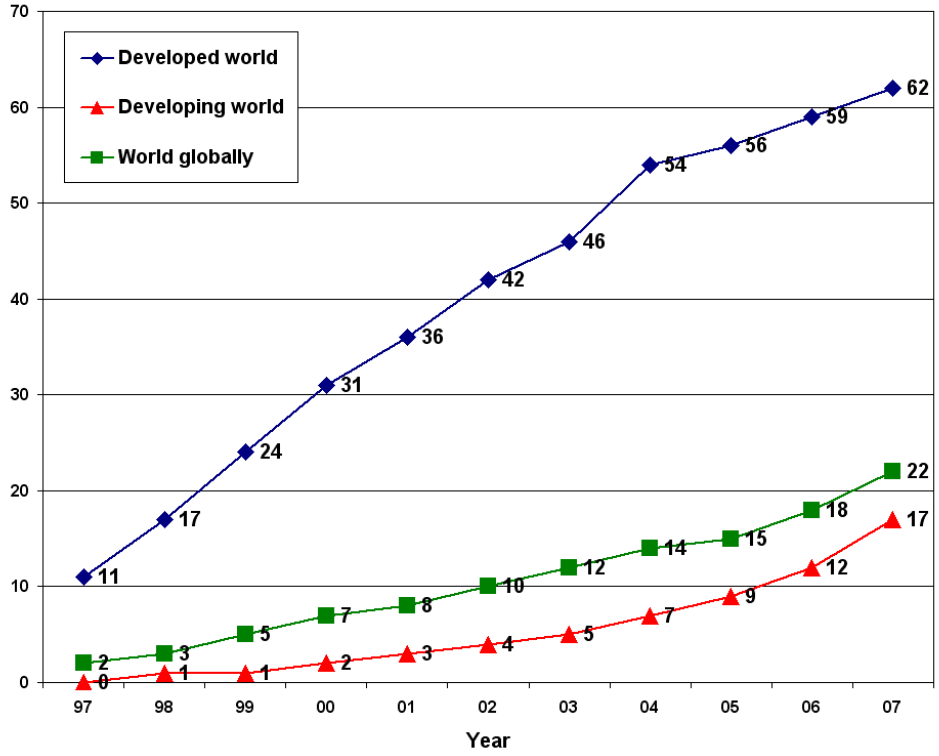
Outline

- Background
- What is Android
- Android as a Sensor
- Develop for Android

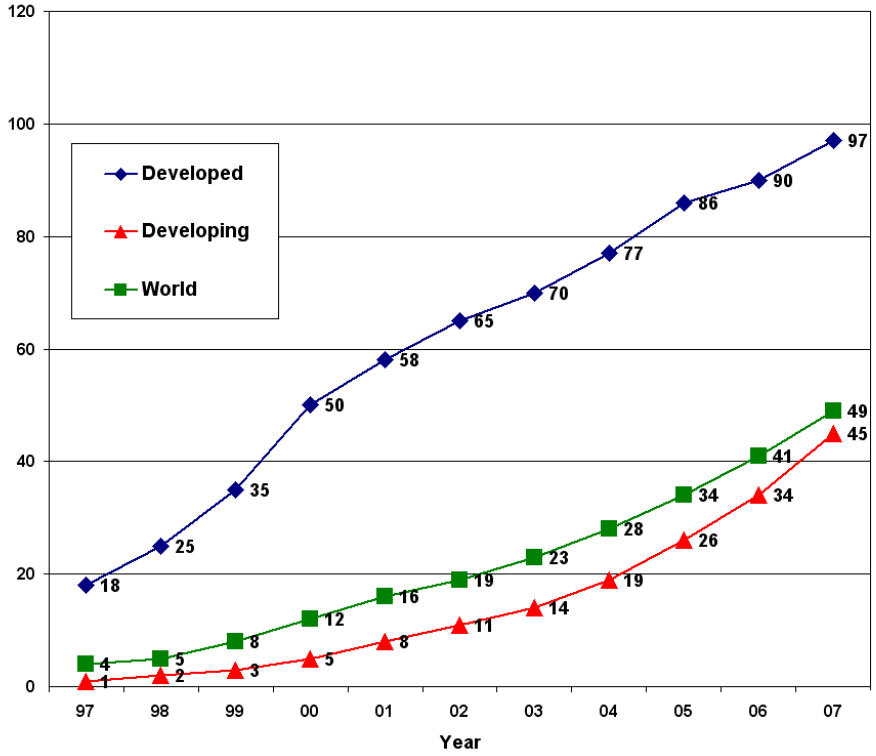
Background

Internet users and Mobile phone users

Internet users per 100 inhabitants 1997-2007 (Source: ITU)



Mobile phone subscribers per 100 inhabitants 1997-2007



Open Handset Alliance (OHA)

Mobile Operators

中国移动通信 CHINA MOBILE
China unicom中国联通
Designing The Future KDDI
NTT DoCoMo
Sprint
T-Mobile
vodafone
Telefónica

Handset Manufacturers

acer
ASUS Rock Solid · Heart Touching
GARMIN
htc smart mobility
HUAWEI
lenovo 联想移动
LG Electronics
MOTOROLA
SAMSUNG
Sony Ericsson
TOSHIBA

Semiconductor Companies

AKM
Audience
ARM
intel
ATHEROS
BROADCOM
MIPS TECHNOLOGIES
NVIDIA
ST ERICSSON

Software Companies

Ascender Corporation
ebay
Google
Living Image
myriad
NUANCE
OMRON
pv
SkyPoP

Commercialization Companies

Aplix Corporation
BORQS
noser
tat
TELECA
WIND RIVER

What is Android?

What is Android?

Android delivers a complete set of software for mobile devices:

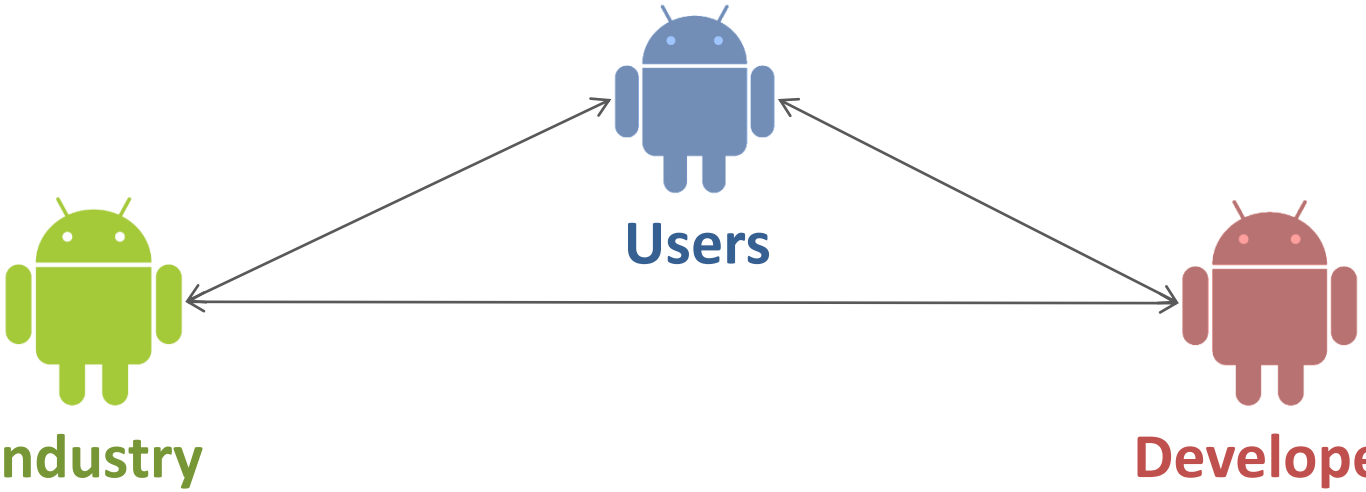
- Operating System
- Middleware
- Key mobile applications

- Open
- Breaking down Application Boundaries
- Fast & Easy Application Development

History of Android

- 2001 search service for wireless device
- 2005
  - Acquire Android(Andy Rubin: Danger CEO, Development Sidekick of T-Mobile)
  - Acquire Skia(2D Graphics for mobile device)
  - Acquire RegWireless(Browser and Email for mobile device)
  - Move Engineers from PlamSource(Dianne Hackborn, etc…)
- 2007 Nov 5: Android announced
- 2007 Nov 12: Android SDK released by OHA
- 2007 Dec 14: Bug-fix SDK released
- 2008 Jan 3: Android Developer Challenge I starts accepting submissions
- 2008 Feb 13: m5-rc15 SDK released
- 2008 Apr 14: 1788 total submissions for Challenge I
- 2008 May 12: Top 50 Applications in Challenge I announced
- 2008 Nov: Android Phone(G1 Phone by HTC/T-mobile)
- 2008 Nov: Full Source Open
- 2009 Apr: HTC Magic
- 2009 July: HTC Hero, Samsung i7500, Android Netbook, Set-top……
- 2009 Aug: Android Developer Challenge II

Open Source



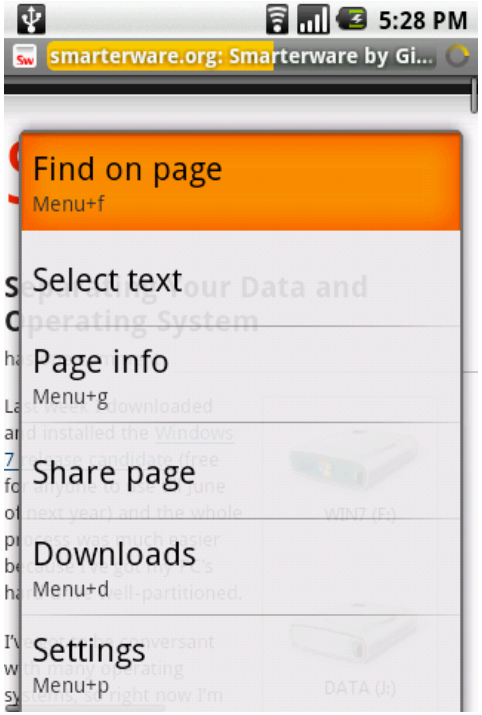
Industry
- Software stack open-sourced under Apache 2.0 license
- Source available after first handsets ship
- Anyone will be able to build a system image

Users
- Users have control of their experience
- They control what gets installed
- They choose the defaults

Developer
- Don not need permission to ship an application
- No hidden or privileged framework APIs
- Can integrate, extend and replace existing components

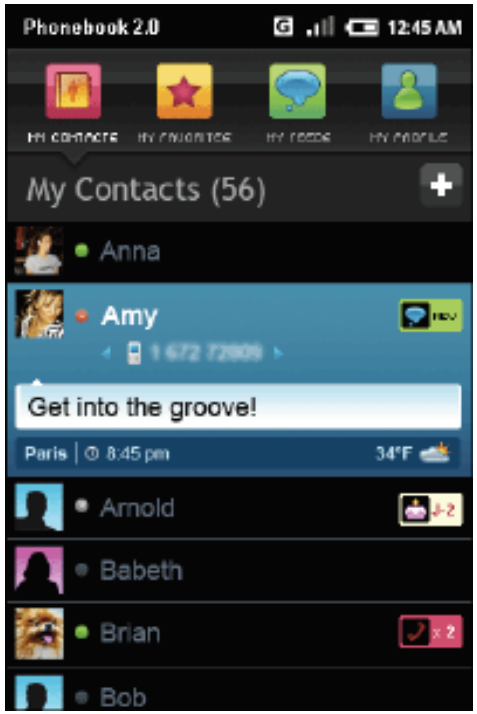
A Developer can:

Integrate

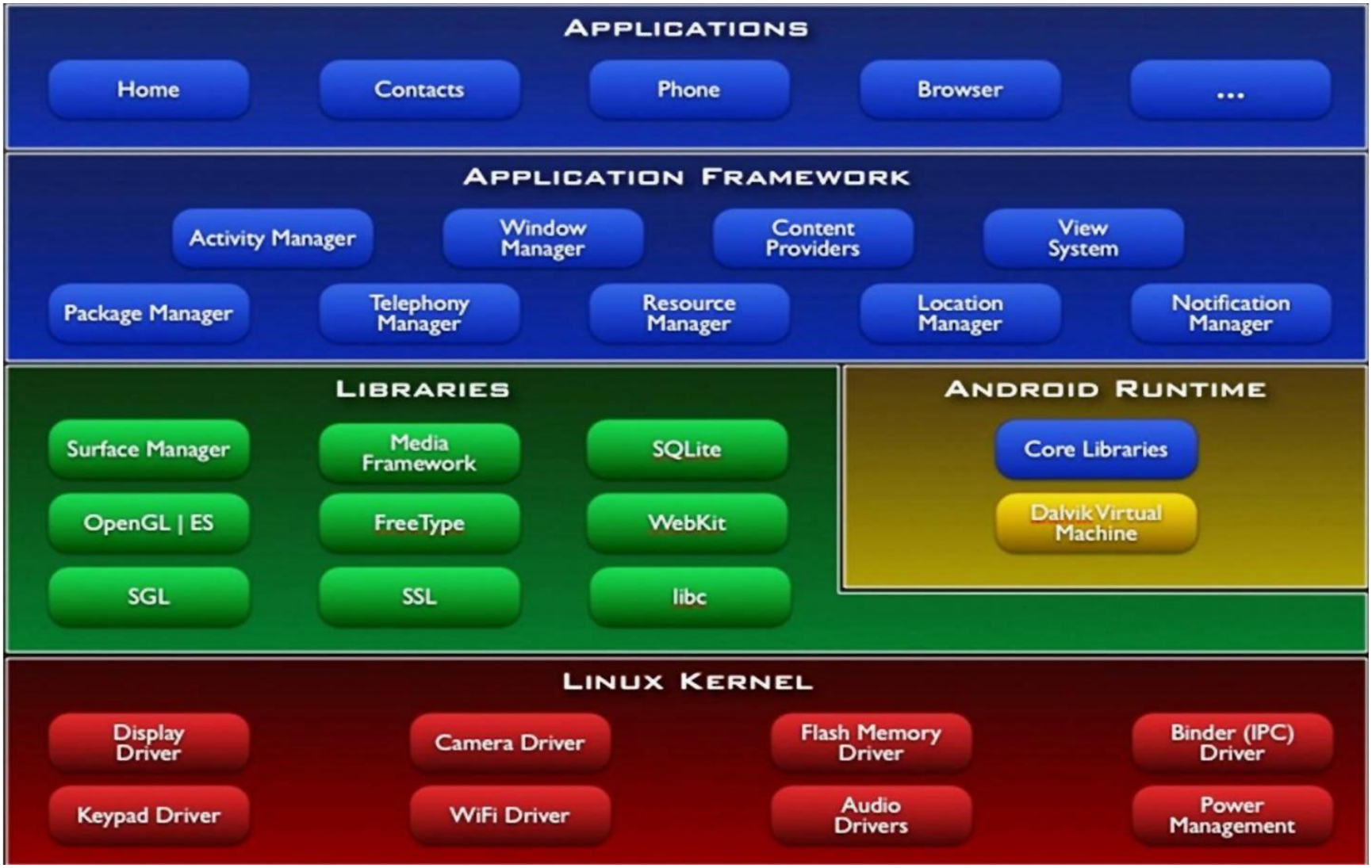


Extend

Replace



Android Architecture



Linux Kernel

- Android OS is built on top of the Linux 2.6 Kernel
  - Linux Core functionality
    - Memory management
    - Process management
    - Networking
    - Security settings
  - Hardware drivers

Libraries

- Android's native libraries.
  - **Libc:** c standard lib.
  - **SSL:** Secure Socket Layer
  - **SGL:** 2D image engine
  - **OpenGL|ES:** 3D image engine
  - **Media Framework:** media codecs
  - **SQLite:** Database engine
  - **WebKit:** Kernel of web browser
  - **FreeType:** Bitmap and Vector
  - **SufraceManager:** Compose window manager with off-screen buffering.

Android Runtime

- Core Libraries
  - Provides the functionality of the JAVA Programming Language

- Dalvik VM
  - A type of Java Virtual Machine
  - Register based (not stack machine like JVM)
  - Optimization for low memory requirements
  - Executes .dex (Dalvik-Executable) files instead of .class
  - DX tool converts classes to .dex format

Each Android application:
- runs on its own Process
- runs on its own Instance of Dalvik VM
- is assigned its own Linux user ID

Application Framework

- The blocks that our applications directly interact with.

- Important blocks:
  - **Activity Manager**: Manages the activity life cycle of applications
  - **Content Providers:** Manage the data sharing between applications
  - **Telephony Manager:** Manages all voice calls. We use telephony manager if we want to access voice calls in our application.
  - **Location Manager:** Location management, using GPS or cell tower
  - **Resource Manager:** Manage the various types of resources we use in our Application

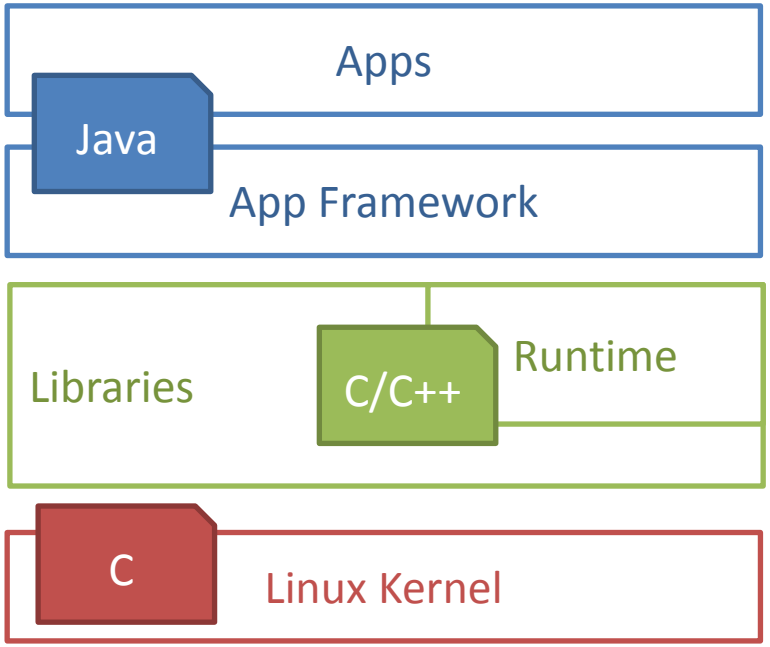
Applications

- This is where our applications are placed.
- Some pre-installed applications:
  - SMS client app
  - Dialer
  - Web browser
  - Contact manager

- No compulsory applications
- Equality among apps
- Easily embedded web browser
- Parallel running

- As developers, we are able to write an app which replaces any existing system app.

Details



- Design goals
  - Open Source
  - High flexibility
  - High data accessibility
  - Rapid development (XML, Java)
- Used Languages
  - App: Java
  - Framework: Java
  - Libraries: C/C++
  - OS & Drivers: C

Android Device as a Sensor

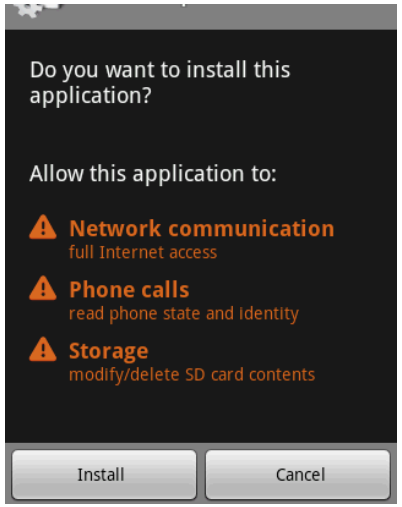
Android Device as a Sensor

Motion Sensors:
- Accelerometer
- Gyroscope

Position Sensors:
- Magnetometer
- Proximity
- GPS

Environment Sensors:
- Barometer
- Photometer
- Thermometer

Network Interfaces:
- GSM/CDMA
- 802.11
- Bluetooth



- After **user authorization**, an app can access detailed sensor readings, using the Application Framework layer.

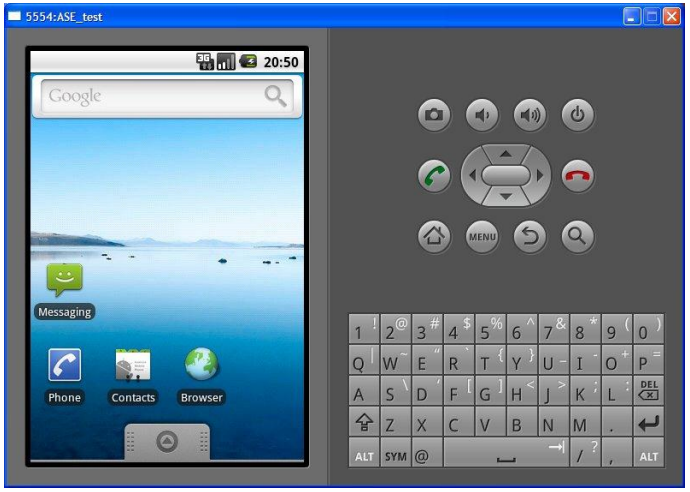
Develop for Android

Android SDK

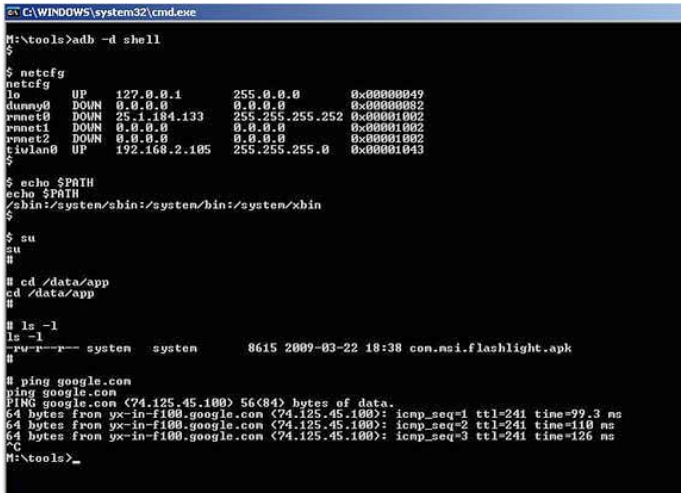
- Android-sdk
  - add-ons
  - docs (Javadoc style documentation)
  - extras
  - platforms
  - platform-tools
    - adb
  - samples (sample applications)
  - temp
  - tools
    - emulator
  - SDK manager.exe

Android SDK

- Emulator
  - Android applications may be run on a real device or on the Android Emulator, which ships with the Android SDK.

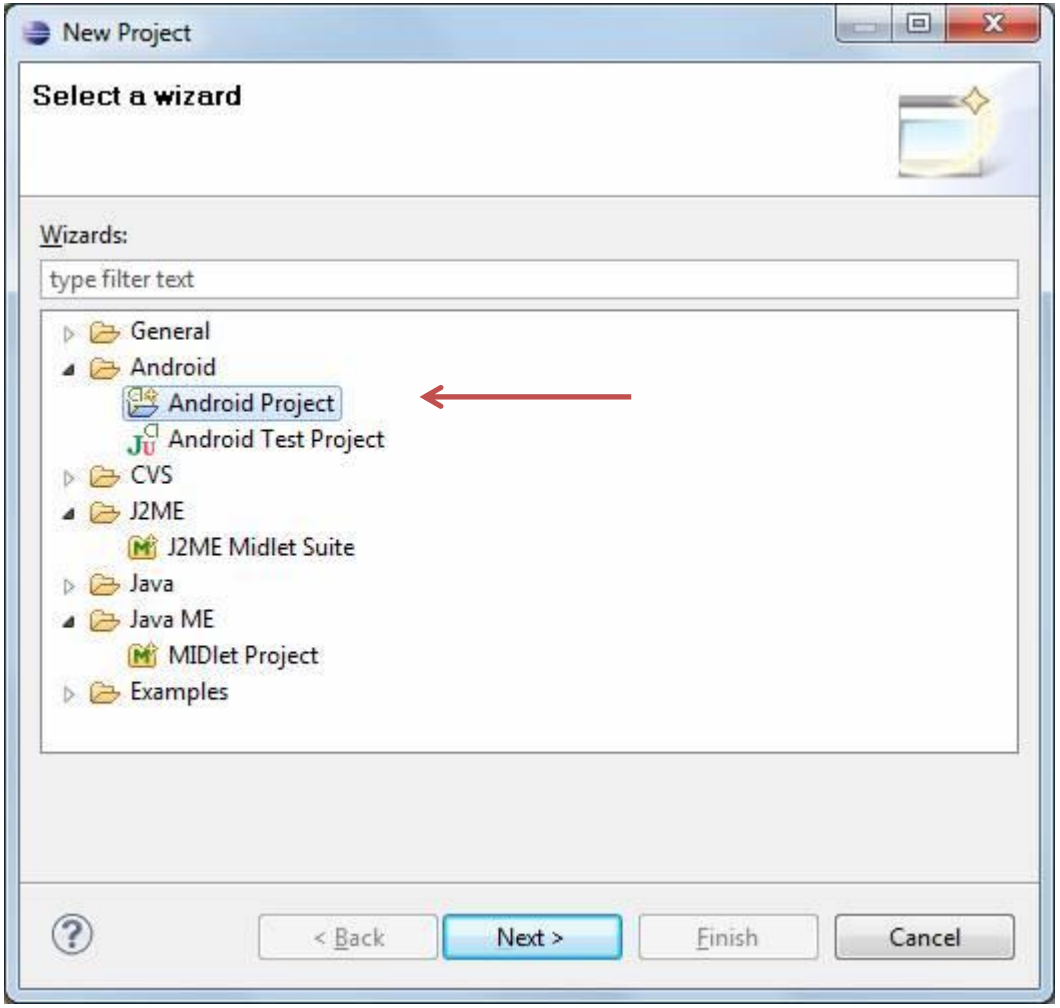


- ADB (Android Debug Bridge)
  - The ADB utility lets you connect to the phone itself and issue rudimentary shell commands, such as copying files to and from the device.



Development Environment

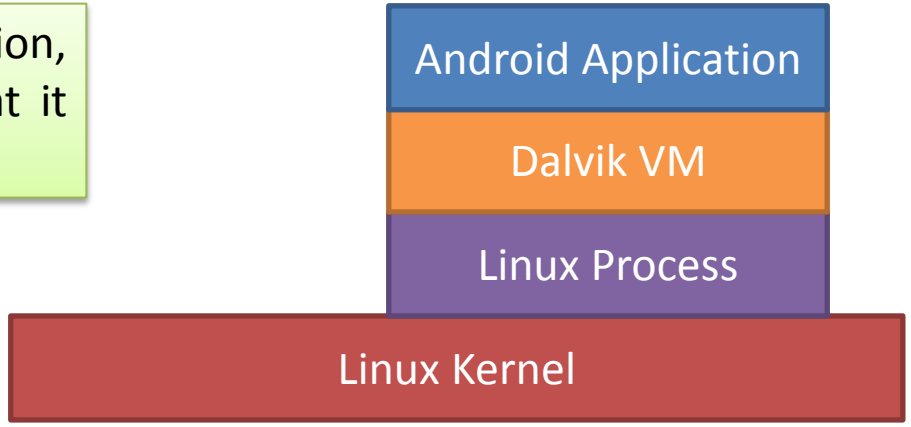
- JDK 5 or 6
- Eclipse IDE
  - JDT plugin
  - ADT plugin



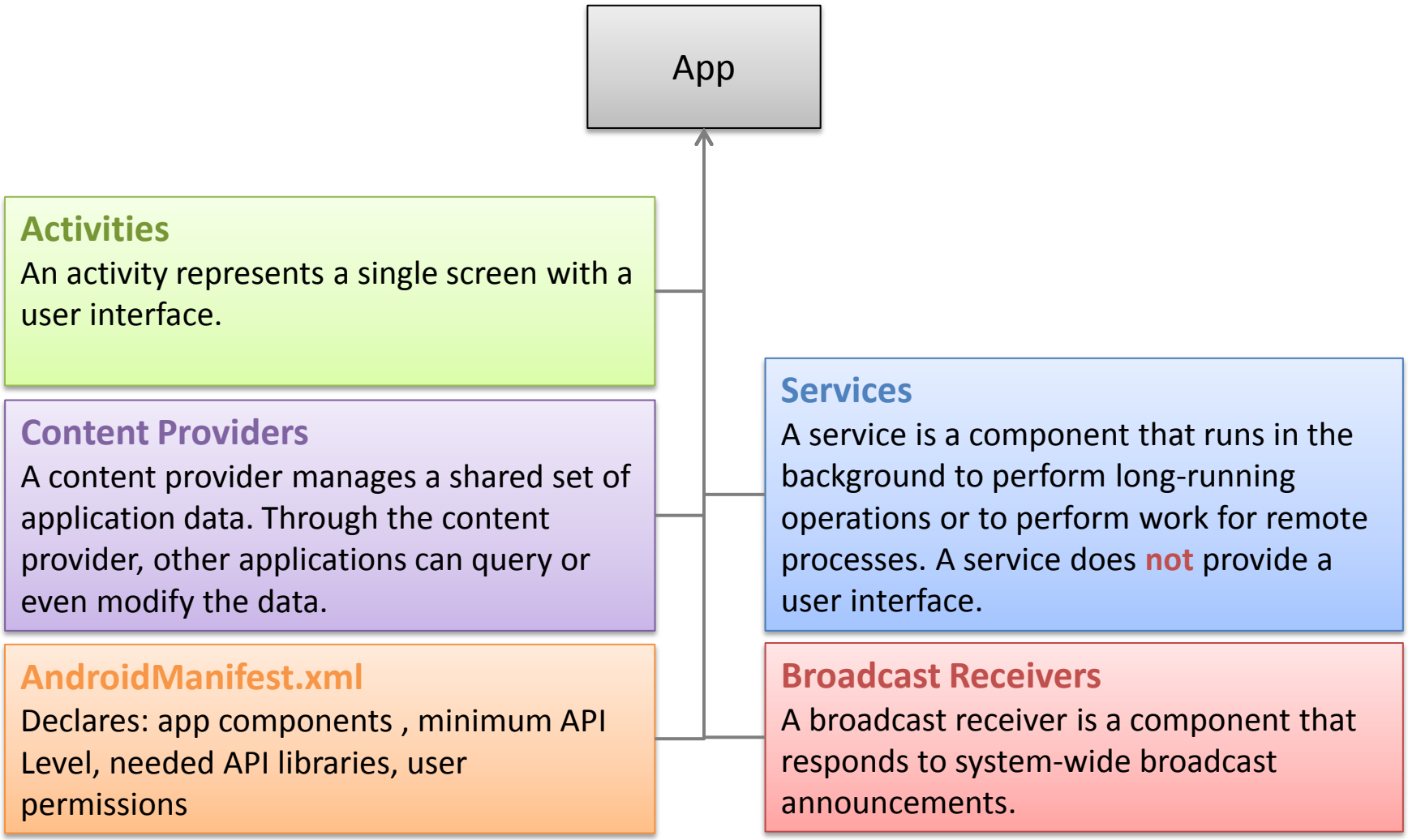
Application Fundamentals

- Development Language: Java
- Android SDK tools compile the code into an Android package, an archive file with an .apk suffix
- Security sandbox
  - Each application has a unique Linux user ID
  - Each process has its own virtual machine (VM)
  - Every application runs in its own Linux process

Principle of least privilege: Each application, has access only to the components that it requires to do its work and no more.



Application Components

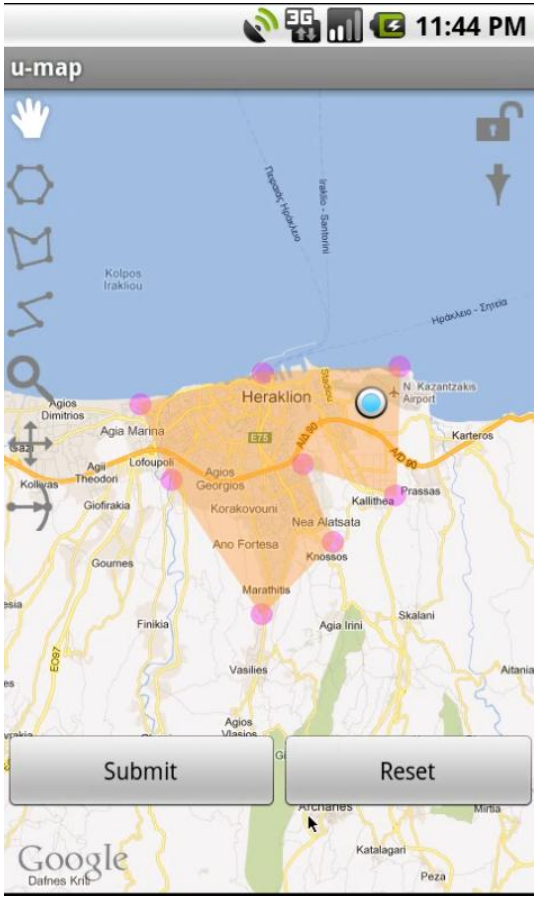


Cases

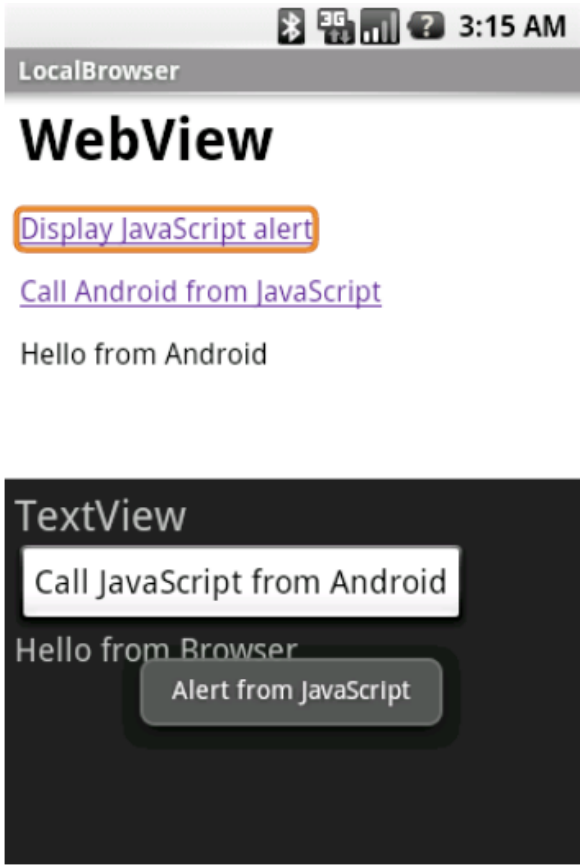

7:26 PM
Game
3 6
4 2 3 8
4 2
7 4 6 3
8 2 1 4
5 1 3 2
1 9
7 4 8 3
4 5


3:12 AM
OpenGL
ANDROID
ANDROID

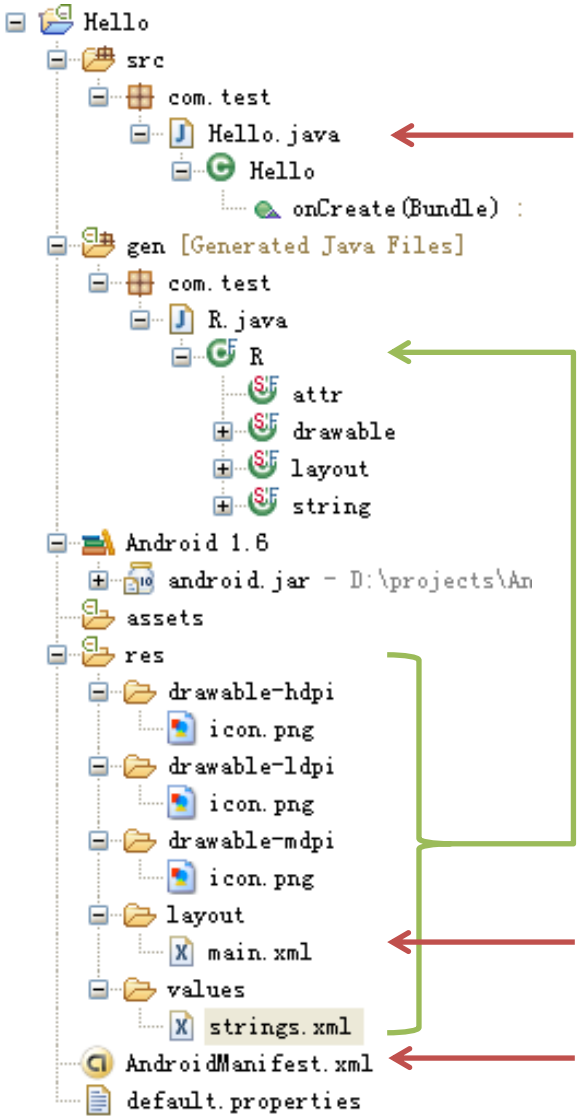
Cases


11:44 PM
u-map
Heraklion
Agia Marina
Agios Georgios
Kallithea
Prassas
Nea Alatsata
Knossos
Marathitis
Agia Irini
Skalani
Finikia
Vasilies
Katalagari
Peza
Submit
Reset
Google

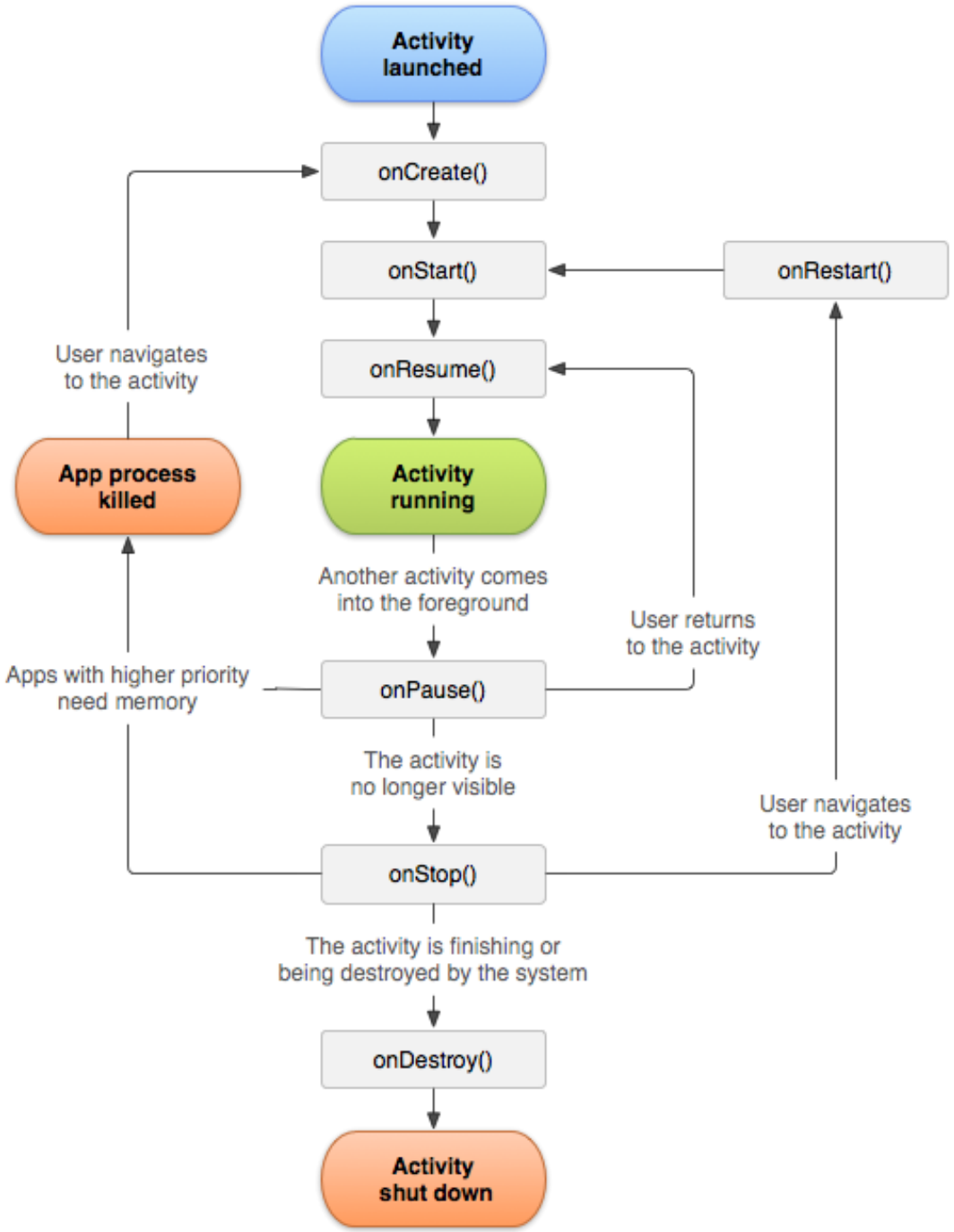

1:18 AM
Translate
From:
English (en)
This translation is goofy.
To:
Japanese (ja)
まぬけには、この翻訳されています。
And back again:
A klutz, this has been translated.


3:15 AM
LocalBrowser
WebView
Display JavaScript alert
Call Android from JavaScript
Hello from Android
TextView
Call JavaScript from Android
Hello from Browser
Alert from JavaScript

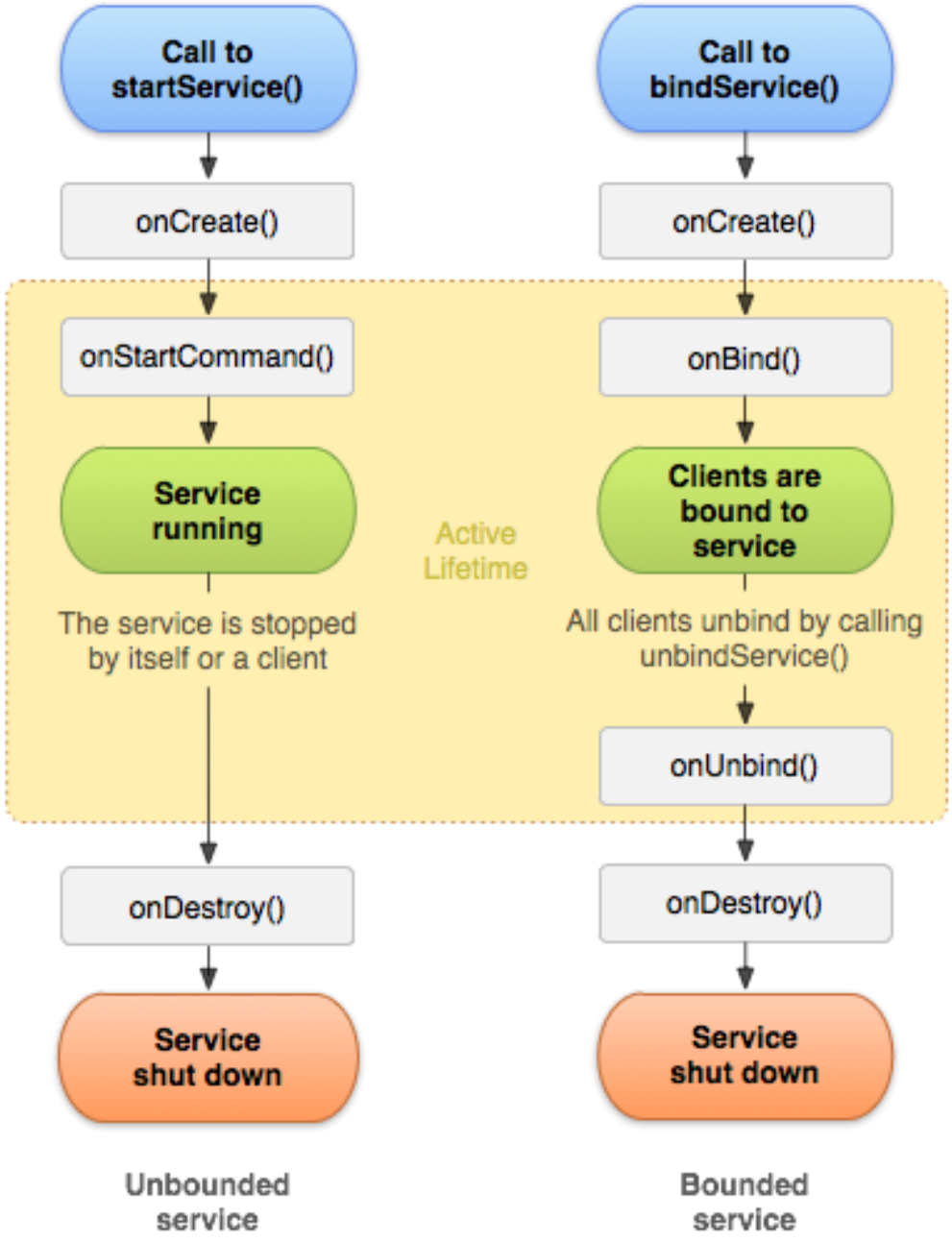
Case: Hello World



Activity Lifecycle



Service Lifecycle



Intents

- Activities, Services, and Broadcast Receivers are activated through intents.

- What is an Intent?
  - Message (Bundle of information)
  - Facility for late run-time binding between components
  - Passive data structure describing an operation to be performed
  - Description of something that has happened and is being announced

Next Tutorial

- Practical Exercise on Android Development
  - Hello World
  - Multiple Activity Application
  - 802.11 RSSI measurements

Resources

- Introduction to Android
  https://code.google.com/p/androidgroup/downloads/detail?name=Introduction%20to%20Android.pdf

- Android Architecture
  http://www.android-app-market.com/android-architecture.html

- Application Fundamentals
  http://developer.android.com/guide/components/fundamentals.html

- Layouts
  http://developer.android.com/guide/topics/ui/declaring-layout.html