



# An Introduction to Android

**Michalis Katsarakis**

M.Sc. Student

[katsarakis@csd.uoc.gr](mailto:katsarakis@csd.uoc.gr)

Tutorial: hy439 & hy539

16 October 2012

<http://www.csd.uoc.gr/~hy439/>

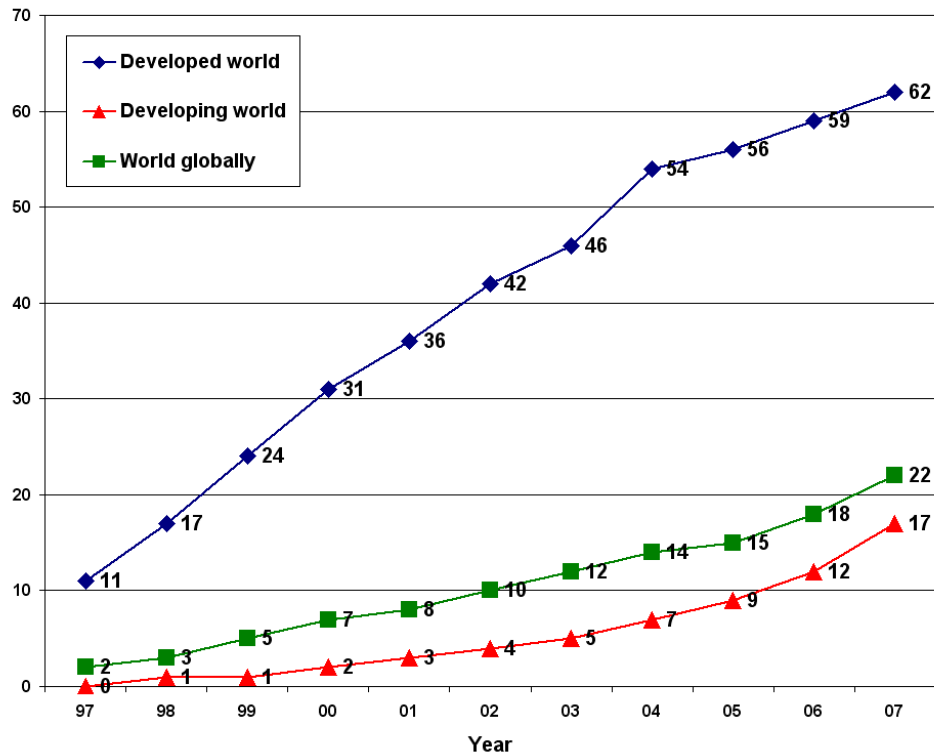
# Outline

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

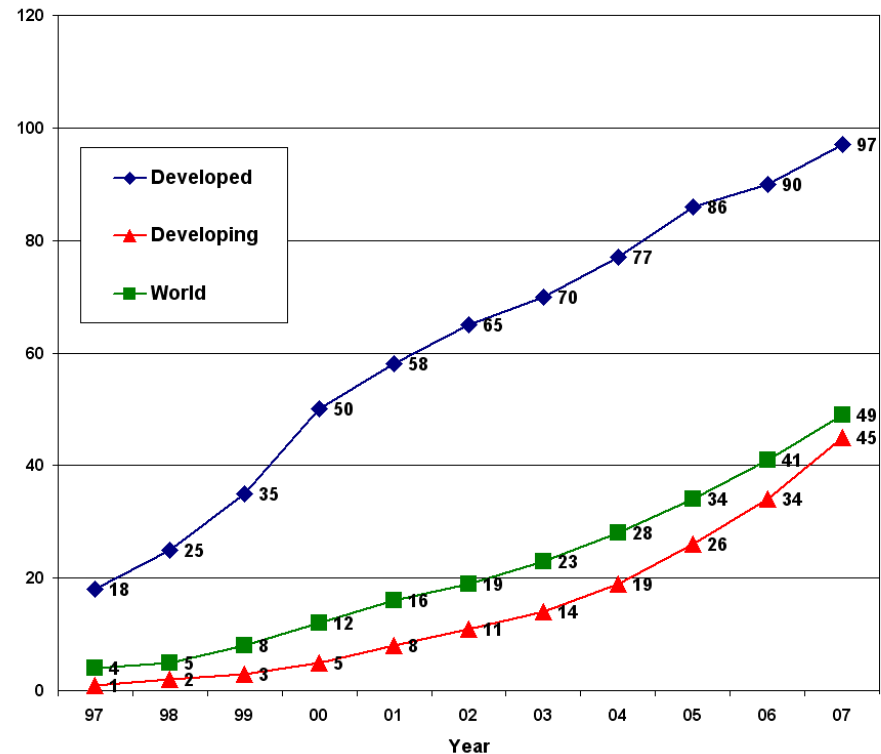
**Background**

# 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



open handset alliance

## Handset Manufacturers



## Semiconductor Companies



## Software Companies



## Commercialization Companies



**What is Android?**

Android delivers a complete set of software for mobile devices:

- Operating System
- Middleware
- Key mobile applications

# ANDROID

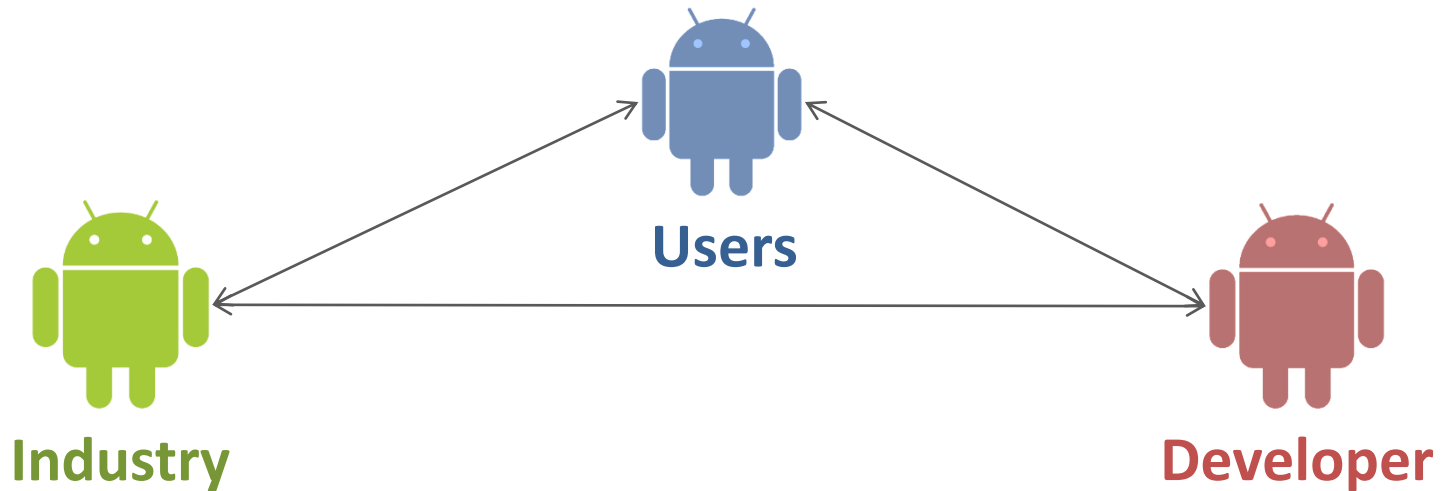
- Open
- Breaking down Application Boundaries
- Fast & Easy Application Development

# 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

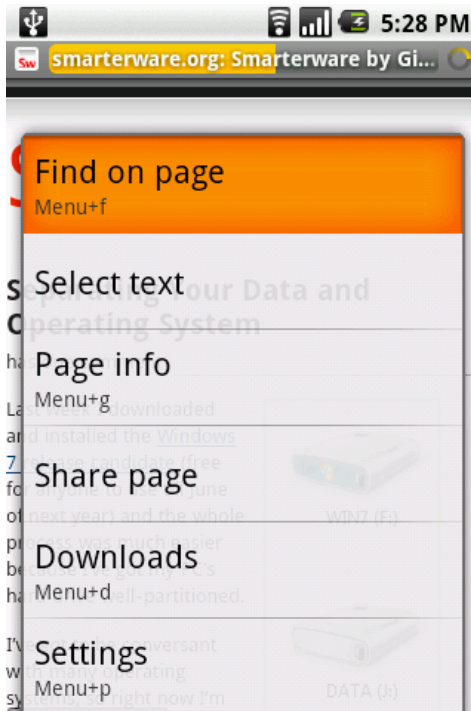
- Users have control of their experience
- They control what gets installed
- They choose the defaults

## 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:

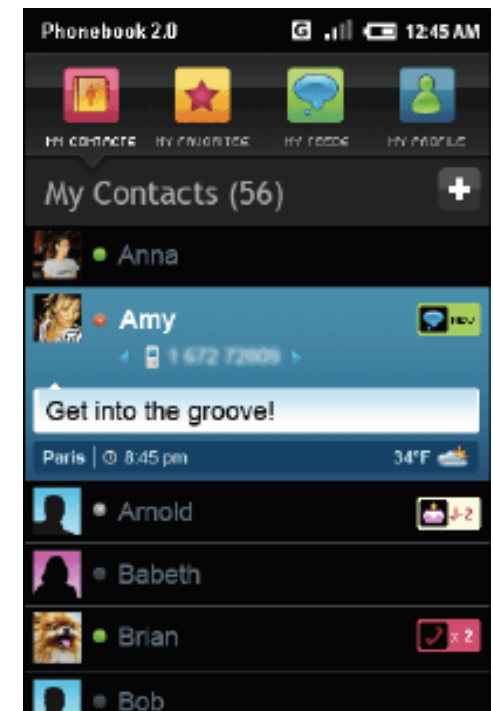
Integrate



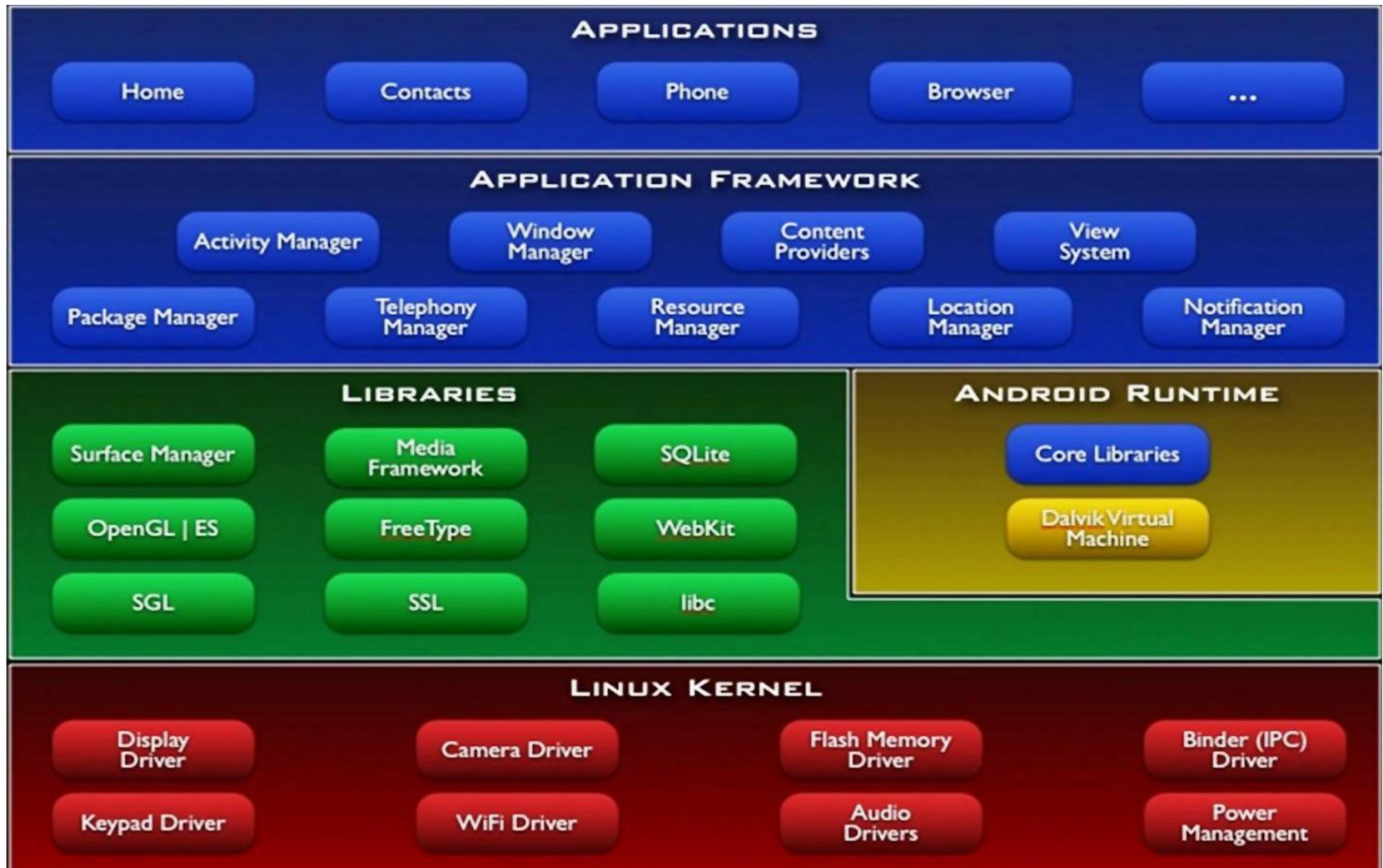
Extend



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

## LINUX KERNEL

Display  
Driver

Camera Driver

Flash Memory  
Driver

Binder (IPC)  
Driver

Keypad Driver

WiFi Driver

Audio  
Drivers

Power  
Management

# 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
  - **SurfaceManager**: 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.

## APPLICATIONS

Home

Contacts

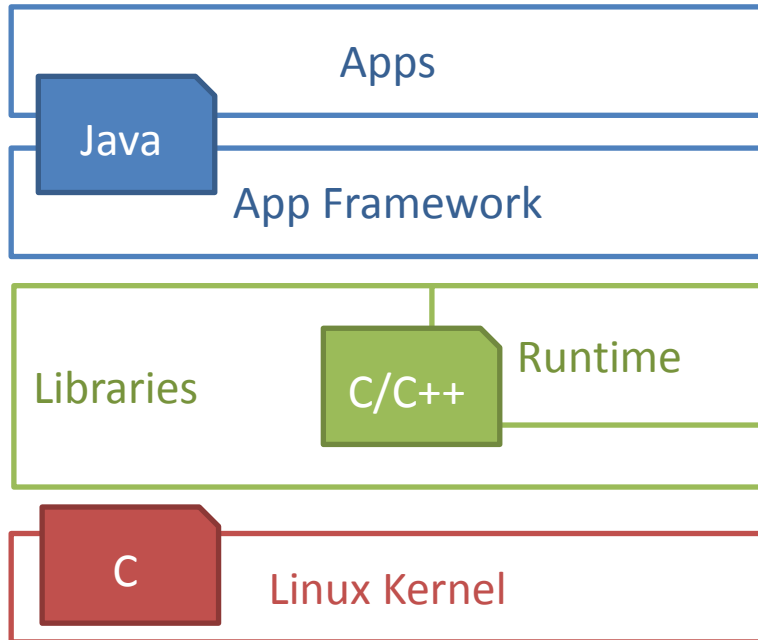
Phone

Browser

...



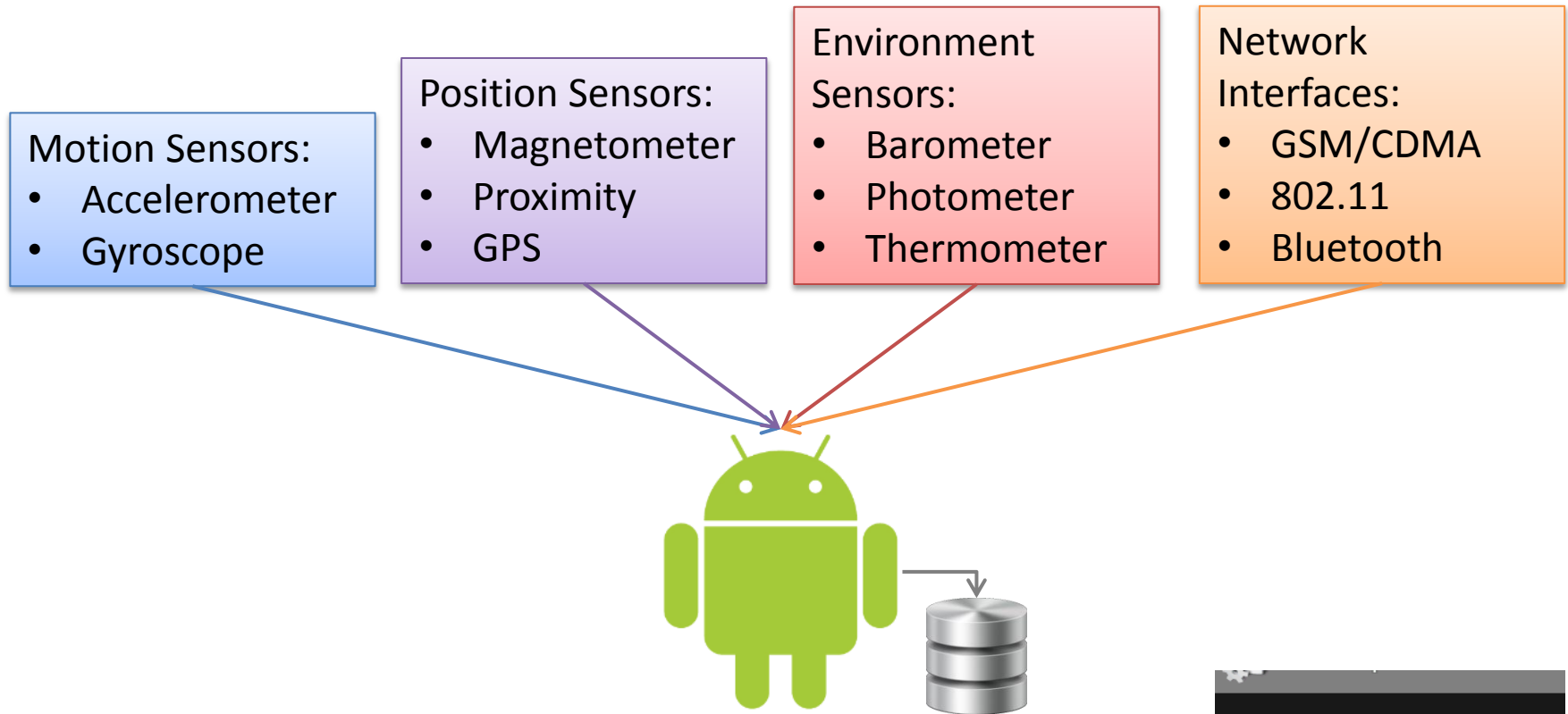
# Details



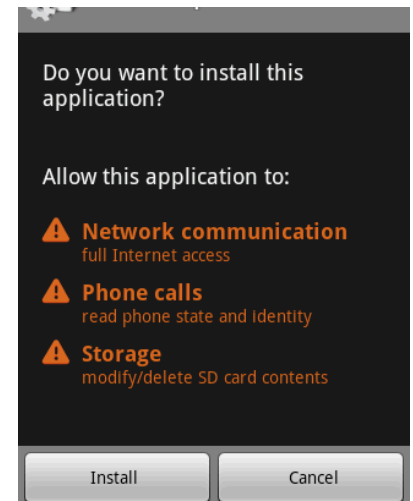
- Design goals
  - Open Source
  - High flexibility
  - High data accessibility
  - Rapid development (XML, Java)
- Used Languages
  - App: Java
  - Framework: Java
  - Libraries: C/C++
  - OS & Drivers: C

# Android Device as a Sensor

## Android Device as a Sensor



- 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.

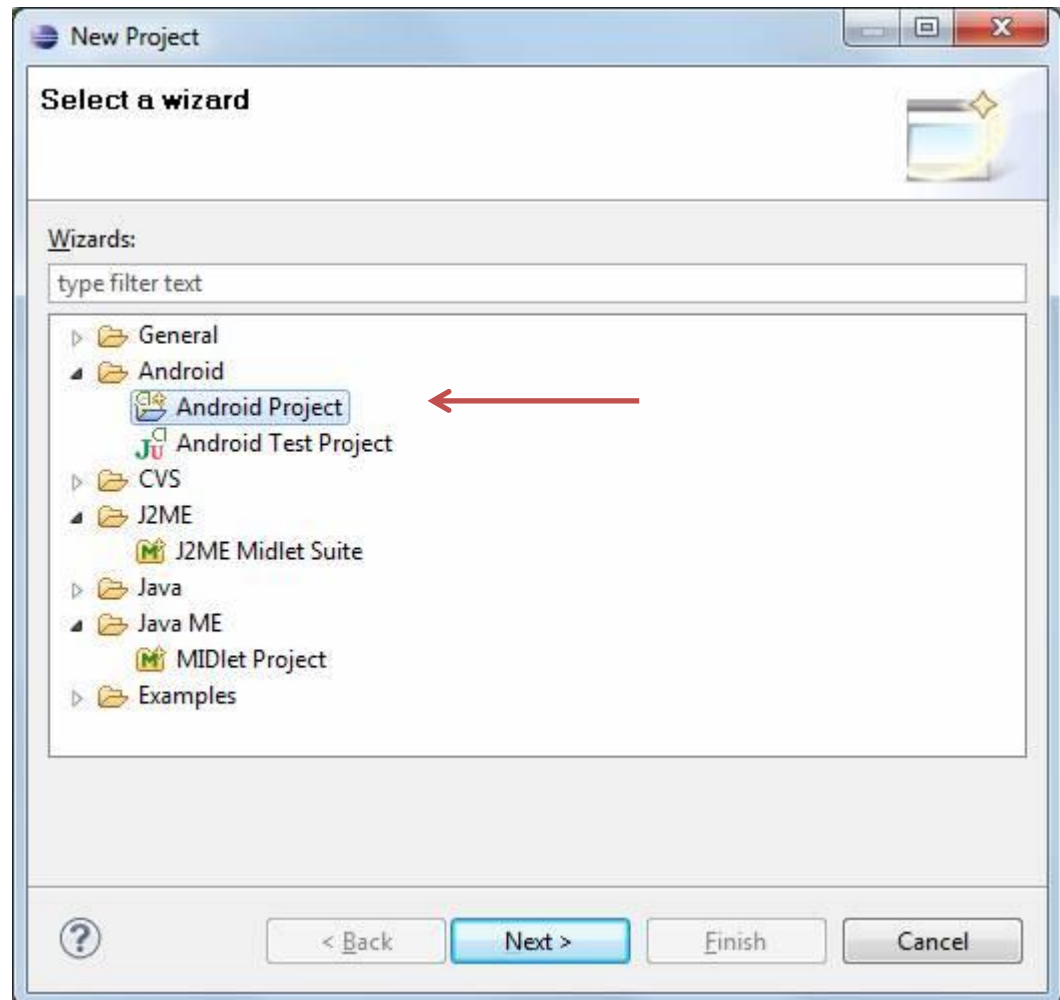


```

C:\WINDOWS\system32\cmd.exe
H:\tools>adb -d shell
$ netcfg
netcfg
lo UP 127.0.0.1 0.0.0.0 0x00000049
dunsp0 DOWN 0.0.0.0 0.0.0.0 0x00000082
rnnet0 DOWN 25.1.184.133 255.255.255.252 0x00001002
rnnet1 DOWN 0.0.0.0 0.0.0.0 0x00001002
rnnet2 DOWN 0.0.0.0 0.0.0.0 0x00001002
t1lan0 UP 192.168.2.185 255.255.255.0 0x00001043
$
$ echo $PATH
echo $PATH
/sbin:/system/sbin:/system/bin:/system/xbin
$ su
su
#
# cd /data/app
cd /data/app
#
# ls -l
ls -l
-rw-r--r-- system system 8615 2009-03-22 18:38 com.msi.flashlight.apk
#
# ping google.com
ping google.com
PING google.com (74.125.45.100) 56(84) bytes of data:
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=1 ttl=241 time=99.3 ms
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=2 ttl=241 time=110 ms
64 bytes from yx-in-f100.google.com (74.125.45.100): icmp_seq=3 ttl=241 time=126 ms
^C
H:\tools>_
  
```

# Development Environment

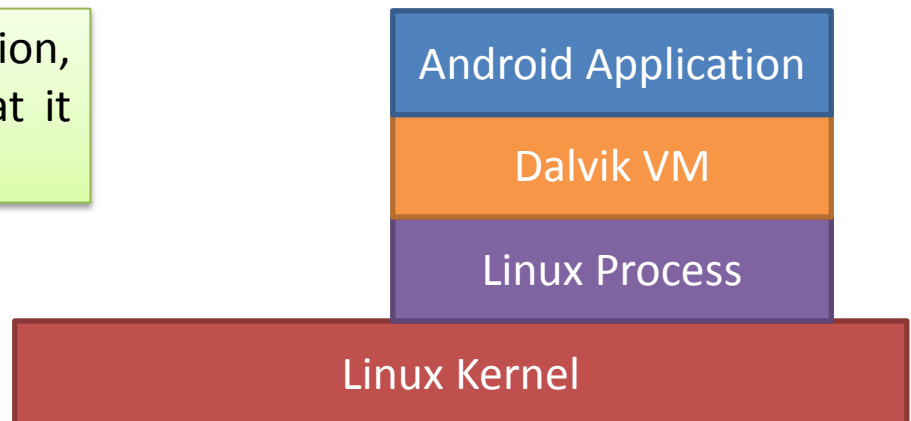
- JDK 5 or 6
- Eclipse IDE
  - JDT plugin
  - ADT plugin



# Application Fundamentals

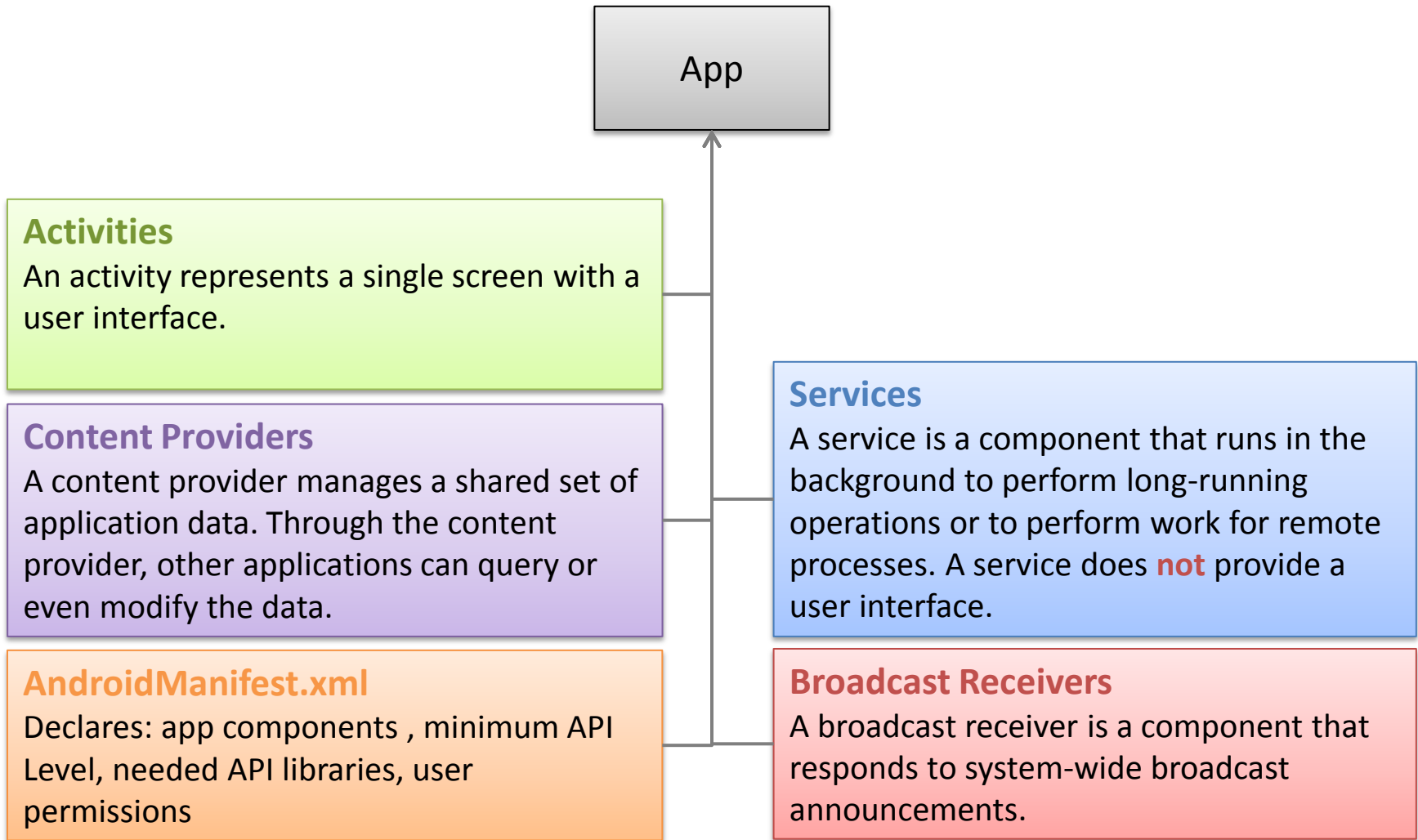
- Development Language: Java
- Android SDK tools compile the code into an Android package, an archive file with an `.apk` suffix
- Security sandbox
  - Each application has a unique Linux user ID
  - Each process has its own virtual machine (VM)
  - Every application runs in its own Linux process

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





# Application Components



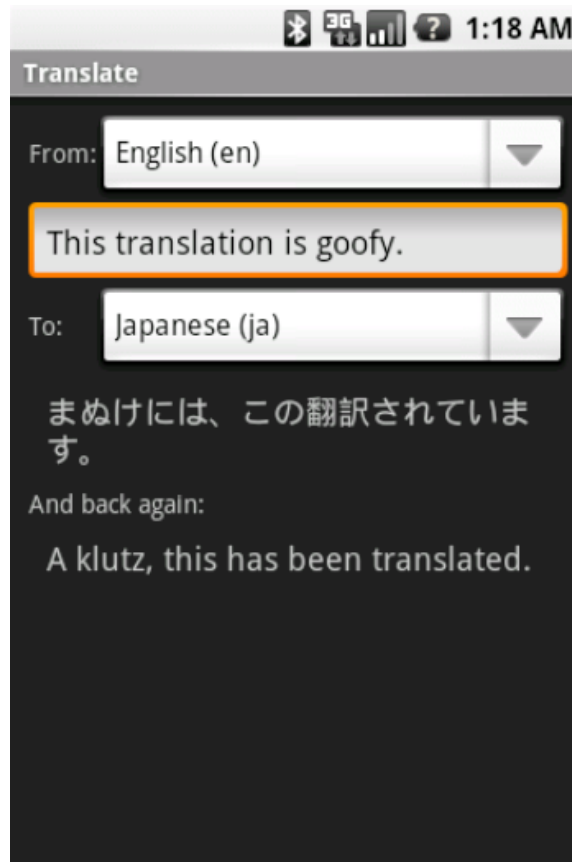
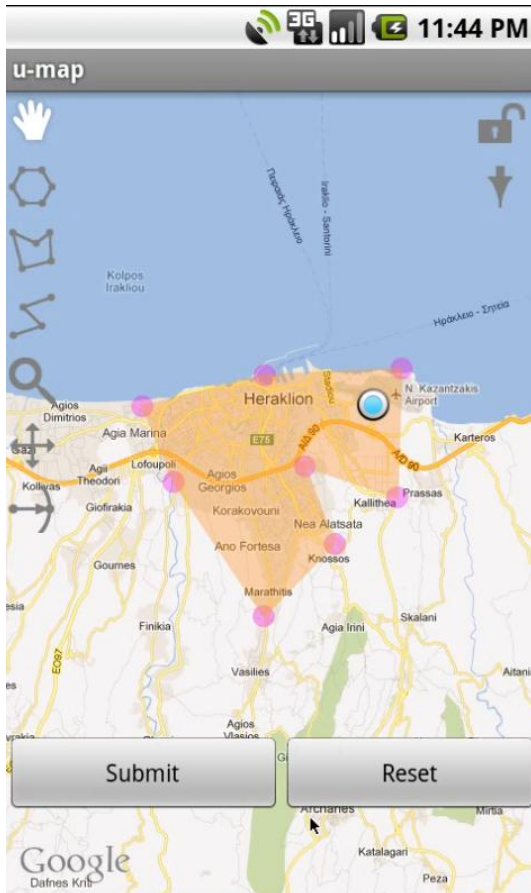
# Cases

Game

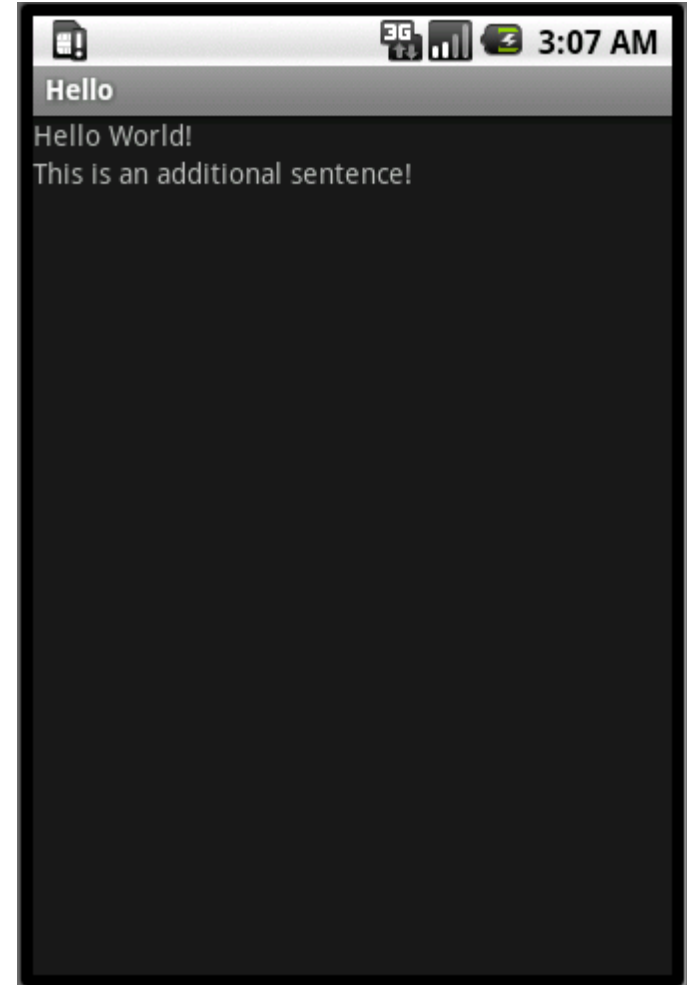
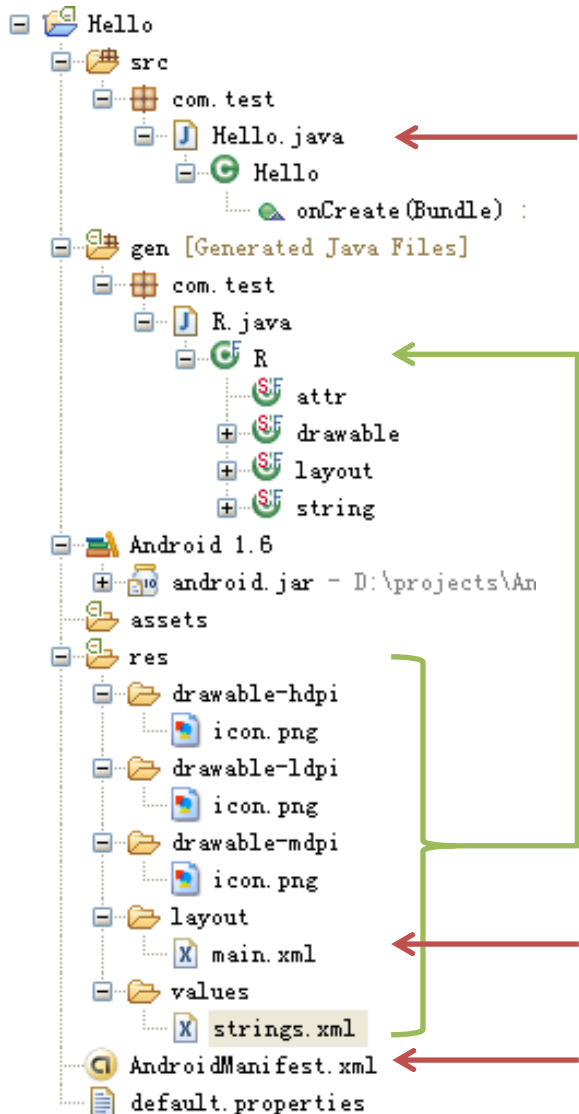
3	6						
		4	2	3		8	
					4	2	
	7	4	6				3
8	2						1 4
5				1	3		2
		1	9				
	7		4	8	3		
							4 5



# Cases

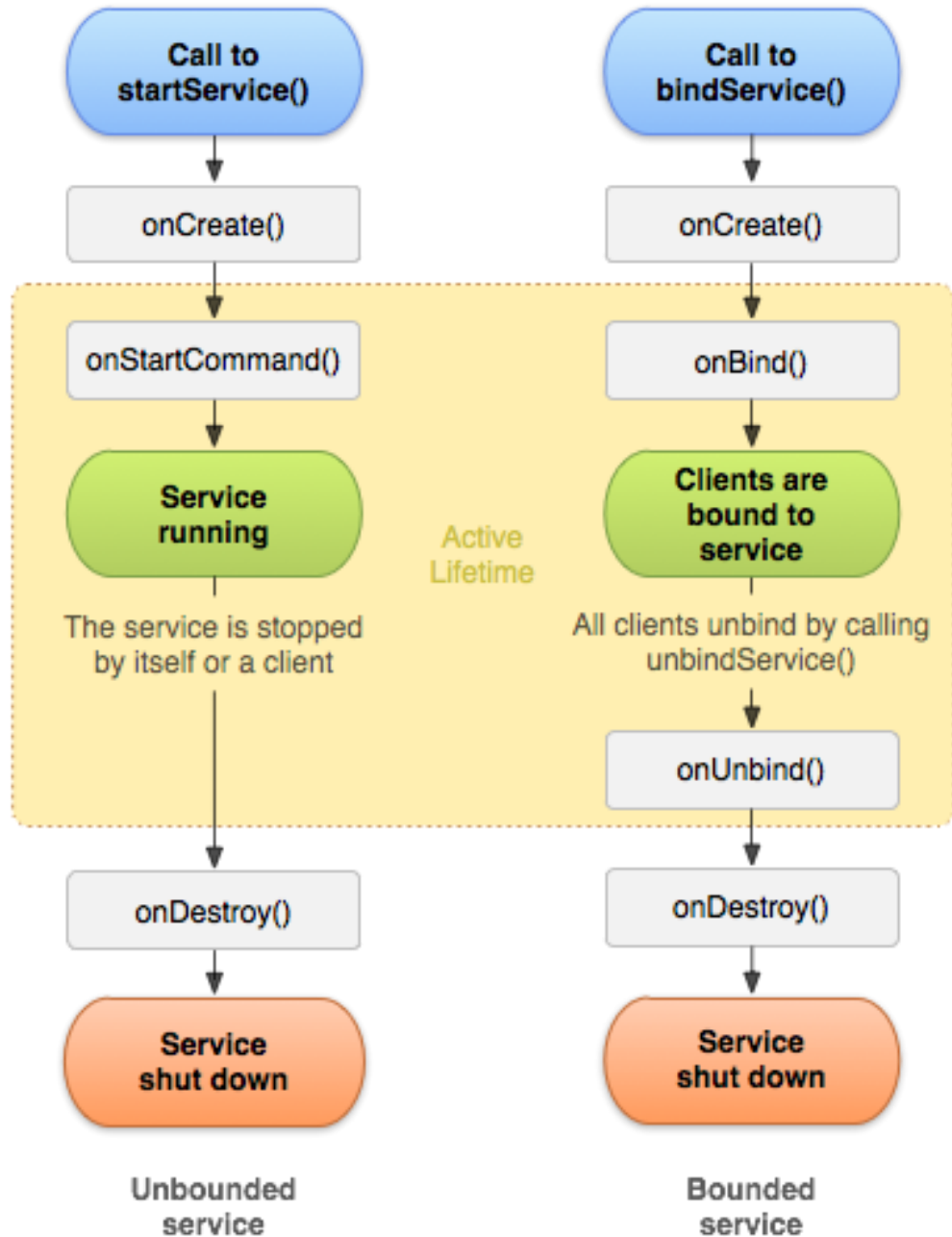


# Case: Hello World





# 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>