An Introduction to Android

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Outline

• Background
• What is Android
• Android as a Sensor
• Develop for Android
Background
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)

Background

Mobile Operators
- China Mobile
- Sprint
- T-Mobile
- Telefonica
- Vodafone

Handset Manufacturers
- Acer
- Asus
- Garmin
- HTC
- Huawei
- Lenovo
- LG Electronics
- Motorola
- Samsung
- Sony Ericsson
- Toshiba

Semiconductor Companies
- AKM
- Audience
- ARM
- Intel
- Atheros
- Broadcom
- MIPS Technologies
- NVIDIA
- ST Ericsson

Software Companies
- Aplix Corporation
- eBay
- Google
- Logic Supply
- Myriad
- Nuance
- Omron
- PV
- SkyPop

Commercialization Companies
- Ascender Corporation
- 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
What is Android?

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
What is Android?

**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't 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 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
  – **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
• 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

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

• No compulsory applications
• Equality among apps
• Easily embedded web browser
• Parallel running
What is Android? > Android Architecture

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

Diagram:

- Apps
  - Java
  - App Framework
- Libraries
  - C/C++
  - Runtime
- C
  - Linux Kernel
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
• 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
• 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.
Develop for Android

Application Components

Activities
An activity represents a single screen with a user interface.

Content Providers
A content provider manages a shared set of application data. Through the content provider, other applications can query or even modify the data.

AndroidManifest.xml
Declares: app components, minimum API Level, needed API libraries, user permissions

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.

Broadcast Receivers
A broadcast receiver is a component that responds to system-wide broadcast announcements.
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Cases

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OpenGL
Cases

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**Translate**

From: English (en)  
To: Japanese (ja)  
This translation is goofy.

And back again:  
A klutz, this has been translated.

**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

Develop for Android

Hello World!
This is an additional sentence!
Activity Lifecycle

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Service Lifecycle

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- **Call to startService()**
  - onCreate()
  - onStartCommand()
  - Service running
    - The service is stopped by itself or a client
  - onDestroy()
  - Service shut down

Unbounded service

- **Call to bindService()**
  - onCreate()
  - onBind()
  - Clients are bound to service
    - All clients unbind by calling unbindService()
  - onUnbind()
  - onDestroy()
  - Service shut down

Bounded service
• 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**

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

• **Application Fundamentals**

• **Layouts**