Android Overview

Tomi.Mickelsson@idean.com
Senior Technology Specialist
http://mobiledevcamp.fi/
http://www.slideshare.net/atomi/
Feb 21, 2009

Agenda

- Why Android?
- What is it?
- SDK and tools
- UI and widgets
- Resources, animation
- Debugging, packaging
- Market
- Demo: Spin the Bottle app

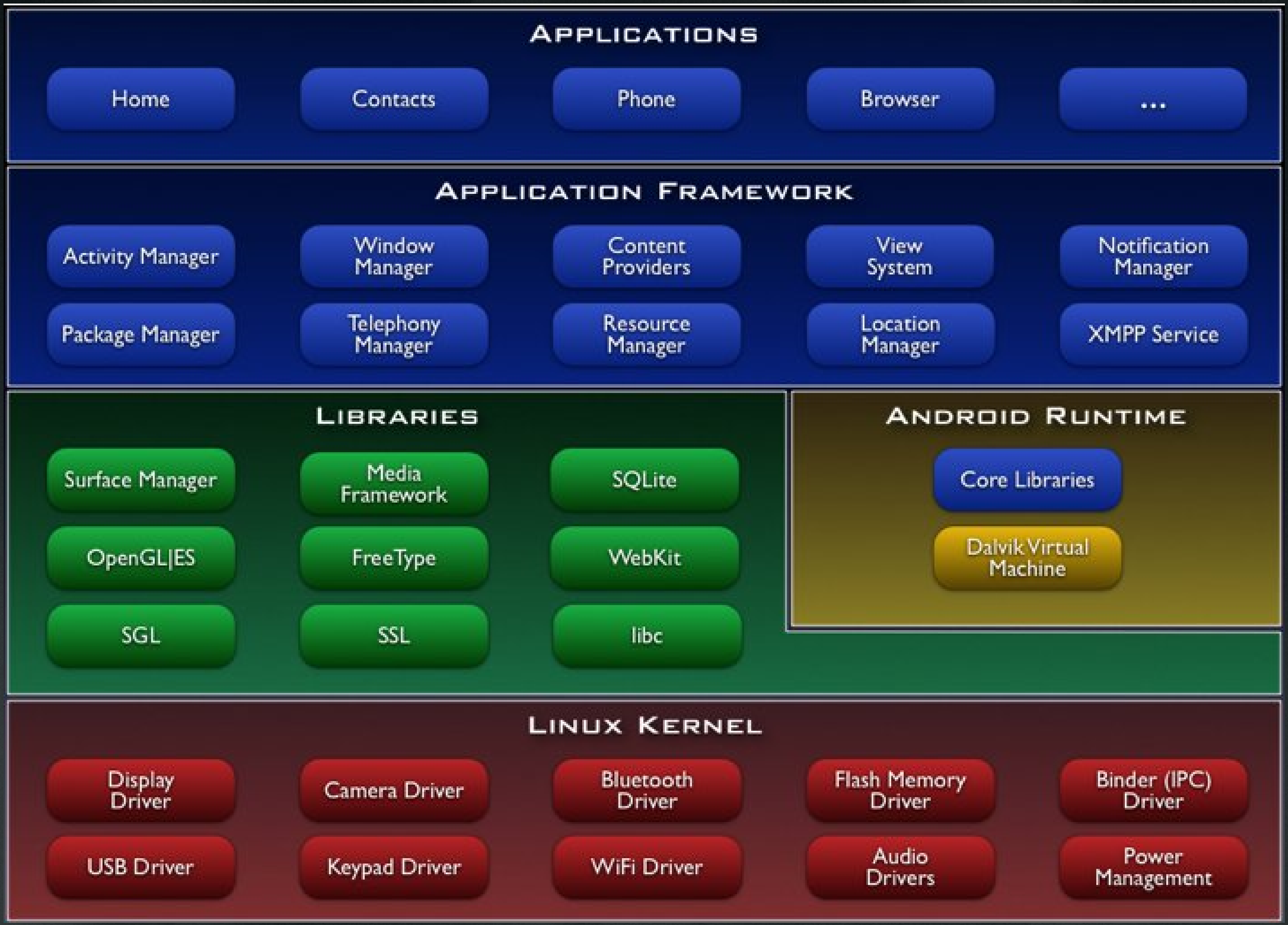
What is Android?

- modern open-source mobile operating system
- full software stack
  - Linux kernel 2.6
  - Java middleware, framework
  - core applications
- Google & OHA

Why Android?

- open-source
  - apache license
  - cost
  - sets developers free
- solid foundation: Linux kernel
- good framework based on Java
- empower users
  - replace core apps
  - personalize
- Google stuff
- huge opportunity for vendors, developers, users
  - OS for free, innovate at app level
- not just for phones

Building blocks



APPLICATIONS

Home, Contacts, Phone, Browser, ...

APPLICATION FRAMEWORK

Activity Manager, Window Manager, Content Providers, View System, Notification Manager

Package Manager, Telephony Manager, Resource Manager, Location Manager, XMPP Service

LIBRARIES

Surface Manager, Media Framework, SQLite

OpenGL|ES, FreeType, WebKit

SGL, SSL, libc

ANDROID RUNTIME

Core Libraries

Dalvik Virtual Machine

LINUX KERNEL

Display Driver, Camera Driver, Bluetooth Driver, Flash Memory Driver, Binder (IPC) Driver

USB Driver, Keypad Driver, WiFi Driver, Audio Drivers, Power Management

Java Framework

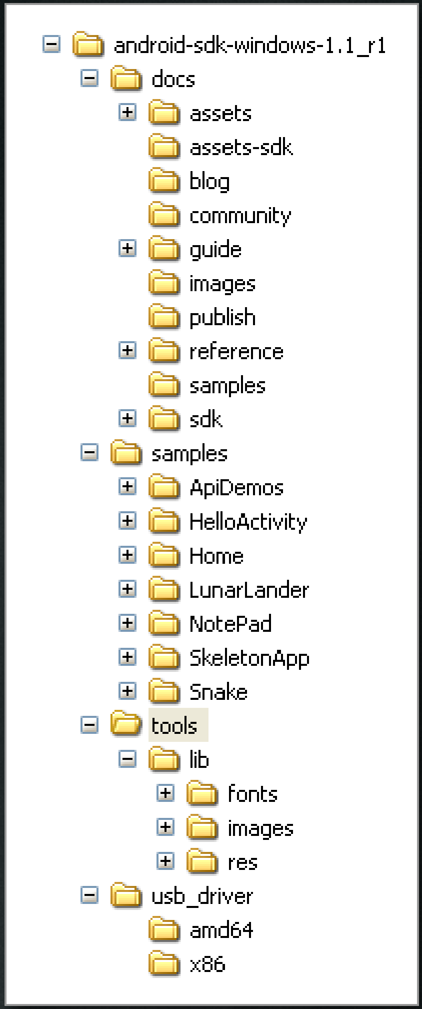
- Java: reasonable choice
  - mainstream language
  - millions of developers
- J2SE, not J2ME
- Dalvik VM: fast register based VM
- modular app architecture
  - building screens and services, not monolithic black-boxes
  - loosely coupled, addressable parts
- every app runs its own process
- multitasking; background processes
- JNI discouraged at this point
- other frameworks possible

Quickstart

- install JDK 1.5
- install Android SDK
- install eclipse
- read SDK docs
- learn about samples, API demos
- get help from newsgroup
- read sources for advanced stuff
- test on G1 or dev phone
- publish app in Market

SDK

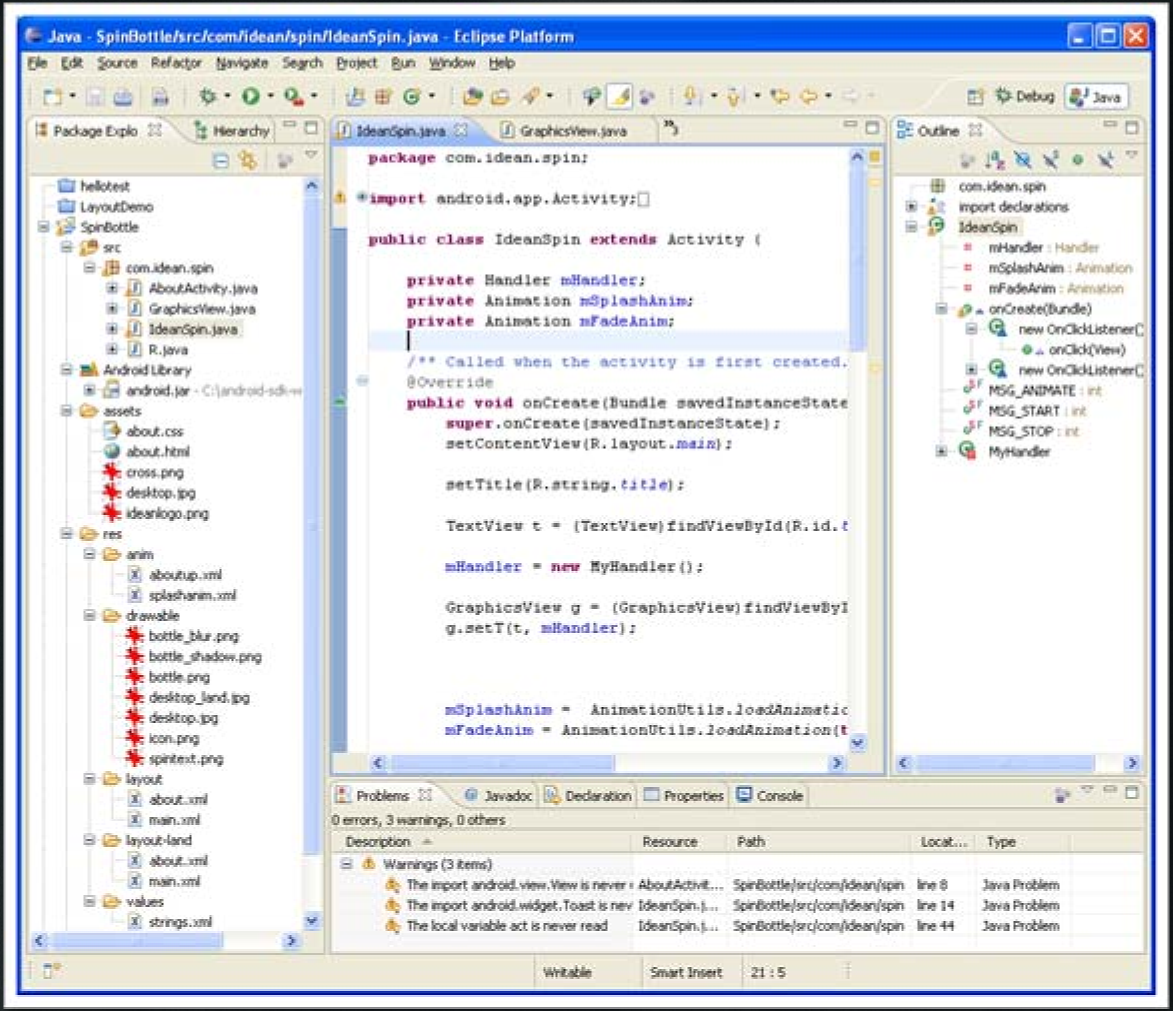
- all platforms supported
  - linux, windows, mac
- no installation, just unzip
- 81.4MB - ver1.1
- clean and compact
- good documentation
- 1.1 latest version



```
⊟ android-sdk-windows-1.1_r1
  ⊟ docs
    ⊞ assets
      assets-sdk
      blog
      community
    ⊞ guide
      images
      publish
    ⊞ reference
      samples
    ⊞ sdk
  ⊟ samples
    ⊞ ApiDemos
    ⊞ HelloActivity
    ⊞ Home
    ⊞ LunarLander
    ⊞ NotePad
    ⊞ SkeletonApp
    ⊞ Snake
  ⊟ tools
    ⊟ lib
      ⊞ fonts
      ⊞ images
      ⊞ res
  ⊟ usb_driver
      amd64
      x86
```

Eclipse Editor

- most popular Java editor
  - tons of features
  - refactoring
  - debugging
  - integrated help
- ADT: Android Development Tools plugin

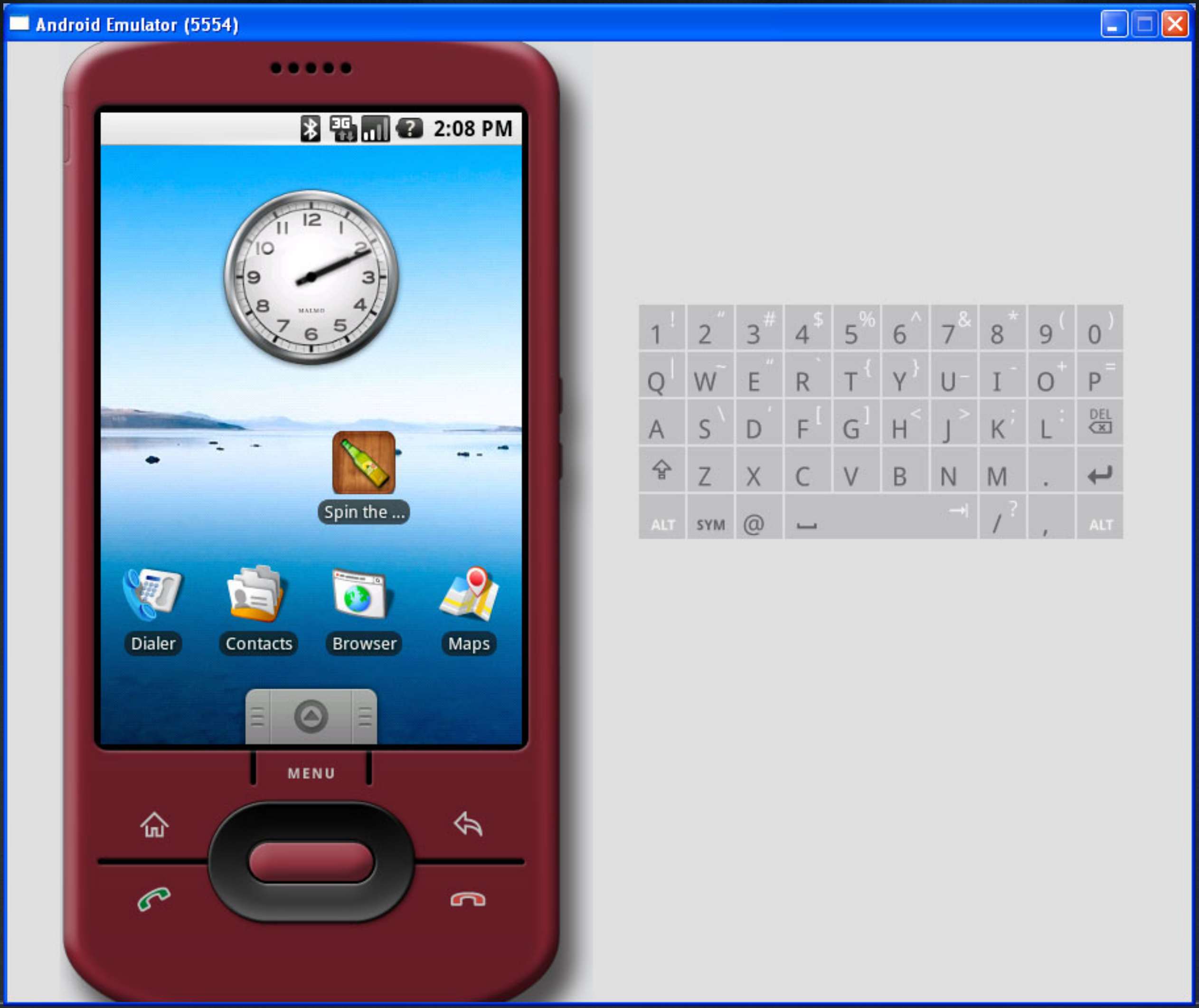


```
package com.idean.spin;

import android.app.Activity;

public class IdeanSpin extends Activity {

    private Handler mHandler;
    private Animation mSplashAnim;
    private Animation mFadeAnim;

    /** Called when the activity is first created.
    @Override
    public void onCreate(Bundle savedInstanceState
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);

        setTitle(R.string.title);

        TextView t = (TextView)findViewById(R.id.t

        mHandler = new MyHandler();

        GraphicsView g = (GraphicsView)findViewByI
        g.setT(t, mHandler);



        mSplashAnim =  AnimationUtils.loadAnimatic
        mFadeAnim = AnimationUtils.loadAnimation(t
```

0 errors, 3 warnings, 0 others

Description	Resource	Path	Locat...	Type
Warnings (3 items)				
The import android.view.View is never	AboutActivit...	SpinBottle/src/com/idean/spin	line 8	Java Problem
The import android.widget.Toast is nev	IdeanSpin.j...	SpinBottle/src/com/idean/spin	line 14	Java Problem
The local variable act is never read	IdeanSpin.j...	SpinBottle/src/com/idean/spin	line 44	Java Problem

Emulator


Android Emulator (5554)
2:08 PM
Spin the ...
Dialer
Contacts
Browser
Maps
MENU
1 2 3 4 5 6 7 8 9 0
Q W E R T Y U I O P
A S D F G H J K L DEL
Z X C V B N M .
ALT SYM @ / , ALT

Emulator

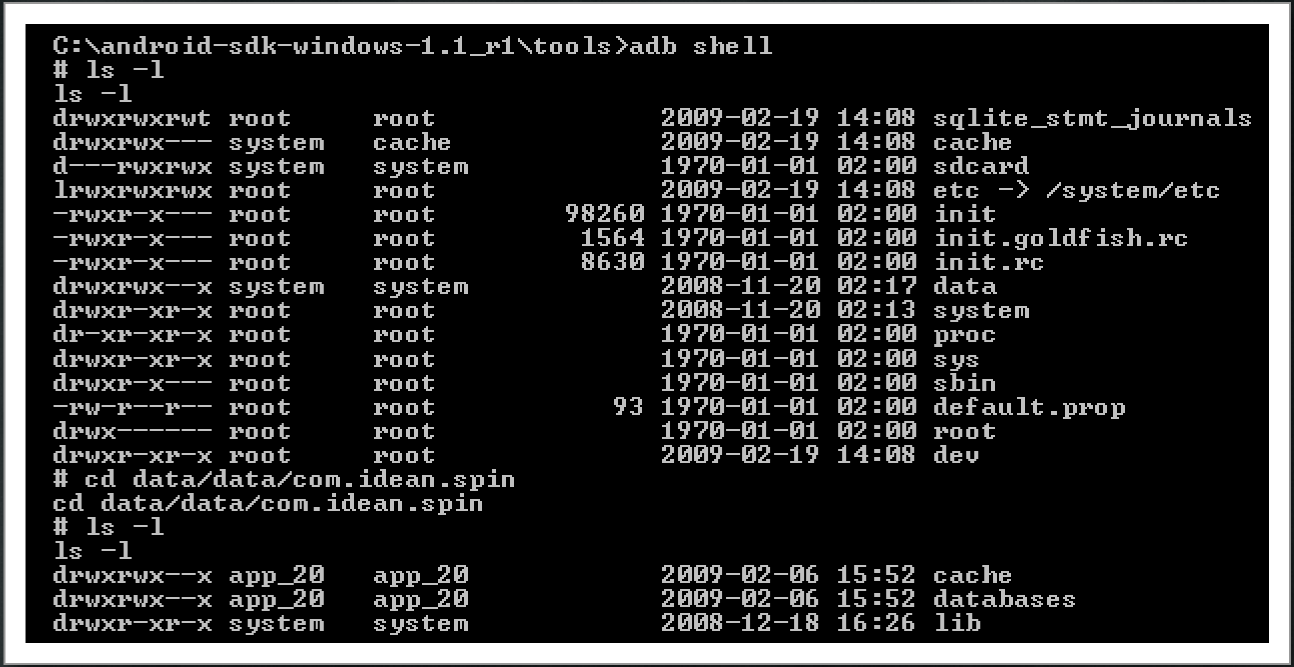
- based on QEMU emulator for ARM processor
  - boots up real linux kernel
- camera previews
- easy networking
- audio recording
- switch orientation: CTRL+F12
- install apps with browser or adb
- market app not available
- skins

Tools in SDK

- all tools available as cmdline
  - eclipse not required
- adb - Android Debug Bridge
  - adb push - transfer files from/to emulator
  - adb install - install app
  - adb logcat - view debug log
  - adb shell - linux shell access
- aapt - Android Asset Packaging Tool
- ddms
- draw9patch
- mksdcard
- hierarchyviewer
- sqlite

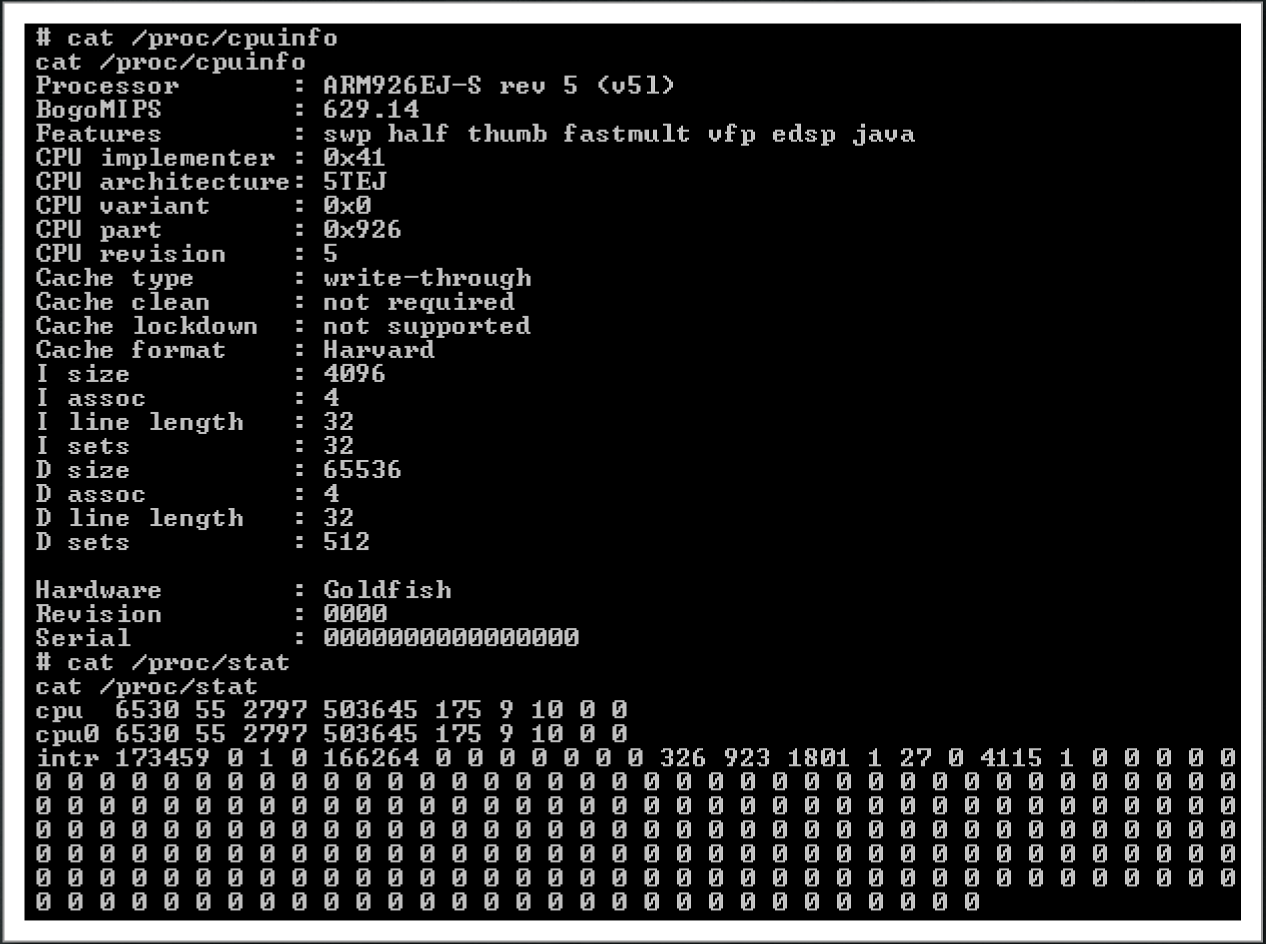
Tools - adb shell

- live shell access to emulator file system



```
C:\android-sdk-windows-1.1_r1\tools>adb shell
# ls -l
ls -l
drwxrwxrwt root     root              2009-02-19 14:08 sqlite_stmt_journals
drwxrwx--- system   cache             2009-02-19 14:08 cache
d---rwxrwx system   system            1970-01-01 02:00 sdcard
lrwxrwxrwx root     root              2009-02-19 14:08 etc -> /system/etc
-rwxr-x--- root     root        98260 1970-01-01 02:00 init
-rwxr-x--- root     root         1564 1970-01-01 02:00 init.goldfish.rc
-rwxr-x--- root     root         8630 1970-01-01 02:00 init.rc
drwxrwx--x system   system            2008-11-20 02:17 data
drwxr-xr-x root     root              2008-11-20 02:13 system
dr-xr-xr-x root     root              1970-01-01 02:00 proc
drwxr-xr-x root     root              1970-01-01 02:00 sys
drwxr-x--- root     root              1970-01-01 02:00 sbin
-rw-r--r-- root     root           93 1970-01-01 02:00 default.prop
drwx------ root     root              1970-01-01 02:00 root
drwxr-xr-x root     root              2009-02-19 14:08 dev
# cd data/data/com.idean.spin
cd data/data/com.idean.spin
# ls -l
ls -l
drwxrwx--x app_20   app_20            2009-02-06 15:52 cache
drwxrwx--x app_20   app_20            2009-02-06 15:52 databases
drwxr-xr-x system   system            2008-12-18 16:26 lib
```

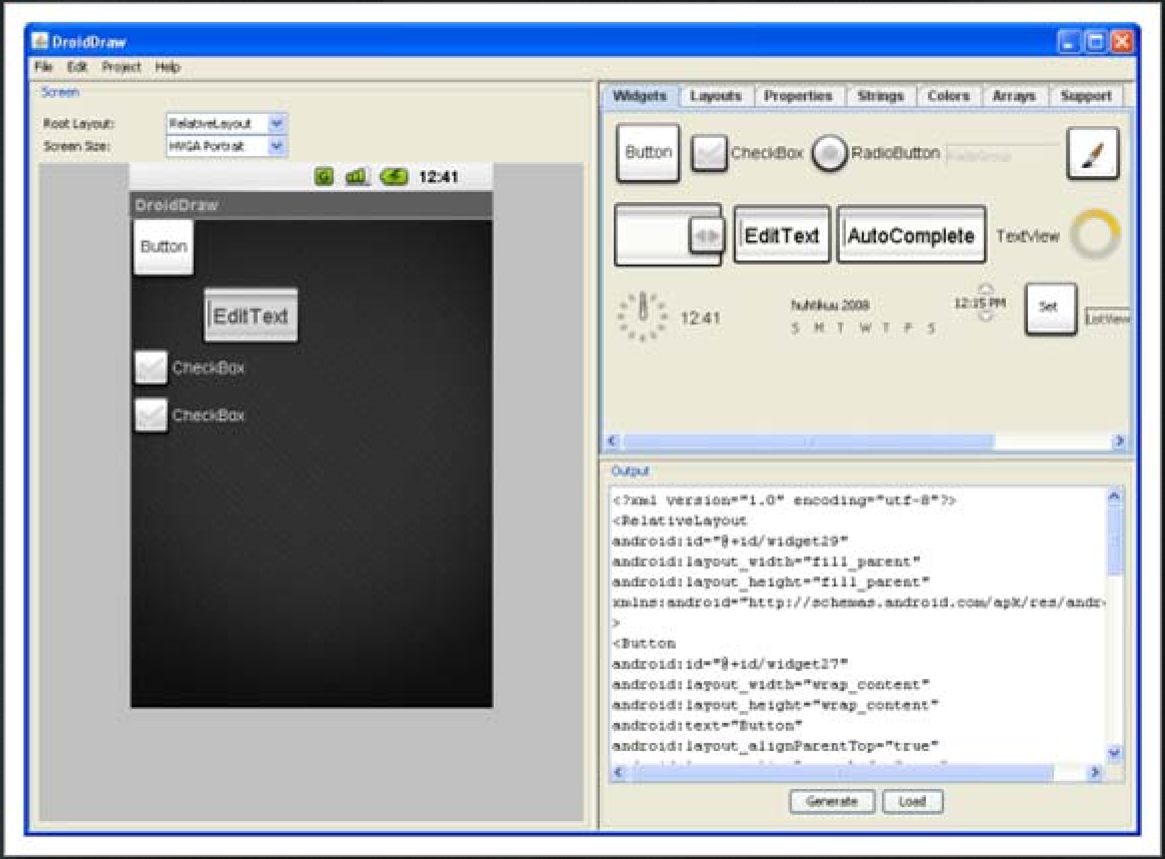
Tools - cpuinfo



```
# cat /proc/cpuinfo
cat /proc/cpuinfo
Processor        : ARM926EJ-S rev 5 (v5l)
BogoMIPS         : 629.14
Features         : swp half thumb fastmult vfp edsp java
CPU implementer : 0x41
CPU architecture: 5TEJ
CPU variant      : 0x0
CPU part         : 0x926
CPU revision     : 5
Cache type       : write-through
Cache clean      : not required
Cache lockdown   : not supported
Cache format     : Harvard
I size           : 4096
I assoc          : 4
I line length    : 32
I sets           : 32
D size           : 65536
D assoc          : 4
D line length    : 32
D sets           : 512

Hardware         : Goldfish
Revision         : 0000
Serial           : 0000000000000000
# cat /proc/stat
cat /proc/stat
cpu  6530 55 2797 503645 175 9 10 0 0
cpu0 6530 55 2797 503645 175 9 10 0 0
intr 173459 0 1 0 166264 0 0 0 0 0 0 0 326 923 1801 1 27 0 4115 1 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

3rd party tools - UI builder

- http://www.droiddraw.org/
- create UI visually

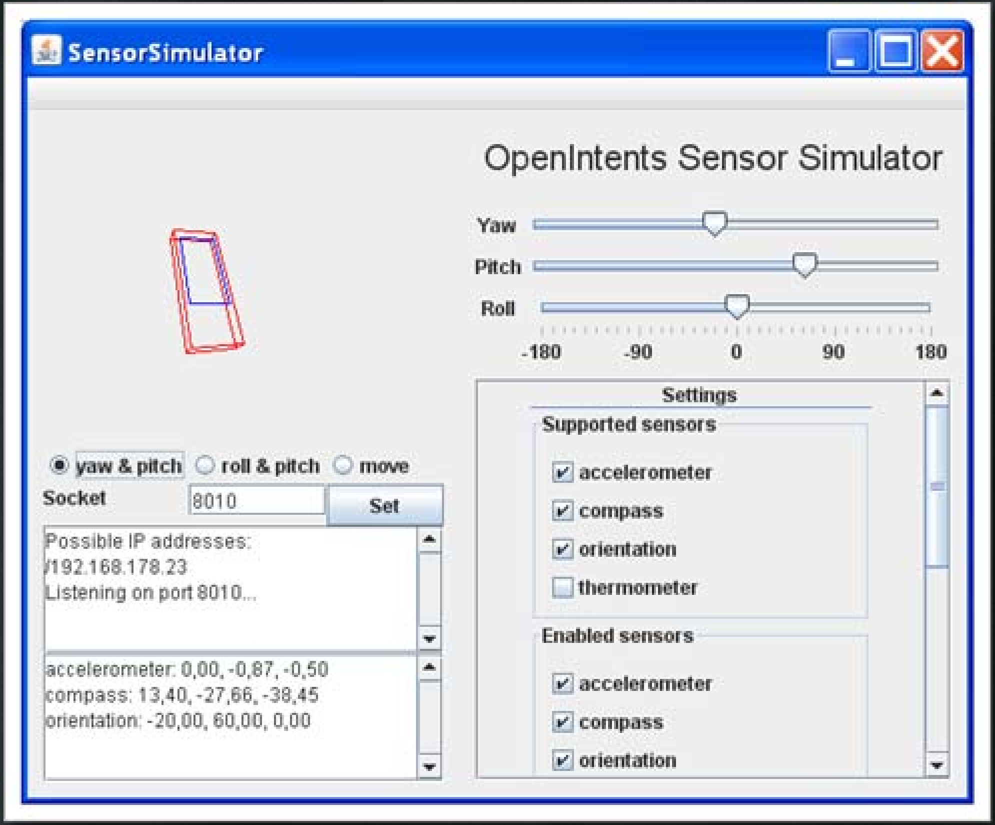


```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout
android:id="@+id/widget29"
android:layout_width="fill_parent"
android:layout_height="fill_parent"
xmlns:android="http://schemas.android.com/apk/res/andr
>
<Button
android:id="@+id/widget27"
android:layout_width="wrap_content"
android:layout_height="wrap_content"
android:text="Button"
android:layout_alignParentTop="true"
```

idean

3rd party tools - Sensor simulator

- http://code.google.com/p/openintents/wiki/SensorSimulator
- feed sensor data to emulator



SensorSimulator
OpenIntents Sensor Simulator
Yaw
Pitch
Roll
-180
-90
0
90
180
● yaw & pitch ○ roll & pitch ○ move
Socket
Set
Settings

Socket 8010

```
Possible IP addresses:
/192.168.178.23
Listening on port 8010...
```

```
accelerometer: 0,00, -0,87, -0,50
compass: 13,40, -27,66, -38,45
orientation: -20,00, 60,00, 0,00
```

Supported sensors

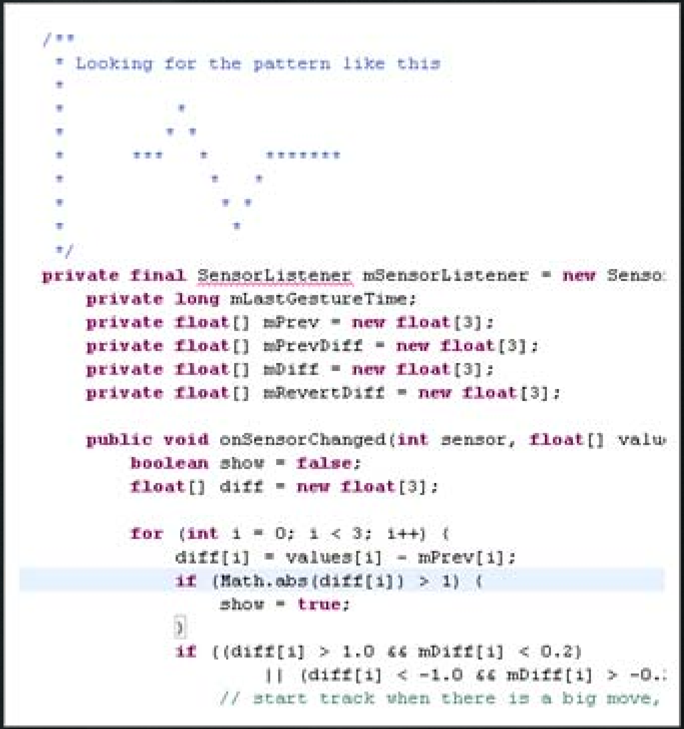
- ☑ accelerometer
- ☑ compass
- ☑ orientation
- □ thermometer

Enabled sensors

- ☑ accelerometer
- ☑ compass
- ☑ orientation

Source code

- "use the source, Luke!"
- http://source.android.com/
- GIT version control
- whole package 2.1GB
- just to peek at some files:
  - http://android.git.kernel.org/
  - http://www.google.com/codesearch
- sources for core apps: launcher, browser...
  - great for learning advanced stuff!



```
/**
 * Looking for the pattern like this
 *
 *          *
 *         * *
 *      ***   *     *******
 *             *   *
 *              * *
 *               *
 */
private final SensorListener mSensorListener = new Senso
    private long mLastGestureTime;
    private float[] mPrev = new float[3];
    private float[] mPrevDiff = new float[3];
    private float[] mDiff = new float[3];
    private float[] mRevertDiff = new float[3];

    public void onSensorChanged(int sensor, float[] valu
        boolean show = false;
        float[] diff = new float[3];

        for (int i = 0; i < 3; i++) {
            diff[i] = values[i] - mPrev[i];
            if (Math.abs(diff[i]) > 1) {
                show = true;
            }
            if ((diff[i] > 1.0 && mDiff[i] < 0.2)
                    || (diff[i] < -1.0 && mDiff[i] > -0.
                // start track when there is a big move,
```

App Architecture

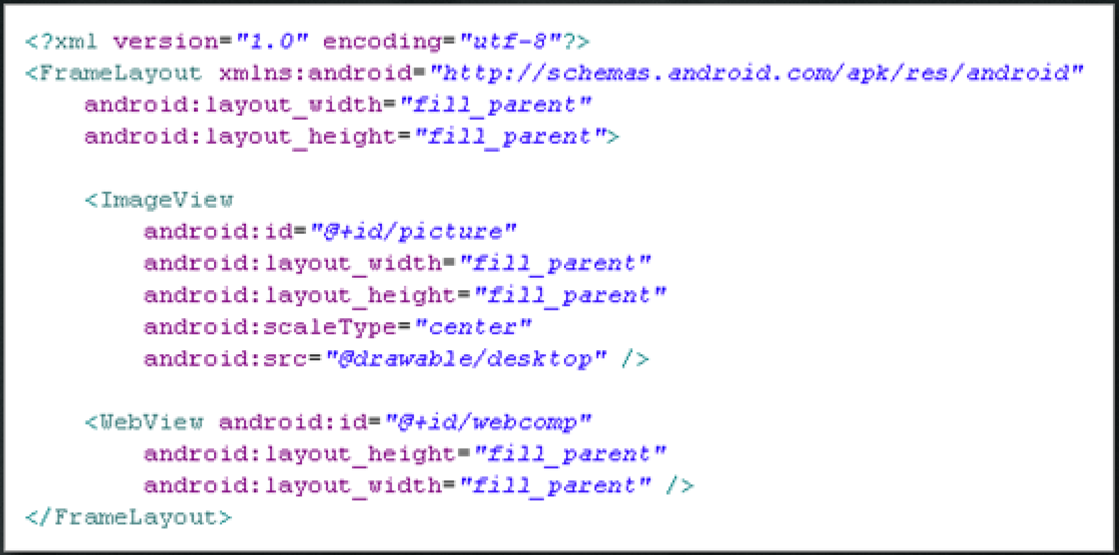
- Activity
  - visible screens
- Service
  - background services
- Content Provider
  - shared data
- Broadcast receivers
  - receive and react to broadcasted events
- Intent
  - activating components

UI

- rich Java UI API
  - layouts and widgets
- declarative programming ala XML
- customization features
  - inherit and override a base widget
  - combine existing widgets
  - fully draw yourself - View::onDraw(Canvas canvas)
- designed for touch right from start
  - padmode, touhmode
  - context menu with a long touch
- focus management
- OpenGL
- may not beat iPhone, but foundation ok for future

Layouts

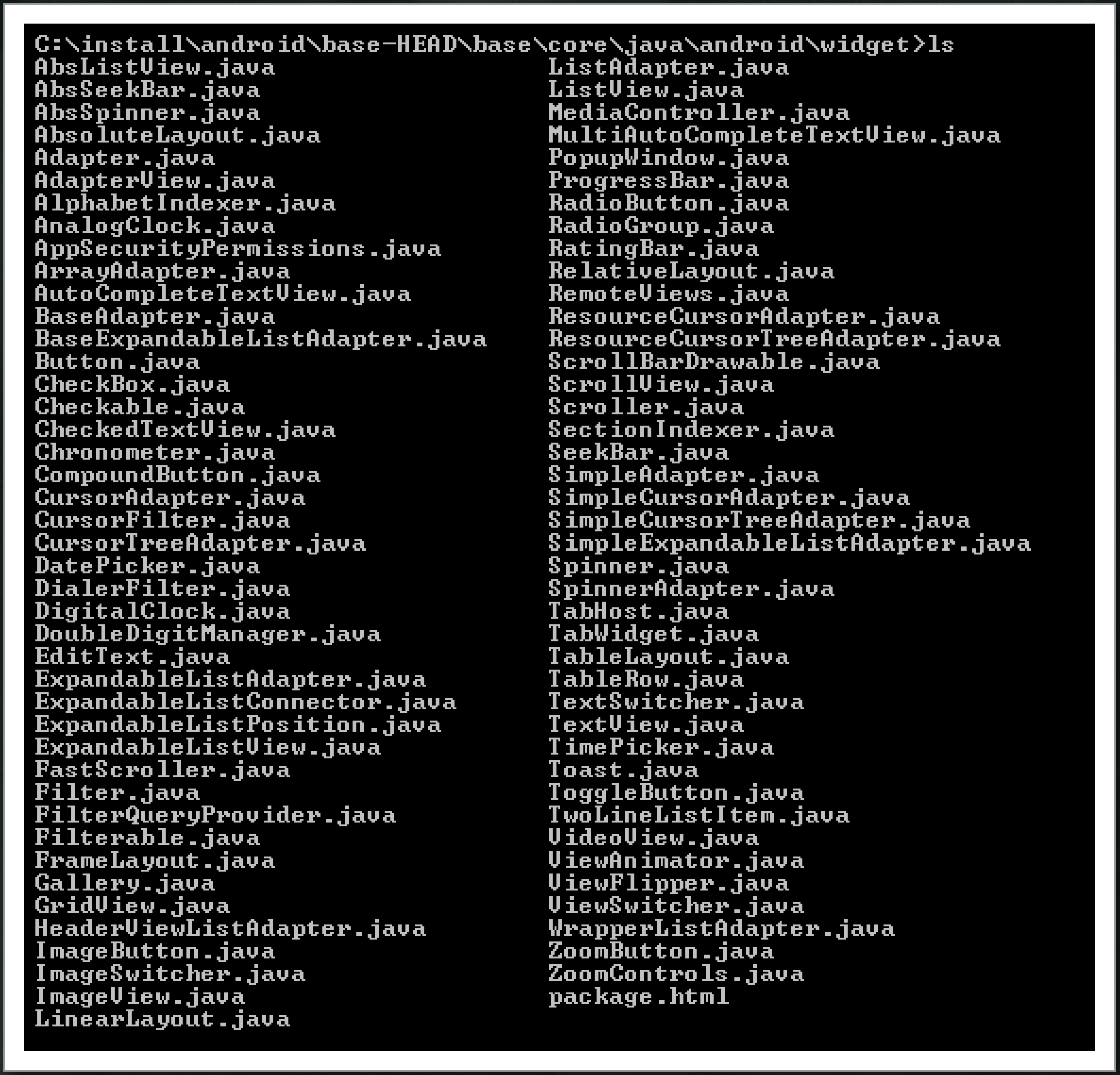
- container for widgets
- XML party; similar to web's XHTML
- widgets refered from code with IDs
- relative layouts, fits in various screens
- AbsoluteLayout discouraged



```xml
<?xml version="1.0" encoding="utf-8"?>
<FrameLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent">

    <ImageView
        android:id="@+id/picture"
        android:layout_width="fill_parent"
        android:layout_height="fill_parent"
        android:scaleType="center"
        android:src="@drawable/desktop" />

    <WebView android:id="@+id/webcomp"
        android:layout_height="fill_parent"
        android:layout_width="fill_parent" />
</FrameLayout>
```

Widgets

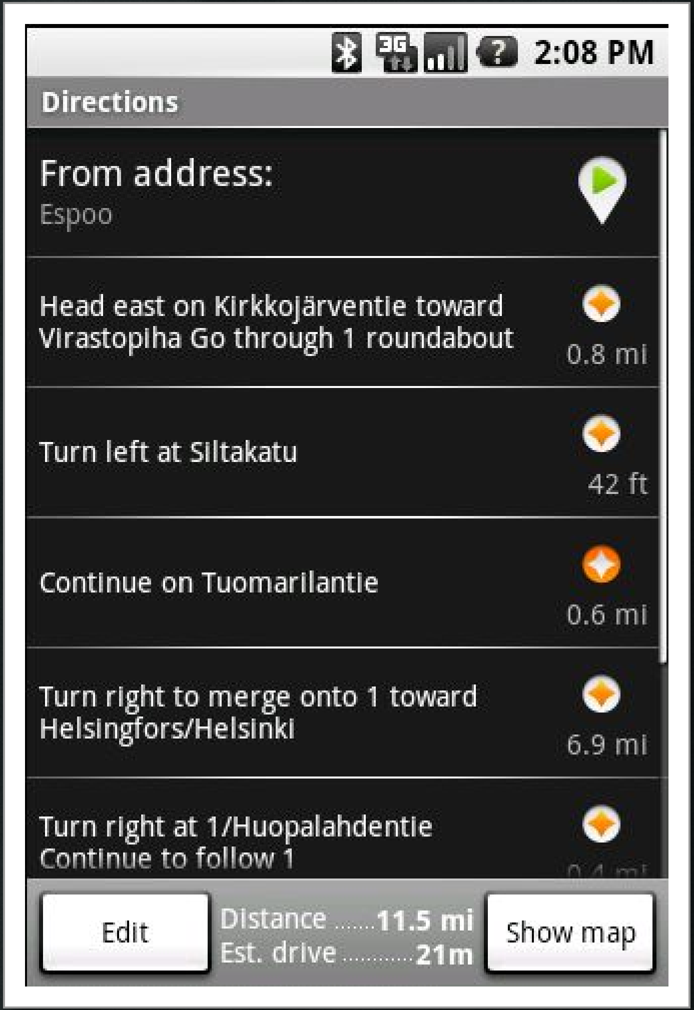
- great number of widgets
- android.widgets.*



```
C:\install\android\base-HEAD\base\core\java\android\widget>ls
AbsListView.java                   ListAdapter.java
AbsSeekBar.java                    ListView.java
AbsSpinner.java                    MediaController.java
AbsoluteLayout.java                MultiAutoCompleteTextView.java
Adapter.java                       PopupWindow.java
AdapterView.java                   ProgressBar.java
AlphabetIndexer.java               RadioButton.java
AnalogClock.java                   RadioGroup.java
AppSecurityPermissions.java        RatingBar.java
ArrayAdapter.java                  RelativeLayout.java
AutoCompleteTextView.java          RemoteViews.java
BaseAdapter.java                   ResourceCursorAdapter.java
BaseExpandableListAdapter.java     ResourceCursorTreeAdapter.java
Button.java                        ScrollBarDrawable.java
CheckBox.java                      ScrollView.java
Checkable.java                     Scroller.java
CheckedTextView.java               SectionIndexer.java
Chronometer.java                   SeekBar.java
CompoundButton.java                SimpleAdapter.java
CursorAdapter.java                 SimpleCursorAdapter.java
CursorFilter.java                  SimpleCursorTreeAdapter.java
CursorTreeAdapter.java             SimpleExpandableListAdapter.java
DatePicker.java                    Spinner.java
DialerFilter.java                  SpinnerAdapter.java
DigitalClock.java                  TabHost.java
DoubleDigitManager.java            TabWidget.java
EditText.java                      TableLayout.java
ExpandableListAdapter.java         TableRow.java
ExpandableListConnector.java       TextSwitcher.java
ExpandableListPosition.java        TextView.java
ExpandableListView.java            TimePicker.java
FastScroller.java                  Toast.java
Filter.java                        ToggleButton.java
FilterQueryProvider.java           TwoLineListItem.java
Filterable.java                    VideoView.java
FrameLayout.java                   ViewAnimator.java
Gallery.java                       ViewFlipper.java
GridView.java                      ViewSwitcher.java
HeaderViewListAdapter.java         WrapperListAdapter.java
ImageButton.java                   ZoomButton.java
ImageSwitcher.java                 ZoomControls.java
ImageView.java                     package.html
LinearLayout.java
```

Widgets - ListView

- most common widget; the workhorse
  - learn well
- scroll and fling
- list fading at ends
- scrollbar on off
- cache optimization



From address:
Espoo

Head east on Kirkkojärventie toward Virastopiha Go through 1 roundabout 0.8 mi

Turn left at Siltakatu 42 ft

Continue on Tuomarilantie 0.6 mi

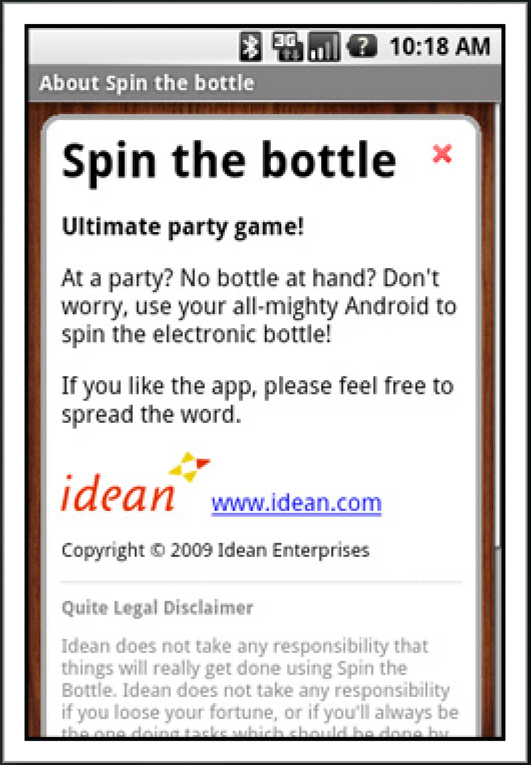
Turn right to merge onto 1 toward Helsingfors/Helsinki 6.9 mi

Turn right at 1/Huopalahdentie Continue to follow 1 0.4 mi

Distance ....11.5 mi
Est. drive 21m

Widgets - Webkit

- embedded browser
- fetch local or remote content
- Javascript and AJAX supported
- bridge for Java/Javascript communication



10:18 AM

About Spin the bottle

Spin the bottle

Ultimate party game!

At a party? No bottle at hand? Don't worry, use your all-mighty Android to spin the electronic bottle!

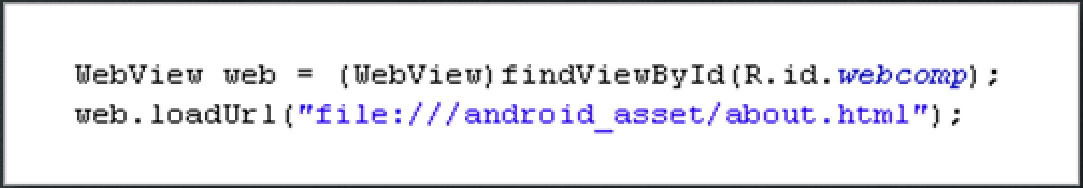
If you like the app, please feel free to spread the word.

idean www.idean.com

Copyright © 2009 Idean Enterprises

Quite Legal Disclaimer

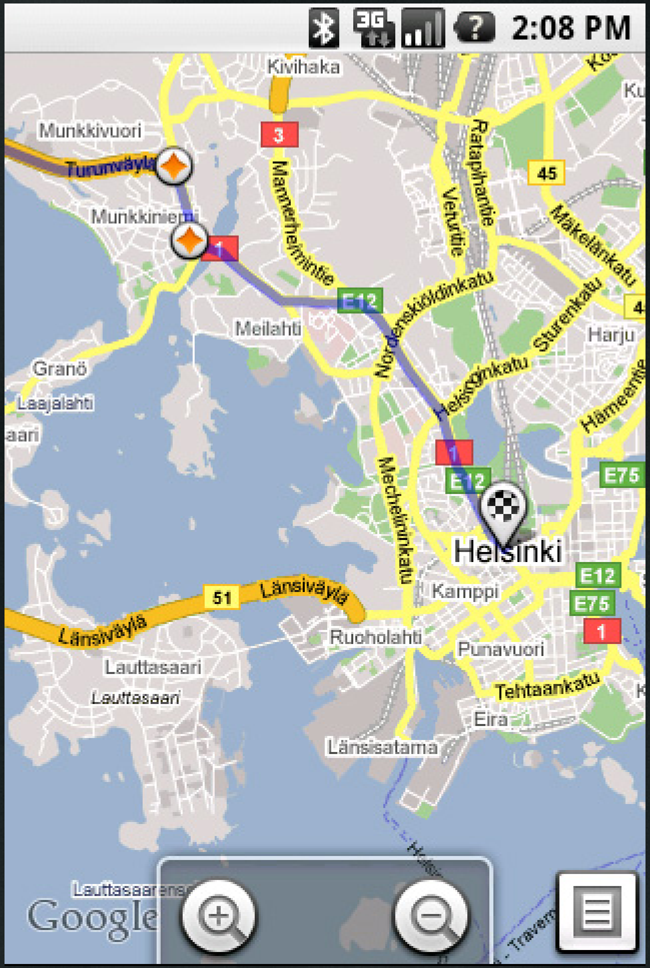
Idean does not take any responsibility that things will really get done using Spin the Bottle. Idean does not take any responsibility if you loose your fortune, or if you'll always be the one doing tasks which should be done by



```
WebView web = (WebView)findViewById(R.id.webcomp);
web.loadUrl("file:///android_asset/about.html");
```

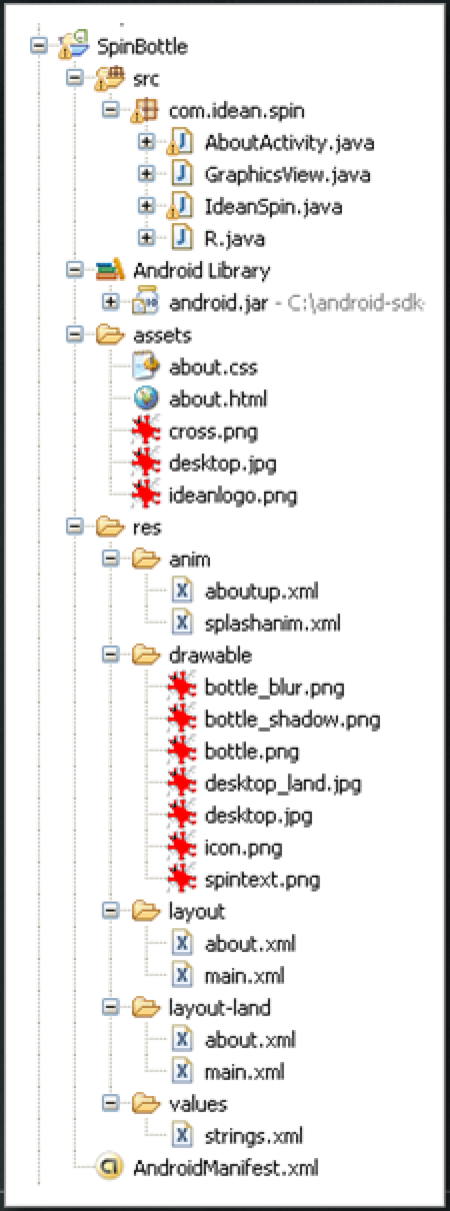
Widgets - MapView

- location-based apps will be hot
- maps built-in
- based on Google Maps



Resources

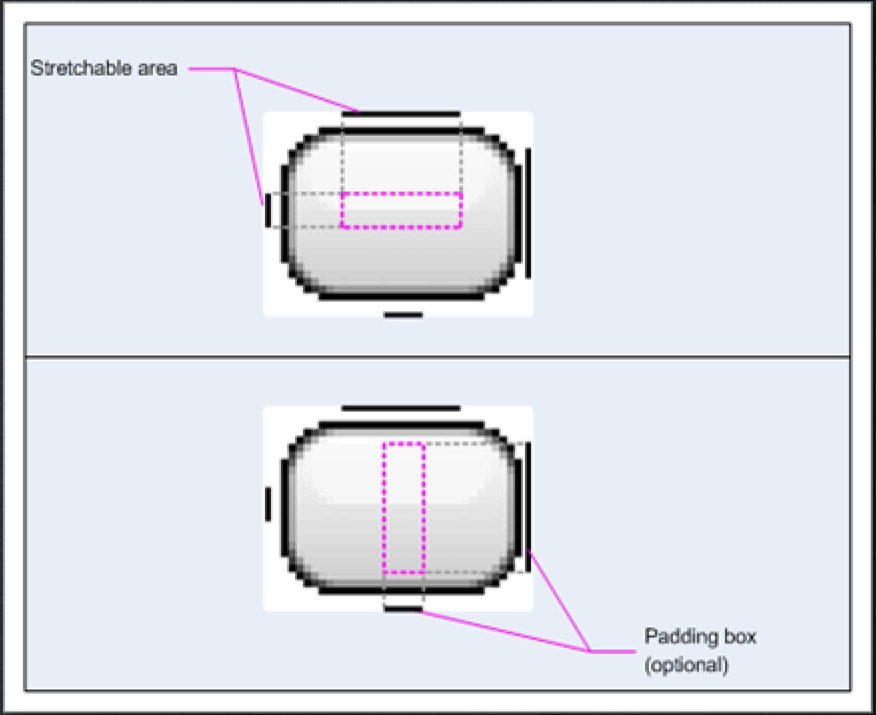
- images, audio, video, strings, layouts, themes, color values
- divided into logical dir hierarchy
- fetch from code
  - drawables: Resources.getDrawable()
  - XML: Resources.getXML()
  - strings: Resources.getString()
  - raw: Resources.openRawResource()
- intelligent resource matching
  - values-en/, values-fr/
  - drawable-land/
  - drawable-nokeys/
  - drawable-en-finger/
- XML all over

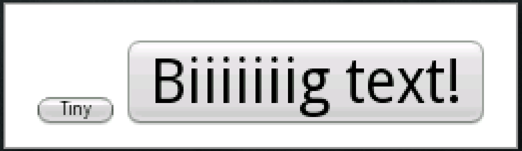


```
⊟ SpinBottle
  ⊟ src
    ⊟ com.idean.spin
      ⊞ AboutActivity.java
      ⊞ GraphicsView.java
      ⊞ IdeanSpin.java
      ⊞ R.java
  ⊟ Android Library
    ⊞ android.jar - C:\android-sdk
  ⊟ assets
      about.css
      about.html
      cross.png
      desktop.jpg
      ideanlogo.png
  ⊟ res
    ⊟ anim
        aboutup.xml
        splashanim.xml
    ⊟ drawable
        bottle_blur.png
        bottle_shadow.png
        bottle.png
        desktop_land.jpg
        desktop.jpg
        icon.png
        spintext.png
    ⊟ layout
        about.xml
        main.xml
    ⊟ layout-land
        about.xml
        main.xml
    ⊟ values
        strings.xml
    AndroidManifest.xml
```

9-Patch Bitmaps

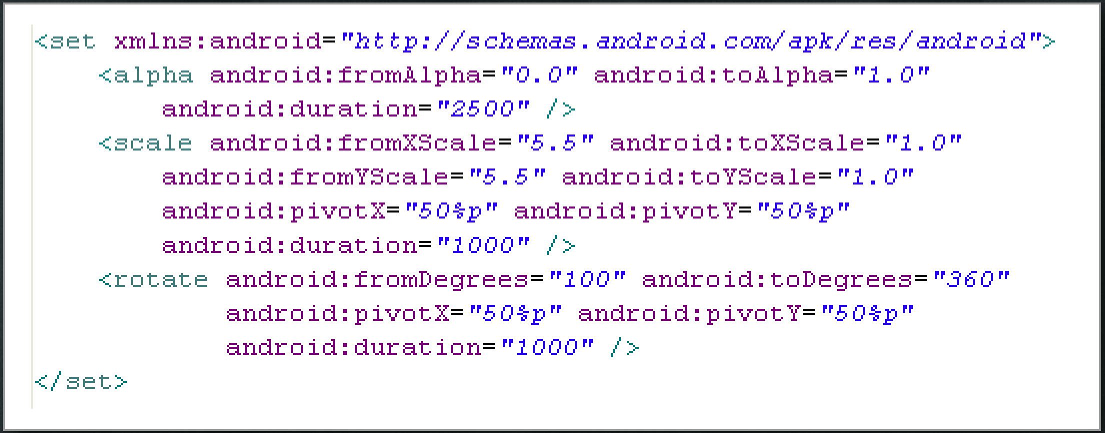
- image stretching for widgets
- embedded padding measurements





Animation

- in-built animation framework
- all views animable, View.StartAnimation()
- tweened anim
  - scale, alpha, transition, rotation
- frame-by-frame anim
  - list images



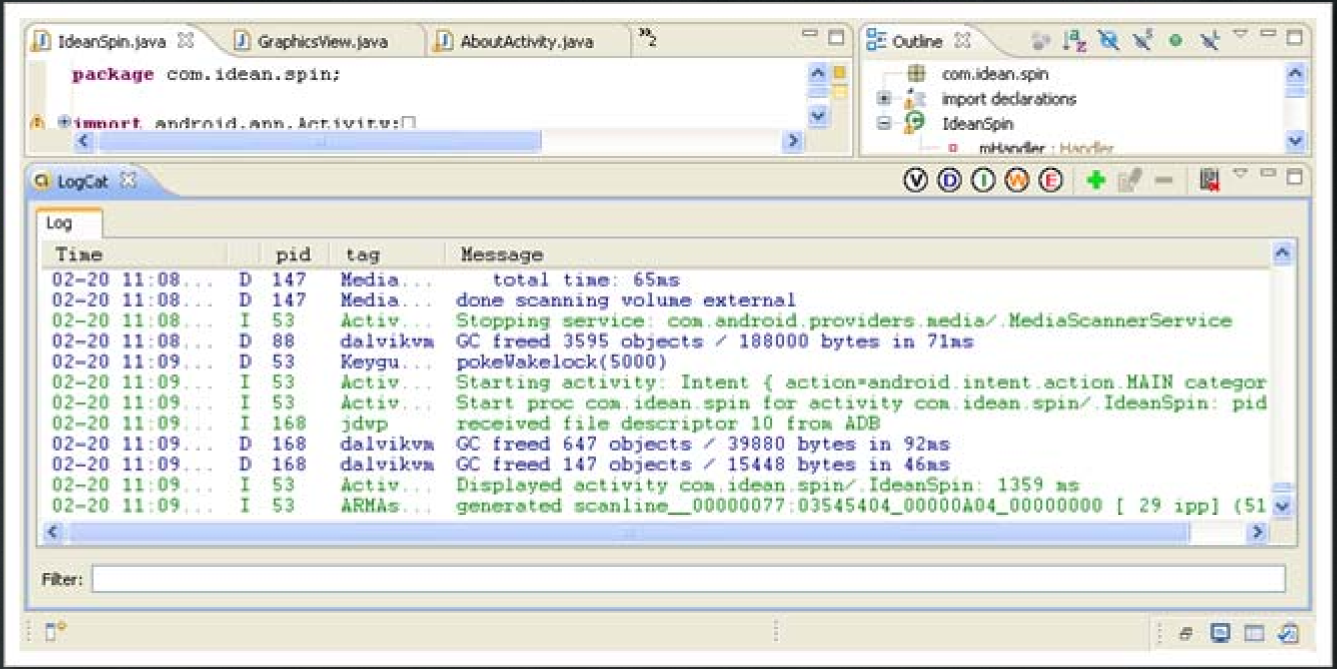
```
<set xmlns:android="http://schemas.android.com/apk/res/android">
    <alpha android:fromAlpha="0.0" android:toAlpha="1.0"
        android:duration="2500" />
    <scale android:fromXScale="5.5" android:toXScale="1.0"
        android:fromYScale="5.5" android:toYScale="1.0"
        android:pivotX="50%p" android:pivotY="50%p"
        android:duration="1000" />
    <rotate android:fromDegrees="100" android:toDegrees="360"
            android:pivotX="50%p" android:pivotY="50%p"
            android:duration="1000" />
</set>
```

App Data

- sandboxed file system
  - adb push, pull
- preferences
- SQLite
- SDcard for bigger files

Debugging

- Eclipse & DDMS
  - DDMS: Dalvik Debug Monitor Server tool
- breakpoints and watches
- actual device debugged via USB



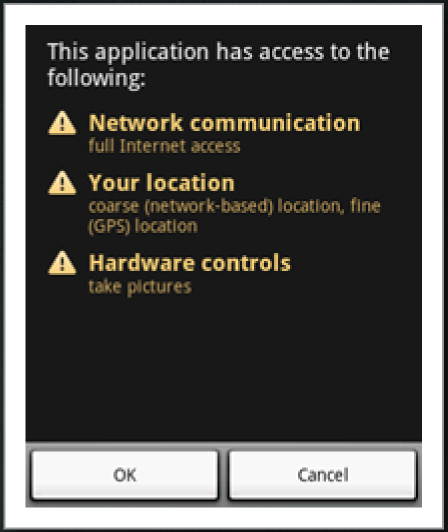
```
package com.idean.spin;

import android.app.Activity;
```

```
com.idean.spin
import declarations
IdeanSpin
  mHandler : Handler
```

```
Time                pid  tag        Message
02-20 11:08...  D  147  Media...      total time: 65ms
02-20 11:08...  D  147  Media...   done scanning volume external
02-20 11:08...  I  53   Activ...   Stopping service: com.android.providers.media/.MediaScannerService
02-20 11:08...  D  88   dalvikvm   GC freed 3595 objects / 188000 bytes in 71ms
02-20 11:09...  D  53   Keygu...   pokeWakelock(5000)
02-20 11:09...  I  53   Activ...   Starting activity: Intent { action=android.intent.action.MAIN categor
02-20 11:09...  I  53   Activ...   Start proc com.idean.spin for activity com.idean.spin/.IdeanSpin: pid
02-20 11:09...  I  168  jdwp       received file descriptor 10 from ADB
02-20 11:09...  D  168  dalvikvm   GC freed 647 objects / 39880 bytes in 92ms
02-20 11:09...  D  168  dalvikvm   GC freed 147 objects / 15448 bytes in 46ms
02-20 11:09...  I  53   Activ...   Displayed activity com.idean.spin/.IdeanSpin: 1359 ms
02-20 11:09...  I  53   ARMAs...   generated scanline__00000077:03545404_00000A04_00000000 [ 29 ipp] (51
```

Security

- linux user account per app
- based on app permissions
- apps are signed by developer private key
  - no central authority
- why signing at all:
  - two sibling apps can share data (process and userid)
  - upgrade also smooth, same key



This application has access to the following:

⚠ **Network communication**
full Internet access

⚠ **Your location**
coarse (network-based) location, fine (GPS) location

⚠ **Hardware controls**
take pictures

Delivery - APK

- zip file
- Java .class converted to .dex
- XML-files compressed into binary form
- manifest for app permissions
- signed with developer private key
- developer public key included
- assets packaged as is

Market

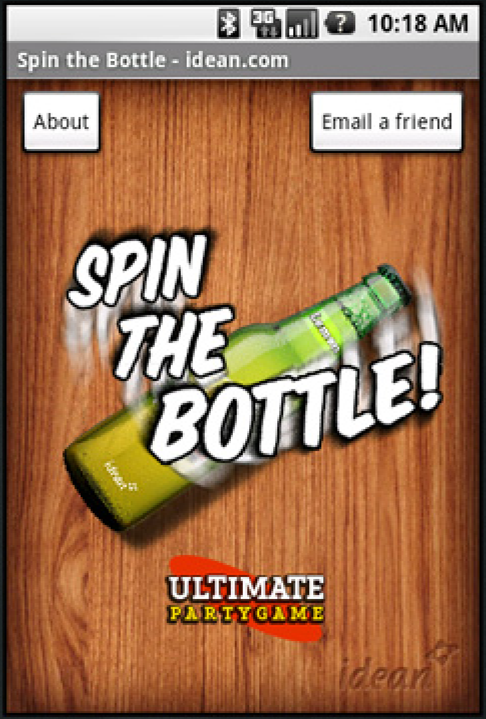
- since Oct08, free apps only
- payment system for US/UK developers Feb09
  - Google Checkout system
- 25$ registration fee per developer
- developer gets 70%
- price range $0.99 - $200
  - "I'm rich!"-apps disallowed
- over 13y of age
- 24h money-back
- no explicit content
- upgrade logic for apps
- user ratings
- uninstall percentage

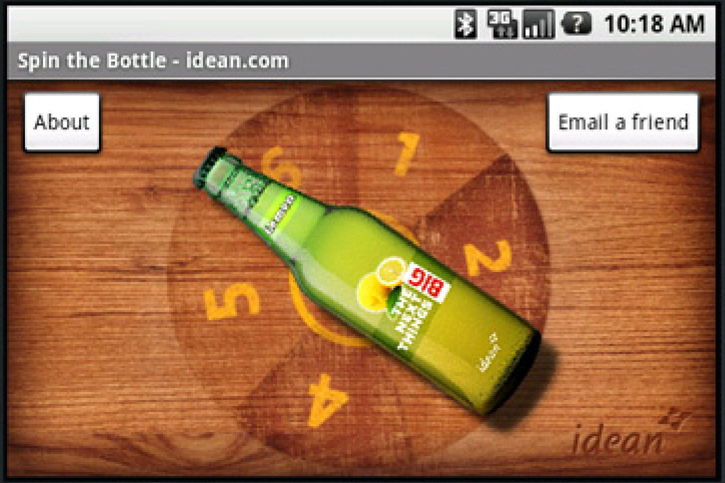
Future

- new versions coming
  - SDK 1.1 just released
  - "cupcake" in the works
- new phones coming
  - G2 from HTC
  - Huawei 2H09
  - Samsung 2H09
  - O2: 6-8 phones 2H09?
  - Dell, Acer?
- Innovations, cool apps

Demo - Spin the Bottle

- experimental fun app, "turhake"
- available in Android Market for free
- 10000 downloads in 44hours
- 22000 downloads in 10 days
- rating 3.78/5





Why be a mobile developer?

- innovation hotspot
- 4B subscriptions in the world
- "mother of all markets"

Thank you

- See you around at dev camp