Lesson 1

Android Development Introduction

Victor Matos
Cleveland State University

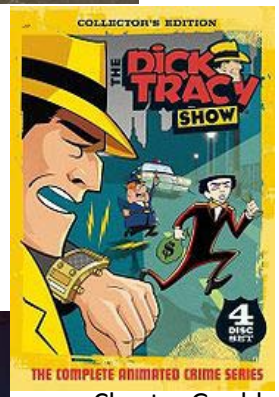
Mobile Phone Evolution

1876

- ***Alexander Graham Bell*** became the first to receive a patent for the electric phone.

1936

- **Alfred Gross.** Case Tech OH (Case Western Reserve University). Invented/Patented Walkie-talkie, CB radio, Telephone Pager.



Chester Gould

1975

- **Dr. Martin Cooper** invented first commercial portable Motorola radio phone

2007

- iPhone
- Android

Images from: http://en.wikipedia.org/wiki/Dick_Tracy http://en.wikipedia.org/wiki/Martin_Cooper_(inventor)

Hardware: What is inside a Smart Cellular Phone?

Oversimplifying…

Smart cellular phone ≥ radio + computer*

Industries ⟵ $\sum$ Software + Telecom+ Semiconductor + Marketing

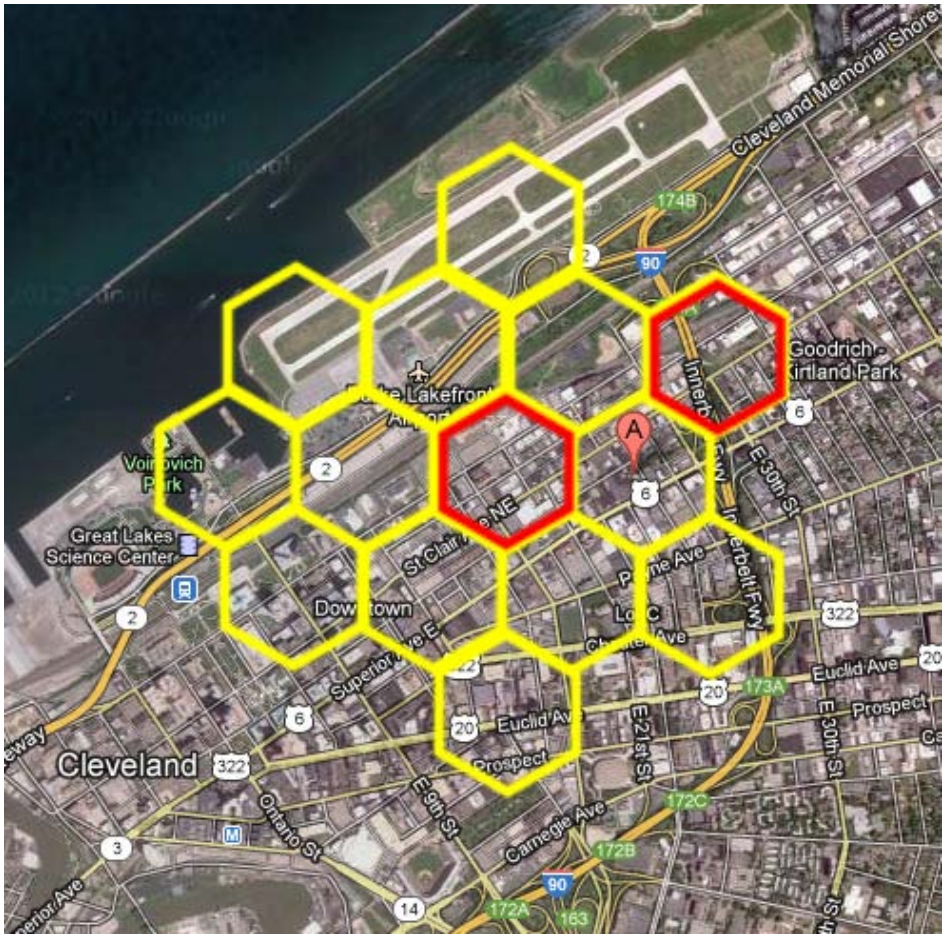
Hardware: Reusing Cell Phone Frequencies

Base stations of the world, unite!

The main idea behind cellular communications is the division of a large city into small areas called **cells** each hosting a *Base-Station*.

Base-Stations operate with just enough power to reach only the users inside their individual cells.

Each hexagonal cell covers approx. 10 sq miles (26 km^2)



Base stations use low-power transmitters, therefore the same frequencies can be reused in non-contiguous cells.

Software: What is Android?

- Android OS is an open-source Linux-based operating system for mobile devices.
- It is being developed by the Open Handset Alliance and Google Inc.
- The operating system has a number of native applications supporting telephony, messaging, emailing, contact management, calendar, entertainment, multimedia experience, location services, mapping, social interaction, etc.
- Third party Java developers can use the Android API to extend the functionality of the devices.
- Google provides an on-line electronic market for third-party developers to sell-distribute their custom applications.

Why Android?

Listen from the project creators/developers (2.19 min)

- Nick Sears. Co-founder of Android
- Steve Horowitz. Engineering Director
- Dam Morrill. Developer
- Peisun Wu. Engineering Project Manager
- Erick Tseng. Project Manager
- Iliyan Malchev. Engineer
- Mike Cleron. Software Manager
- Per Gustafsson. Graphics Designer.

Link accessed on Sept 1, 2014:
http://www.youtube.com/watch?v=6rYozIZOgDk&eurl=http://www.android.com/about/&feature=player_embedded

You will hear statements such as:

"…currently it is too difficult to make new products … open software brings more innovation … choices … lower costs … enables the industry to create….more applications such as family planner, my taxes, … understand my wife better, … "

What is the Open Handset Alliance?

A consortium of 80+ technology and mobile business companies.

Quoting from **www.OpenHandsetAlliance.com** site (2/25/2012)

" … Today, there are 1.5 billion television sets in use around the world. 1 billion people are on the Internet. But nearly 3 billion people have a mobile phone, making it one of the world's most successful consumer products…

Building a better mobile phone would enrich the lives of countless people across the globe.

The Open Handset Alliance™ is a group of mobile and technology leaders who share this vision for changing the mobile experience for consumers …"

Open Handset Alliance Members

Operators	Software Co.	Commercializat.	Semiconductor	Handset Manf
Bouygues Tele	Ascender Corp.	Accenture	ARM	ACER
China Mobile	Borqs	Aplix	Atheros	ASUS
China Telec.	eBay	Astonishing Tribe	Audience	Dell
China Unicom	Esmertec	Noser Engineering	Broadcom Corp.	Garmin
KDDI Corp.	Google	Omron Software	CSR Plc.	HTC
NTT DoCoMo	LivingImage	Sasken	Cypress	Kyocera
Softbank	NMS Comm.	Teleca	Freescale	Lenovo Mobile
Sprint Nextel	Nuance Comm.	…	Gemalto	LG
Telecom Italia	PacketVideo	Wind River Systems	Intel Corp.	Motorola
Telefónica	SkyPop		Marvell Tech	NEC
Telus	…		MediaTek	
T-Mobile	SONiVOX		MIPS Techn.	Samsung
…			Nvidia Corp	Sharp
Vodafone			Qualcomm	…
			Renesas Corp	Sony Ericsson
			ST-Ericsson	…
			Synaptics	Toshiba
			Texas Instrum.	
			Via Telecom	

Android Developers Talk

Short video (4 min.)

Dave Bort and
Dan Borstein,

Two members of the Android Open Source Project talk about their experience.

Link accessed on Sept 1, 2014
http://www.youtube.com/watch?v=7Y4thikv-OM

The Mobile Revolution

Electronic tools commonly carried by a typical business warrior

Not so long ago …	Today
1. Phone 2. Pager 3. PDA Organizer 4. Laptop 5. MP3 Portable music player 6. Wired modem 7. No Internet access / limited access	1. Smartphone 2. Laptop (perhaps!)

Tomorrow ?

The Mobile Revolution

Dreaming aloud
I want my 2015 Smartphone to be …

1. Phone
2. Pager
3. PDA Organizer
4. High Quality Camera (still & video)
5. Portable music player
6. Portable TV / Video Player / Radio
7. Laptop
8. Play Station
9. GPS / Compass / Navigation (road & inside buildings)
10. Golf Caddy (ball retriever too)
11. Book Reader (I don't read, It reads to me with passion!)
12. Electronic key (Car / Home / Office)
13. Remote Control (Garage, TV, …)
14. Credit Card / Driver's License / Passport / Airplane Ticket
15. Cash
16. Cook, house chores
17. Psychologist / Mentor / Adviser
18. Personal trainer
19. Dance instructor
20. ????

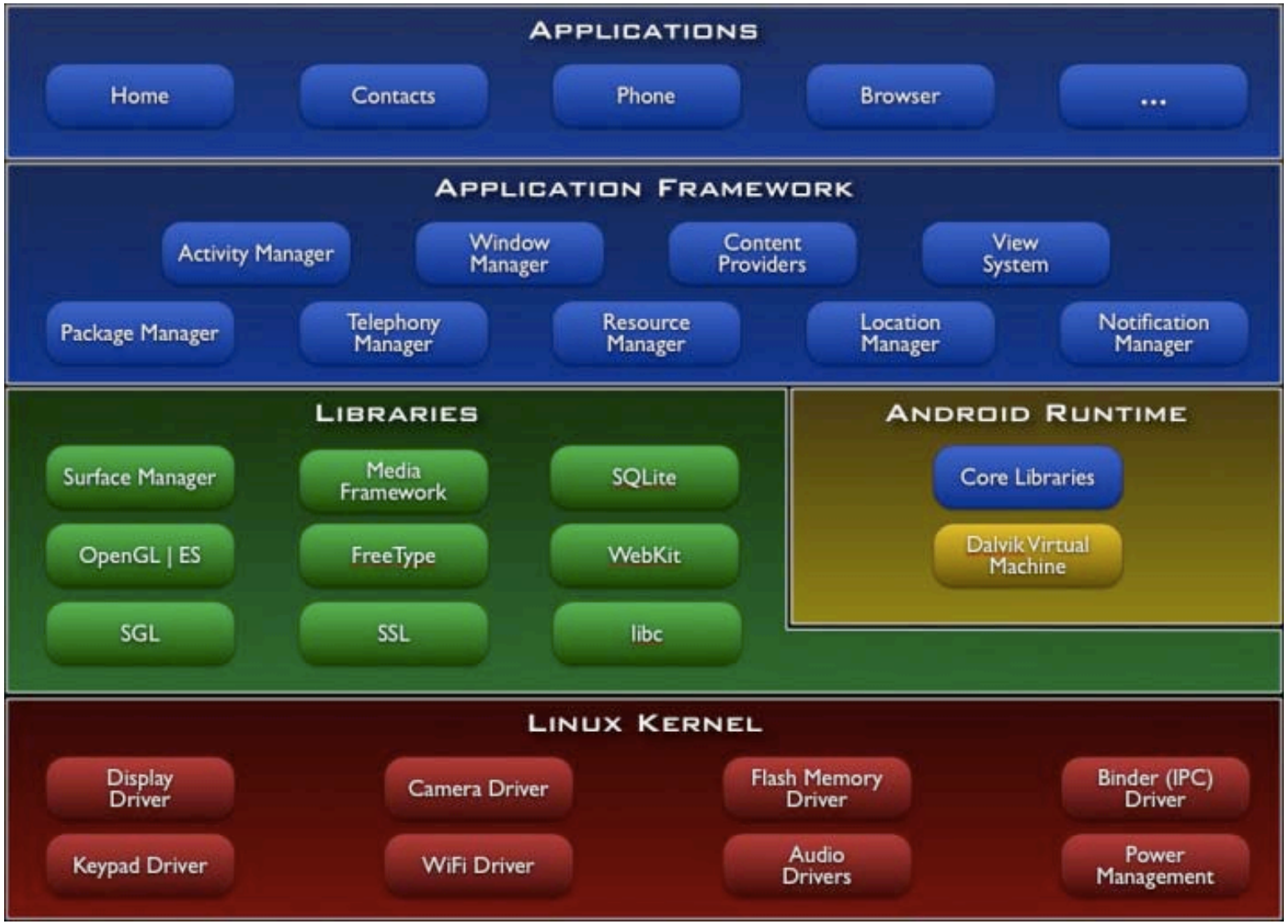
Android vs. OS Competitors

 vs.	1. Apple Inc. 2. Microsoft ~~3. Nokia Symbiam~~ ~~4. Palm & webOS~~ 5. Research In Motion

Android Software/Hardware Components

- **Dalvik virtual machine** (soon to be replaced by **ART**)
- **Integrated browser** (WebKit)
- **Graphic Capabilities** (hardware acceleration)
- **SQLite** for structured data storage
- **Media support** (audio/video)
- **GSM Telephony** (hardware dependent)
- **Bluetooth, EDGE, 3G, 4G, NFC, and Wi-Fi** (hardware manufacturer dependent)
- **Camera, GPS, compass, accelerometer, gyroscope, proximity/ambient light, barometric pressure, fingerprint reader, heart rate sensor** (hardware dependent)
- **Software Development Tools** & **Application framework** (device emulator, debugging, profiling, plugin for the Eclipse IDE, resource managers, Android Studio)

Android's Software Architecture



Android's Software Architecture

Video 1/3:

Software Layers

Presented by Mike Cleron, Google Corp. (13 min)
Available at: http://www.youtube.com/watch?v=QBGfUs9mQYY

Android's Software Architecture

Video 2/3:

Application's Life Cycle

Presented by Mike Cleron, Google Corp. (7 min)
Available at: http://www.youtube.com/watch?v=fL6gSd4ugSI&feature=channel

Android's Software Architecture

Video 3/3:

Android's API

Presented by Mike Cleron, Google Corp. (8 min)
Video available at:
http://www.youtube.com/watch?v=MPukbH6D-lY&feature=channel

Android Application Framework

Video:

Inside the

Android Application Framework

(about 52 min)

Presented by Dan Morrill – Google

At Google Developer Conference

San Francisco – 2008

Available at:

http://sites.google.com/site/io/inside-the-android-application-framework

Android is designed to be fast, powerful, and easy to develop for. This session will discuss the Android application framework in depth, showing you the machinery behind the application framework.

explains the life-cycle of an android apk. very good!

Android Support - Education

Video:

Android Development Tools

(about 60 min)

Google 2011 Developer Conference
San Francisco

Presented by

- Xavier Ducrohet, tech-lead for the Android SDK and Developer Tools.
- Tor Norbye, engineer on the Android SDK team working on visual tools for Android development.

LINK:
http://www.google.com/events/io/2011/sessions/android-development-tools.html

An Introduction to Android

Video:

An Introduction to Android

(about 52 min)

Presented by Jason Chen – Google

At Google Developer Conference

San Francisco - 2008

Video available at:

http://www.youtube.com/watch?v=x1ZZ-R3p_w8

The Dalvik Virtual Machine

Video (61 min)

Dalvik VM Internals

Presented by Dan Borstein

At Google Developer – 2008

San francisco

Video available at:

http://www.youtube.com/watch?v=ptjedOZEXPM

Android Intents

- An **Intent** is a request for services offered by an Android based device.

- An **Intent** is made up of various pieces including:
  - desired *action* or *service*,
  - *data*, and
  - *category* of component that should handle the intent and instructions on how to launch a target activity.

Action	Data
The general action to be performed, such as: **ACTION_VIEW** **ACTION_EDIT** **ACTION_MAIN** etc.	The data to operate on, such as a person record in the contacts database, expressed as a **Uri**.

Android Intents

Some examples of Intent's action/data pairs are:

ACTION_VIEW ***content://contacts/1*** -- Display information about the person whose identifier is "1".

ACTION_DIAL ***content://contacts/1*** -- Display the phone dialer with the person filled in.

ACTION_VIEW ***tel:123*** -- Display the phone dialer with the given number filled in

ACTION_DIAL ***tel:123*** -- Display the phone dialer with the given number filled in.

ACTION_EDIT ***content://contacts/1*** -- Edit information about the person whose identifier is "1".

ACTION_VIEW ***content://contacts/*** -- Display a list of people, which the user can browse through.

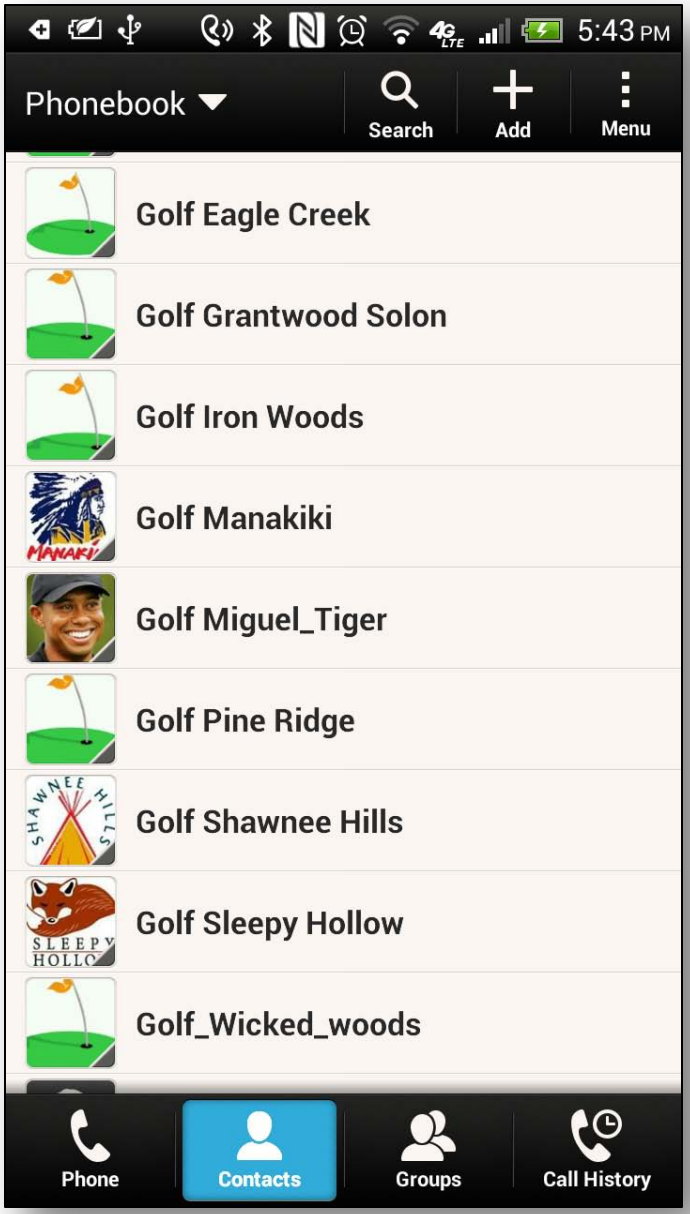
Example1: Java + Built-in Intent

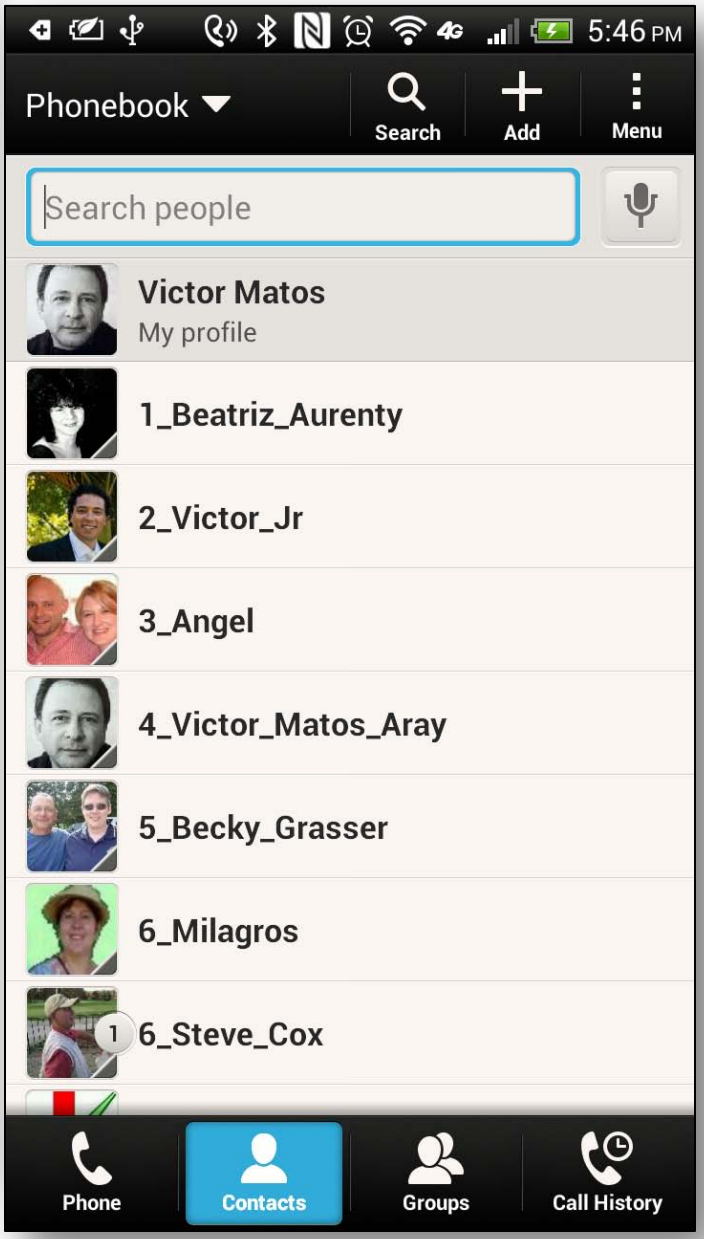
The following code fragment calls an **Intent** whose job is to invoke a built-in task (*ACTION_VIEW*) and explore the *Contacts* available in the phone.

```
Intent myIntent = new Intent(
           Intent.ACTION_VIEW,
           Uri.parse("content://contacts/people") );

startActivity(myIntent);
```

Example1: Java + Built-in Intent

Intent uses **ACTION_VIEW** to see Contacts.





Example1: Java + Built-in Intent

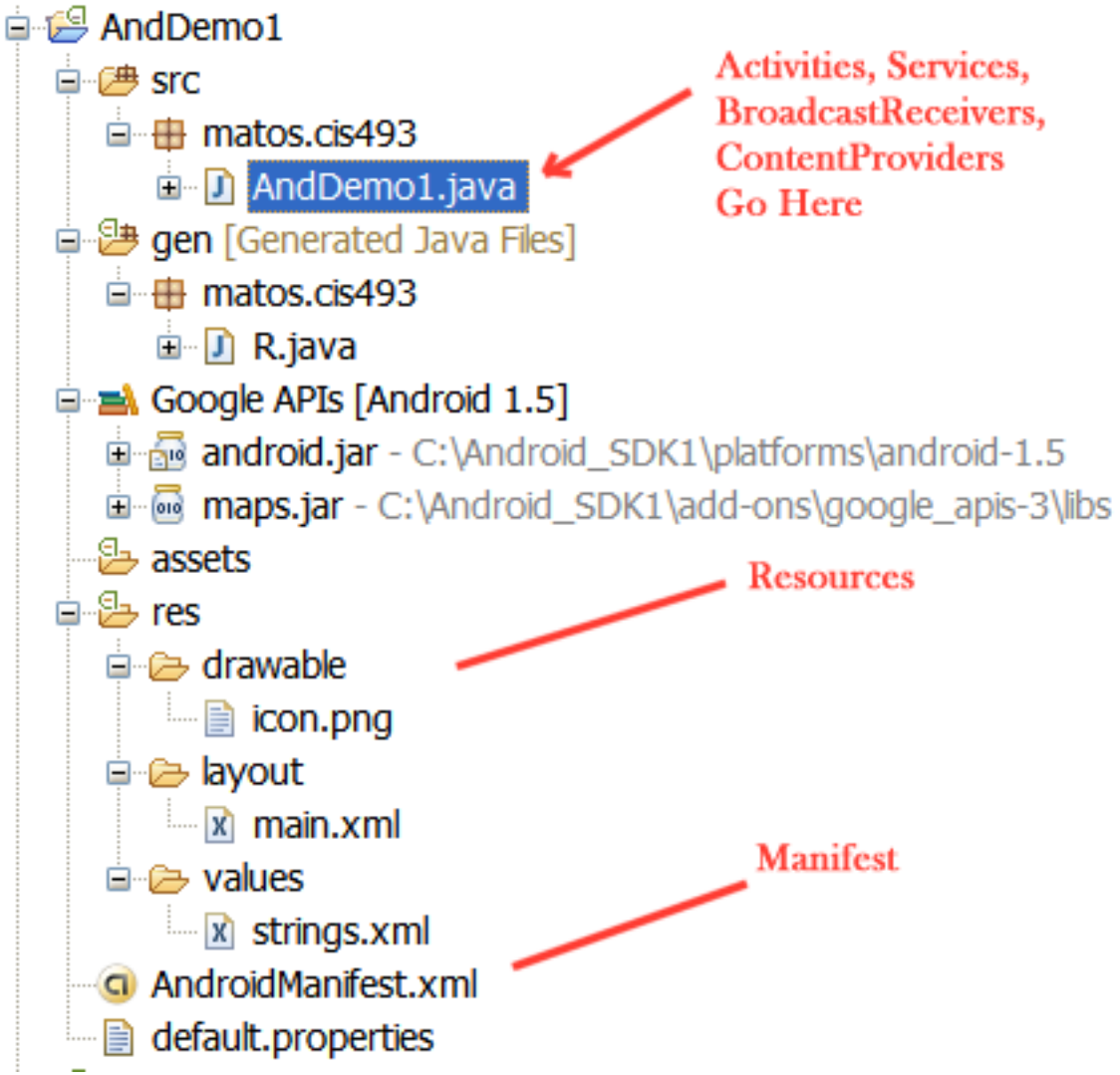
Java class including invocation to an Intent to display Contacts.

```
public class AndDemo1 extends Activity {
    /** show contact list */
    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.main);

        Intent myIntent = new Intent(
                Intent.ACTION_VIEW,Uri.parse( "content://contacts/people"));

        startActivity(myIntent);
    }

}
```

Dissecting an Android Application

Structure of a typical Android Application

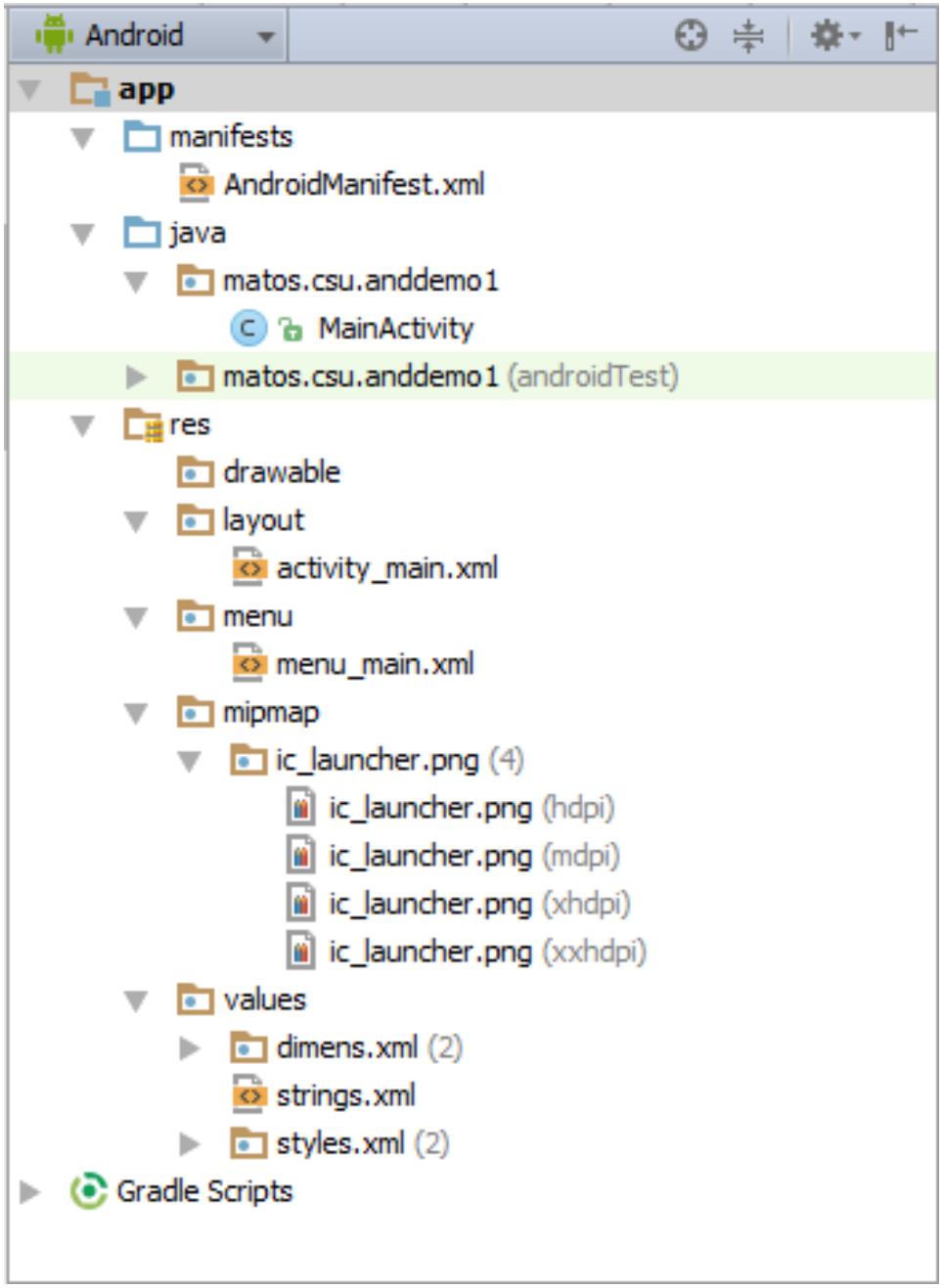
(Shown by Eclipse's Project Explorer)



Dissecting an Android Application

Structure of a typical Android Application

(Android Studio)

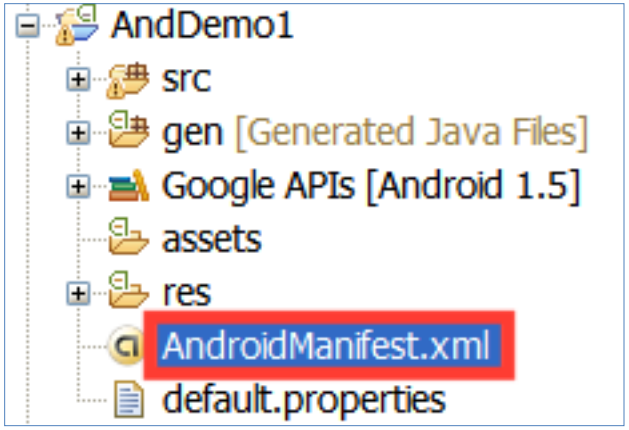


Android Manifest XML File

- Every application must have an AndroidManifest.xml file

  in its root directory.

- The manifest presents essential information about the application to the Android system, for instance it has an entry for each activity, library request, and special permissions needed to assemble the app.



Android Manifest XML File

This is a list of the <XML-elements> allowed in the Manifest file.

<action>
<activity>
<activity-alias>
<application>
<category>
<data>
<grant-uri-permission>
<instrumentation>
<intent-filter>
<manifest>
<meta-data>
<permission>
<permission-group>
<permission-tree>
<provider>
<receiver>
<service>
<uses-configuration>
<uses-library>
<uses-permission>
<uses-sdk>

Android Manifest XML File

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
      package="matos.earthquake"
      android:versionCode="1"
      android:versionName="1.0.0">
    <application android:icon="@drawable/yellow_circle" android:label="@string/app_name">


        <activity android:name=".AndQuake"
                  android:label="@string/app_name">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>

        <activity android:name=".SatelliteMapping">  </activity>

        <service  android:name="AndQuakeService" android:enabled="true" >
        </service>

        <receiver android:name="AndQuakeAlarmReceiver" >
           <intent-filter>
             <action
                  android:name = "ALARM_TO_REFRESH_QUAKE_LIST"/>
           </intent-filter>
        </receiver>
    </application>

    <uses-library android:name="com.google.android.maps" />
    <uses-permission android:name="android.permission.INTERNET" />

</manifest>
```

Example2. Currency converter

Implementing a currency converter:

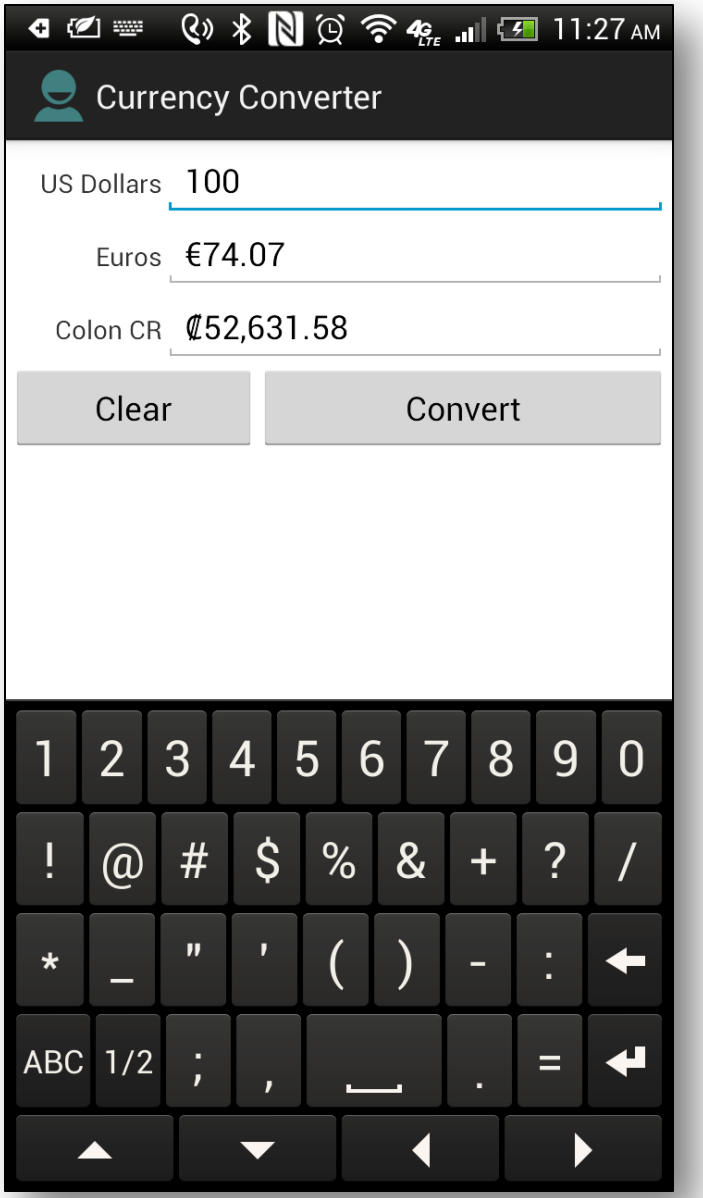
USD ⟶ Euro ⟶ Colon (CR)

Note.

Naive implementation using a fixed exchange rate:

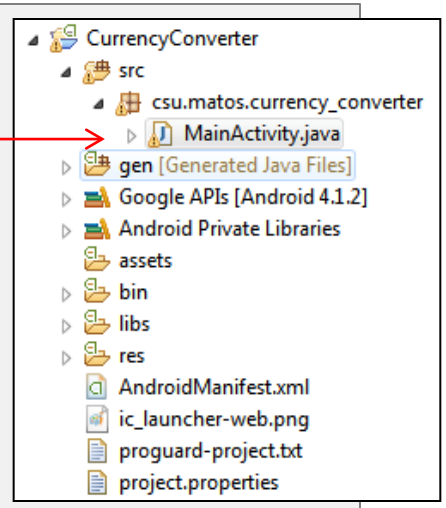
1 Costa Rican Colon = 0.0019 U.S. dollars

1 Euro = 1.35 U.S. dollars



Example2. Currency converter

```
package csu.matos.currencyconverter;
import android.app.Activity;
import android.os.Bundle;
import android.view.View;
import android.view.View.OnClickListener;
import android.widget.Button;
import android.widget.EditText;

public class Currency1 extends Activity {
    //USA money format (12 digits, 2 decimals)
    DecimalFormat usaDf = new DecimalFormat("###,###,###,###.##");

    // naive currency converter (USD to Euros & Colones)
    private final double EURO2USD = 1.35;
    private final char EUROSYM = '\u20AC';
    private final double COLON2USD = 0.0019;
    private final char COLONSYM = '\u20A1';
    // GUI widgets
    Button btnConvert;
    Button btnClear;
    EditText txtUSDollars;
    EditText txtEuros;
    EditText txtColones;
```



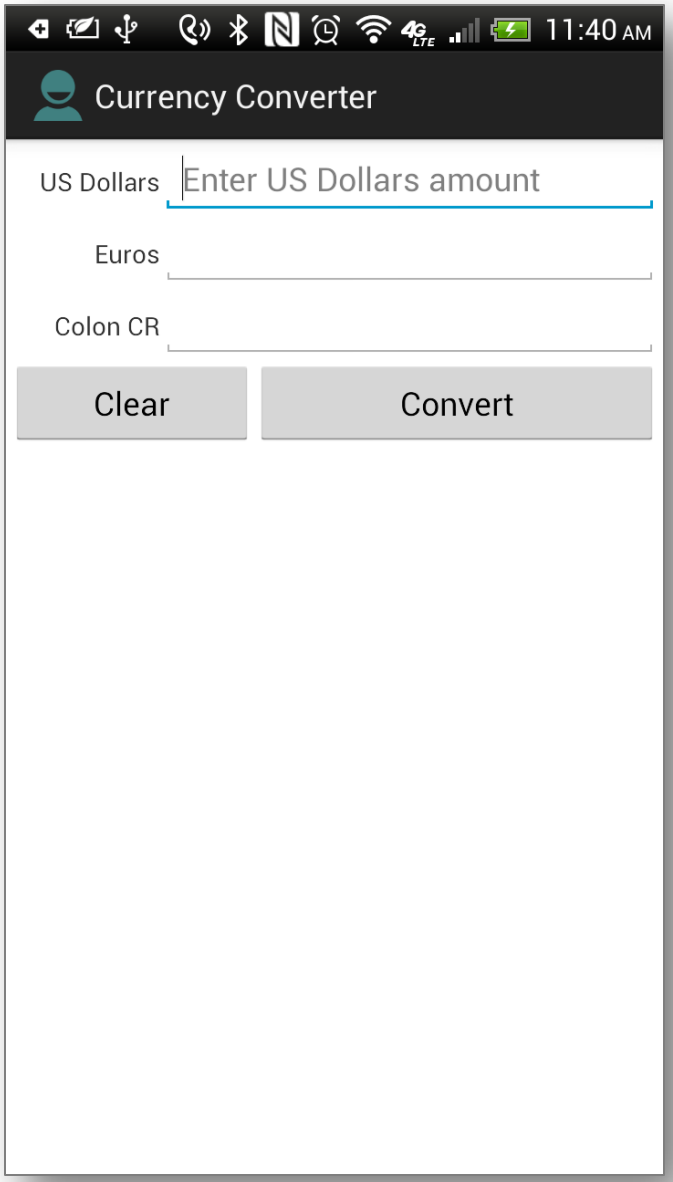
Example2. Currency converter

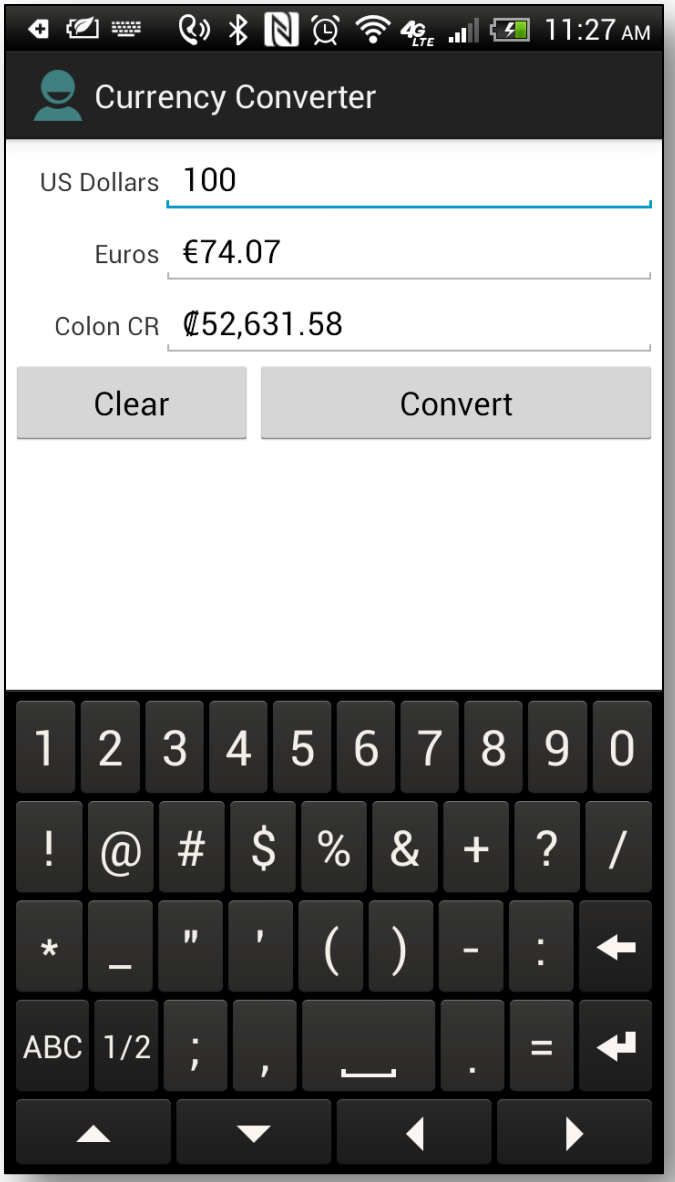
```
@Override
   public void onCreate(Bundle savedInstanceState) {
       super.onCreate(savedInstanceState);
       setContentView(R.layout.activity_main_linear);

       // bind local controls to GUI widgets
       txtUSDollars = (EditText)findViewById(R.id.txtUSDollars);
       // make 'Euros' box not-editable (no user input)
       txtEuros = (EditText)findViewById(R.id.txtEuros);
       txtEuros.setInputType(EditorInfo.TYPE_NULL);
       // No user input. See layout:   android:editable="false"
       txtColones = (EditText)findViewById(R.id.txtColones);

      // attach click behavior to buttons
       btnClear = (Button)findViewById(R.id.btnClear);
       btnClear.setOnClickListener(new OnClickListener() {
          // clear the text boxes
           @Override
           public void onClick(View v) {
             txtColones.setText("");
             txtEuros.setText("");
             txtUSDollars.setText("");
           }
       });
```

Example2. Currency converter

```
        // do the conversion from USD to Euros and Colones
        btnConvert = (Button) findViewById(R.id.btnConvert);
        btnConvert.setOnClickListener(new OnClickListener() {
           @Override
           public void onClick(View v) {
               try {
                  String usdStr = txtUSDollars.getText().toString();
                  double usd = Double.parseDouble(usdStr);
                  String euros = EUROSYM +
                                 String.valueOf(usaDf.format(usd / EURO2USD));
                  String colones = COLONSYM +
                                   String.valueOf(usaDf.format(usd / COLON2USD));
                  txtEuros.setText(euros);
                  txtColones.setText(colones);
               } catch (NumberFormatException e) {
                  // ignore errors
               }

           }
      });// setOnClick...

    }// onCreate

}// class
```

Example2. Currency converter

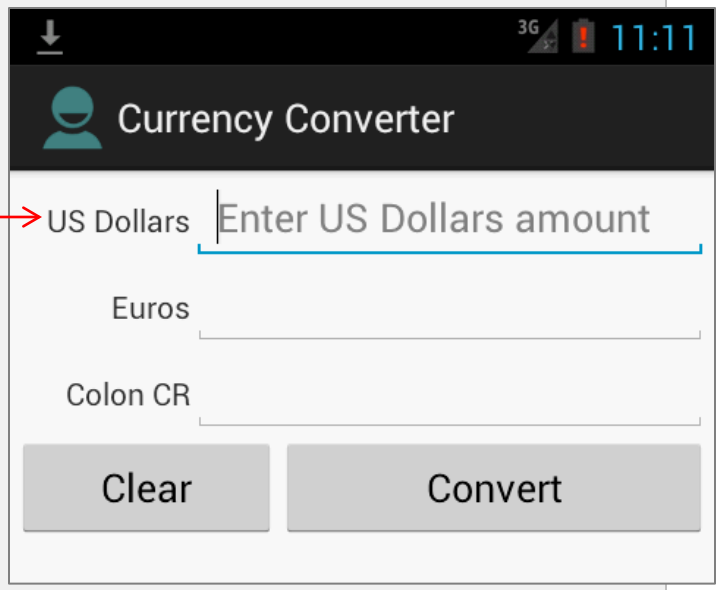




Example2. Currency converter

LAYOUT: res/layout/activity_main_linear.xml (1 of 3)

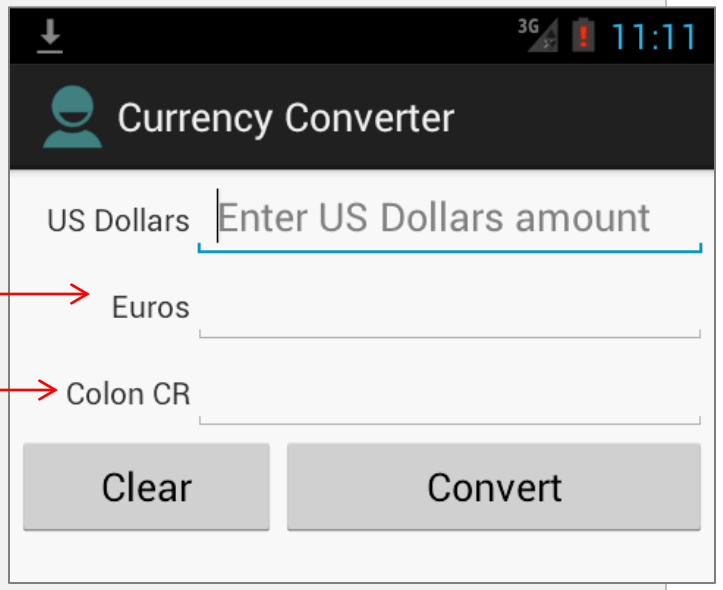
```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:orientation="vertical"
    android:padding="2dp" >

    <LinearLayout
        android:layout_width="match_parent"
        android:layout_height="wrap_content" >

        <TextView
            android:id="@+id/textView2"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:ems="5"
            android:gravity="right"
            android:text="US Dollars" />

        <EditText
            android:id="@+id/txtUSDollars"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_weight="2"
            android:hint="Enter US Dollars amount"
            android:inputType="numberDecimal" />

        <requestFocus />
    </LinearLayout>
```



Example2. Currency converter

LAYOUT: res/layout/activity_main_linear.xml (2 of 3)

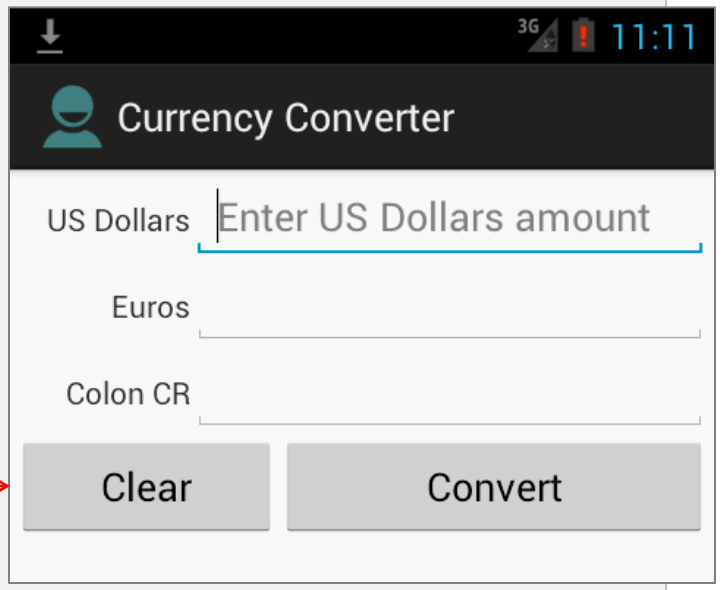
```
<LinearLayout
    android:layout_width="match_parent"
    android:layout_height="wrap_content" >

    <TextView
        android:id="@+id/textView3"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:ems="5"
        android:gravity="right"
        android:text="Euros" />

    <EditText
        android:id="@+id/txtEuros"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_weight="2" />
</LinearLayout>

<LinearLayout
    android:layout_width="match_parent"
    android:layout_height="wrap_content" >

    <TextView
        android:id="@+id/textView4"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:ems="5"
        android:gravity="right"
        android:text="Colon CR" />
```



Example2. Currency converter

LAYOUT: res/layout/activity_main_linear.xml (3 of 3)

```
        <EditText
            android:id="@+id/txtColones"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_weight="2"
            android:editable="false" />
    </LinearLayout>

    <LinearLayout
        android:layout_width="match_parent"
        android:layout_height="wrap_content" >

        <Button
            android:id="@+id/btnClear"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_weight="1"
            android:text="Clear" />

        <Button
            android:id="@+id/btnConvert"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_weight="2"
            android:text="Convert" />
    </LinearLayout>

</LinearLayout>
```



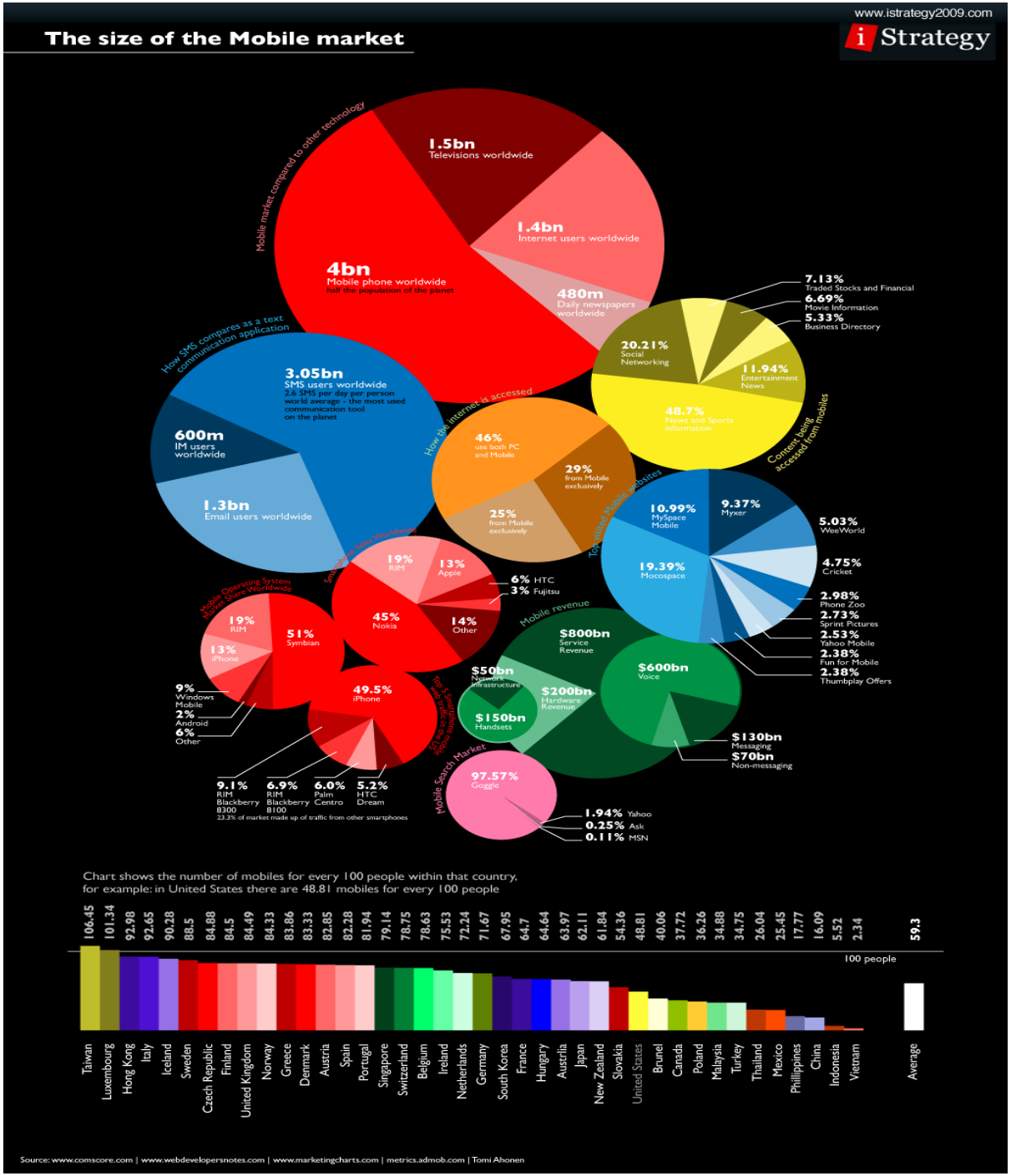
APPENDIX A.

The Size of the Mobile Market Year 2009

Reference:

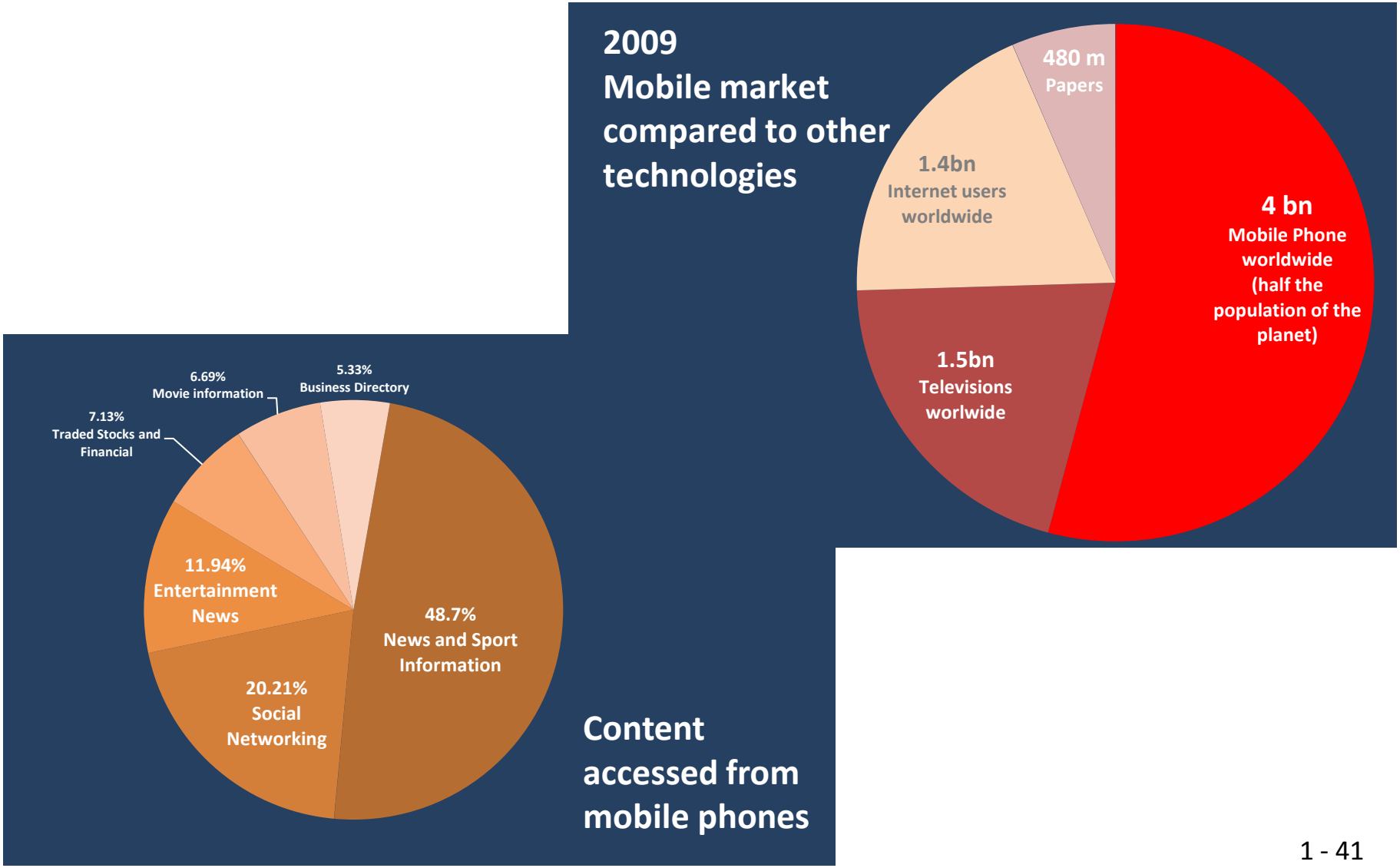
http://gizmodo.com/5489036/cellphone-overshare

Accessed on April 2010



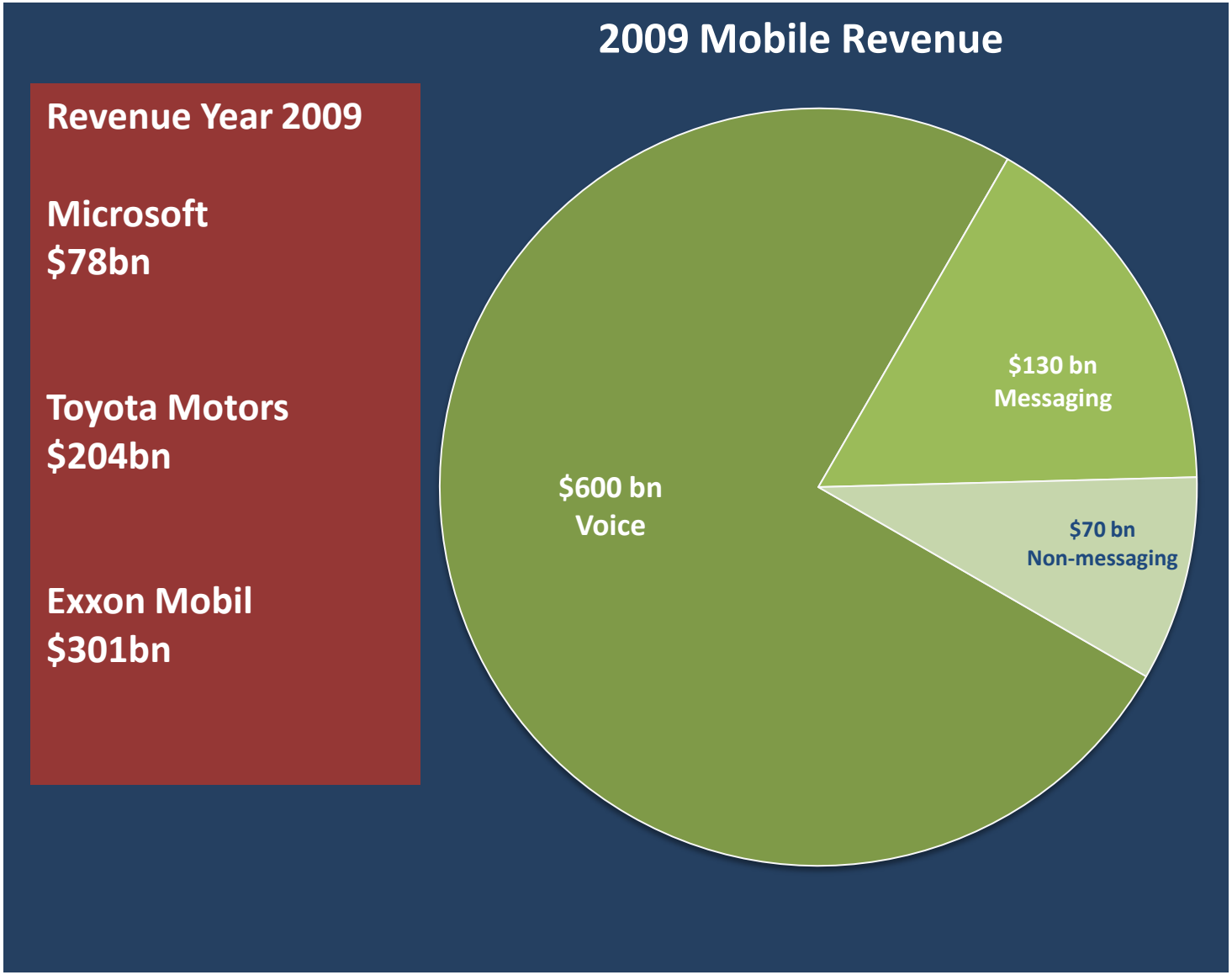
The Size of the Mobile Market – 2009

Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010



The Size of the Mobile Market – 2009

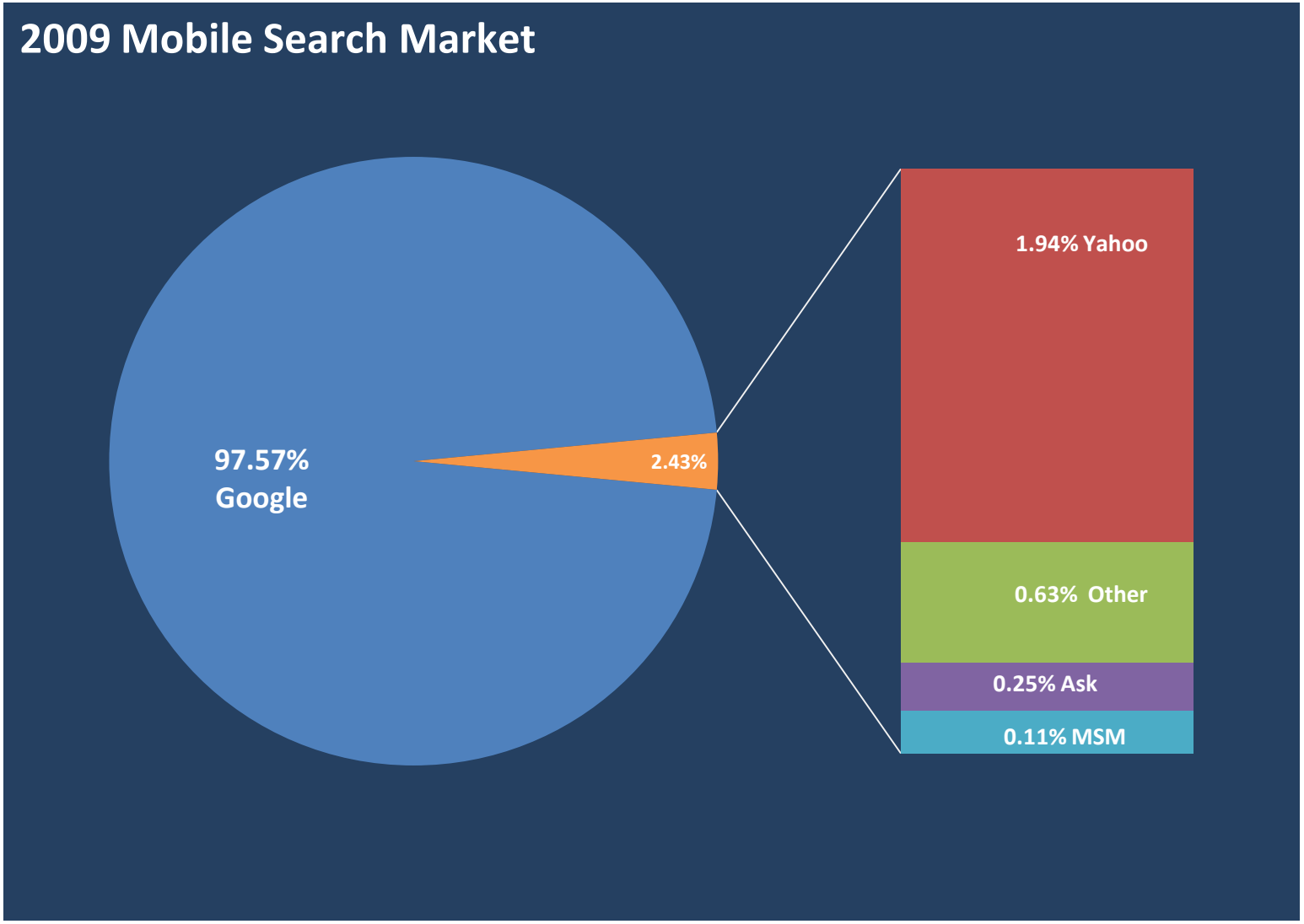
Extracted from:
http://gizmodo.com/5489036/cellphone-overshare
http://www.microsoft.com/investor/reports/ar09/10k_fr_bal.html
Exxon Mobil 2009 Summary Annual Report
2010 Toyota Annual Report (pp 12)



Revenue is the collective amount of income made by a company (usually from the sales of goods & services)

The Size of the Mobile Market – 2009

Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010

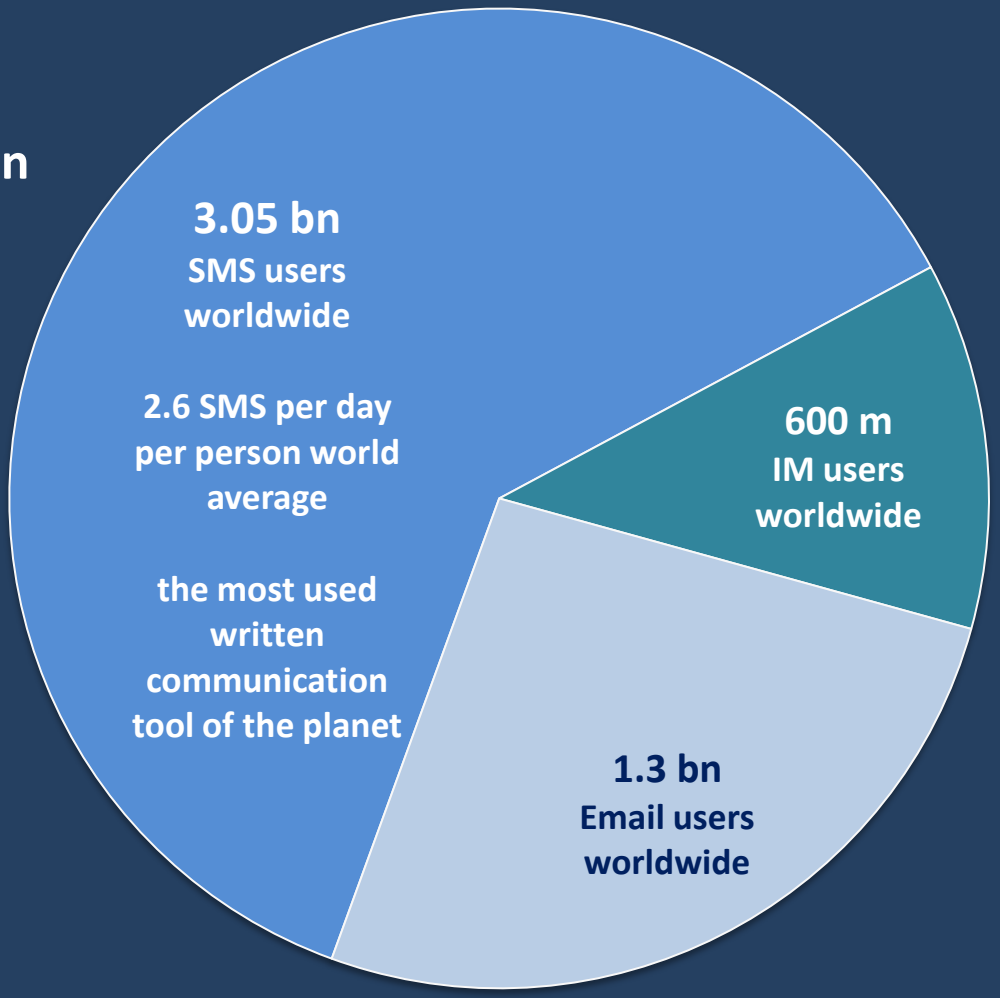


The Size of the Mobile Market – 2009

Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010

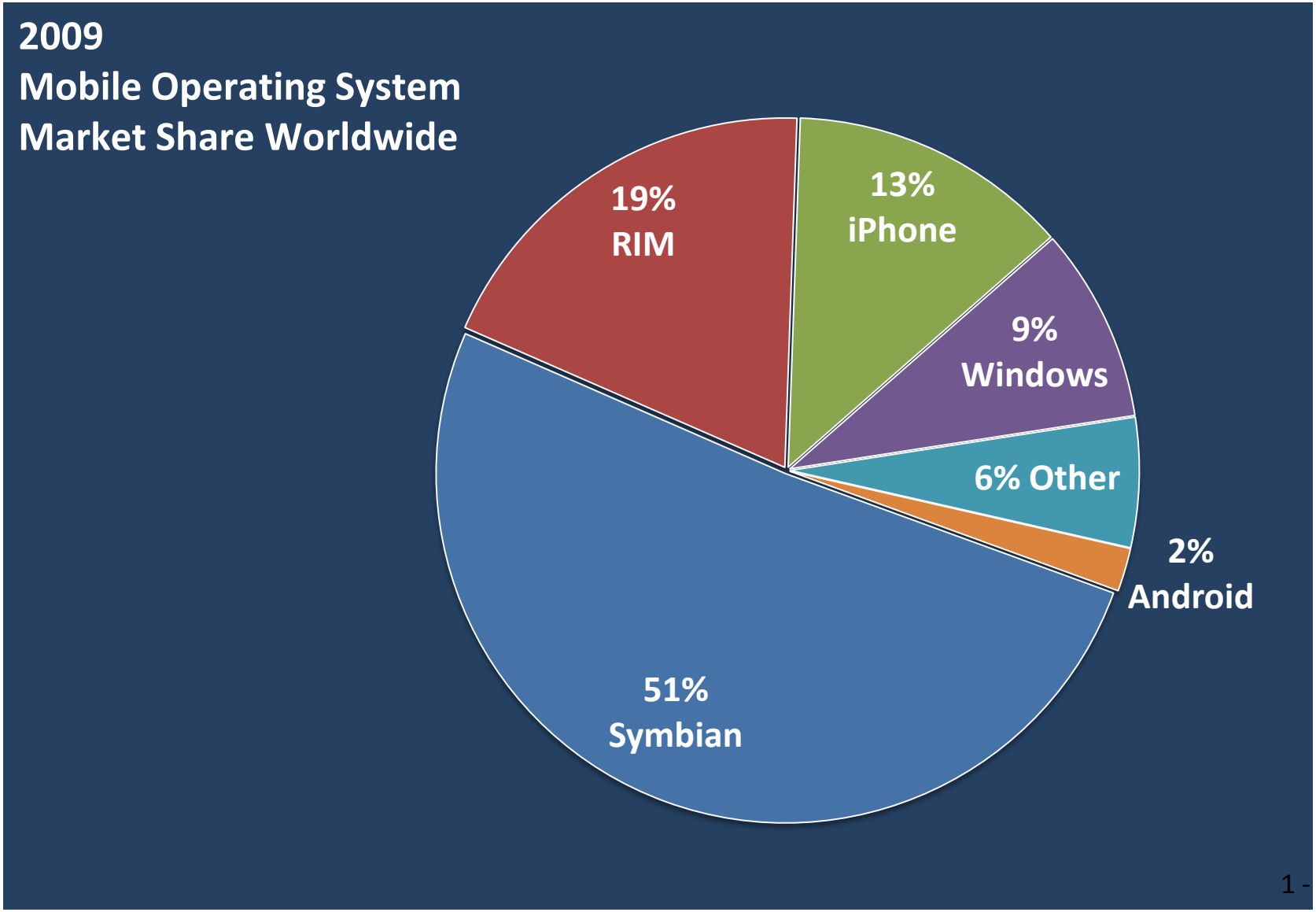
2009

How SMS compares as a text communication application



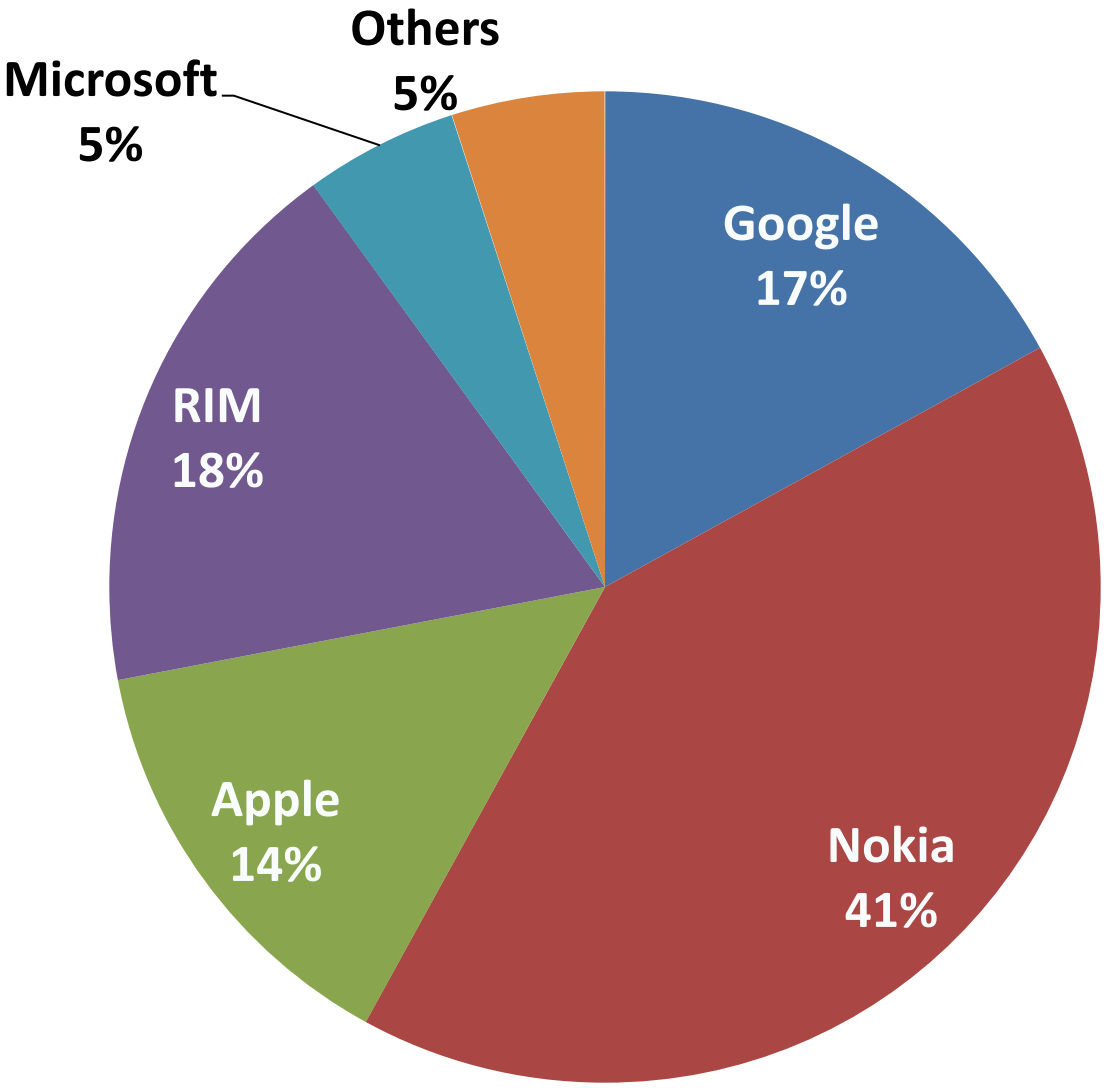
The Size of the Mobile Market – Fourth Quarter 2009-Q4

Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010



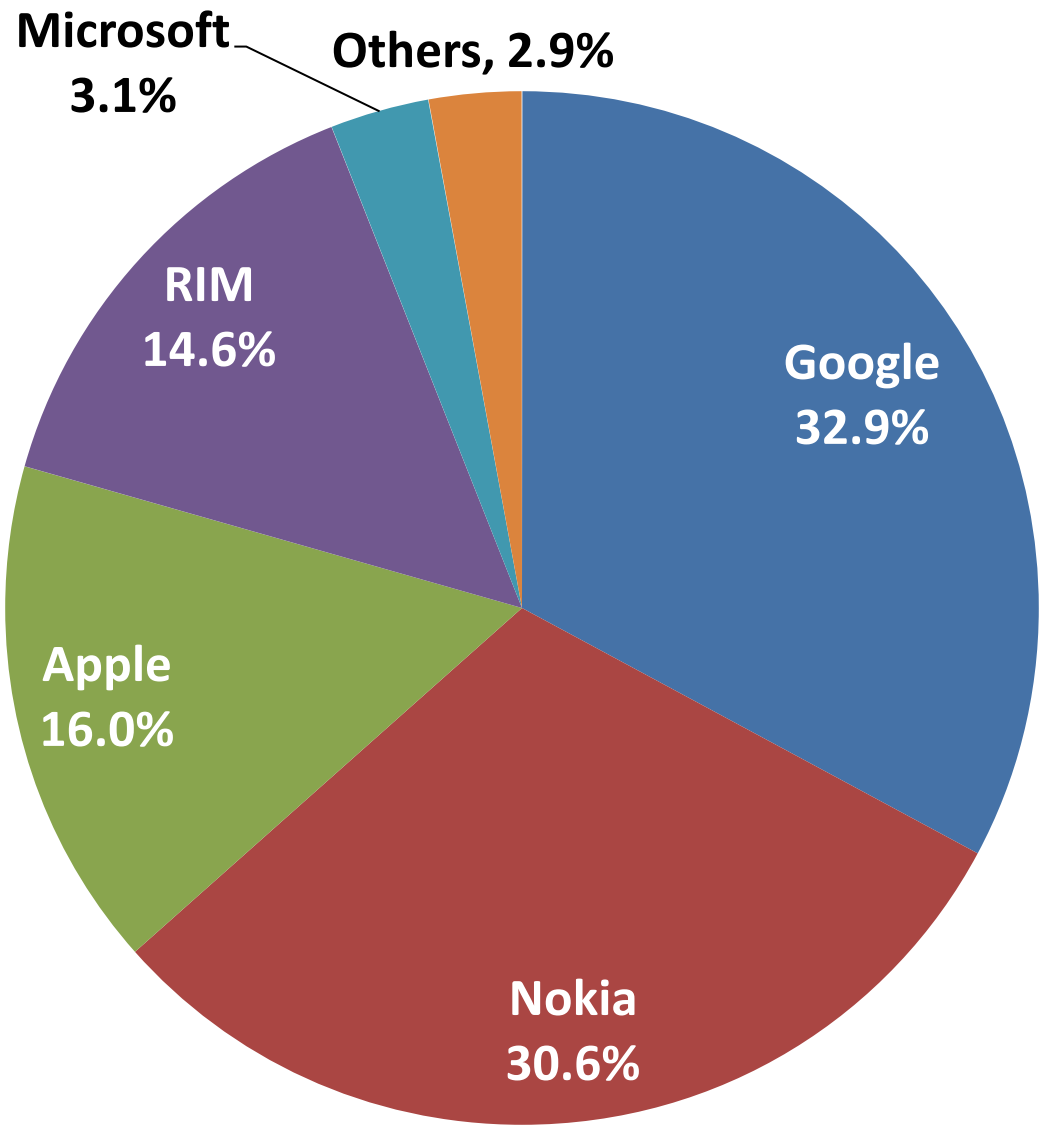
The Size of the Mobile Market – Second Quarter 2010-Q2

Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010



The Size of the Mobile Market – Fourth Quarter 2010-Q4

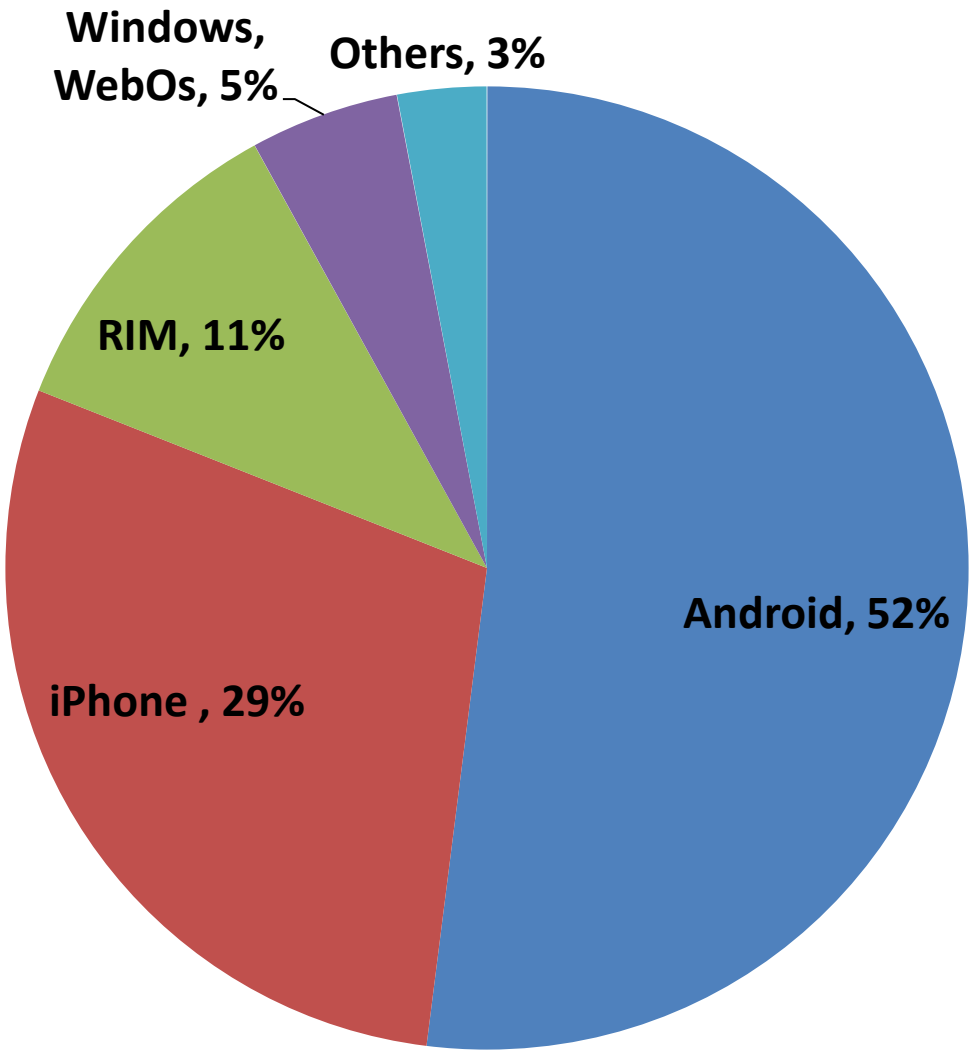
Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010



Combined sales in Q4
300 million units

The Size of the Mobile Market – Second Quarter 2011-Q2

Extracted from: http://gizmodo.com/5489036/cellphone-overshare Accessed on April 2010



The Size of the Mobile Market – First Quarter 2014-Q1

Taken on Sept 2014, from:
http://techcrunch.com/2014/05/06/android-still-growing-market-share-by-winning-first-time-smartphone-users/

	1Q 2014	4Q 2013	1Q 2013	1Q 2014 Market Share %	4Q 2013 Market Share %
Android	187,027,721	188,227,483	150,621,700	44%	39%
AOSP	53,749,521	53,919,640		13%	11%
Apple iOS	43,719,000	51,024,482	37,406,800	10%	11%
BlackBerry 10	550,000	765,000	981,300	0%	0%
BlackBerry OS	750,000	3,516,300	5,426,500	0%	1%
Windows Phone	13,274,030	11,418,218	6,070,800	3%	2%
Basic Mobile Phones	127,593,495	167,338,026	229,408,800	30%	35%
Others	545,000	428,637	1,126,600	0%	0%
Grand Total	427,208,766	476,637,786	431,042,500	100%	100%

Number of new devices sold in the indicated periods.

AOSP = Android Open Source Project

The Size of the Mobile Market – First Quarter 2014-Q3

Obtained on Dec 2014 from: http://www.gartner.com/document/2911618

Worldwide Smartphone Sales to End Users by Operating System in 3Q14 (Thousands of Units)

Operating System	3Q14 Units	3Q14 Market Share (%)	3Q13 Units	3Q13 Market Share (%)
Android	250,060.2	83.1	205,243	82.0
iOS	38,186.6	12.7	30,330	12.1
Windows	9,033.4	3.0	8,916	3.6
Blackberry	2,419.5	0.8	4,401	1.8
Other OS	1,310.2	0.4	1,407	0.6
Total	**301,009.9**	**100.0**	**250,296.8**	**100.0**

Source: Gartner (December 2014)

Some New Products-Ideas for 2011 -15

Open Automotive Alliance
http://www.openautoalliance.net/#members

Flex screen phones

Wearable devices

Large screen smartphones

Some New Products-Ideas for 2011 -15

Open Automotive Alliance

http://www.openautoalliance.net/#members

"The OAA is a global alliance of technology and auto industry leaders committed to bringing the Android platform to cars starting in 2015 “

Founding members

Audi, GM, Google, Honda, Hyundai and NVIDIA

New Members

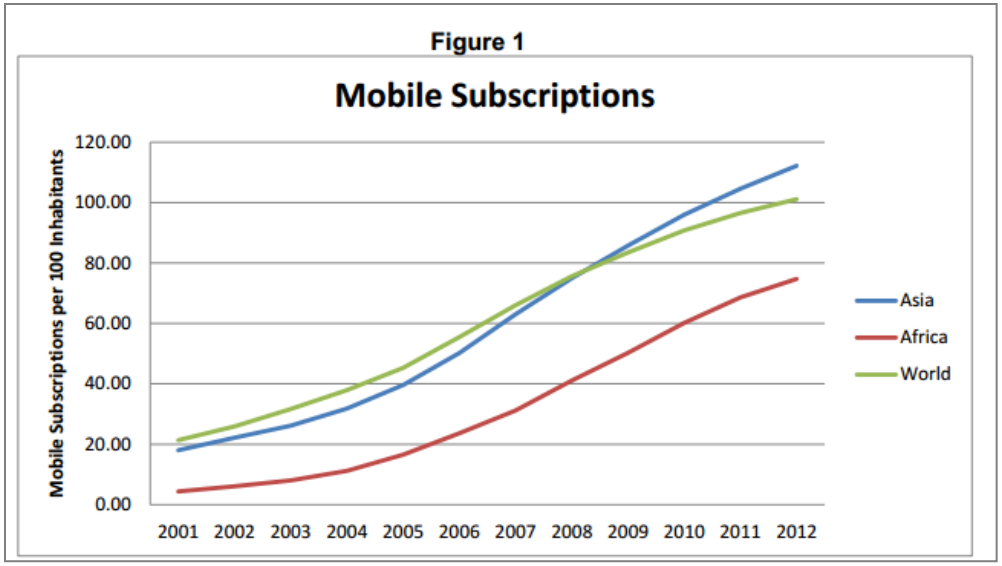
• Alpine • Bentley • Clarion • CloudCar • Delphi • FIAT Chrysler • Ford • Freescale	• FUJITSU TEN • HARMAN • Infiniti • JVCKENWOOD • LG • Maserati • Mazda • Mitsubishi	• Nissan • Panasonic • Parrot • Pioneer • Renault • Renesas • SEAT • Škoda	• Subaru • Suzuki • Symphony Teleca • Volkswagen • Volvo

Cell-Phone Diffusion

Dr. Lyza Lyth
Mma Justine & her children

Mount Kilimanjaro
Tanzania, October 2010

Cell-Phone Diffusion



Taken from
Determinants of Mobile Phone Penetration Rates in Asia and Africa: A Panel Data Analysis. By Kokila P. Doshi and Andrew Narwold.
Proceedings of 9th International Business and Social Science Research Conference January, 2014, Dubai, UAE, ISBN: 978-1-922069-41-2

Figure 1.
Mobile subscription per 100 inhabitants

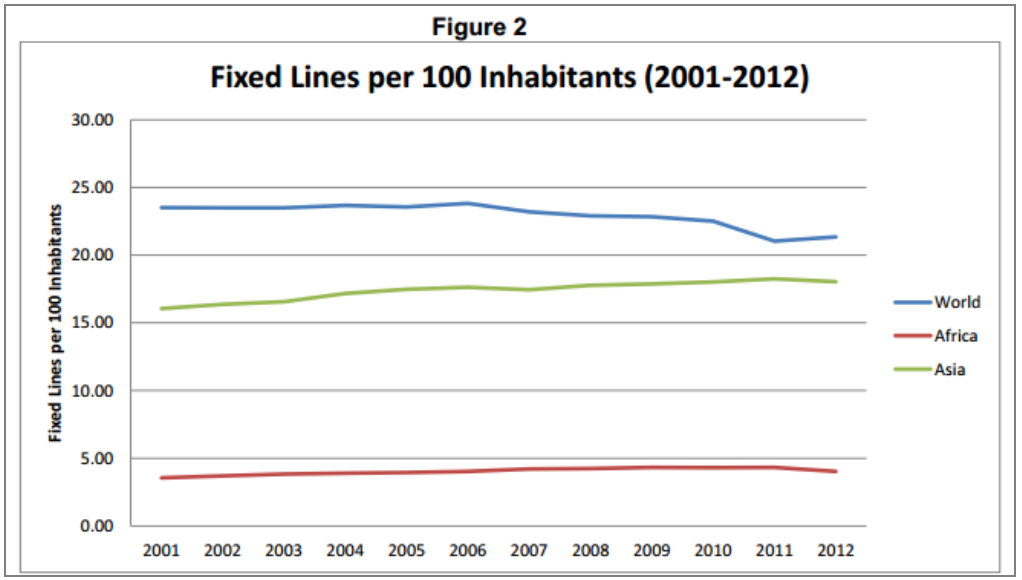
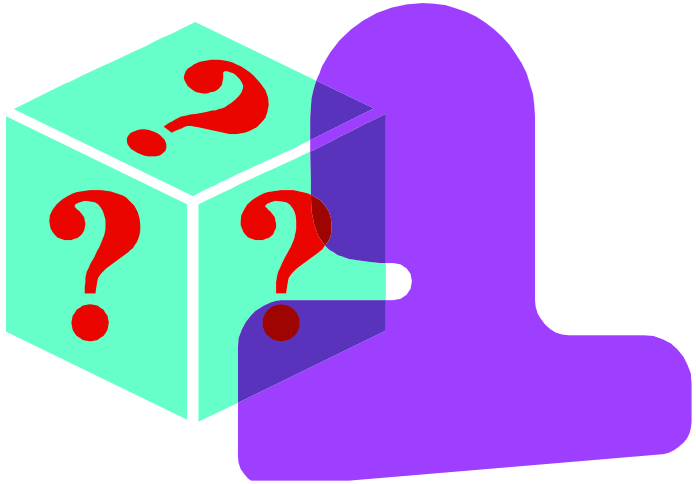


Figure 2.
Fixed lines per 100 inhabitants

Thanks for being here



Questions?