Lesson 1

Android Development Introduction

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Cleveland State University

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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.

1975
- **Dr. Martin Cooper** invented first commercial portable Motorola radio phone

2007
- iPhone
- Android

Hardware: What is inside a Smart Cellular Phone?

Oversimplifying...

Smart cellular phone ≥ radio + computer*

Industries ← \( \sum \) Software + Telecom + Semiconductor + Marketing
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 km²)

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

1 - 8
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

<table>
<thead>
<tr>
<th>Not so long ago ...</th>
<th>Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Phone</td>
<td>1. Smartphone</td>
</tr>
<tr>
<td>2. Pager</td>
<td>2. Laptop (perhaps!)</td>
</tr>
<tr>
<td>3. PDA Organizer</td>
<td></td>
</tr>
<tr>
<td>4. Laptop</td>
<td></td>
</tr>
<tr>
<td>5. MP3 Portable music player</td>
<td></td>
</tr>
<tr>
<td>6. Wired modem</td>
<td></td>
</tr>
<tr>
<td>7. No Internet access / limited access</td>
<td></td>
</tr>
</tbody>
</table>

*Tomorrow?*
# The Mobile Revolution

## Dreaming aloud
I want my 2015 Smartphone to be ...

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

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

![Android Logo](image1.png)  
![OS Competitors](image2.png)
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

Software Layers

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

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

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 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!
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:  
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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>The general action to be performed, such as:</td>
<td>The data to operate on, such as a person record in the contacts database, expressed as a <strong>Uri</strong>.</td>
</tr>
<tr>
<td>ACTION_VIEW</td>
<td></td>
</tr>
<tr>
<td>ACTION_EDIT</td>
<td></td>
</tr>
<tr>
<td>ACTION_MAIN</td>
<td></td>
</tr>
</tbody>
</table>

**Uri**
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.
Example 1: 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);
```
Example 1: Java + Built-in Intent

Intent uses `ACTION_VIEW` to see Contacts.
Example 1: Java + Built-in Intent

Java class including invocation to an Intent to display Contacts.

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

<table>
<thead>
<tr>
<th><code>&lt;action&gt;</code></th>
<th><code>&lt;permission&gt;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;activity&gt;</code></td>
<td><code>&lt;permission-group&gt;</code></td>
</tr>
<tr>
<td><code>&lt;activity-alias&gt;</code></td>
<td><code>&lt;permission-tree&gt;</code></td>
</tr>
<tr>
<td><code>&lt;application&gt;</code></td>
<td><code>&lt;provider&gt;</code></td>
</tr>
<tr>
<td><code>&lt;category&gt;</code></td>
<td><code>&lt;receiver&gt;</code></td>
</tr>
<tr>
<td><code>&lt;data&gt;</code></td>
<td><code>&lt;service&gt;</code></td>
</tr>
<tr>
<td><code>&lt;grant-uri-permission&gt;</code></td>
<td><code>&lt;uses-configuration&gt;</code></td>
</tr>
<tr>
<td><code>&lt;instrumentation&gt;</code></td>
<td><code>&lt;uses-library&gt;</code></td>
</tr>
<tr>
<td><code>&lt;intent-filter&gt;</code></td>
<td><code>&lt;uses-permission&gt;</code></td>
</tr>
<tr>
<td><code>&lt;manifest&gt;</code></td>
<td><code>&lt;uses-sdk&gt;</code></td>
</tr>
<tr>
<td><code>&lt;meta-data&gt;</code></td>
<td></td>
</tr>
</tbody>
</table>
<?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" />
        <service android:name="AndQuakeService" android:enabled="true" />
        <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>
Implementing a currency converter:

USD $\rightarrow$ Euro $\rightarrow$ 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
public class Currency1 extends Activity {
    DecimalFormat usaDf = new DecimalFormat("###,###,###,###.##");

    private final double EURO2USD = 1.35;
    private final char EUROSYM = '€';
    private final double COLON2USD = 0.0019;
    private final char COLONSYM = '₡';

    // GUI widgets
    Button btnConvert;
    Button btnClear;
    EditText txtUSDollars;
    EditText txtEuros;
    EditText txtColones;
Example 2. Currency converter

```java
@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(
""");
        }
    });
```
// 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
        }
    }
}); // setOnClickListener...

} // onCreate

} // class
Example 2. Currency converter

![Currency Converter App]

US Dollars: Enter US Dollars amount

- Euros
- Colón CR

Convert

![Converted Currency]

US Dollars: 100

- Euros: €74.07
- Colón CR: ₡52,631.58

Clear

Convert
Example 2. Currency converter

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

```xml
<?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" />
    </LinearLayout>
    <requestFocus />
</LinearLayout>
```

Example: Currency Converter

- **US Dollars**
- **Enter US Dollars amount**
- **Euros**
- **Colon CR**

Buttons: Clear, Convert
Example 2. Currency converter

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

```xml
<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" />
</LinearLayout>
```

Example2. Currency converter
Example 2. Currency converter

```xml
<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>
```
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


- 4 bn Mobile Phone worldwide (half the population of the planet)
- 1.4 bn Internet users worldwide
- 1.5 bn Televisions worldwide
- 480 m Papers

2009 Mobile market compared to other technologies

- 48.7% News and Sport Information
- 20.21% Social Networking
- 11.94% Entertainment News
- 5.33% Business Directory
- 6.69% Movie information
- 7.13% Traded Stocks and Financial

Content accessed from mobile phones
The Size of the Mobile Market – 2009

Revenue Year 2009

Microsoft
$78bn

Toyota Motors
$204bn

Exxon Mobil
$301bn

2009 Mobile Revenue

- $600 bn Voice
- $130 bn Messaging
- $70 bn Non-messaging

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

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)
2009

How SMS compares as a text communication application

- 3.05 bn SMS users worldwide
- 2.6 SMS per day per person worldwide average
- 600 m IM users worldwide
- 1.3 bn Email users worldwide

The most used written communication tool of the planet
The Size of the Mobile Market – Fourth Quarter 2009-Q4


2009
Mobile Operating System
Market Share Worldwide

- 51% Symbian
- 19% RIM
- 13% iPhone
- 9% Windows
- 6% Other
- 2% Android
The Size of the Mobile Market – Second Quarter 2010-Q2


- **Google**: 17%
- **Nokia**: 41%
- **Apple**: 14%
- **RIM**: 18%
- **Microsoft**: 5%
- **Others**: 5%
The Size of the Mobile Market – Fourth Quarter 2010-Q4

Google 32.9%
Nokia 30.6%
Apple 16.0%
RIM 14.6%
Microsoft 3.1%
Others, 2.9%

Combined sales in Q4 300 million units

Extracted from: http://gizmodo.com/5489036/cellphone-overshare
Accessed on April 2010
The Size of the Mobile Market – Second Quarter 2011-Q2

- Android: 52%
- iPhone: 29%
- RIM: 11%
- Windows, WebOs: 5%
- Others: 3%

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/

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

Number of new devices sold in the indicated periods.
AOSP = Android Open Source Project
### Worldwide Smartphone Sales to End Users by Operating System in 3Q14 (Thousands of Units)

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

Source: Gartner (December 2014)
Some New Products-Ideas for 2011 -15

Flex screen phones

Wearable devices

Large screen smartphones

Open Automotive Alliance
http://www.openautoalliance.net/#members
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        | • FUJITSU TEN | • Nissan       |
| • Bentley       | • HARMAN     | • Panasonic    |
| • Clarion       | • Infiniti   | • Parrot       |
| • CloudCar      | • JVCKENWOOD | • Pioneer      |
| • Delphi        | • LG         | • Renault      |
| • FIAT Chrysler | • Maserati   | • Renesas      |
| • Ford          | • Mazda      | • SEAT         |
| • Freescale     | • Mitsubishi | • Škoda       |
|                |              |                |
| • Subaru        | • Suzuki     |                |
| • Symphony      | • Teleca     |                |
| • Teleca        | • Volkswagen |                |
|                |              | • Volvo        |
Cell-Phone Diffusion

Dr. Lyza Lyth
Mma Justine & her children

Mount Kilimanjaro
Tanzania, October 2010
Cell-Phone Diffusion

Figure 1. Mobile subscription per 100 inhabitants

Figure 2. Fixed lines per 100 inhabitants

Thanks for being here

Questions?