Lesson 1

Android Development

Introduction

Victor Matos
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**

- **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 ← ∑ 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 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.

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**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=6rYozlZOGdk&feature=player_embedded](http://www.youtube.com/watch?v=6rYozlZOGdk&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, ...”
**Lesson 1**

### What is the Open Handset Alliance?

A consortium of 80+ technology and mobile business companies.

Quoting from [www.OpenHandsetAlliance.com](http://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

<table>
<thead>
<tr>
<th>Operators</th>
<th>Software Co.</th>
<th>Commercializ.</th>
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<tbody>
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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=7Y4thiky-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>
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</tr>
<tr>
<td>7. No Internet access / limited access</td>
<td></td>
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</tbody>
</table>

Tomorrow?


Lesson 1

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

| Android | 1. Apple Inc.  
<table>
<thead>
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<tbody>
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<td>vs.</td>
<td>2. Microsoft</td>
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<td></td>
<td>3. Nokia Symbian</td>
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<tr>
<td></td>
<td>4. Palm &amp; webOS</td>
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<tr>
<td></td>
<td>5. Research In Motion</td>
</tr>
</tbody>
</table>

1 - 12
Lesson 1

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
Lesson 1

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

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-IY&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!*
Lesson 1

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:

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

---

## 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.

```java
Intent myIntent = new Intent(
    Intent.ACTION_VIEW,
    Uri.parse("content://contacts/people")
); startActivity(myIntent);
```
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);
    }
}
```
Lesson 1

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)
Lesson 1

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.

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

<table>
<thead>
<tr>
<th>XML-element</th>
<th>Description</th>
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<tbody>
<tr>
<td>&lt;action&gt;</td>
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<td>&lt;activity&gt;</td>
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<td>&lt;category&gt;</td>
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<td>&lt;data&gt;</td>
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<td>&lt;grant-uri-permission&gt;</td>
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<td>&lt;instrumentation&gt;</td>
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<td>&lt;intent-filter&gt;</td>
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<td>&lt;manifest&gt;</td>
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<td>&lt;permission-tree&gt;</td>
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<td>&lt;uses-permission&gt;</td>
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<tr>
<td>&lt;uses-sdk&gt;</td>
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Lesson 1

**Android Manifest XML File**

```xml
<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 for the main application, labeled as the 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>
```

---

**Example 2. 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
Example 2. Currency converter

```java
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 = '€';
    private final double COLON2USD = 0.0019;
    private final char COLONSYM = '₡';
    // GUI widgets
    Button btnConvert;
    Button btnClear;
    EditText txtUSDollars;
    EditText txtEuros;
    EditText txtColones;
    @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);
        txtEuros = (EditText)findViewById(R.id.txtEuros);
        txtColones = (EditText)findViewById(R.id.txtColones);
        // make 'Euros' box not-editable (no user input)
        txtEuros.setInputType(EditorInfo.TYPE_NULL);
        // No user input. See layout: android:editable="false"
        // Attach click behavior to buttons
        btnClear = (Button)findViewById(R.id.btnClear);
        btnClear.setOnClickListener(new OnClickListener() {
            @Override
            public void onClick(View v) {
                txtEuros.setText("".toString());
                txtColones.setText("".toString());
                txtUSDollars.setText("".toString());
            }
        });
    }
```
Lesson 1

Example 2. 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(usd / EURO2USD);
            String colones = COLONSYM +
                             String.valueOf(usd / COLON2USD);
            txtEuros.setText(euros);
            txtColones.setText(colones);
        } catch (NumberFormatException e) {
            // ignore errors
        }
    }
});

});// setOnClick...

});// onCreate

});// class
Example2. Currency converter

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

```xml
<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">
    <!-- Layout contents here -->
</LinearLayout>
```

Example2. 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/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>
```

Example2. Currency converter

LAYOUT: res/layout/activity_main_linear.xml (3 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>
```
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>
</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

2009 Mobile market compared to other technologies

Content accessed from mobile phones

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)
2009 Mobile Search Market

- Google: 97.57%
- Yahoo: 1.94%
- Other: 2.43%
- Ask: 0.25%
- MSM: 0.11%

The Size of the Mobile Market – 2009


2009

- How SMS compares as a text communication application
  - 3.05 bn SMS users worldwide
  - 2.6 SMS per day per person world average
  - the most used written communication tool of the planet
  - 1.3 bn Email users worldwide
  - 600 m IM users worldwide

Lesson 1

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

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

- Google: 32.9%
- Apple: 16.0%
- RIM: 14.6%
- Microsoft: 3.1%
- Others: 2.9%

Combined sales in Q4: 300 million units

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

- Android: 52%
- iPhone: 29%
- RIM: 11%
- Windows, WebOs: 5%
- Others: 3%
Lesson 1

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


<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>187,022,721</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>961,300</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>BlackBerry OS</td>
<td>750,000</td>
<td>3,515,300</td>
<td>5,426,500</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Windows Phone</td>
<td>13,274,030</td>
<td>11,418,210</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>167,330,026</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><strong>Grand Total</strong></td>
<td><strong>427,208,766</strong></td>
<td><strong>476,637,786</strong></td>
<td><strong>431,042,500</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Number of new devices sold in the indicated periods.

AOSP = Android Open Source Project

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


<table>
<thead>
<tr>
<th>Operating System</th>
<th>2014 Units</th>
<th>2014 Market Share (%)</th>
<th>2013 Units</th>
<th>2013 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>1.4</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>295,818.8</strong></td>
<td><strong>100.0</strong></td>
<td><strong>290,384.8</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Gartner (December 2014)
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
- Skoda
- Subaru
- Suzuki
- Symphony Teleca
- Volkswagen
- Volvo
Lesson 1

Cell-Phone Diffusion

Dr. Lyza Lyth
Mina Justine & her children
Mount Kilimanjaro
Tanzania, October 2010

Figure 1.
Mobile subscription per 100 inhabitants

Figure 2.
Fixed lines per 100 inhabitants

Taken from
Thanks for being here.

Questions?