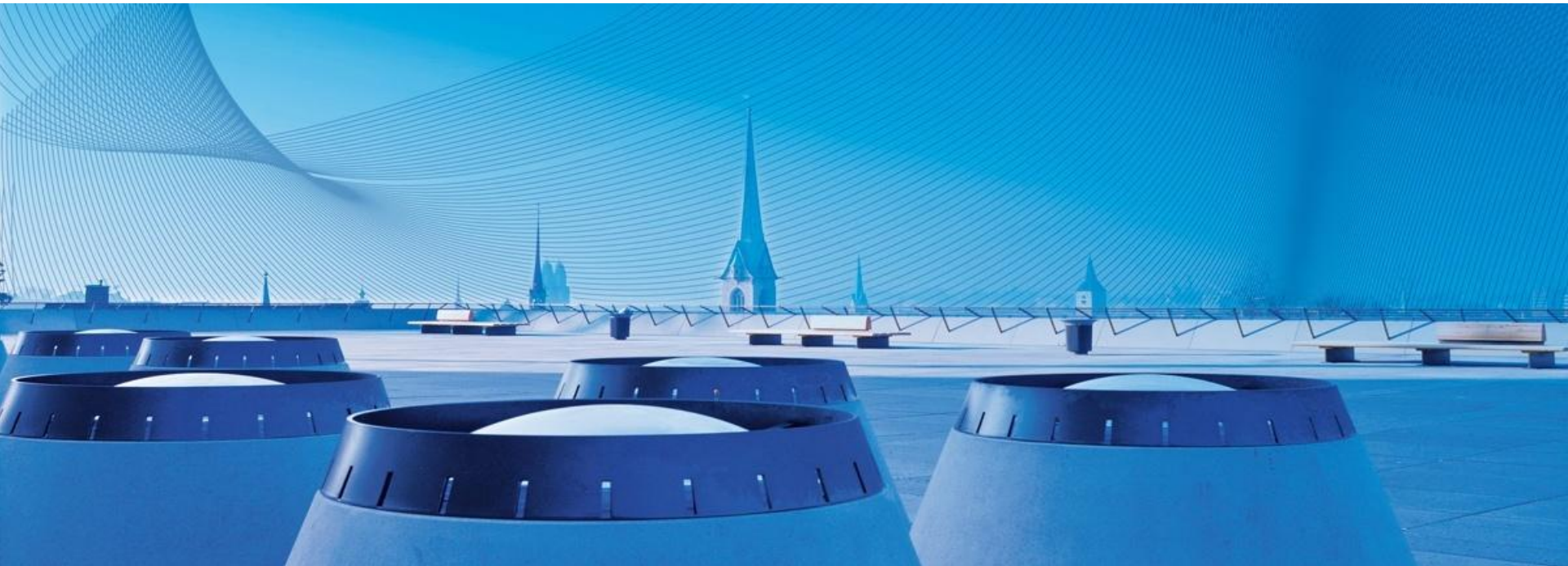


# Distributed Systems – Introduction

Matthias Kovatsch  
Distributed Systems Group



# Team

## Prof. Friedemann Mattern



Matthias Kovatsch



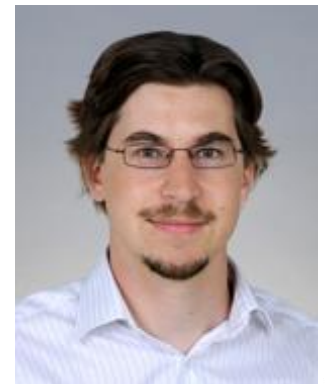
Wilhelm Kleiminger



Iulia Ion



Simon Mayer



Benedikt Ostermaier

# Web Site

- <http://www.vs.inf.ethz.ch/edu/HS2010/VS/>

ETH Zurich : Computer Science : Pervasive Computing : Distributed Systems : Education : DS HS2010

Home | Research | Publications | **Education** | Contact

## Verteilte Systeme

Prof. Dr. Friedemann Mattern  
Prof. Dr. Roger Wattenhofer

**Zeit und Ort:**

Montag 9:15 – 12:00 NO C 6 (Vorlesung, fallweise auch Übung)  
Freitag 9:15 – 12:00

**Inhalt:**

Einführung (Charakteristika und Konzepte), verteilte Kontrollalgorithmen (Flooding- / Echo-Verfahren, wechselseitiger Ausschluss, logische Uhren), Basis-Kommunikationsmodelle (Remote Procedure Call, Client-Server-Modelle, synchrone und asynchrone Kommunikation, Socket-Programmierschnittstelle), abstraktere Kommunikationsprinzipien (Broadcast, Ereignisse, Tupelräume), Namensverwaltung, Middleware und Techniken offener Systeme, Infrastruktur für spontan vernetzte Systeme (Jini), Sicherheits- und Schutzmechanismen, Fehlertoleranz (Modelle, Consensus, Agreement), Replikation (Primary Copy, 2PC, 3PC, Paxos, Quorum-Systeme), Multi-Prozessor-Programmierung.

**Selbständige Arbeit:**

Parallel zur Vorlesung werden Übungen in Form praktischer, mehrwöchiger Aufgaben angeboten, welche in die Note eingehen. Ziel ist es, praxisbezogene Aspekte verteilter Systeme zu vermitteln. Hierzu dient Android auf dem HTC Desire als mobile Programmierplattform.

**Vorlesungsunterlagen:**

Folienkopien der Vorlesung werden (in mehreren Teilen) im Laufe des Semesters hier bereitgestellt.

| Vorlesung | Termin | PDF | Dozent |
|-----------|--------|-----|--------|
| Vorlesung | Termin | PDF | Dozent |

Folienkopien der Vorlesung werden (in mehreren Teilen) im Laufe des Semesters hier bereitgestellt.

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**Selbständige Arbeit:**


Parallel zur Vorlesung werden Übungen in Form praktischer, mehrwöchiger Aufgaben angeboten, welche in die Note eingehen. Ziel ist es,

# Lecture Organization

- Extended to 8 ECTS credits
- G: «Vorlesung mit Übung»
  - Part I – F. Mattern
  - Part II – R. Wattenhofer
- A: «selbständige Arbeit»
  - Graded practical assignments



# OUTLINE

- General Information 
- **Exercise Organization**
- The Android Platform
- Homework

# Types of Exercises

- Practical assignments
  - Programming on the Android platform
  - Three detailed assignments
  - Open project
  - Graded!
- Theoretical exercises
  - Preparation for the exam
  - Two exercise sheets
  - Discussion of the exercises on given dates (according to progress of the lecture)



# Practical Assignments

- A1: GUI and hardware
  - 04 Oct 2010 – 14 Oct 2010 (1.5 weeks)
  
- A2: Client-server, REST, and Cloud services
  - 15 Oct 2010 – 28 Oct 2010 (2 weeks)
  
- A3: Unreliable network and vector clock
  - 29 Oct 2010 – 14 Nov 2010 (2.5 weeks)
  
- A4: Open project (with presentation)
  - 15 Nov 2010 – 20 Dec 2010 (5 weeks)



# Practical Assignments

- Procedure
  - Teams of three
  - Develop on the emulator
  - Test on an actual Android phone
  - One HTC Desire per team
  - Individual documentation of the code
- Grading
  - Individual submissions (grades) for detailed assignments
  - Team grade for open project



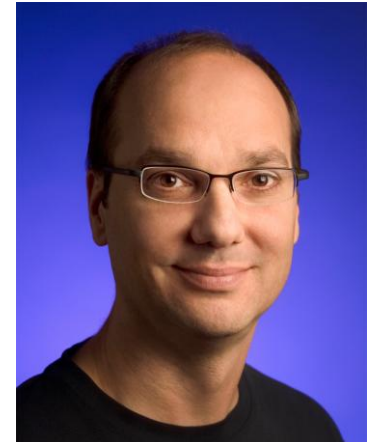


# OUTLINE

- General Information 
- Exercise Organization 
- **The Android Platform**
- Homework

# A Little History

- 09/2003: Android, Inc. founded in Palo Alto
- 07/2005: Google buys Android, Inc.
- 11/2007: Open Handset Alliance announced
  - HTC, LG, Samsung, Motorola, ...
  - Texas Instruments, Intel, Nvidia, ...
  - T-Mobile, Vodafone, Telecom Italia, ...
- 09/2008: T-Mobile's G1 launches
- 10/2008: Android goes open source
  - Apache license allows commercial development



Andy Rubin  
Co-Founder, Android



G1 (HTC Dream)

# Android Alternatives



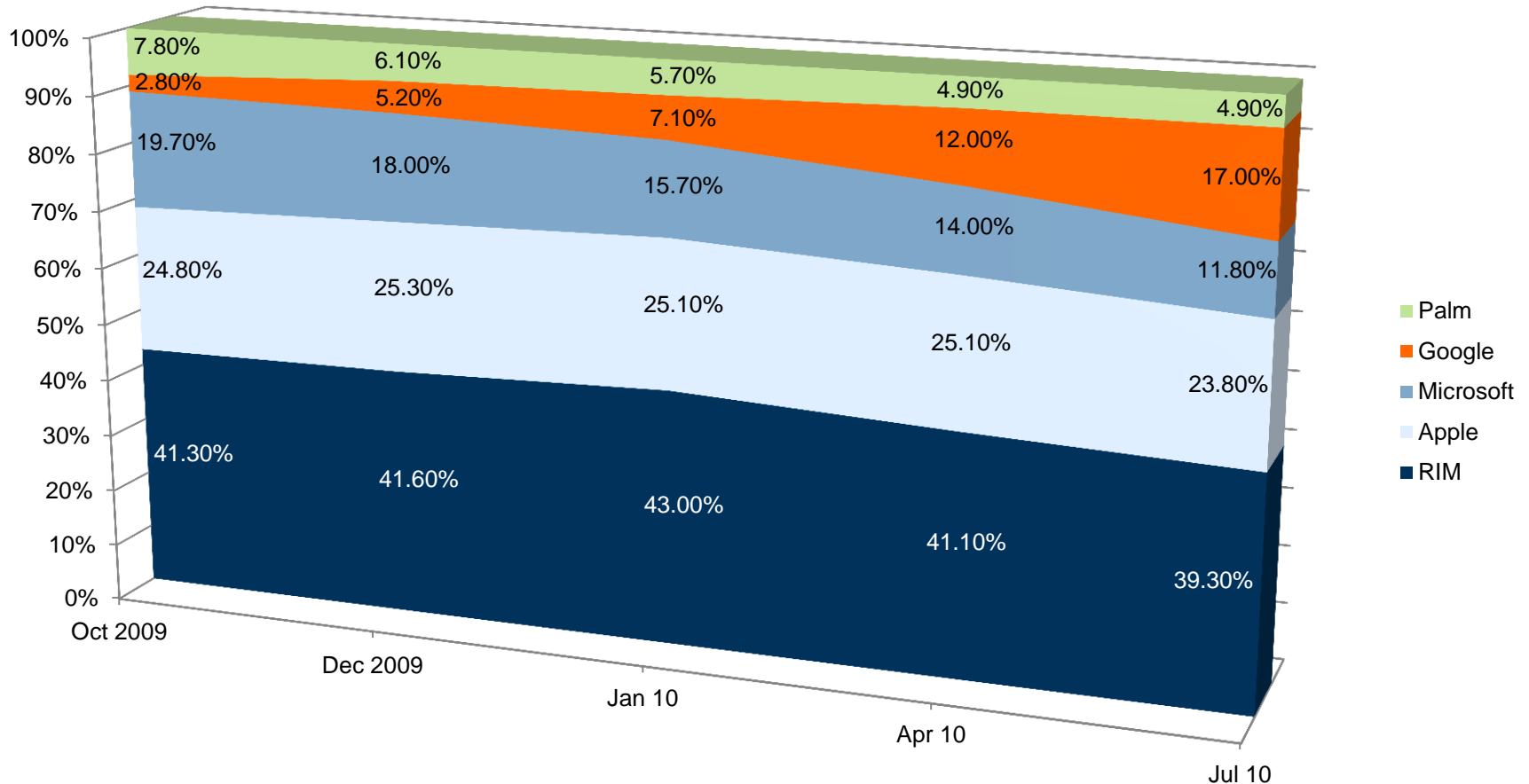
|              | Android    | iPhone       | BlackBerry   | Windows Mobile    | Symbian Foundation | Palm WebOS |
|--------------|------------|--------------|--------------|-------------------|--------------------|------------|
| Language     | Java       | ObjectiveC   | JavaME/MDS   | .NET (VB/C#), C++ | Symbian C++        | JavaScript |
| Kernel       | Linux      | Mac OS X     | RT OS        | Windows           | Real-Time OS       | Linux      |
| License      | Open       | Closed       | Closed       | Closed            | Open (02/2010)     | Mixed      |
| IDE          | Eclipse    | Xcode        | Eclipse      | Visual Studio     | Symbian ADT        | Eclipse    |
| IDE Platform | Multiple   | Mac OS X     | Multiple     | Windows           | Windows            | Multiple   |
| Version      | 2.2        | 4.1          | 6.0          | 6.5               | ^3 (S60: 5th v9.4) | 1.4.5      |
| Handsets     | Multiple   | Apple        | RIM          | Multiple          | Nokia              | Palm       |
| App Install  | Open       | Registration | Registration | Registration      | Registration       | Open       |
| Sponsor      | Google/OHA | Apple        | RIM          | Microsoft         | Nokia              | Palm       |

# Android Alternatives



|              | Android    | iPhone       | BlackBerry   | Windows Phone 7   | MeeGo (Moblin/Maemo) | bada         |
|--------------|------------|--------------|--------------|-------------------|----------------------|--------------|
| Language     | Java       | ObjectiveC   | JavaME/MDS   | .NET (VB/C#), C++ | C/C++                | C++          |
| Kernel       | Linux      | Mac OS X     | RT OS        | Windows           | Linux                | RT/Linux     |
| License      | Open       | Closed       | Closed       | Closed            | Open                 | Closed       |
| IDE          | Eclipse    | Xcode        | Eclipse      | Visual Studio     | QtCreator            | Eclipse      |
| IDE Platform | Multiple   | Mac OS X     | Multiple     | Windows           | Linux                | Windows      |
| Version      | 2.2        | 4.1          | 6.0          | «7.0»             | 1.0.3                | 1.0          |
| Handsets     | Multiple   | Apple        | RIM          | Multiple          | Multiple             | Samsung      |
| App Install  | Open       | Registration | Registration | Registration      | Open                 | Registration |
| Sponsor      | Google/OHA | Apple        | RIM          | Microsoft         | Intel/Nokia          | Samsung      |

# Android Smartphone Market Share (U.S. 13+)



Source: www.comScore.com

# Android Key Points

- Free and open for commercialization
  - Any vendor can improve (e.g., «HTC SenseUI»)
- Linux-based OS, Java-based Applications
  - Supports robust system and quick development
  - Highly optimized Java VM «Dalvik»
- All apps are equal!
  - No core OS applications
  - 3rd party apps can exchange any part of system (dialer, SMS, email)



# Android Versioning



| Version | API Level | Release Name            | Kernel  | Release Date | Note                                     |
|---------|-----------|-------------------------|---------|--------------|--|
| 1.0     | 1         | -                       | 2.6.25  | Sep 2008     | Original G1 Firmware                     |
| 1.1     | 2         | -                       | 2.6.25  | Feb 2009     | G1 Update                                |
| 1.5     | 3         | Cupcake                 | 2.6.27  | 30 Apr 2009  | More apps, languages, soft-keyboard      |
| 1.6     | 4         | Donut                   | 2.6.29  | 15 Sep 2009  | New search, Market, gestures, VPN        |
| 2.0     | 5         | Eclair                  | 2.6.29  | 26 Oct 2009  | Exchange, BT2.1, multitouch (e.g., Hero) |
| 2.0.1   | 6         |                         | 2.6.29  | 03 Dec 2009  | Bug fixes                                |
| 2.1     | 7         | <del>Flan?</del> Eclair | 2.6.29  | 12 Jan 2010  | WebKit updates, bug fixes                |
| 2.2     | 8         | FroYo                   | 2.6.32  | 20 May 2010  | JIT, RAM support, PUSH, apps to SD       |
| 3.0     | 9         | Gingerbread             | 2.6.35? | Q4 2010?     | WebM video, UI improvements, ...?        |
| 3.1     | 10        | Honeycomb               | ?       | ?            | ?  |



# Android Hardware

|                    | HTC Dream (G1)              | HTC Desire                                     | Samsung i9200 Galaxy S2                          |
|--------------------|-----------------------------|--|--|
| Date               | October 2008                | April 2010                                     | Q1 2011  |
| Android Version    | 1.0 / 1.5                   | 2.1 / 2.2                                      | 3  |
| Processor          | Qualcomm 528 MHz            | Qualcomm 1 GHz                                 | 2 GHz  |
| ROM                | 256 MB                      | 512 MB   | 4 GB   |
| RAM                | 192 MB                      | 576 MB   | 1 GB   |
| Display Technology | TFT-LCD                     | TFT-AMOLED / <b>Super LCD</b>                  | Super AMOLED 2                                   |
| Display Size       | 3.2" (320x480)              | 3.7" (480x800)                                 | 4.3" (1280x720)                                  |
| Battery            | 1150 mAh                    | 1400 mAh                                       | ?  |
| Bluetooth          | 2.0                         | 2.1  | 3.0  |
| Bluetooth Profiles | A2DP (Headsets)             | A2DP, FTP, OPP,...                             | ?  |
| WiFi               | 802.11 b/g                  | 802.11 b/g                                     | 802.11 b/g/n                                     |
| Sensors            | GPS, compass, accelerometer | GPS, compass, accel., proximity, ambient light | GPS, accel., gyroscope, proximity, ambient light |



# Android Hardware

- Tablets and more

**Dell Streak**



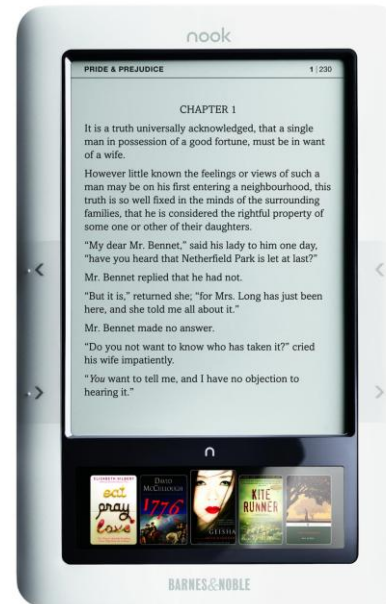
1 GHz, 5" (480x800), b/g

**Archos 8**



600 MHz, 8" (800x600), b/g

**Barnes&Noble nook**



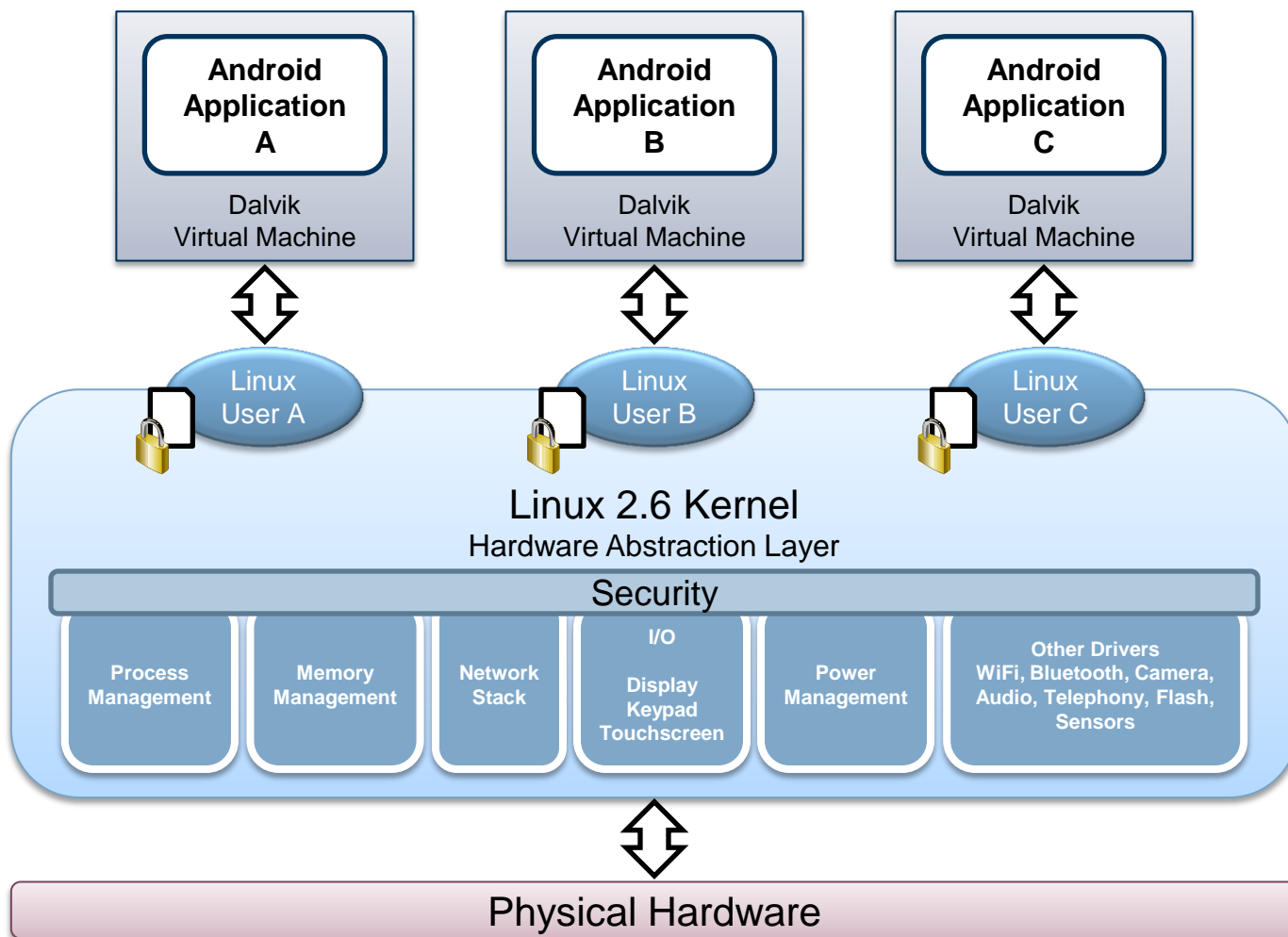
~600 MHz, 6" E ink  
+ 3.5" LCD, b/g

**Samsung Galaxy Tab P1000**



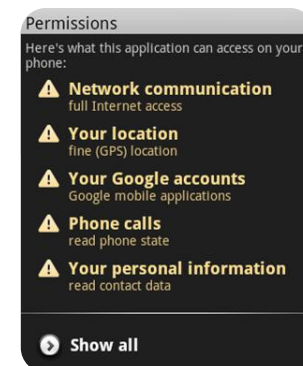
1 GHz, 7" (1024x600),  
a/b/g/n

# Android Platform

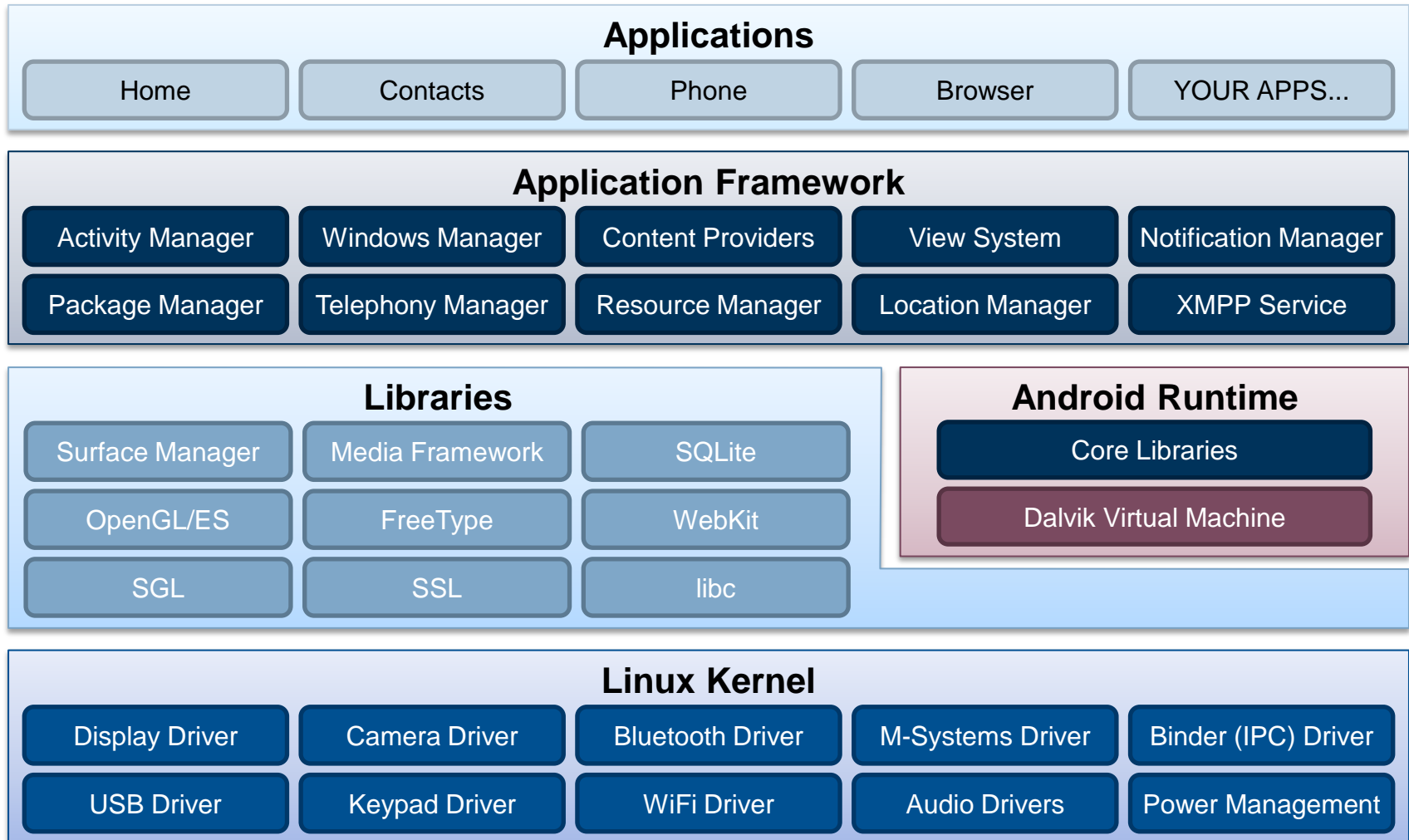


# Android Security Model

- Each application runs as individual Linux user
  - Created upon application installation by Android
  - Per default no access to other apps, data
- Apps can declare needed access permissions
  - Access to GPS location, Internet, auto-start, ...
- Multiple apps can share single user ID
  - Allows direct access to each others data
  - Apps needs to declare the same **android:sharedUserId**
  - All apps need to be signed with the same digital signature
- All applications include digital signature
  - Generic default signature while developing
  - Needs to be properly signed with your certificate when distributing (e.g., selling on Market)



# Android Software Stack



See also <http://www.youtube.com/watch?v=QBfUs9mQYY&feature=user>

# Android Key Terms

- **Activity**
  - «Logical unit of user action» (cf., window of PC application)
  - Typically a single screen with multiple Views
  - Also UI-less (Service)
- **View**
  - Hierarchical UI element
  - Combine in View Groups
- **Service**
  - Faceless task (Activity) that runs in background (e.g., music player)



# Android Key Terms

- Intent
  - Launches activities or couples multiple Activities
  - Passive data structure
  - Also describes operation to be performed
  - Explicit by calling the exact class
  - Implicit by using «Intent filters» to find matching components
- BroadcastReceiver
  - Responds to broadcast announcements (e.g., «headset plugged in» Intent by system)
  - Can wake up your application or start an Activity
  - Or just notify user



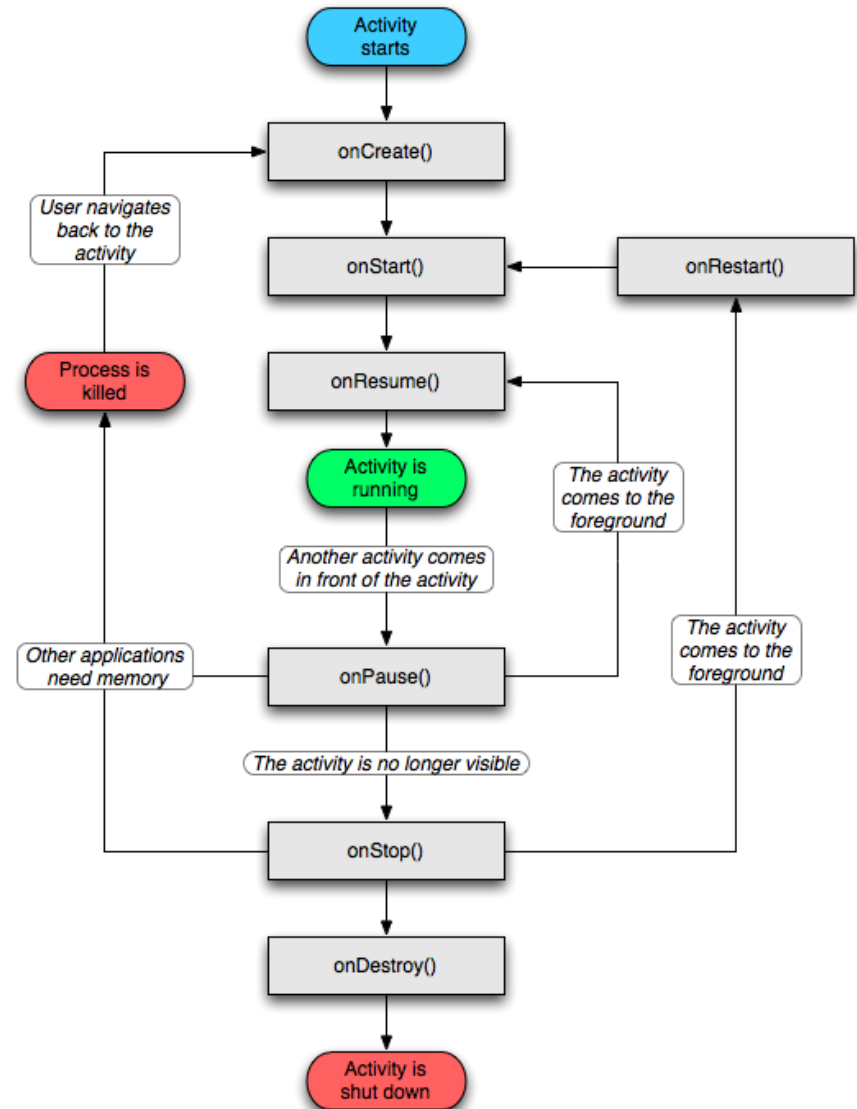
# Android Key Terms

- **ContentProvider**
  - Enables application to share data (e.g., to offer contacts to other apps)
  - Can use file system, SQLite, or «any way you want»
  - Other apps use a ContentResolver to access the data
  
- **See also**
  - <http://www.youtube.com/watch?v=QBGfUs9mQYY&feature=user>
  - <http://developer.android.com/guide/topics/fundamentals.html>



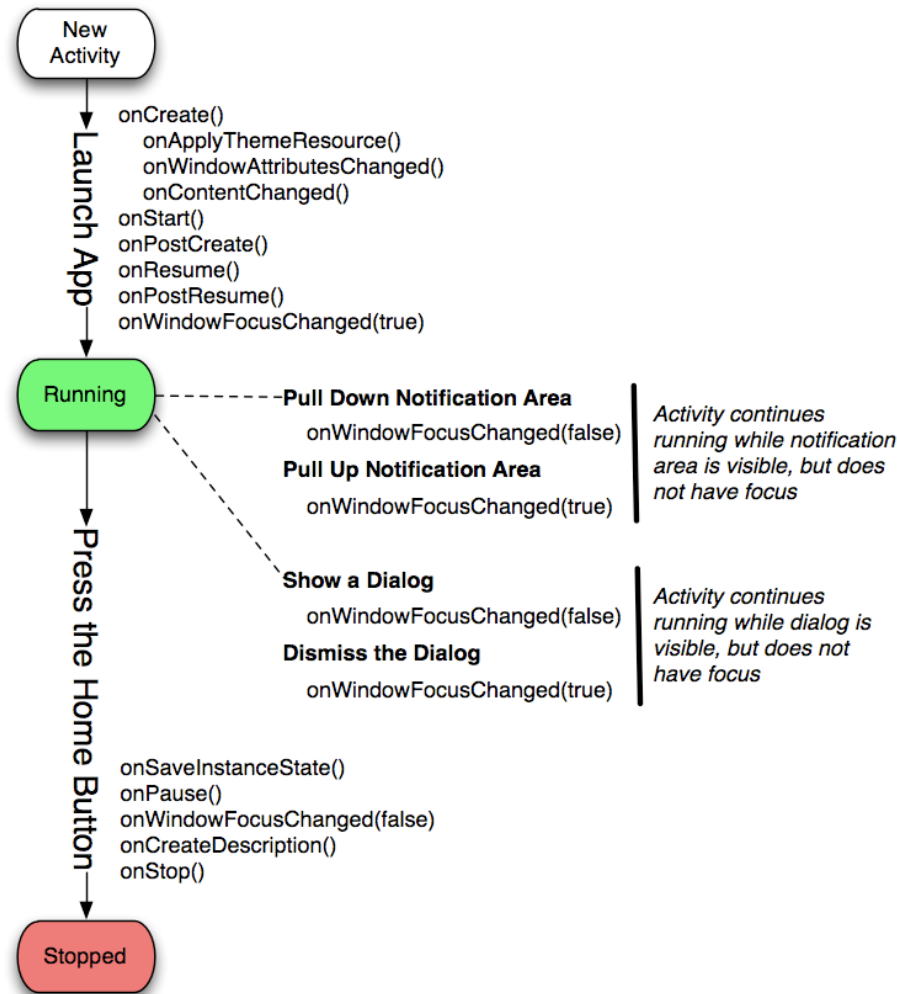
# Program Lifecycle

- Android multi-tasking
  - OS tries to maintain application process as long as possible
  - If short on memory, low priority processes may be killed
- Activity States
  - Running
  - Paused
  - Stopped
  - Finished/killed

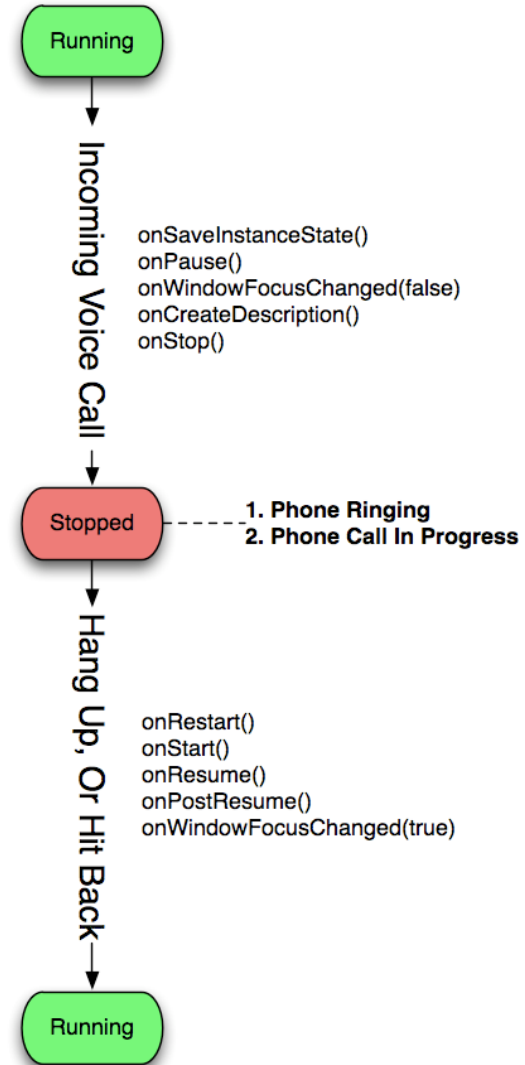
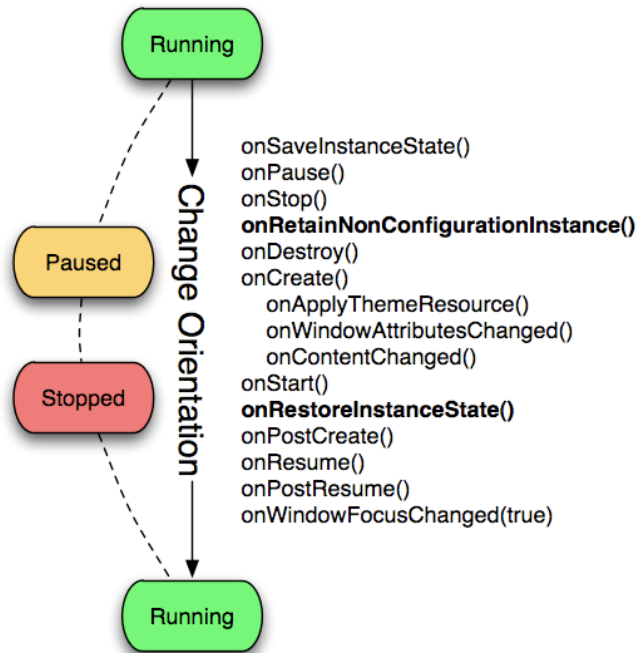




# Triggered Methods I



# Triggered Methods II






# Online Resources

- Android developers: [developer.android.com](http://developer.android.com)
  - The Guide (Intro): [/guide/index.html](http://developer.android.com/guide/index.html)
  - Resources (Tutorials): [/resources/index.html](http://developer.android.com/resources/index.html)
  - Videos: [/videos/index.html](http://developer.android.com/videos/index.html)
  
- Android blogs
  - <http://android-developers.blogspot.com>
  - <http://www.androidguys.com/>
  - ...
  
- Google



# OUTLINE

- General Information 
- Exercise Organization 
- The Android Platform 
- **Homework**

# Teams

- Form teams of 3 students each
  - Vote a representative
  - Send representative to collect the HTC Desire
- |             |             |             |
|-------------|-------------|-------------|
| ■ Monday    | 2 pm – 4 pm | CNB H 107.2 |
| ■ Tuesday   | 2 pm – 4 pm | CNB H 108   |
| ■ Wednesday | 11am – 1 pm | CNB H 108   |
| ■ Thursday  | 2 pm – 4 pm | CNB H 103.1 |
| ■ Friday    | 2 pm – 4 pm | CNB H 108   |



# HTC Desire

- Check package for completeness
- Charge the battery first
- Configure Wi-Fi access
  - «Settings > Wireless & networks > Wi-Fi settings»
- Update to Android 2.2
  - «Settings > About Phone > System software updates > Check now»
- Enable debugging
  - «Settings > Applications > Development > USB debugging»
- Get familiar with the device



# Toolchain Installation



- Java SE JDK 6
  - <http://www.oracle.com/technetwork/java/javase/downloads/index.html>
- Android SDK
  - <http://developer.android.com/sdk/index.html>
  - Extract to your disk somewhere
- Eclipse 3.5 «**Galileo**» (e.g. IDE for Java Developers)
  - <http://www.eclipse.org/downloads/>
  - Add ADT Plugin («Help > Install New Software»)
    - Software Site <https://dl-ssl.google.com/android/eclipse/>
  - Set up SDK location («Window > Preferences > Android»)
  - Install API8 packages («Window > Android SDK and AVD Manager»)

# Windows

## ■ ADB driver

1

2

3

4

5

6

7

See also <http://developer.android.com/sdk/win-usb.html>



# Ubuntu Linux

- USB Configuration Rules
  - Log in as root
  - Create file `/etc/udev/rules.d/51-android.rules`
  - For Gusty/Hardy insert

```
SUBSYSTEM=="usb", SYSFS{idVendor}=="0bb4", MODE="0666"
```

- For Dapper insert

```
SUBSYSTEM=="usb_device", SYSFS{idVendor}=="0bb4", MODE="0666"
```



- Change permissions

```
chmod a+r /etc/udev/rules.d/51-android.rules
```

# Mac OS X

- 10.6.x only includes Java 6 (both 32- & 64-bit version)
  - 64-bit version is used by default
  - May cause problems with Eclipse ADT
- Solution: Make 32-bit version default
  - Run Java Settings application
  - Bring 32-bit Java 6 to the top of the list for «Java Programs»





# Computer Labs

- Windows
  - Drivers, Eclipse, and ADT Plugin are installed 
  - Download and extract Android SDK to your home directory
  - Set up SDK location in Eclipse
  - Install API8 packages
- Linux
  - USB configuration already done 
  - Download and extract Android SDK to your home directory (or /local/)
    - **Red Hat tool ignores empty folders** → recreate «platforms» and «add-ons» folders
  - Update Eclipse («Help > Install New Software»)
    - Software Site <http://download.eclipse.org/eclipse/updates/3.5>
  - Install ADT Plugin
  - Set up SDK location
  - Install API8 packages

# Test Toolchain

- Can create an Android project?
- A sample project compiles?
- Driver for HTC Desire working?
- Sample application is installed correctly?
- Create a virtual device and run the emulator!

# OUTLINE

- General Information 
- Exercise Organization 
- The Android Platform 
- Homework 

# Next Android Lesson

- Monday, 04 October 2010
- Programming introduction
- Live hacking
- First assignment
- Install the toolchain until then!

# QUESTIONS?