# COMP3011J Mobile Application Development

# Android

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# Outline

- Smartphone Business
- Mobile Application Development
- What is Android?
- Software Stack / Marketplace
- Android Competition
- Addressing FUD

# Smartphone Business

- The Smartphone is one of the most active technologies under continual development of our modern age:
  - Roughly 250 000 active patents impact smart phones, or 1/6 of patents overall (not just technology sector) – techdirt.com
  - Very profitable business, with smartphone and tablet sales overtaking PCs and Laptops
  - Lots of companies (continuously trying) try to get into the market

# Smartphones Business Cont'd

- The pace of development continues to accelerate
  - Flexible displays
  - Google Glass ( AR devices using Android)
  - Smaller, longer-lasting batteries
  - Etc

- We'll have a separate lecture about this later

# Smartphone Application Development

- Never before so much functionality has been made available to developers in one device
- Smartphones are extremely personal devices
- Smartphones have a limited memory, CPU, and storage
- Smartphones have a very limited power source (battery)

=> Design your apps with all of the above in mind!

# What is Android?

- Android is a mobile operating system based on a modified Linux kernel
- Android is Free and Open Source OS
  - (licensed under Apache 2.0 and GPL 2 since Oct 2008, including network & telephony stacks)
- Purchased by Google in 2005, Android is now developed by Open Handset Alliance
  - (but de-facto by Google, which is controlling the development process and doing the lion's share of work)


# Android - History

- 2003 Android Inc. California.
- 2005 Google bought it.
- 2007, January, iPhone!!
- 2007, November, Google

  gave it to OHA
- Managed by **Open Handset Alliance**
  - Open source
  - Lots of members / votes: Techs & Telecoms
  - Goal: Innovative, richer, cheap and better mobile experience.
  - SW & HW are two different things, finally.

# Android - Facts

- Mainly pushed by: **Google**.
- **Comprehensive**: complete SW stack "no need for anything else to get it running"
- **Better deal** for developers (SDK), users (Team = Services) and manufacturers (Diff. Concerns).

*"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."*

open handset alliance


# Android - License

- **Business-friendly licenses (Apache/MIT):**
  - You can freely extend it.
  - You can use it for variety of purposes.
  - Rewrite and include expensive libraries.
  - You have access to the entire source code:
  - Understand the core functionality.
  - Add secret sauces without sharing.

**In brief, there is no need to license Android, you can start using and modifying it today.**

# Android – Assumptions

- Purpose-built platform for mobile devices.
- Android devices are going to always be limited in terms of memory and speed.
- Android is designed to run on all sorts of physical devices.
- Nothing is predefined: screen size, resolution, chipset, … etc.
- Its core is designed to be portable.


# Android – Assumptions

*Google is a media company, and its business model is based on selling advertising.*
*If everyone is using Android, then Google can provide additional services on top*
*of it and compete fairly.*

*Although Google does license some proprietary apps, such as Gmail and Maps, and*
*makes some money off the Android market, its primary motivation is still the advertising*
*revenue that those apps bring in.*

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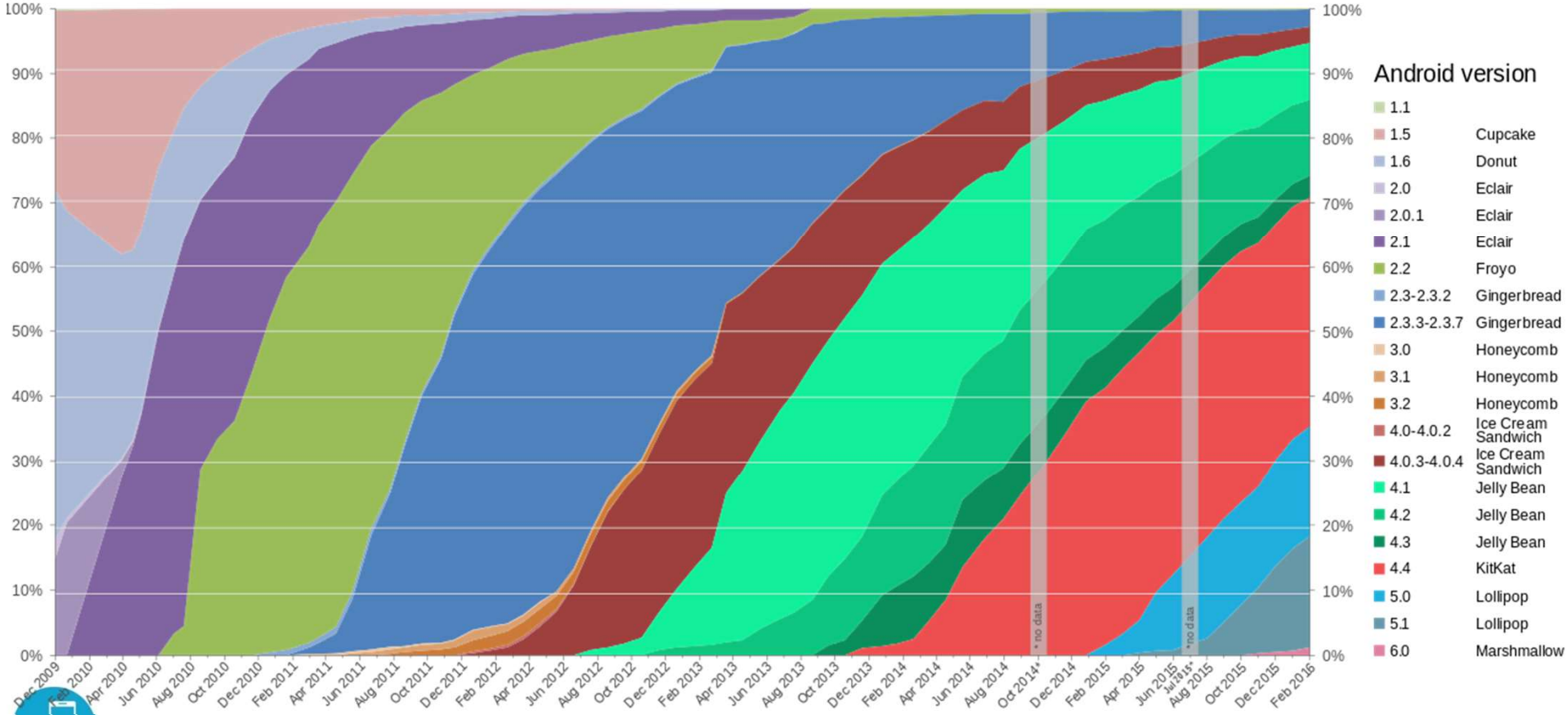
# Android Versions

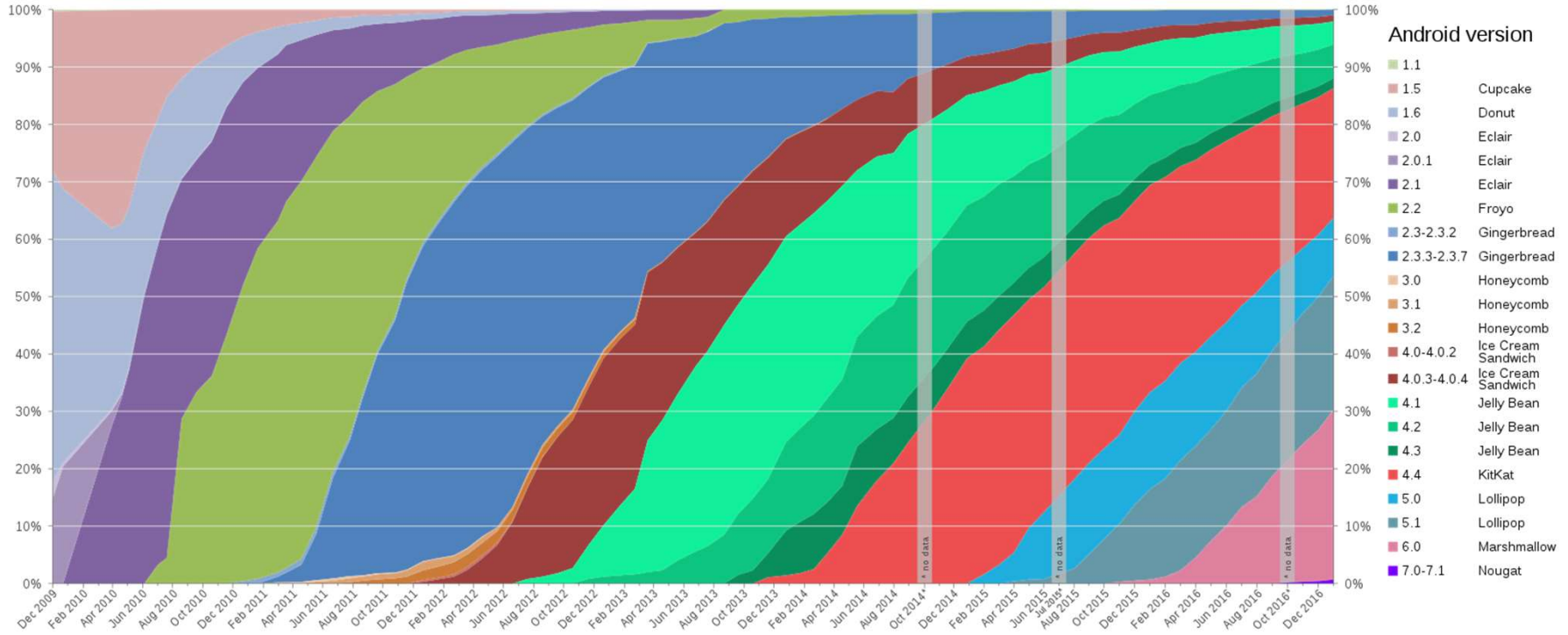
Global Android version distribution since December 2009. As of February 2016, Android 4.4 "KitKat" is the single most widely used Android version, operating on 35.5% of all Android devices accessing Google Play. The second are different Android "Lollipop" versions (5.0–5.1.1), with a combined share of 34.1%.[1].




Wikipedia, "Android Developers: Dashboards". developer.android.com. February 1, 2016. Retrieved February 8, 2016.

# Android Versions

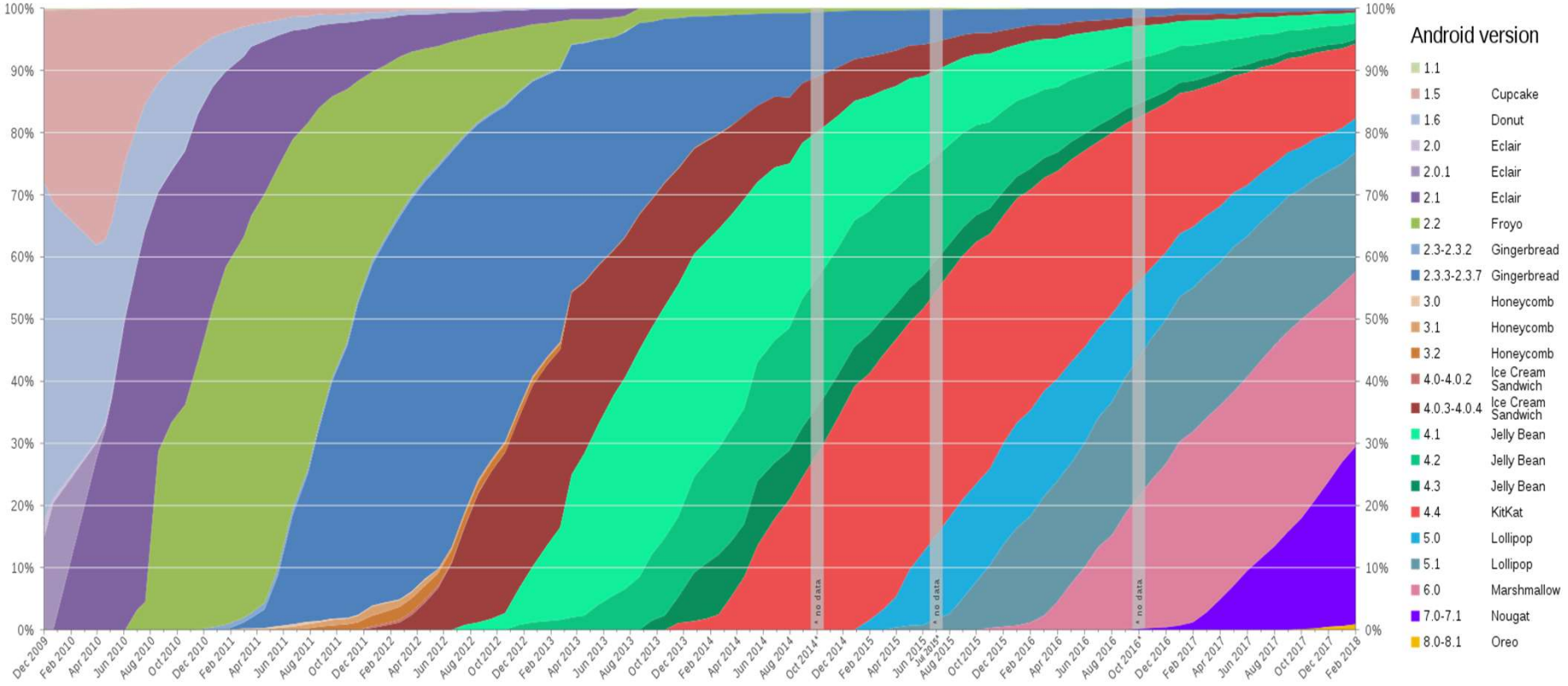
Global Android version distribution since December 2009. As of February 2017, Android 5.x “Lollipop" is the single most widely used Android version, operating on 33% of all Android devices accessing Google Play. The second are Android “Marshmallow“ with 30%.[1].




Wikipedia, "Android Developers: Dashboards". developer.android.com. February 1, 2016. Retrieved February 8, 2017.

# Android Versions

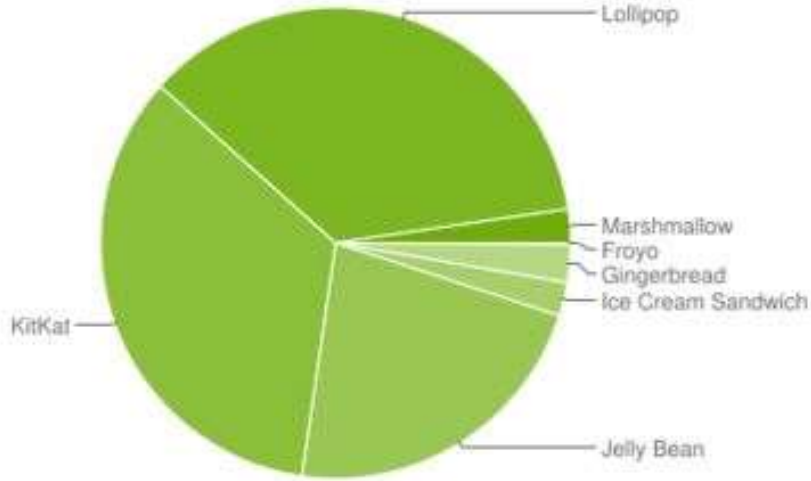
Global Android version distribution since December 2009. As of February 2018, Android Nougat is the most widely used version of Android, running on 28.5% of all Android devices accessing Google Play, while Android Lollipop 5.1.x, the oldest supported Android version runs on 19.2% of devices. *(wikipedia)*




Wikipedia, "Android Developers: Dashboards". developer.android.com. February 1, 2016. Retrieved February 8, 2018

# Android Versions

| Version | Codename | API | Distribution |
|---|---|---|---|
| 2.2 | Froyo | 8 | 0.1% |
| 2.3.3 - 2.3.7 | Gingerbread | 10 | 2.6% |
| 4.0.3 - 4.0.4 | Ice Cream Sandwich | 15 | 2.3% |
| 4.1.x | Jelly Bean | 16 | 8.1% |
| 4.2.x | | 17 | 11.0% |
| 4.3 | | 18 | 3.2% |
| 4.4 | KitKat | 19 | 34.3% |
| 5.0 | Lollipop | 21 | 16.9% |
| 5.1 | | 22 | 19.2% |
| 6.0 | Marshmallow | 23 | 2.3% |

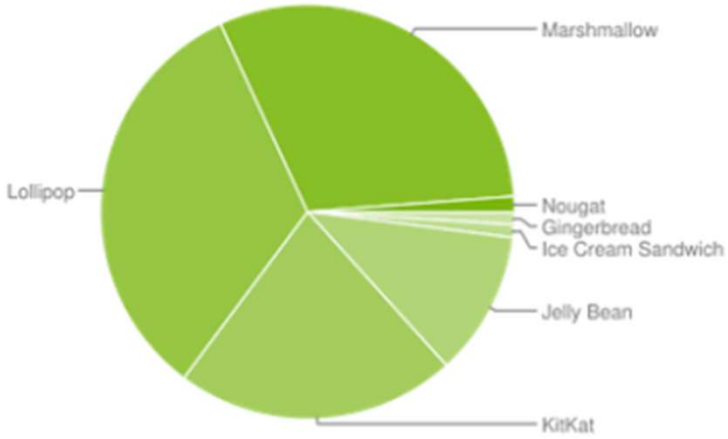



*Data collected during a 7-day period ending on March 7, 2016.*

*Any versions with less than 0.1% distribution are not shown.*

# Android Versions

| Version | Codename | API | Distribution |
|---|---|---|---|
| 2.3.3 - 2.3.7 | Gingerbread | 10 | 1.0% |
| 4.0.3 - 4.0.4 | Ice Cream Sandwich | 15 | 1.0% |
| 4.1.x | Jelly Bean | 16 | 4.0% |
| 4.2.x | | 17 | 5.7% |
| 4.3 | | 18 | 1.6% |
| 4.4 | KitKat | 19 | 21.9% |
| 5.0 | Lollipop | 21 | 9.8% |
| 5.1 | | 22 | 23.1% |
| 6.0 | Marshmallow | 23 | 30.7% |
| 7.0 | Nougat | 24 | 0.9% |
| 7.1 | | 25 | 0.3% |

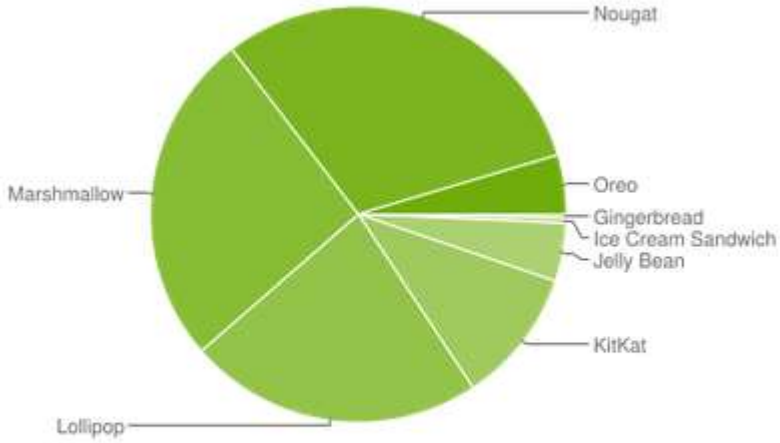



*Data collected during a 7-day period ending on February 6, 2017.*

*Any versions with less than 0.1% distribution are not shown.*

# Android Versions

| Version | Codename | API | Distribution |
|---|---|---|---|
| 2.3.3 - 2.3.7 | Gingerbread | 10 | 0.3% |
| 4.0.3 - 4.0.4 | Ice Cream Sandwich | 15 | 0.4% |
| 4.1.x | Jelly Bean | 16 | 1.7% |
| 4.2.x | | 17 | 2.2% |
| 4.3 | | 18 | 0.6% |
| 4.4 | KitKat | 19 | 10.5% |
| 5.0 | Lollipop | 21 | 4.9% |
| 5.1 | | 22 | 18.0% |
| 6.0 | Marshmallow | 23 | 26.0% |
| 7.0 | Nougat | 24 | 23.0% |
| 7.1 | | 25 | 7.8% |
| 8.0 | Oreo | 26 | 4.1% |
| 8.1 | | 27 | 0.5% |




*Data collected during a 7-day period ending on April 16, 2018.*

*Any versions with less than 0.1% distribution are not shown.*

# Android APIs

If each SDK deals with specific API that targets certain Version, which SDK to use?

| Android version | API level | Nickname |
|---|---|---|
| Android 1.0 | 1 | |
| Android 1.1 | 2 | |
| Android 1.5 | 3 | Cupcake |
| Android 1.6 | 4 | Donut |
| Android 2.0 | 5 | Eclair |
| Android 2.01 | 6 | Eclair |
| Android 2.1 | 7 | Eclair |
| Android 2.2 | 8 | Froyo (frozen yogurt) |
| Android 2.3 | 9 | Gingerbread |
| Android 2.3.3 | 10 | Gingerbread |
| Android 3.0 | 11 | Honeycomb |

Android 2.3.3, you should set your targetSdkVersion to "10"

*Typically your objective is to have your application run on as many devices as possible.*

*So, with that in mind, try to shoot for an API level that is as low as possible. Keep in mind the distribution of Android versions on real devices out there (earlier slides).*

Please, avoid the usual mistake of directly rushing to the latest SDK version.

# Android APIs

| Code name | Version number | Initial release date | API level | Security patches[2] |
|---|---|---|---|---|
| (No codename)[3] | 1.0 | September 23, 2008 | 1 | Unsupported |
| (Internally known as "Petit Four")[3] | 1.1 | February 9, 2009 | 2 | Unsupported |
| Cupcake | 1.5 | April 27, 2009 | 3 | Unsupported |
| Donut[4] | 1.6 | September 15, 2009 | 4 | Unsupported |
| Eclair[5] | 2.0 – 2.1 | October 26, 2009 | 5 – 7 | Unsupported |
| Froyo[6] | 2.2 – 2.2.3 | May 20, 2010 | 8 | Unsupported |
| Gingerbread[7] | 2.3 – 2.3.7 | December 6, 2010 | 9 – 10 | Unsupported |
| Honeycomb[8] | 3.0 – 3.2.6 | February 22, 2011 | 11 – 13 | Unsupported |
| Ice Cream Sandwich[9] | 4.0 – 4.0.4 | October 18, 2011 | 14 – 15 | Unsupported |
| Jelly Bean[10] | 4.1 – 4.3.1 | July 9, 2012 | 16 – 18 | Unsupported |
| KitKat[11] | 4.4 – 4.4.4 | October 31, 2013 | 19 – 20 | Unsupported[12] |
| Lollipop[13] | 5.0 – 5.1.1 | November 12, 2014 | 21 – 22 | Unsupported[14] |
| Marshmallow[15] | 6.0 – 6.0.1 | October 5, 2015 | 23 | Supported |
| Nougat[16] | 7.0 – 7.1.2 | August 22, 2016 | 24 – 25 | Supported |
| Oreo[17] | **8.0 – 8.1** | August 21, 2017 | 26 – 27 | Supported |
| Android P | 9 | | | Developer preview; not yet supported |

**Legend:** Old version | Older version, still supported | **Latest version** | Latest preview version

*s://en.wikipedia.org/wiki/Android_version_history)*

# Android Software Stack

- Android Applications
- Application framework including Java *compatible* libraries based on Apache Harmony
- Middleware, libraries, API written in C/C++
- Dalvik Virtual Machine
- Linux Kernel

# Android Software Stack Cont'd

- Parts of Android written in C/C++
- Surface manager
- OpenCore media framework
- SQLite
- OpenGL ES
- WebKit
- SGL
- SSL

# Android Software Stack Cont'd

- Overall Android 2.x has more than 12 mln lines of code. This includes (in mln)
  - 3 XML
  - 2.8 C
  - 2.1 Java
  - 1.75 C++
- New versions have similar amounts and have even optimised the code to be smaller.

# Typical Android Handset


- Phone
- Networking
- Location
- Multimedia
- Accelerometer, compass, gyro
- Browser
- 2D/3D graphics
- Storage

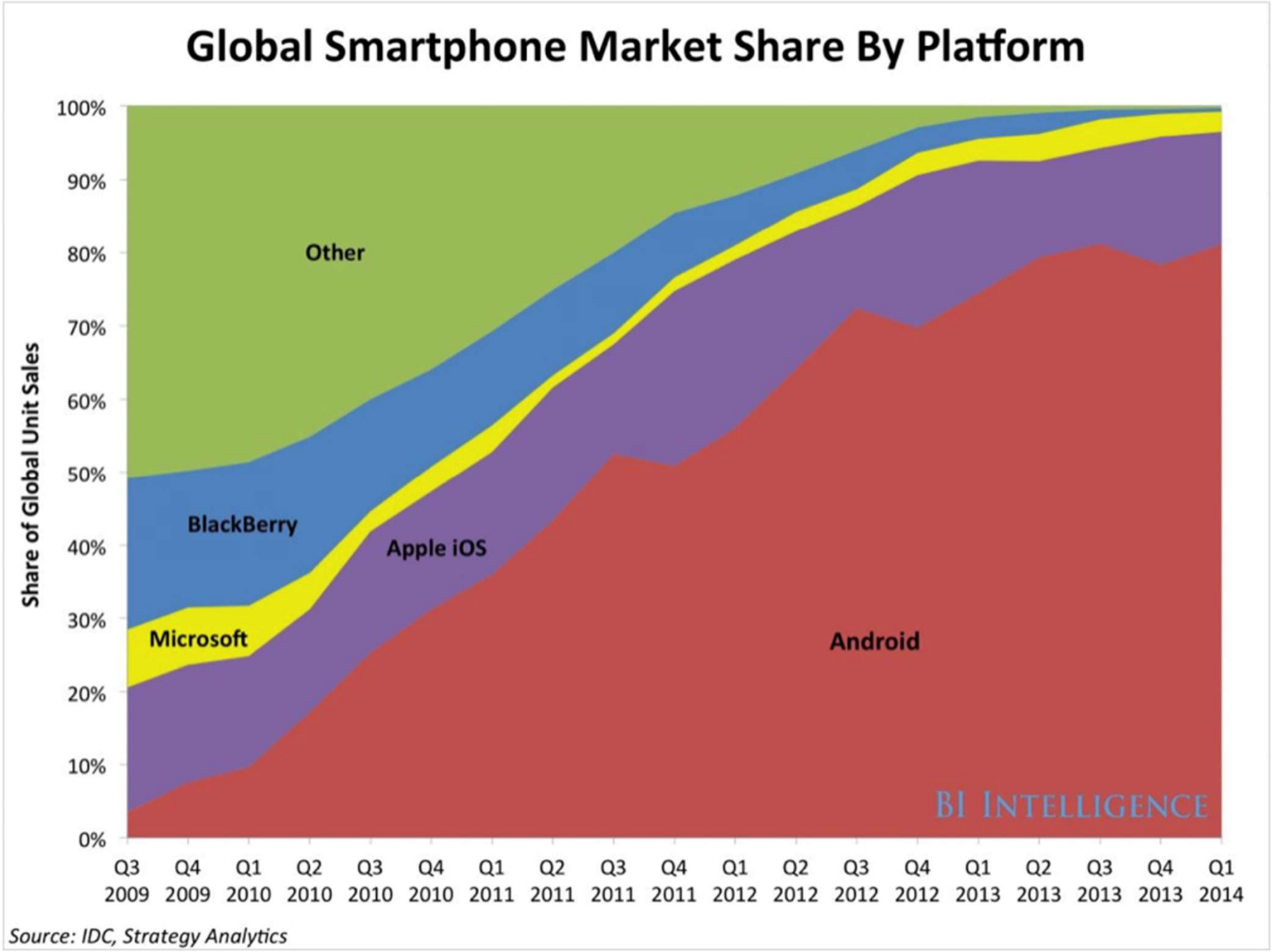
# Google Play (Android Market)

- Developers can write “apps”, extending functionality of Android-powered devices
  - That's why we are here ;-)
- Android Market is an online app store run by Google
  - Other stores are possible and they exist (Amazon App Store, others)
- Apps are developed in Java language working with Google-developed libraries
  - Other ports are in progress (so far unofficially), including PHP(?), Go
  - NDK for C/C++ is already available

# Android Market Cont'd

- The rise of Android in 2010-2014:
- 25+ K applications in December 2009
- 100+ K applications in December 2010
- 620+ K applications in January 2013
- 1 million applications in July 2013
- 1.1 million applications in January 2014
- Over 3.5 Million applications at the end of 2017

*(Source http://www.androlib.com/appstats.aspx and http://www.appbrain.com/stats/number-of-android-apps and https://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store/)*


Global Smartphone Market Share By Platform
Share of Global Unit Sales
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Other
BlackBerry
Apple iOS
Microsoft
Android
BI INTELLIGENCE
Q3 2009
Q4 2009
Q1 2010
Q2 2010
Q3 2010
Q4 2010
Q1 2011
Q2 2011
Q3 2011
Q4 2011
Q1 2012
Q2 2012
Q3 2012
Q4 2012
Q1 2013
Q2 2013
Q3 2013
Q4 2013
Q1 2014
Source: IDC, Strategy Analytics

# Chinese Handset Makers

HUAWEI

# Android Market Cont'd

- Roughly 2 billion  devices in use (2018)
- 1.5 mln new activations every day
- 16 bln application installs (Feb 2014)
- Ireland:
- Smart phone usage is growing (1.6 million + users in ROI)
- Paid applications are available in Ireland since October 2010

# Android Competition (2018)

- Existing
  - IOS by Apple ( billion)
  - WP (dead ) by Microsoft (several million ( can't find a good figure estimate is about 0.7% of 2.8 billion )
- Emerging
  - Firefox OS by Mozilla Foundation
  - Tizen (ex-Maemo, ex-MeeGo) by Samsung
  - Ubuntu Phone by Canonical
- Sunsetting
  - BlackBerry (250+) * by RIM

# Why Android has Become a Dominant Mobile Platform

- Users
  - It gives an excellent budget/feature variation choice
  - Very well integrated into other Google services that people use, *i.e. Search, Mail, Picasa, YouTube...*
  - Hundreds of thousands of apps available

# Why Android Continues to Become a Dominant Mobile Platform Cont'd

- Manufacturers:
  - "*Better than free" - provides excellent incentives for* handset manufacturers
  - "*Unique experience" - allows handset manufacturers to* innovate UI, creating better experience for their users
- Developers:
  - "*No walled garden", i.e. allows applications go to the* market immediately without painful and uncertain "review/approval" process
  - Provides excellent set of free development tools, low registration fee to upload apps to market

# Addressing FUD about Android

- FUD stands for Fear, Uncertainty and Doubt

  *“generally a strategic attempt to influence perception by disseminating negative and dubious or false information”*

# Fragmentation FUD

- Different handsets
- Different versions of Android
- Different Android forks (derivatives)

# Fragmentation FUD Cont'd

- Different handsets:
- Yes, there are hundreds of different handsets (Search GSMArena for Android devices)
- They have different screen sizes, controls, hardware features, processor speeds, etc => same as PC
- Nobody is shouting that “PC market is fragmented!”

# Fragmentation FUD Cont'd

- Google addressing problem of low spec devices with
- Kit Kat 4.4
- Release on 31st October 2013
  - Optimizations for performance on devices with lower specifications
- From Android 5.0 ( 2014) onwards a new runtime ART, but this course will be based on Kit Kat as we will be using eclipse as our IDE and not Android Studio.
- Hence why most of the slides here aim to present information on 4.4 Kitkat, as over the years I find it's the best target for teaching.
- Android Studio is still now stable  to be used development platform of choice for teaching ,but I would still recommend targeting earlier SDK to help with emulation e.g using older images ( technically later version of android actually run better but if its an old image comparability issues could mean 4.4 is still a better choice.
- Latest release Android 9.0 (Nougat) , August 6th 2018

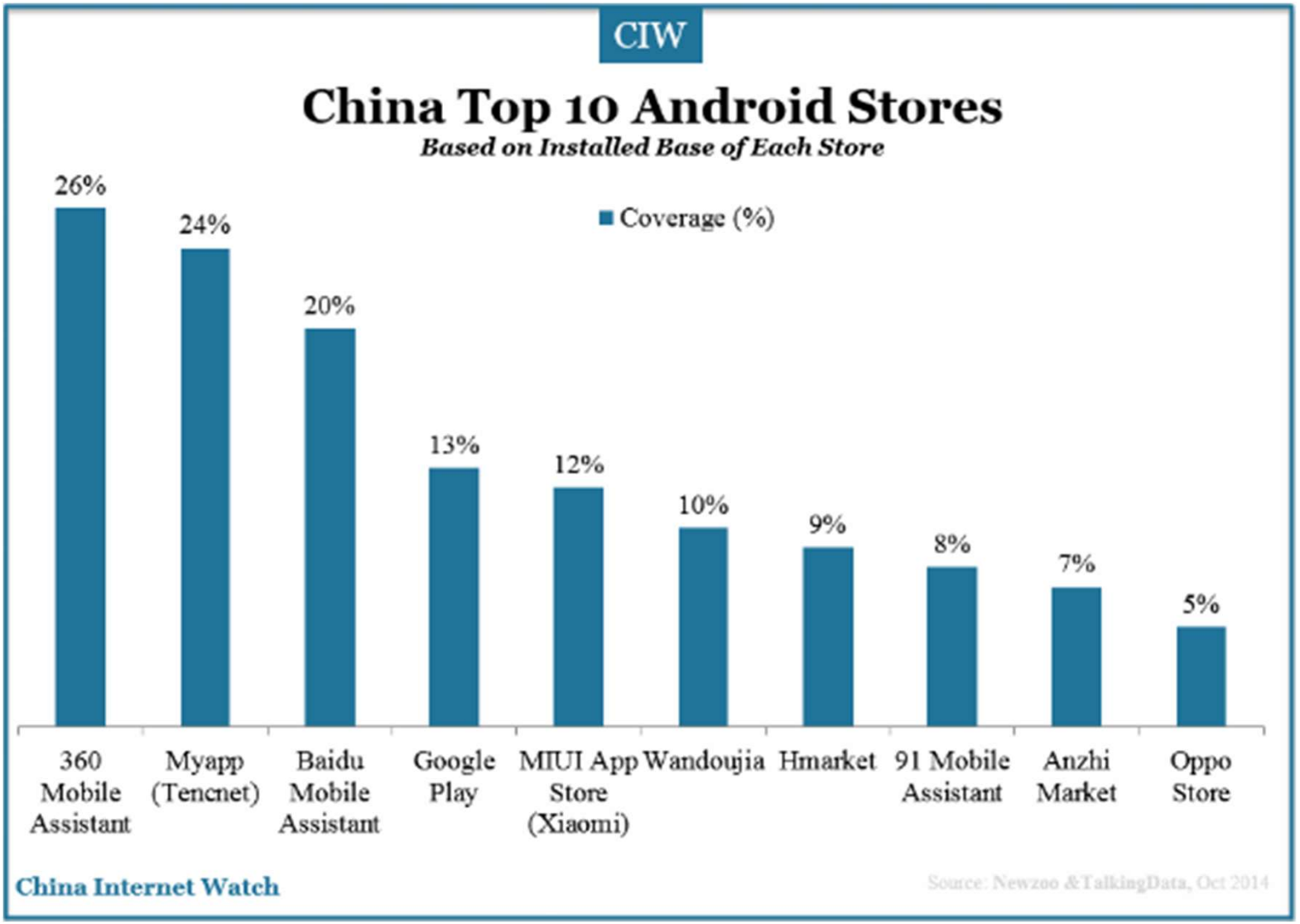
# Android Forks (Derivatives) FUD

- *“Android's openness can lead to various*
- *incompatible forks!”*
- The two most well-known android-based derivatives are
  - Amazon's Kindle Fire series
  - Open source CyanogenMod
  - => both aren't really a problem
- Some Telco Providers have custom layouts/launchers but don’t fork. Remember its still a Linux box with NDK, underneath it all.

# Adult Content FUD

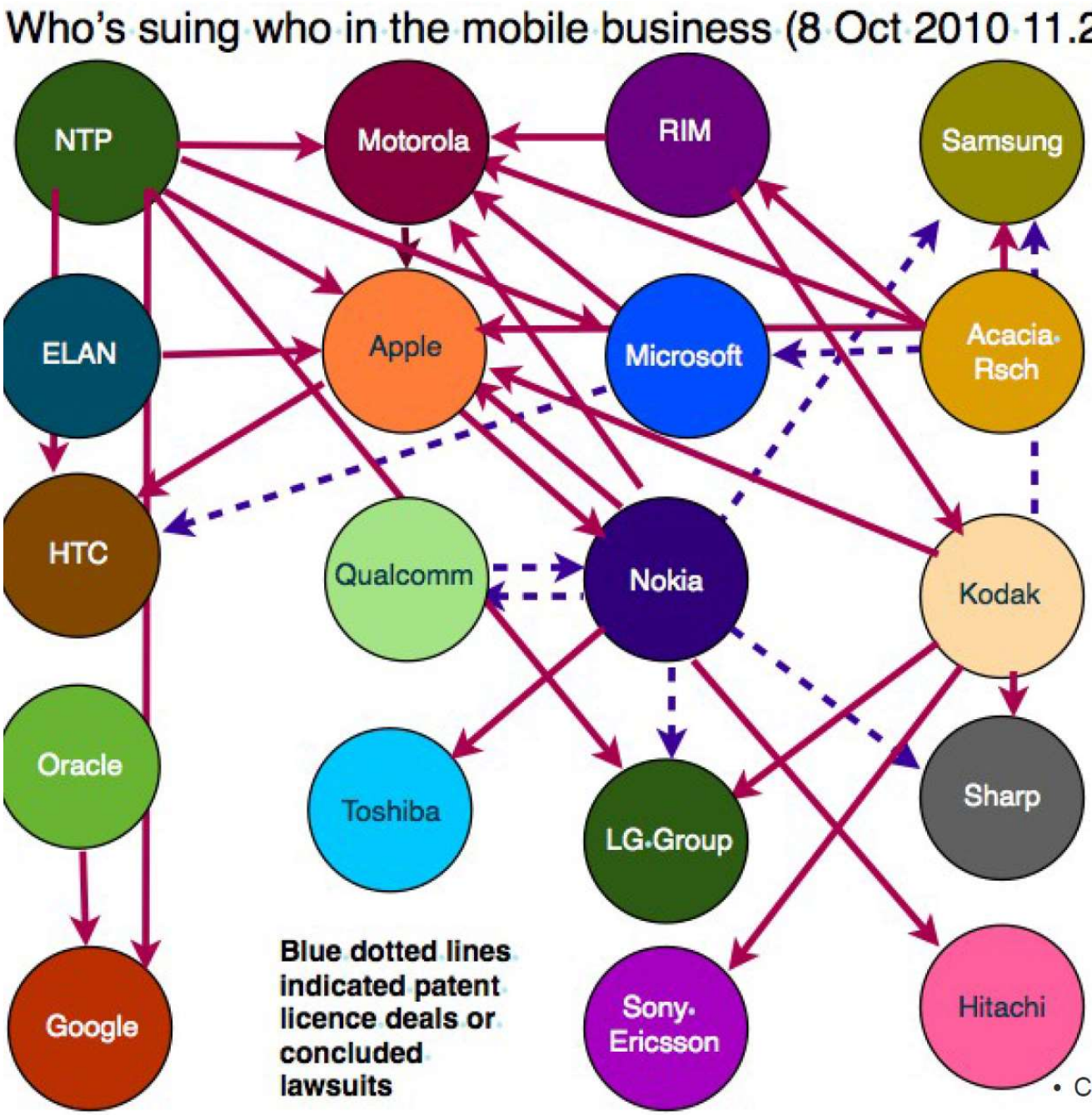
- Google was blamed for allowing adult content
  - False!
- Since November 2011, applications can be rated (similar to TV rating guidelines)
  - Automatic '17+ content if left unrated by the app devs)

# Chinese Market places

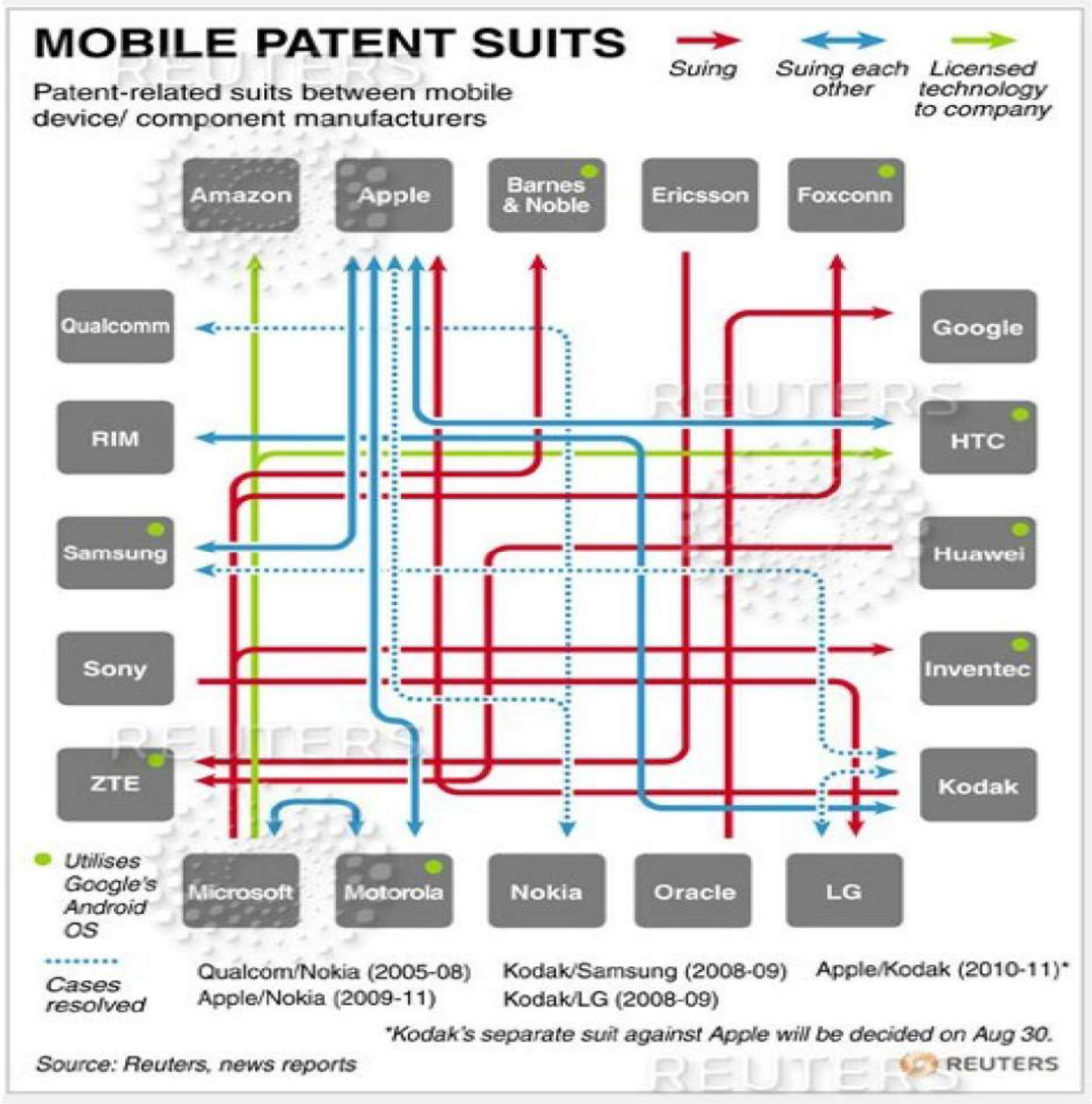


# Litigation FUD

- Oracle sued Google for “knowingly, directly and repeatedly infringed Oracle's Java-related intellectual property”
  - Google won, the appeal is still pending
- Regardless of the lawsuit's outcome Android is not going anywhere
  - Independent developers won't see this money either way :-)
- *Disclaimer: IANAL and TINLA!*

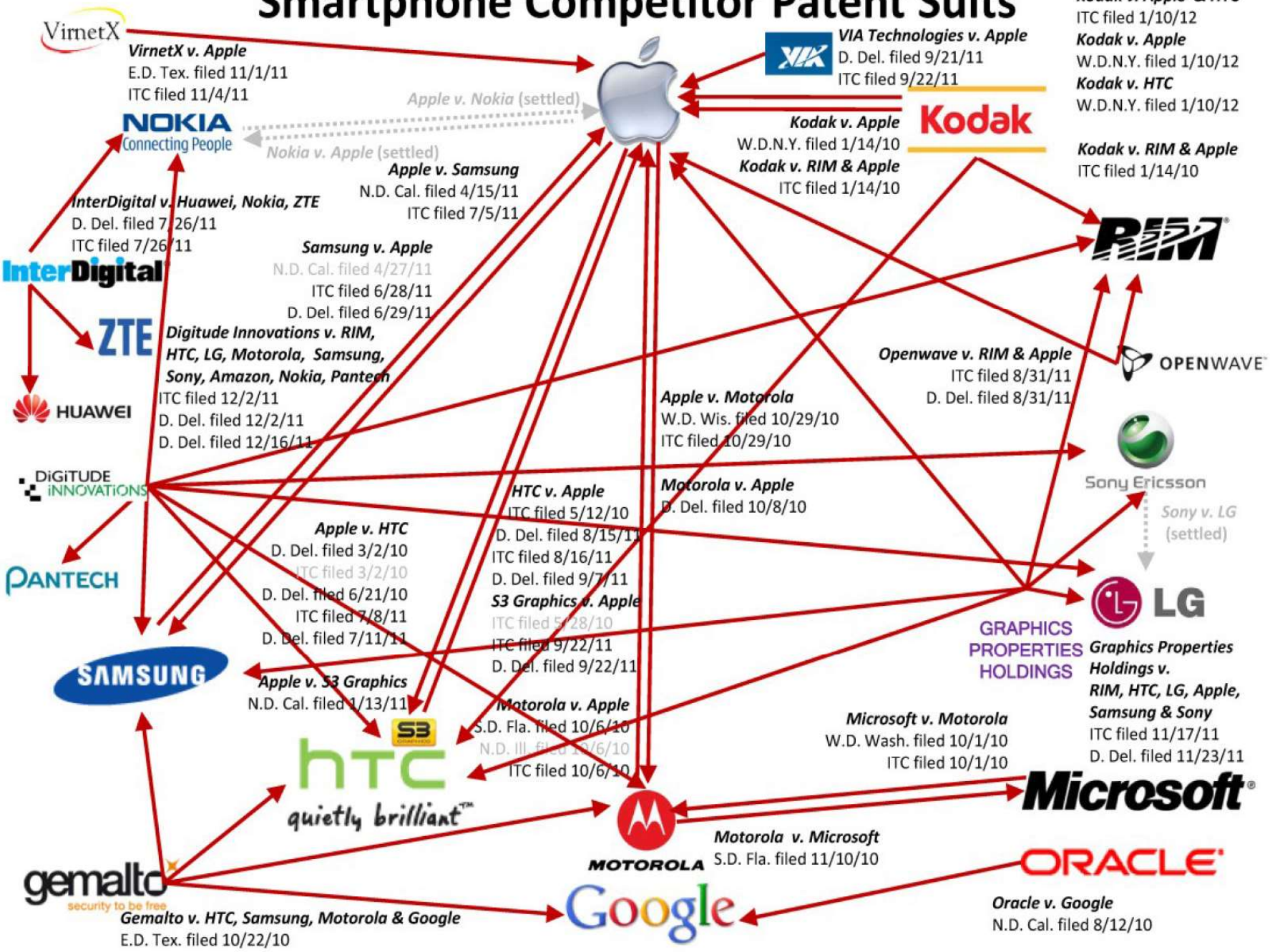



• Credit – Guardian.co.uk




Aug 2011
(c) Reuters

# Smartphone Competitor Patent Suits




Source: droid-life.com

# “Android is insecure” FUD

- “*Android is so insecure it needs an antivirus!*”
  (Antivirus companies love this one :-) However, absolute majority of the malware found in phones was installed by users themselves

- “*Android does not fix bugs*”
  Android phones regularly receive bug fixes via OTA updates

# “Android is insecure” FUD Cont'd

- *“There is no way to remove malicious programmes without an antivirus!”*

  Google has an ability to remove apps that were installed from Android Market remotely, and does it regularly with malware (and other TOS violations)

- *“Android is full of holes!”*

  In fact, “Vanilla” distribution of Android is quite secure. Most of The vulnerabilities are introduced by handset manufacturers (making vulnerabilities unique to specific handset brands), these 'holes' are fixed, too.

# *“Android is a spying machine” FUD*

- CarrierIQ scandal
  - Not present in Vanilla Android, but present in iPhone
  - Added by some manufacturers for specific phones and specific mobile telcos with telcos' consent
  - Detected due to Android being an open and easy to use platform

# Questions ?

- Please read Chapter 1 in Professional Android 4 application development.