

Mobile Application Development

Lecture 1

Introduction to Mobile Computing & Development



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Mobile Computing

Mobile computing is a form of human–computer interaction by which a **computer is expected to be transported during normal usage.**

Mobile computing has **three aspects:**

- **Mobile Communication:** addresses communication issues in ad-hoc and infrastructure networks as well as communication properties, protocols, data formats and concrete technologies.
- **Mobile Hardware:** related to hardware, e.g., mobile devices or device components.
- **Mobile Software:** deals with the characteristics and requirements of mobile applications.

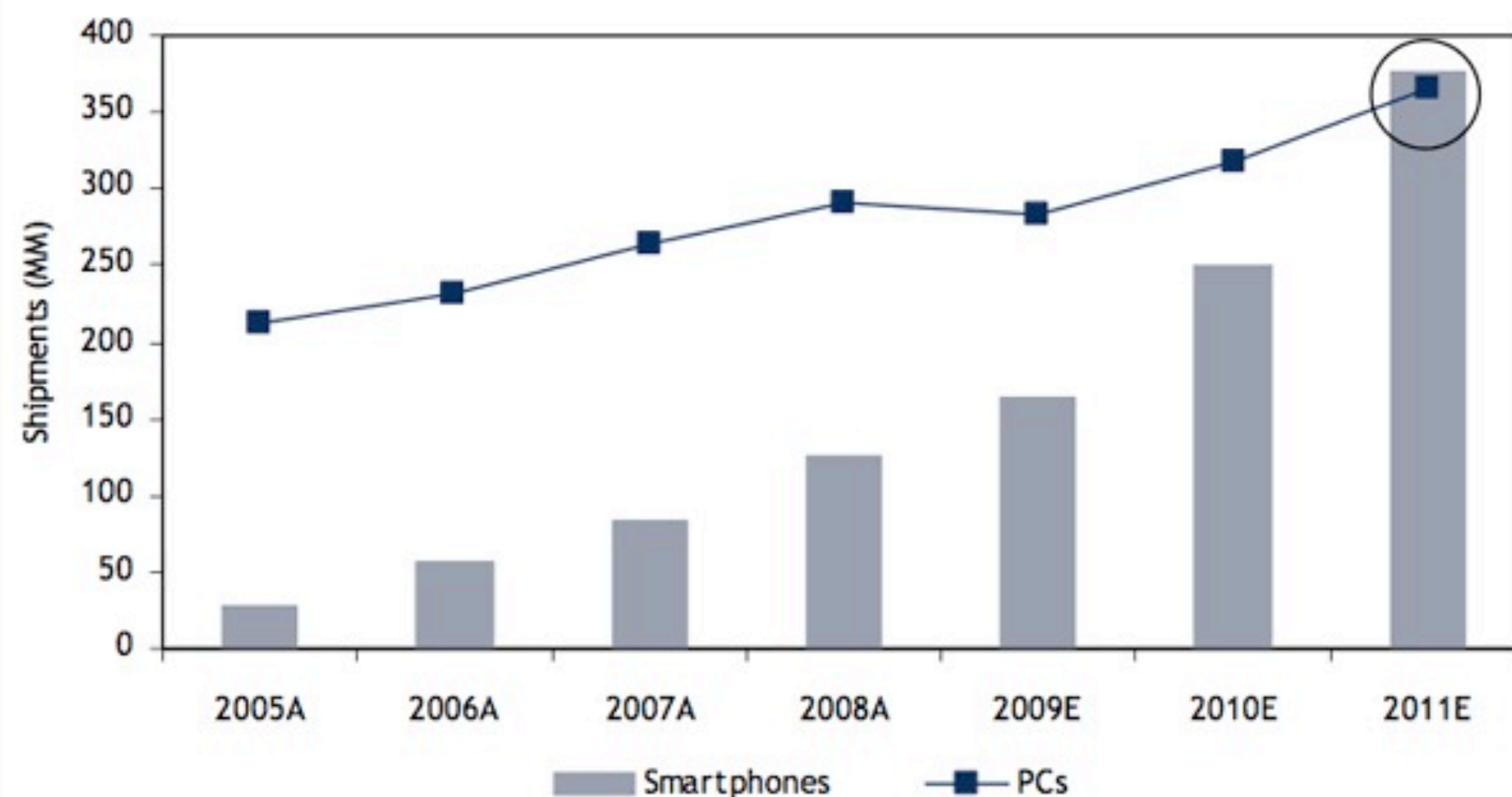
Techniques and Technologies that enable people to
access computing services
Anytime, and Anywhere.

Source: http://en.wikipedia.org/wiki/Mobile_computing

Market Growth (2011-2012)

Silicon Alley Insider Chart of the Day

Smartphone Sales To Beat PC Sales By 2011

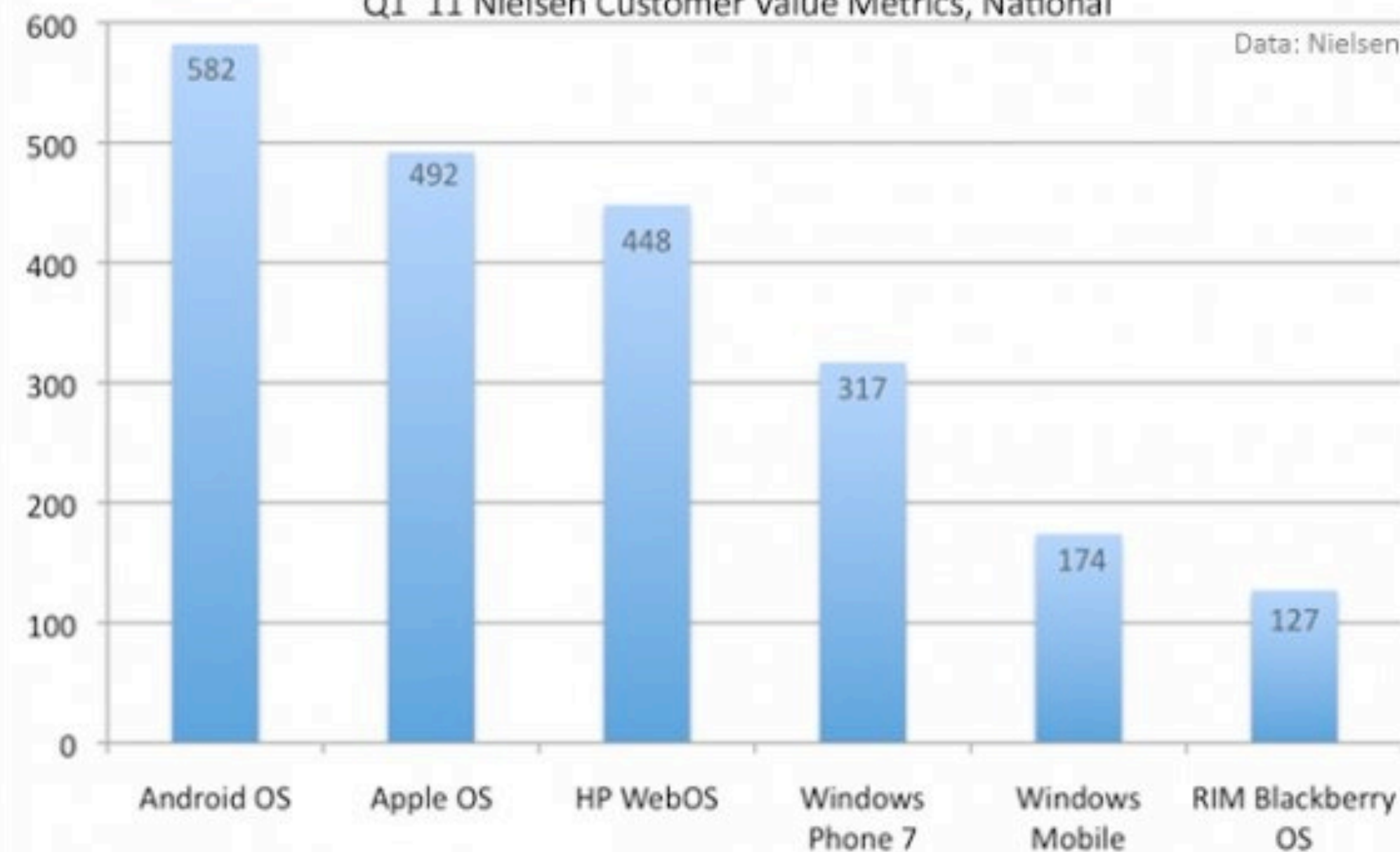


Source: RBC Capital Markets estimates

Silicon Alley Insider Chart of the Day

Average Monthly Data Usage (MBs)

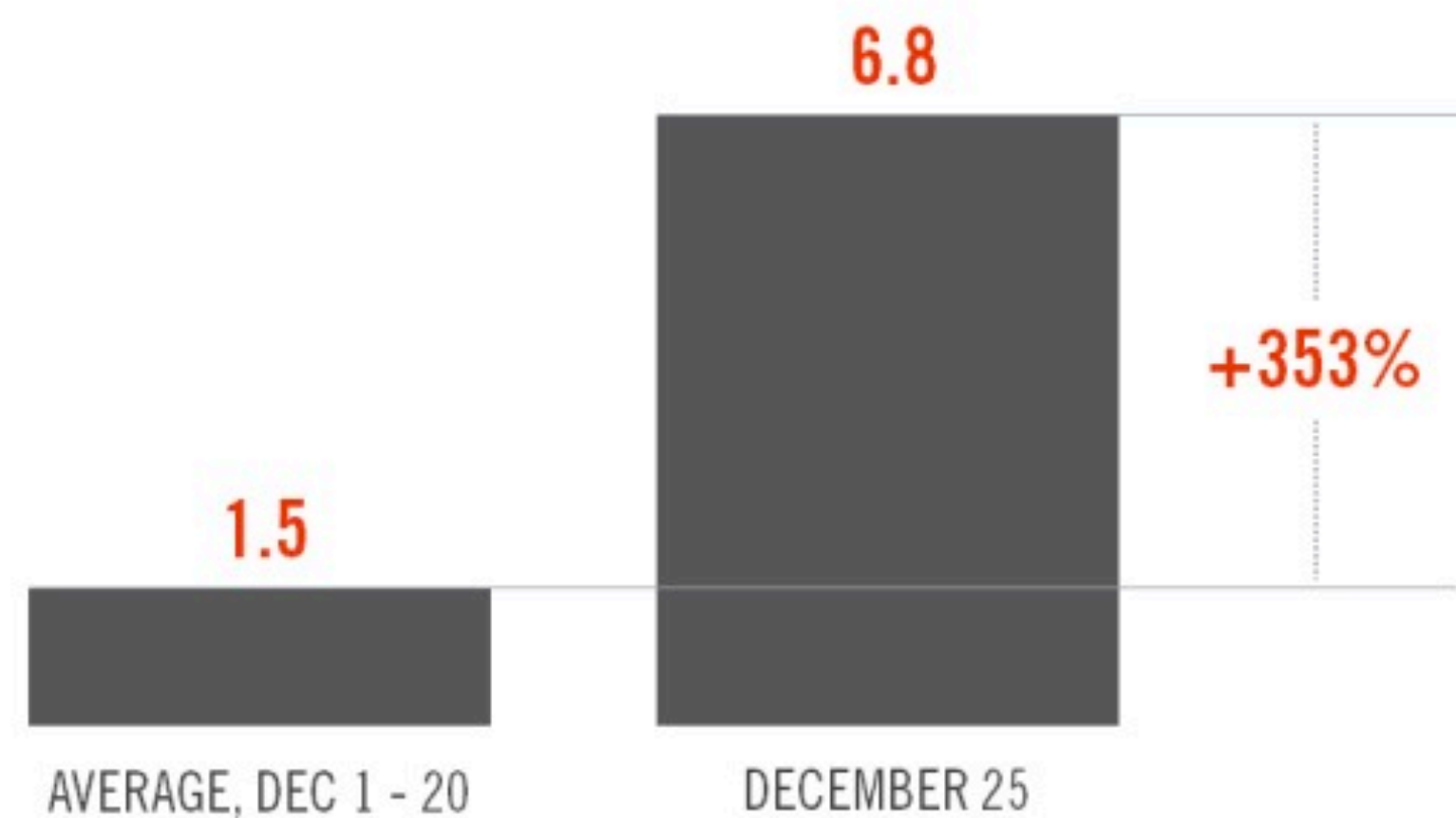
Q1 '11 Nielsen Customer Value Metrics, National



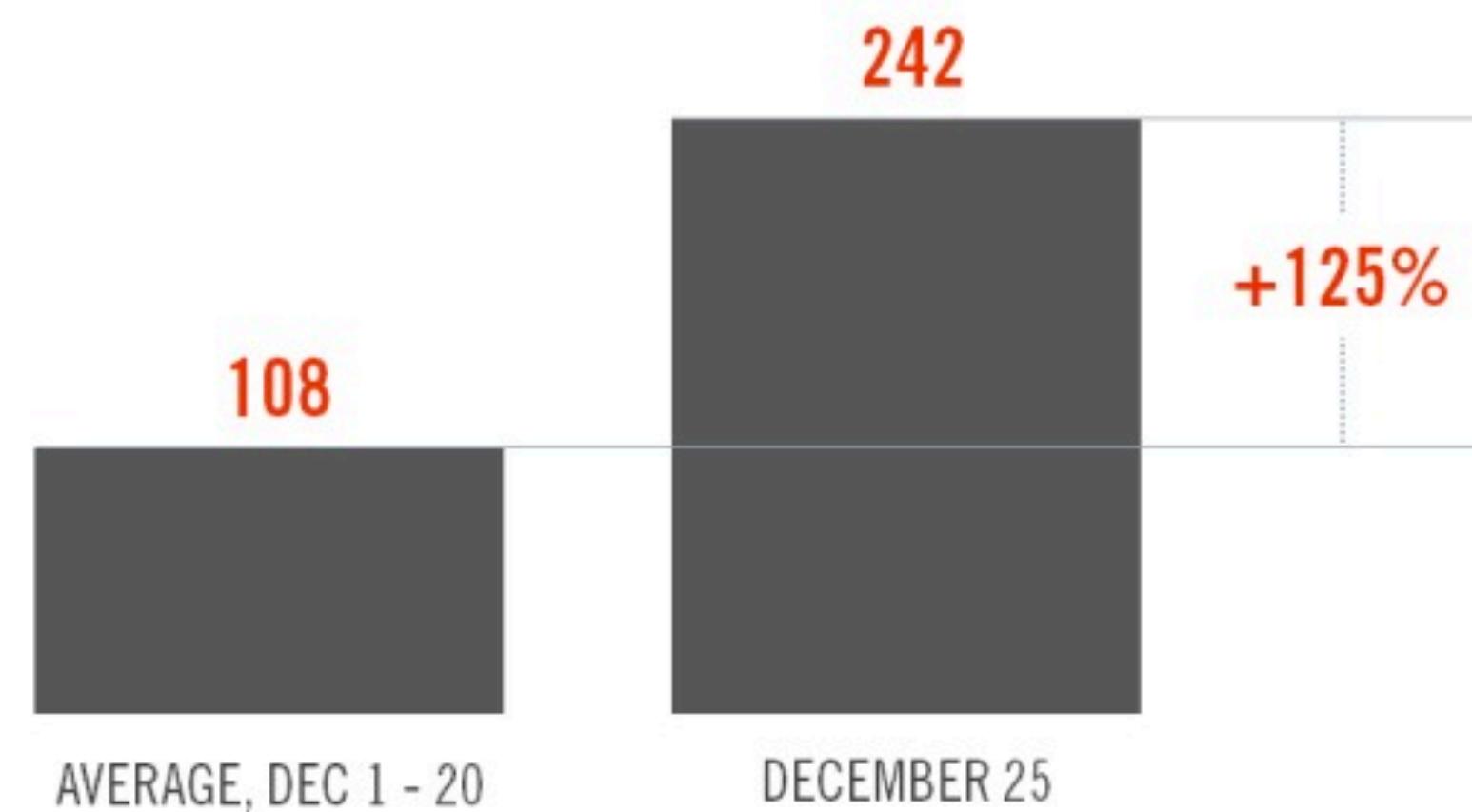
Data: Nielsen

Market Growth

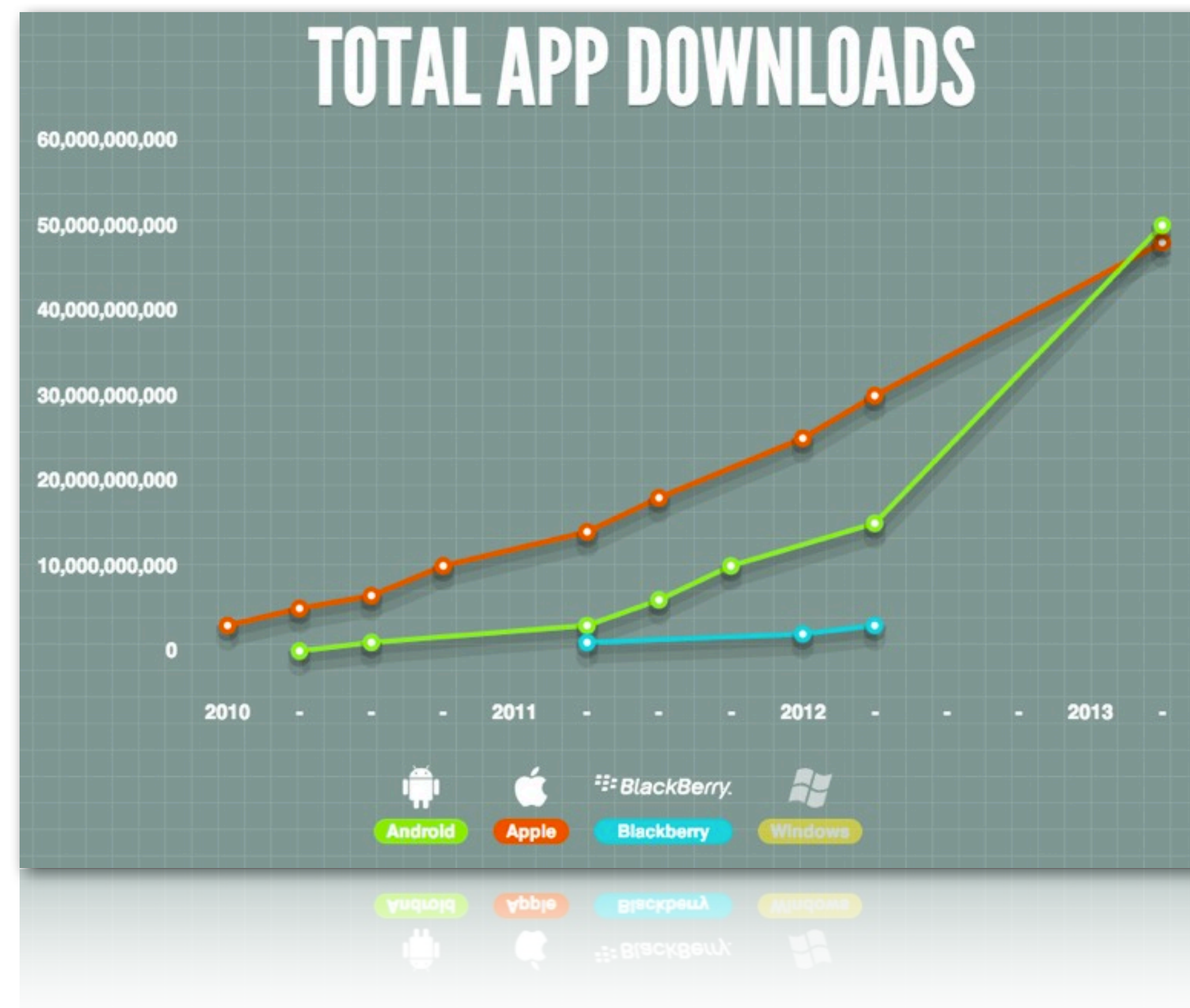
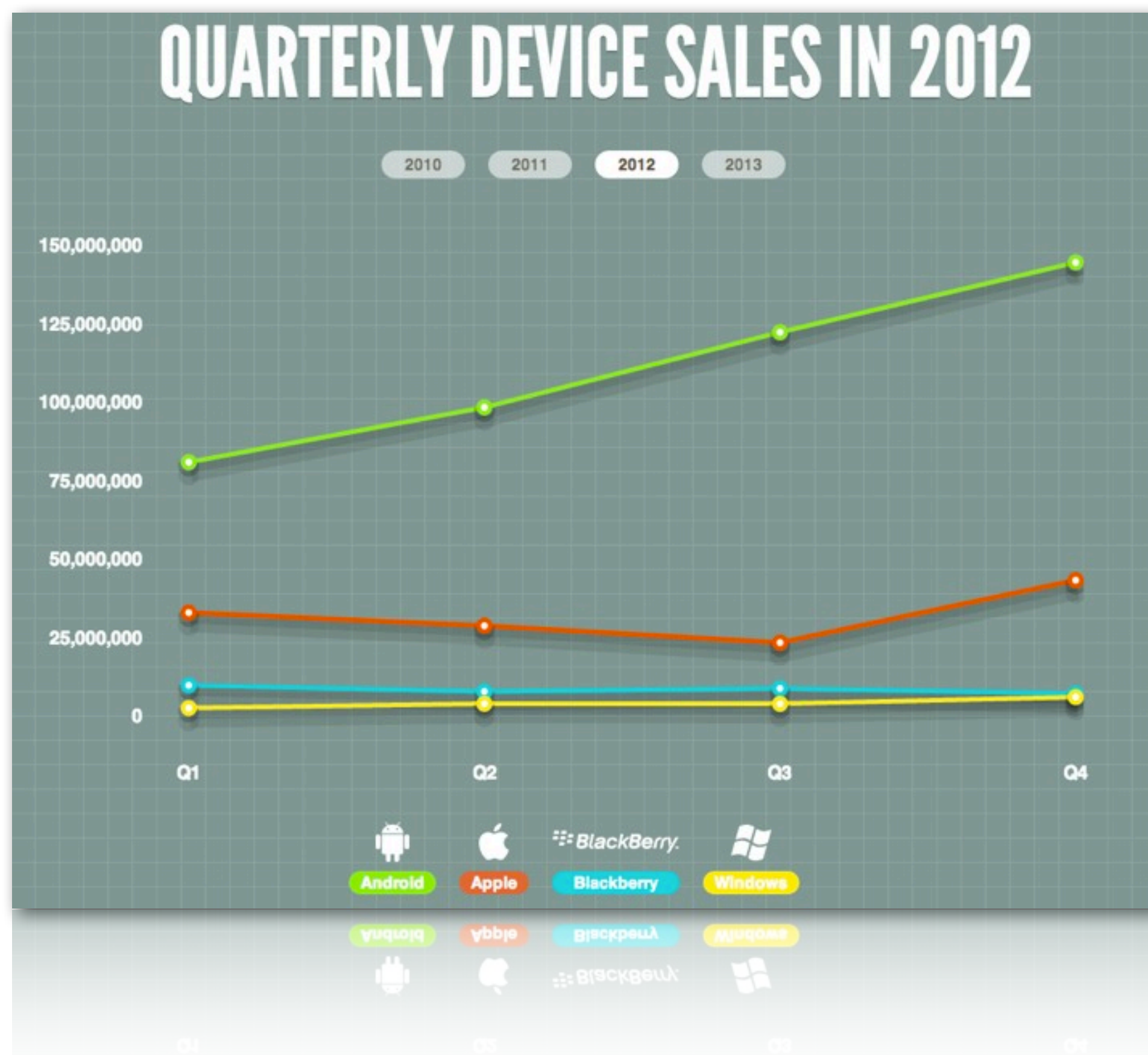
New iOS & Android Device Activations, Christmas Day (millions)



New iOS & Android App Downloads, Christmas Day (millions)

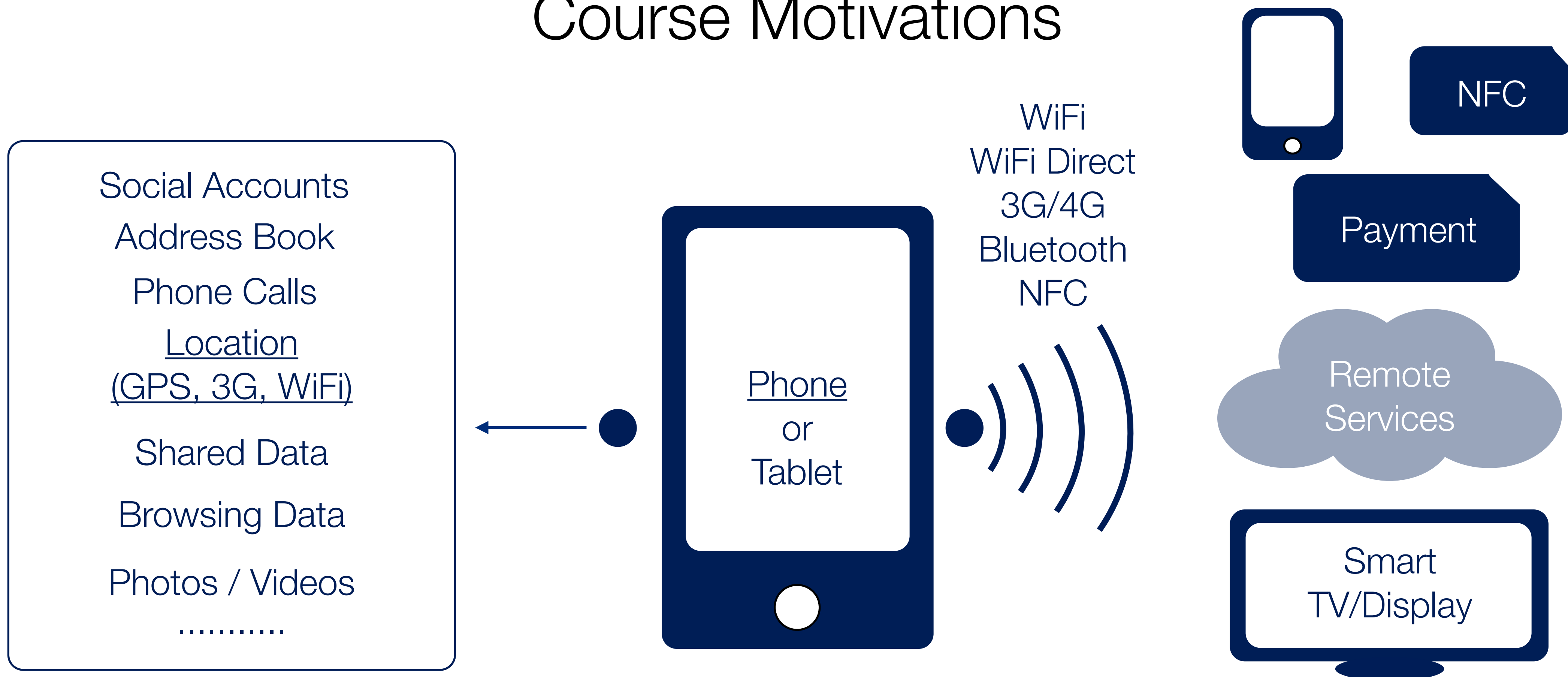


Market Growth



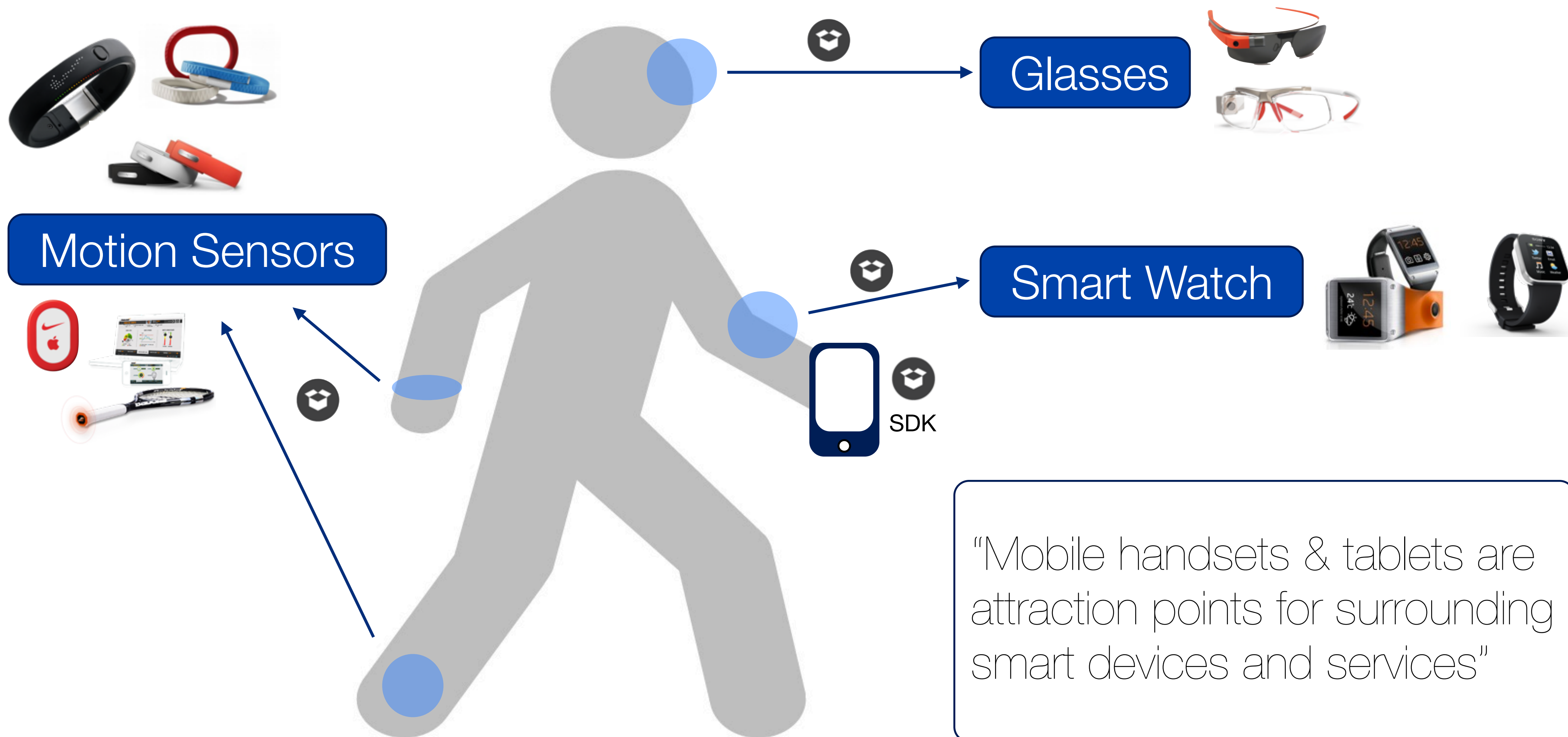
<http://www.mobilestatistics.com/mobile-statistics>

Course Motivations



We are living in the "Mobile-Centric" World !

Course Motivations



Wearable Computing

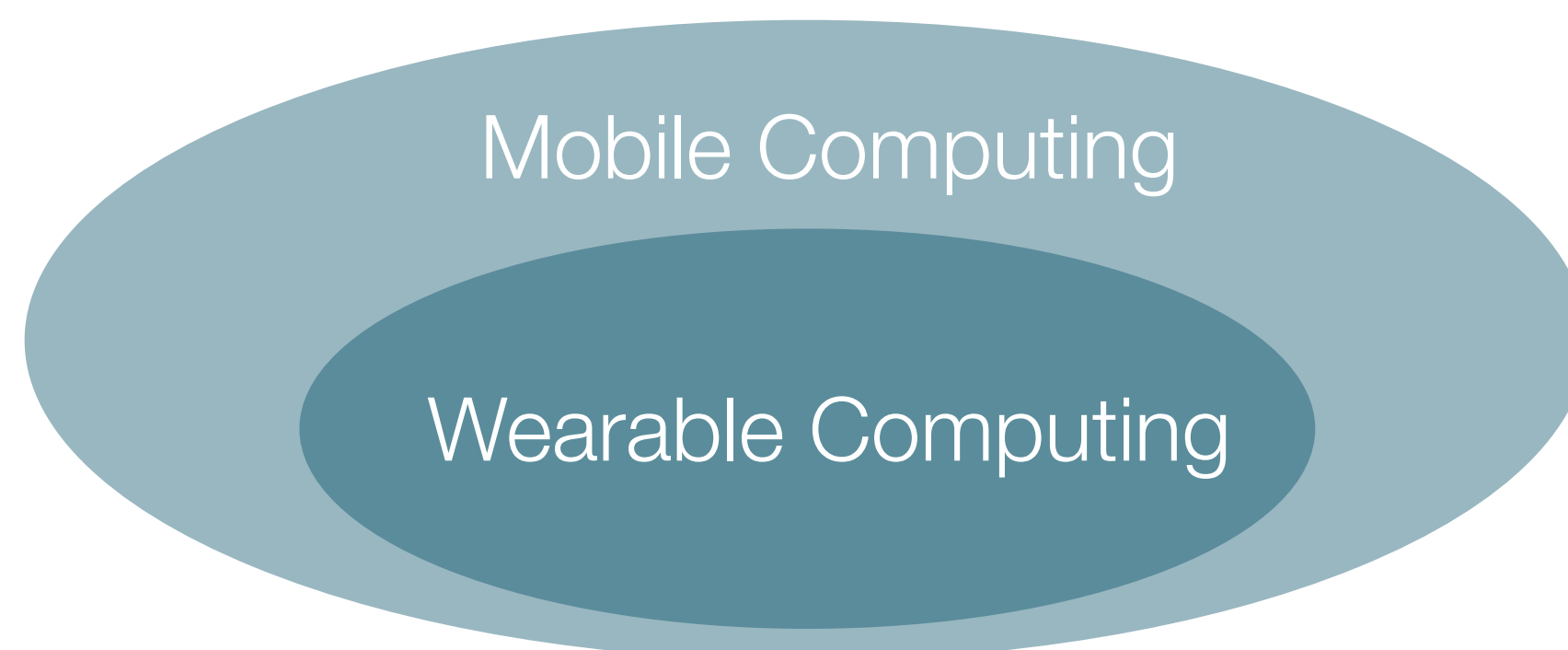
“Wearable Computers (or something like them) have been a dream of futurists, science fiction writers, and business people, among many others since the dawn of the industrial age.”

<http://mat.ucsb.edu/~g.legrady/academic/courses/02w200a/wearable/index.html>

“Wearable computers, also known as body-borne computers or wearables are miniature electronic devices that are worn by the bearer under, with or on top of clothing.”

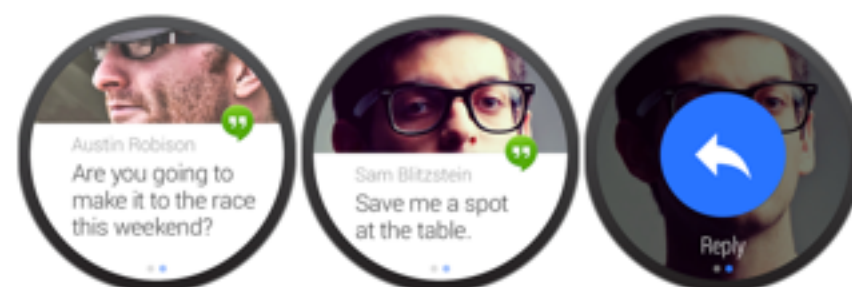
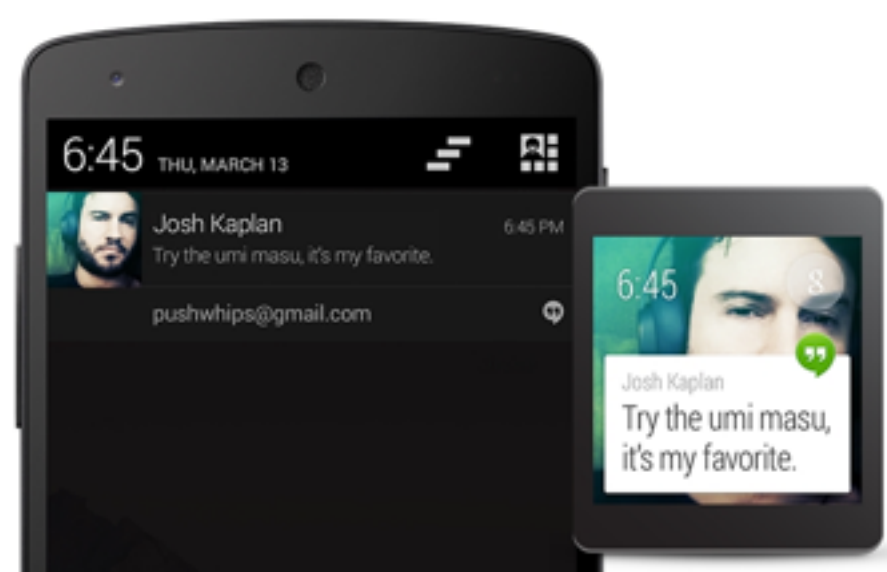
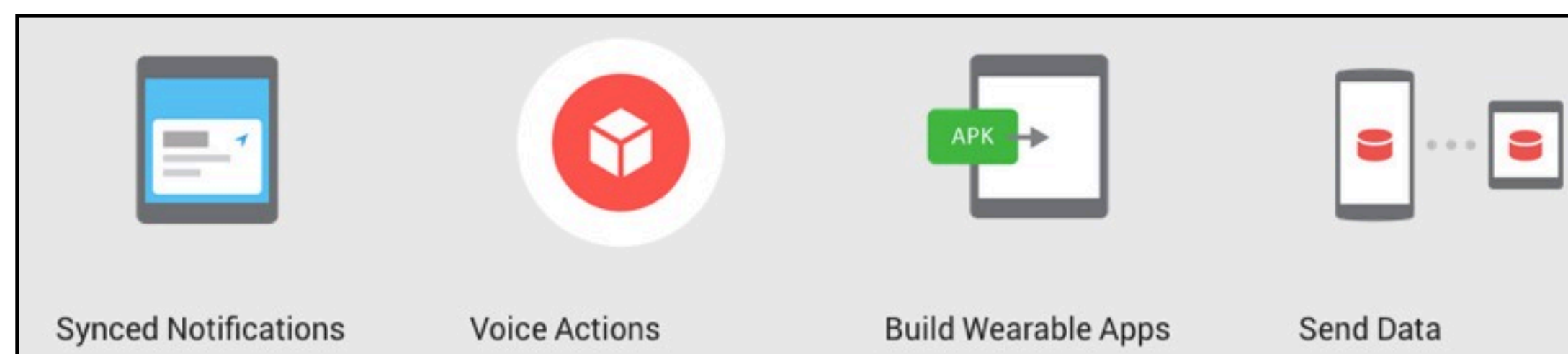


http://en.wikipedia.org/wiki/Wearable_computer



Mobile & Wearable Computing

(a development point of view :)



android wear

APPLE WATCH

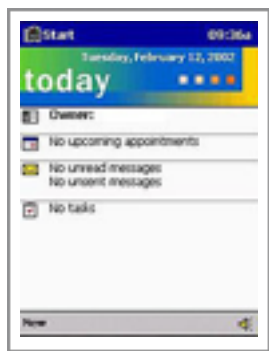
Nokia 1011
GSM Phone,
monochrome display,
12 h standby,
90 min conversation



Palm Pilot 1000
Palm OS,
Network Access,
Data Sync,
Pers. Info. Management.



Windows Mobile PocketPC 2000
Office Suite, Media Player, Internet Explorer, MSN, Outlook



Blackberry 5810
GPRS Connectivity, QWERTY keyboard, 8MB Flash Memory, Internet Browsing



Blackberry 8800
GPRS/EDGE, QWERTY keyboard, Internet Browser, Maps, Multitasking



Motorola's DynaTAC
\$3,995
2.5 Pounds
30 min of call autonomy



IBM Simon
\$899
mobile phone, PDA, Fax, touchscreen and QUERTY virtual keyboard



Apple MessagePad
\$999-\$799
PDA Device, touchscreen, handwriting recognition, QUERTY virtual keyboard



Nokia Communicator 9000
E-Mail, SMS, Web*, Notes, Calendar, Multiple applications, TextWeb



Nokia 7110
WAP Technology, E-mail, Sport Results, News, Music Download



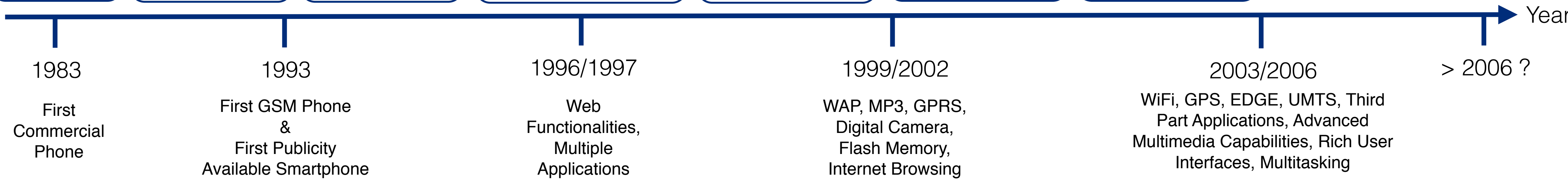
Sony Ericsson T68i
Camera Phone 0.1 Megapixel, Color Display, SMS/MMS, GPRS, Bluetooth, IrDa



Nokia N70
2.0 Megapixel, Audio/Video play and recording, Java Support, Symbian OS, C++ Applications, Internet Browser, Maps, Multitasking



Microsoft Windows Mobile 5
WiFi, GPS, Support, .NET and Java Development, Maps, Multitasking

Mobile Platform SDK

Multi-touch events and controls,

Accelerometer support, **View hierarchy**,
Localization, Camera support
Media, audio mixing and recording
Video playback, Image file formats
Animation, **OpenGL ES**, **Networking**, **SQLite**
database, Location, Threads, TCP/IP
Sockets, **Power management**, File system,
Security



Apple & Google
introduce the App
Store and the
Android Market



Apple introduces
the App Store for
iPhone / iPod
Touch

Apple release the
first version of the
iPad and Samsung
announces the
Galaxy Tab



iOS 5 and Android v4.x Ice
Cream Sandwich have been
released including Cloud
Services support, HD
multimedia features, Social
Network integration, WiFi
System Update,
Synchronization, etc ..,

Microsoft announces the
new release of Windows
Phone OS (7.5) and the
partnership with Nokia.



ios



Windows
phone



BlackBerry

ubuntu



facebook

Apple announces
the first version of
the iPhone.
combining Internet,
Phone and
Multimedia
+
Advanced
Rich UI



Apple and Google
provide easy to use
IDE (Integrated
Development
Environment) to
simplify developer
activities, build
high quality
application with
advanced features
and rich UI



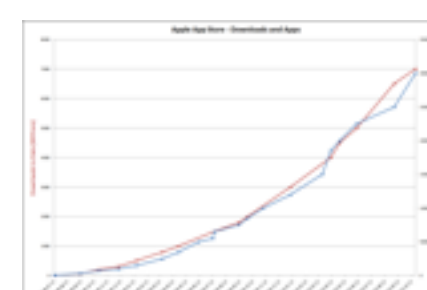
Google announces
the first release of
Android OS.

HTC sells the first
devices: HTC
Dream



Growing Market

3,000,000,000+
Downloads on App
Store



2007

Full Browser (Flash ?)
Advanced SDK, Rich
Functionalities and
User Interface

2008

Multiple Third Part
Applications, Dedicated
Market, Additional
Embedded Sensors

2009

Periodic SDK updates, with
new functionalities, Improved
Development Tools

2010

The same Operating
System for smartphone
and tablet. (SDK &
Applications)

2011

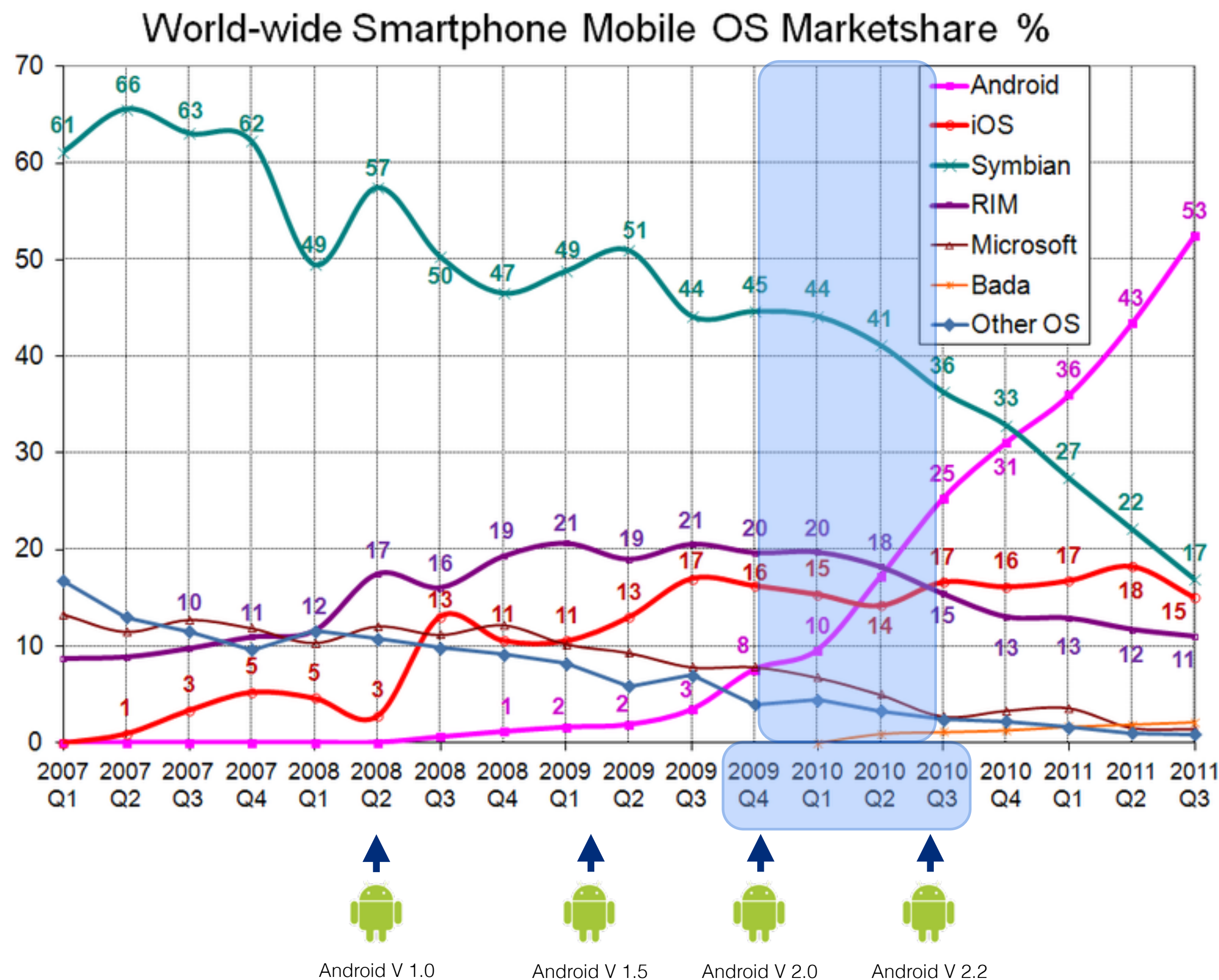
Extended support for external devices
and networking (NFC, WiFi Direct,
Arduino), Advanced Multimedia
Features, Cloud Services

2012

2013/2014 ?

Market Growth Reasons

- Hardware Spec.
 - ▶ CPU / GPU
 - ▶ RAM + Storage
 - ▶ Networking (WiFi, Bluetooth, NFC)
 - ▶ Cellular Network (GPRS, EDGE, UMTS, HSDPA)
- New Generation Operating Systems
 - ▶ Rich User Interface
 - ▶ Multitouch
 - ▶ Multitasking
- Advanced SDK with hundreds of new API for each new release
- New Developer Tools
 - ▶ Editor
 - ▶ UI Design
 - ▶ Database & Application Flow
 - ▶ Performance & Behavior Analysis
 - ▶ Complete Emulator
 - ▶ Easy Deployment



Android Applications Available
From 16000 To 80000



[2009Q4 ; 2010Q3]

- From Android 2.0 to 2.2 in 7 months
- 2.0 New Features:
 - ▶ Bluetooth 2.1 support
 - ▶ Numerous new camera features
 - ▶ Improved typing speed on virtual keyboard
 - ▶ Refreshed browser UI with bookmark thumbnails, double-tap zoom and support for HTML5
 - ▶ Optimized hardware speed and revamped UI
 - ▶ Support for more screen sizes and resolutions
 - ▶ Improved Google Maps 3.1.2
 - ▶ MotionEvent class enhanced to track multi-touch events
- 2.2 New Features
 - ▶ Speed, memory, and performance optimizations
 - ▶ Updated Market application with batch and automatic update features
 - ▶ Push Notification
- New Users use Android
- Symbian users start switching to Android
- **New Developers start using Android !**
- **Symbian Developers start switching to Android!**

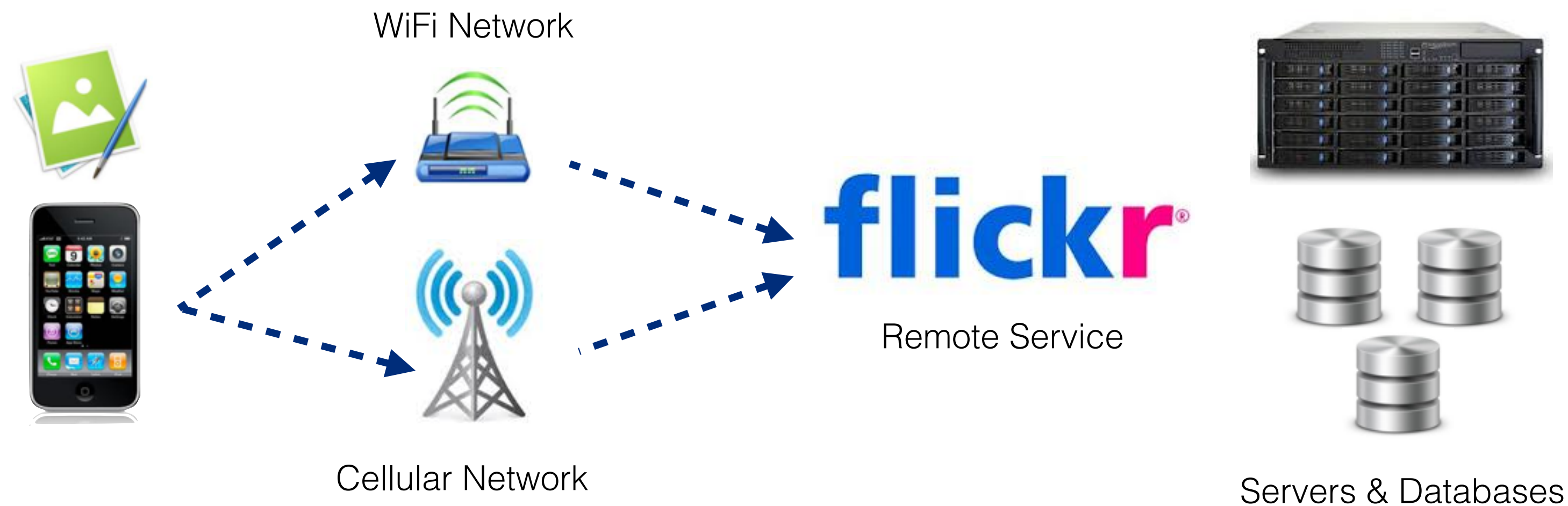
Source: <http://en.wikipedia.org/wiki/File:World-Wide-Smartphone-Market-Share.png>, http://en.wikipedia.org/wiki/Android_Market

Market Growth Effects

- **New Emerging Technologies**
 - ▶ **Cross Platform Solutions** (HTML5, Javascript and CSS)
 - ▶ Speech Recognition & **Voice Interaction**
 - ▶ Ad-hoc communication (WiFi-Direct, NFC)
- Changes in existing solutions, applications and development process
 - ▶ Increased number of client (Search Engines, Web Pages, Peer-to-Peer and Games)
 - ▶ **Customized content design**
 - ▶ Geo-referenced information
 - ▶ Authentication (OAuth ?)
 - ▶ Networking (Increased number of active user over WiFi and Cellular Network)
 - ▶ Device heterogeneity
 - ▶ Porting of mobile world solution to desktop OS

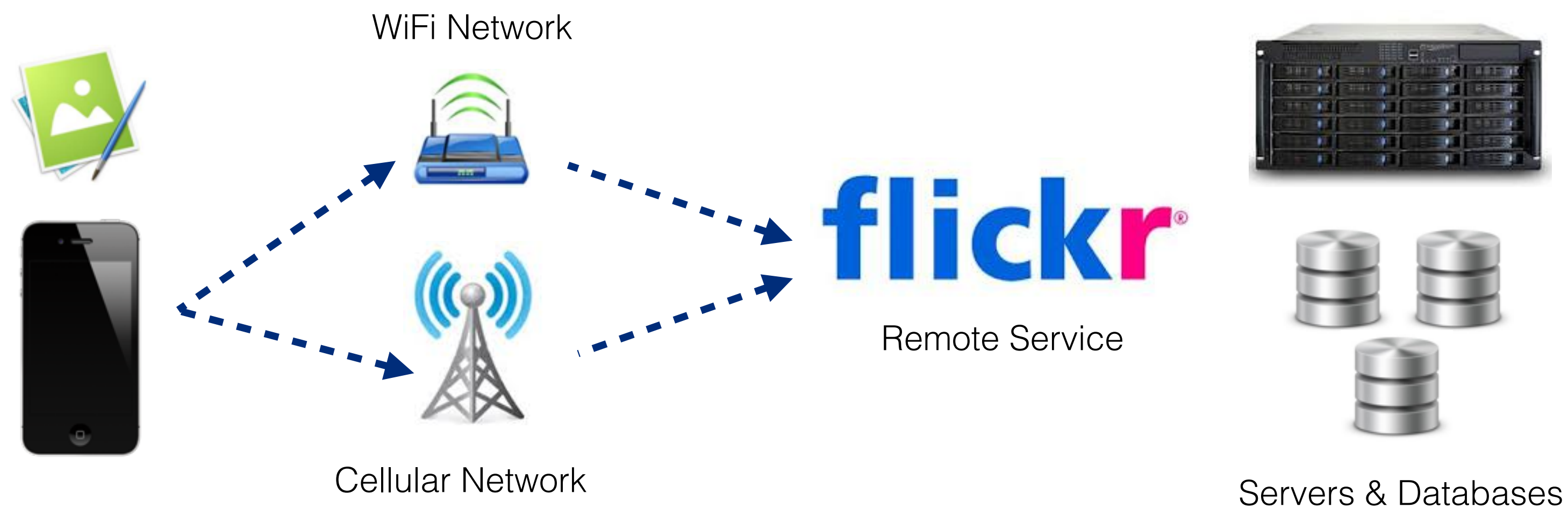
2009

Camera: 3MP
File JPG100 1.0 MB



2011

Camera: 8MP
File JPG100 2.0 MB





“What a difference 8 years makes: St. Peter’s Square in 2005 and yesterday”



Common Software Platforms

Feature	iOS	Android	webOS	Windows Mobile	Windows Phone	BlackBerry OS	Symbian	Maemo	MeeGo	bada
Company	Apple	Open Handset Alliance/Google	<u>Palm, Inc</u> (HP)	Microsoft	Microsoft	RIM	Symbian Foundation	Nokia	Linux Foundation	Samsung
OS Family	Darwin	Linux	Linux	Windows CE 5.2	Windows CE 7	Mobile OS	Mobile OS	Linux	Linux	Proprietary RTOS or Linux
Supported CPU Architecture	ARM	ARM, MIPS, Power Architecture, x86	ARM	ARM	ARM	ARM	ARM	ARM	ARM, x86	ARM
Programmed in	C, C++, Objective-C, Swift	C, C++, Java	C	Many, C++, .NET, Lazarus	Many, .NET (Silverlight/XNA)	Java	C++	C/C++	C++	C++
License	Proprietary EULA except for open source components	Free and open source	Free and open source except closed source modules	Proprietary	Proprietary	Proprietary	Eclipse Public License	Free and open source except closed source components[64]	Free and open source	Proprietary

Source: http://en.wikipedia.org/wiki/Mobile_operating_system

New Mobile Platforms



mozilla

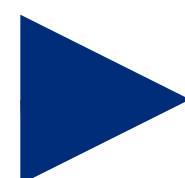


?

OS Improvements



- Phone Functionality
- Additional applications
- Reduced development tools
- Games



- Multitasking
- Third Part Applications
- First Developer Tools & SDK
- Multiple Network Interfaces (WiFi, BT)
- Primordial Web Browser
- Advanced Built-In Apps (Notes, Office Application Maps)



- Rich User Interface
- Advanced Multitasking / Networking
- Background Services
- Embedded Sensors
- Full Web Browser
- 3D Apps/Games
- **New Generation SDK and Developer Tools**
- Application Market



Model	CPU	Storage Capacity	RAM	Display	Camera	Sensors	Network
iPhone	412 MHz ARM	4/8/16 GB	128 MB	320 x 480	1.92 MP	accelerometer, multitouch, proximity sensor	GSM, EDGE, GPRS, WiFi b/g, BT
iPhone 3G	412 MHz ARM	8/16 GB	128 MB	320 x 480	1.92 MP	accelerometer, multitouch, proximity sensor, <u>aGPS</u> , <u>ambient light sensor</u> ,	GSM, EDGE, <u>UMTS</u> , <u>3G</u> , GPRS, WiFi b/g, BT
iPhone 3GS	600 MHz ARM	8/16/32 GB	256 MB	320 x 480	3 MP auto focus	<u>3-axis accelerometer</u> , multitouch, proximity sensor, ambient light sensor, <u>digital compass</u>	GSM, EDGE, <u>UMTS</u> , <u>3G</u> , GPRS, WiFi b/g, BT
iPhone 4	800 MHz Apple A4	8/16/32 GB	512 MB	640 x 960	5 MP, auto focus, flash	3-axis accelerometer, <u>3-axis gyroscope</u> , aGPS, multi-touch, proximity and ambient light sensors, digital compass	GSM, EDGE, UMTS, 3G, GPRS, WiFi b/g,n, BT
iPhone 4S	800MHz, <u>DualCore</u> , Apple A5	16/32/64 GB	512 MB	640 x 960	8 MP, LED flash, face detection, video stabilization	3-axis accelerometer, 3-axis gyroscope, aGPS, multi-touch, proximity and ambient light sensors, digital compass	GSM, EDGE, UMTS, 3G, GPRS, HSDPA, WiFi b/g,n, <u>BT4</u>
iPad 1	1 GHz Apple A4	16/32/64 GB	256 MB	1024x768	-	3-axis accelerometer, 3-axis gyroscope, aGPS, multi-touch, proximity and ambient light sensors, digital compass	EDGE, UMTS, 3G, WiFi b/g,n
iPad 2	1 Ghz <u>DualCore</u> Apple A5	16/32/64 GB	512 MB	1024x768	0.7 MP Front Camera & 0.3 MP Back Camera	3-axis accelerometer, 3-axis gyroscope, aGPS, multi-touch, proximity and ambient light sensors, digital compass	EDGE, UMTS, 3G, WiFi b/g,n
iPad 3	1GHz Dual-core Apple A5X Quad Core GPU	16/32/64 GB	1 GB	2048x1536	5 MP	3-axis accelerometer, 3-axis gyroscope, aGPS, multi-touch, proximity and ambient light sensors, digital compass	4G, WiFi b/g,n, BT4
Google Galaxy Nexus S	1 GHz ARM	16 GB	512 MB	480 x 800	5 MP	3-axis gyroscope, multi-touch, aGPS, proximity and ambient light sensors, digital compass, <u>NFC</u>	EDGE, UMTS, 3G, WiFi b/g,n, BT 2.1
Google Galaxy Nexus	1.2 GHz dual-core	16/32 GB	1 GB	720x1280	5 MP	accelerometer, gyroscope, GPA, aGPS, barometer, digital compass, proximity sensor, dual microphones for active noise cancellation, NFC	EDGE, UMTS, 3G, WiFi b/g,n, BT 3, Wi-Fi hotspot
Asus EEEPad Transformer Prime	NVIDIA® Tegra® 3 Quad-core CPU	32/64 GB	1 GB	1280X800	8 MP	3-axis accelerometer, 3-axis gyroscope, aGPS, multi-touch, proximity and ambient light sensors, digital compass	802.11 b / g / n, Bluetooth 2.1

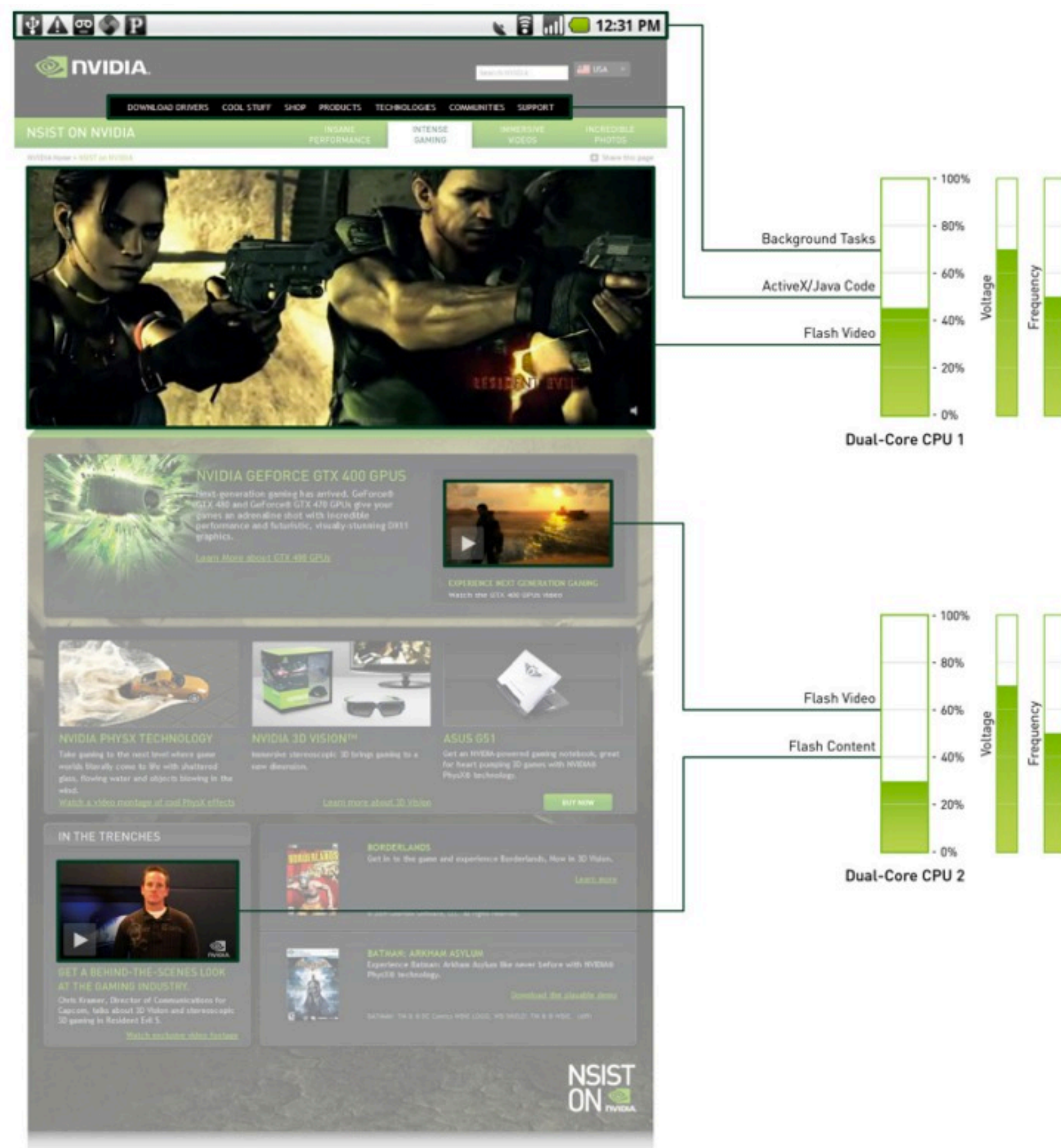
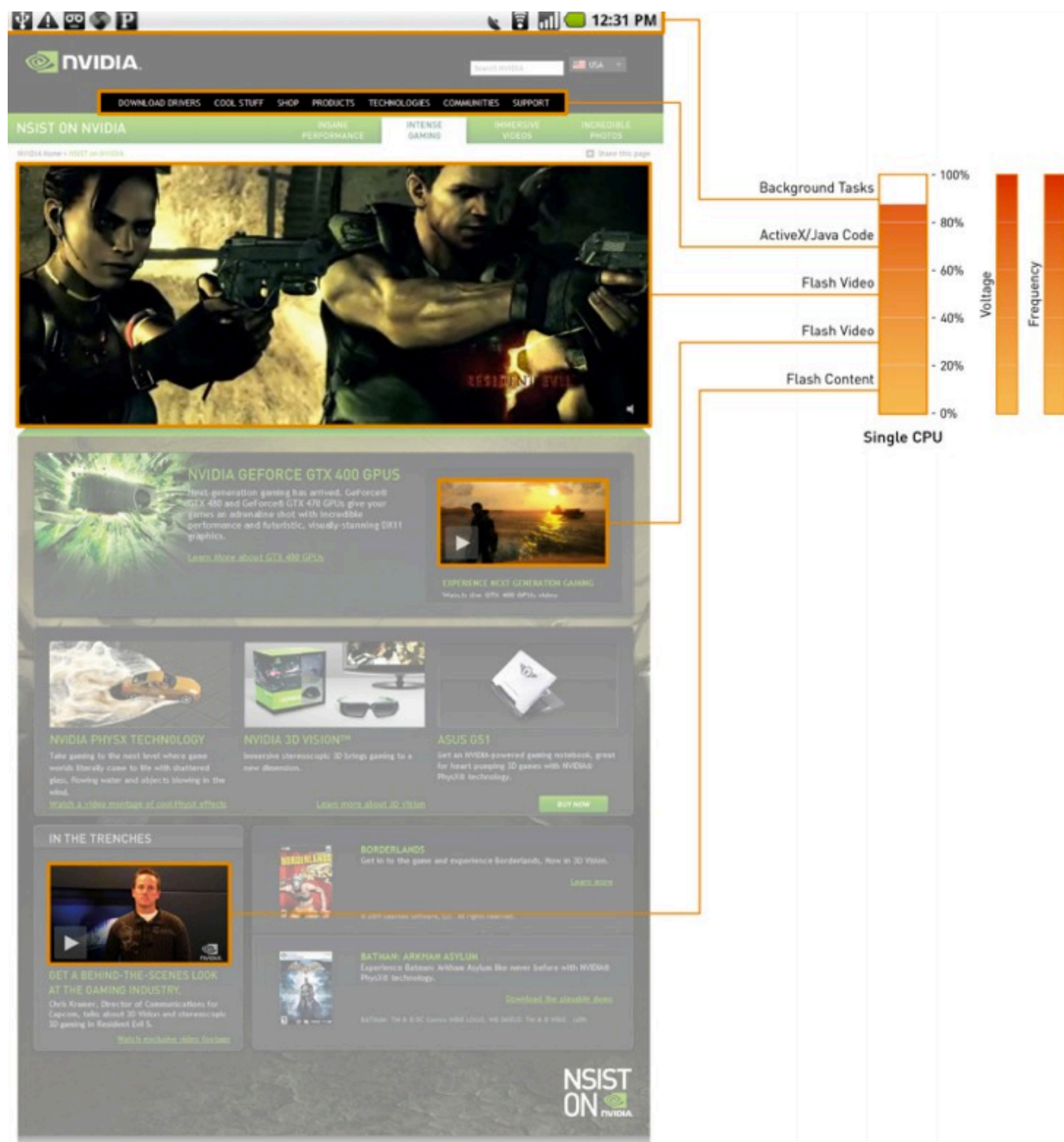
Source: http://en.wikipedia.org/wiki/Comparison_of_smartphones



- ▶ A8 chip with 64-bit architecture (ARM v8-a, 1.4 GHz, DualCore CPU)
- ▶ Image Signal Processor (ISP)
- ▶ M8 Motion Coprocessor
- ▶ Graphics processing unit (GPU)



- ▶ 2.7GHz Quad Core Process
- ▶ 1.9GHz Octa Core (1.9GHz Quad + 1.3GHz Quad Core) Process



Source: http://www.nvidia.com/content/PDF/tegra_white_papers/Benefits-of-Multi-core-CPU-in-Mobile-Devices_Ver1.2.pdf

Mobile Devices Characteristics

- Limited resources ? 
 - ▶ CPU: 412MHz → 1.6GHz Quad/Octa Core
 - ▶ 256MB → 1GB RAM
- Limited storage capabilities ? (128GB)
- Embedded Sensors 
 - ▶ Accelerometers
 - ▶ Proximity Sensors
 - ▶ Compass
 - ▶ Gyroscope
 - ▶ GPS
- Networking 
 - ▶ WiFi
 - ▶ Bluetooth
 - ▶ NFC (Near Field Communication)
- Power management
 - ▶ Battery life
 - ▶ Data safety in case of power loss
- Reliability
 - ▶ Phone functionality always highest priority
 - ▶ “Always on”

Mobile Development Challenges

– Manage Device Heterogeneity (OS, Hardware, Application Updates, Display)

– Application Design

- ▶ Rich User Interface
- ▶ User friendly application
- ▶ Reduced number of click
- ▶ Offline & Online functionalities

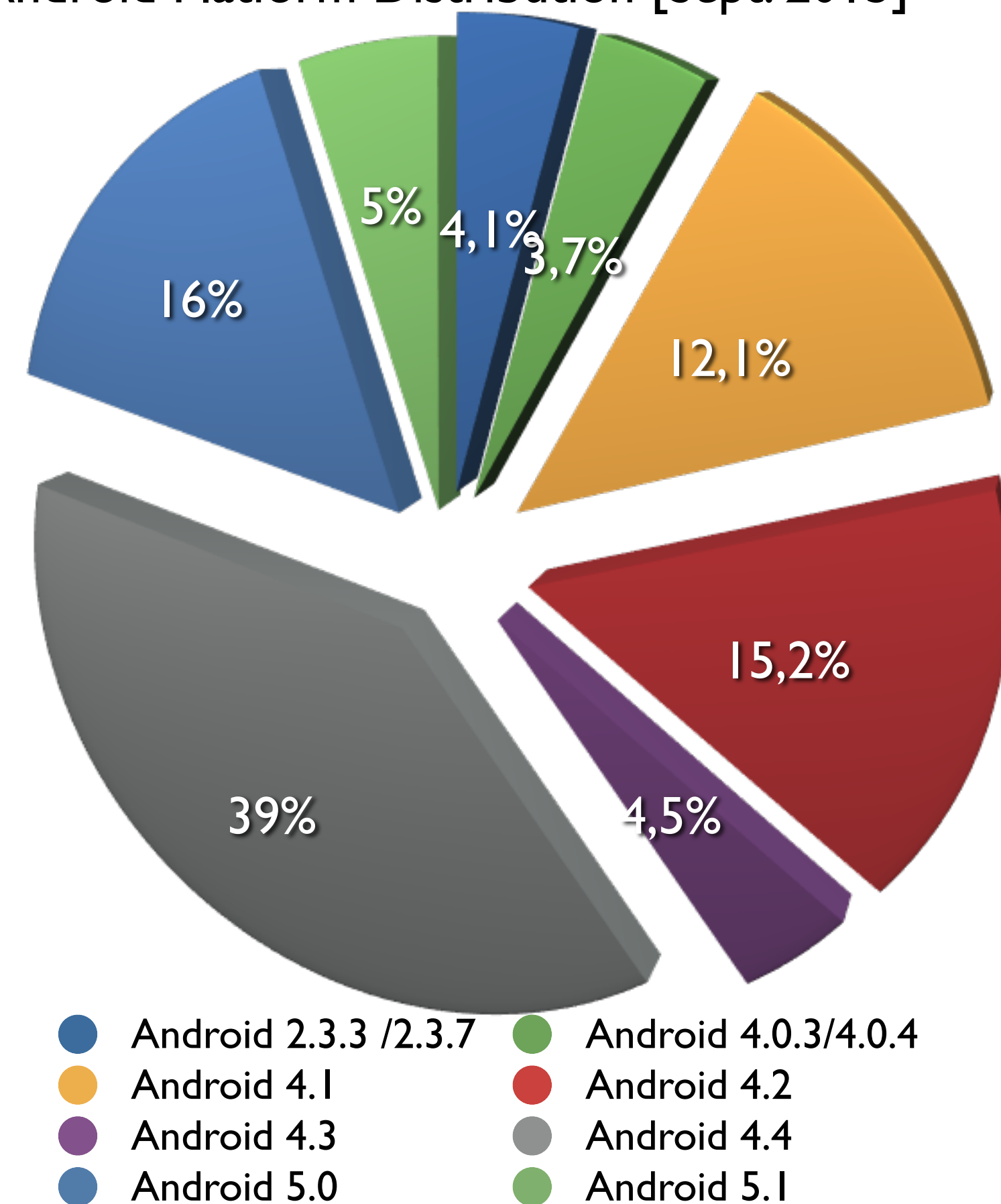
– Performance & Energy Consumption

- ▶ Low resources if compared with traditional PC Hardware
- ▶ Multi-Threading
- ▶ Background Process / Service
- ▶ Remote Services Interaction

– User Expectations

- ▶ Advanced functionalities (Video Streaming, Realtime Games, etc ...)

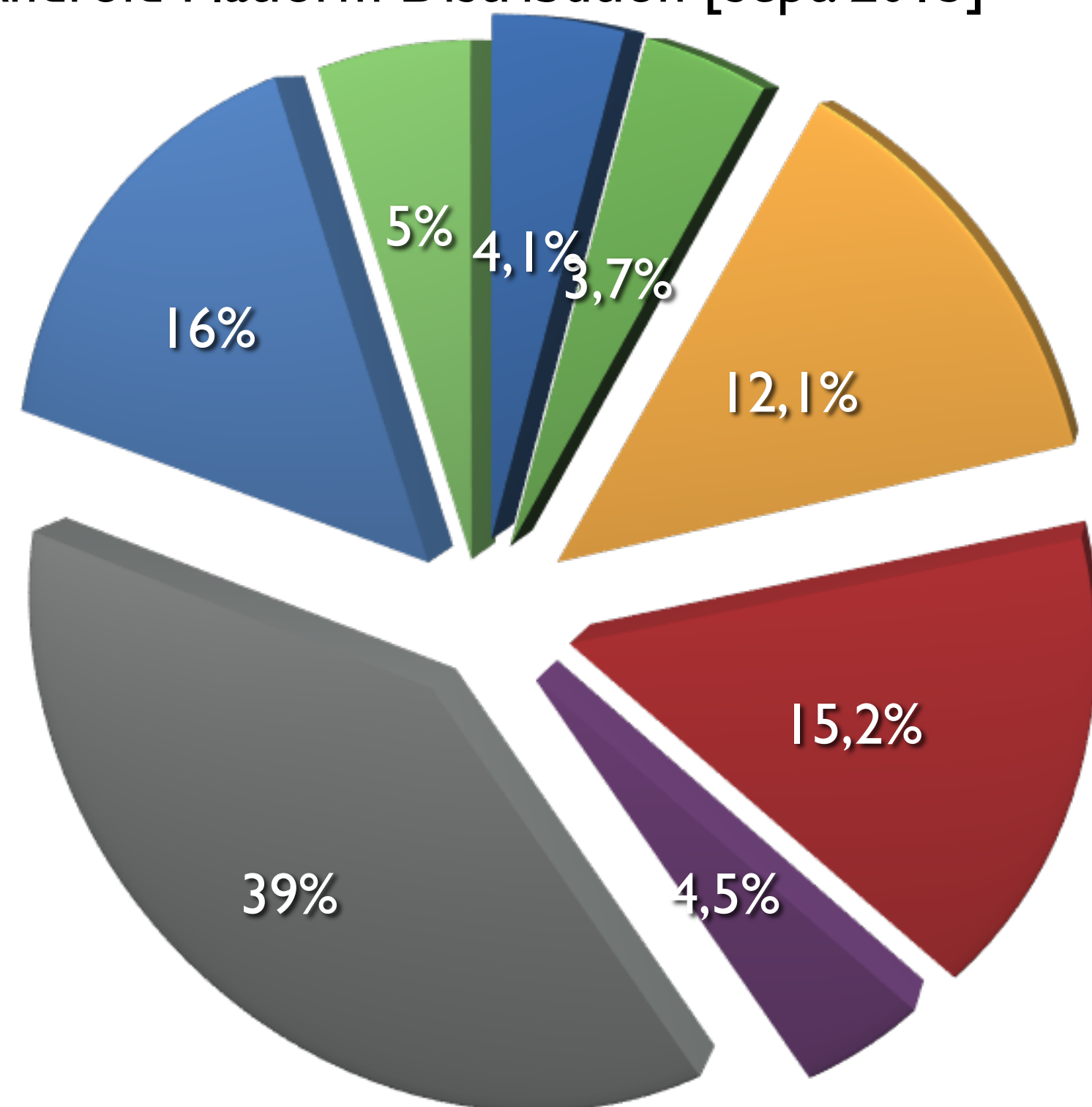
Android Platform Distribution [Sept. 2015]



Source: <http://developer.android.com/resources/dashboard/platform-versions.html>

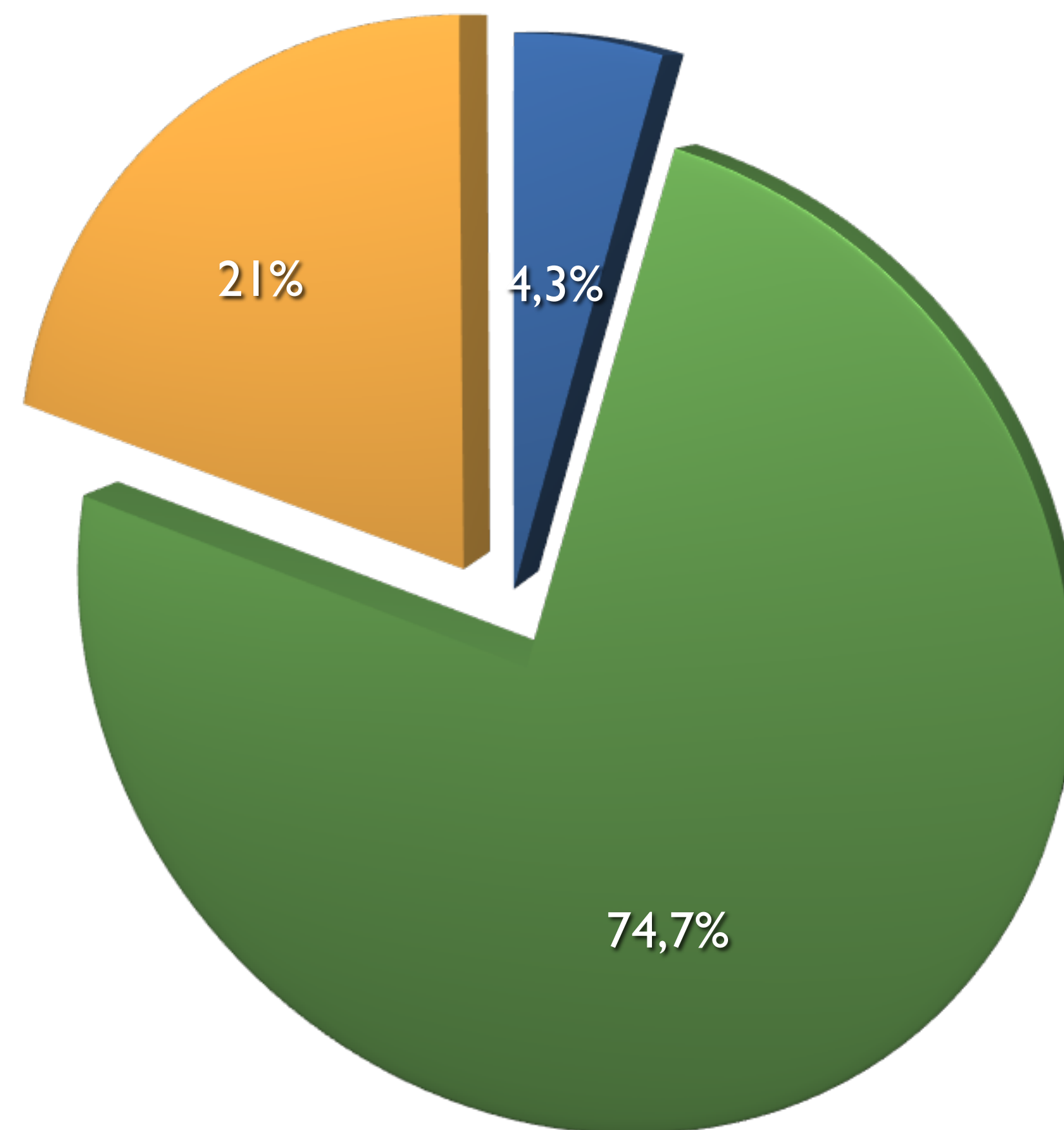
Android Platform Distribution

Android Platform Distribution [Sept. 2015]



- Android 2.3.3 / 2.3.7
- Android 4.0.3 / 4.0.4
- Android 4.1
- Android 4.2
- Android 4.3
- Android 4.4
- Android 5.0
- Android 5.1

Android Platform Distribution [Sept. 2015]



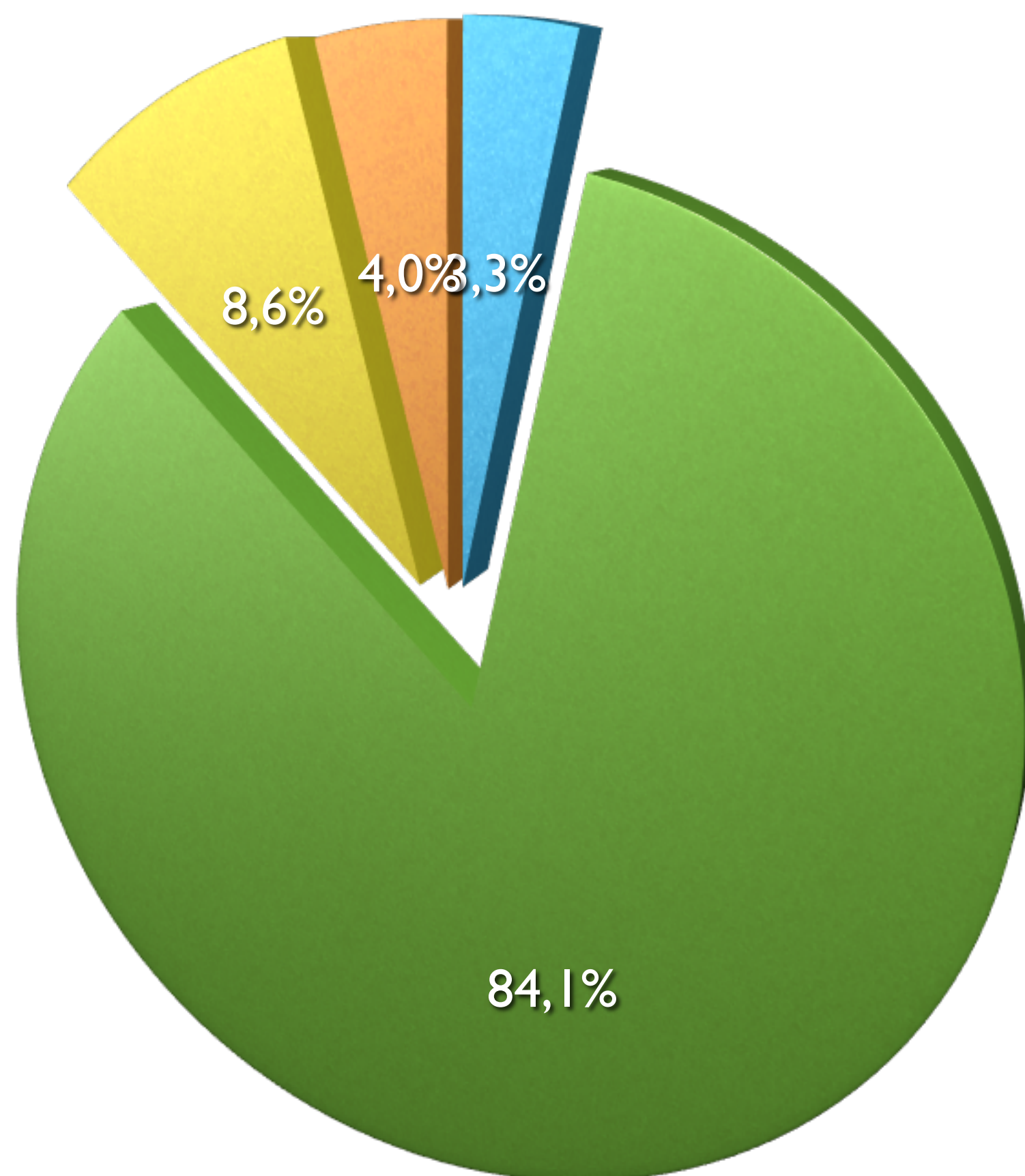
- Android 2.3.3 / 2.3.7
- Android 4.x
- Android 5.x

Source: <http://developer.android.com/resources/dashboard/platform-versions.html>

Android Screen Sizes and Densities

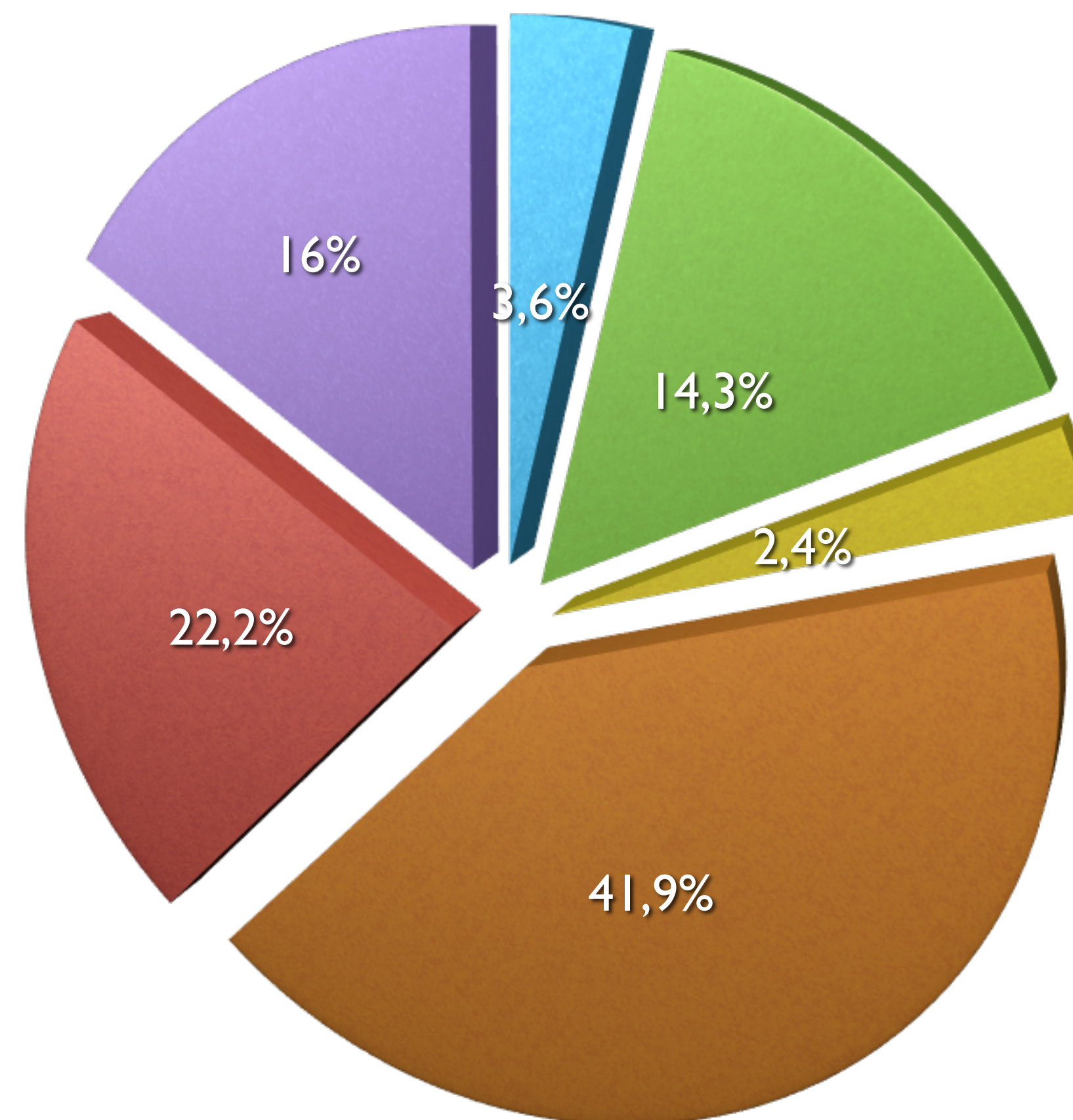
● Small ● Normal ● Large ● XLarge

Android Screen Size [Sept. 2015]



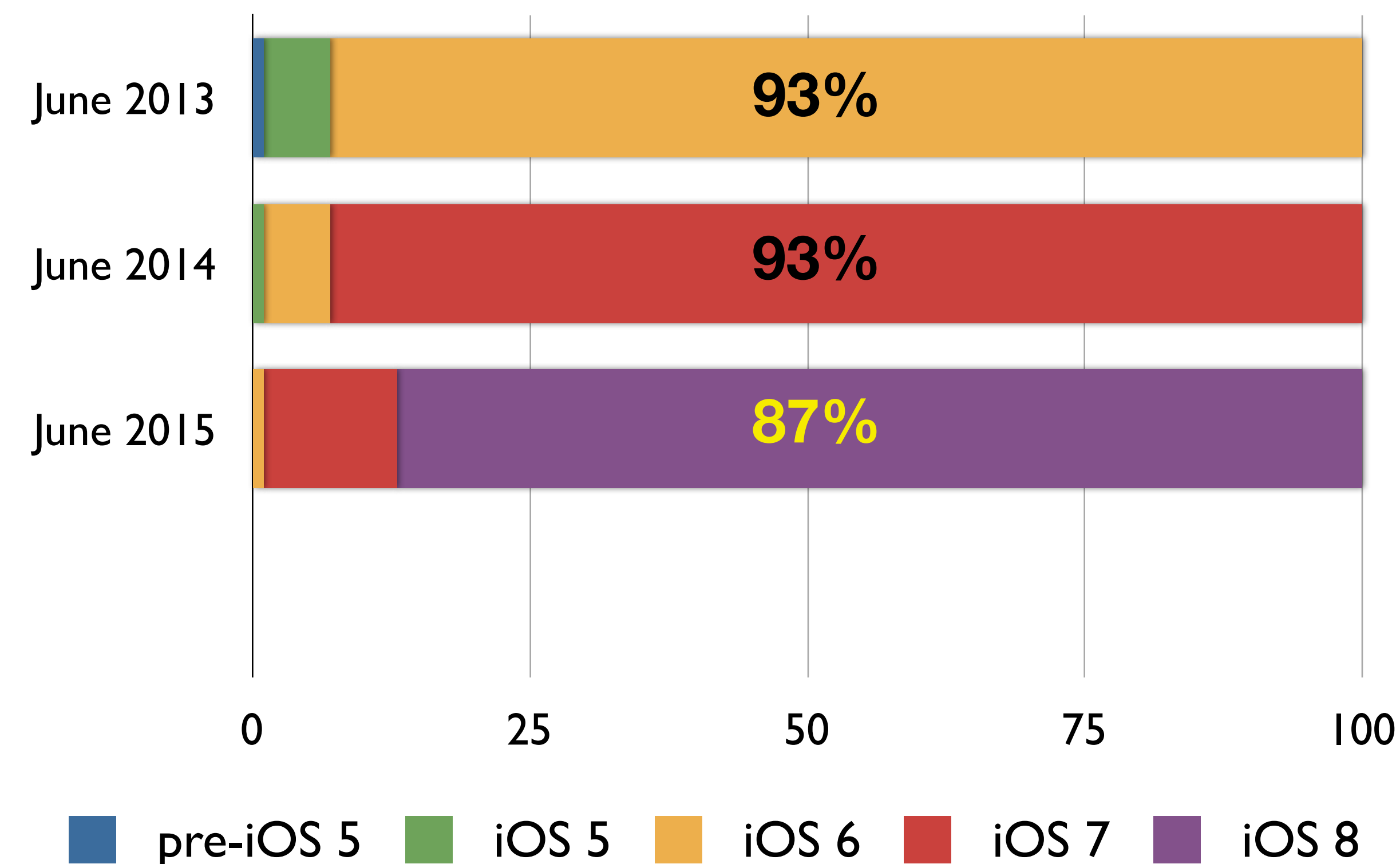
● ldpi ● mdpi ● tvdpi ● hdpi
● xhdpi ● xxhdpi

Android Screen Densities [Sept. 2015]



Source: <http://developer.android.com/resources/dashboard/platform-versions.html>

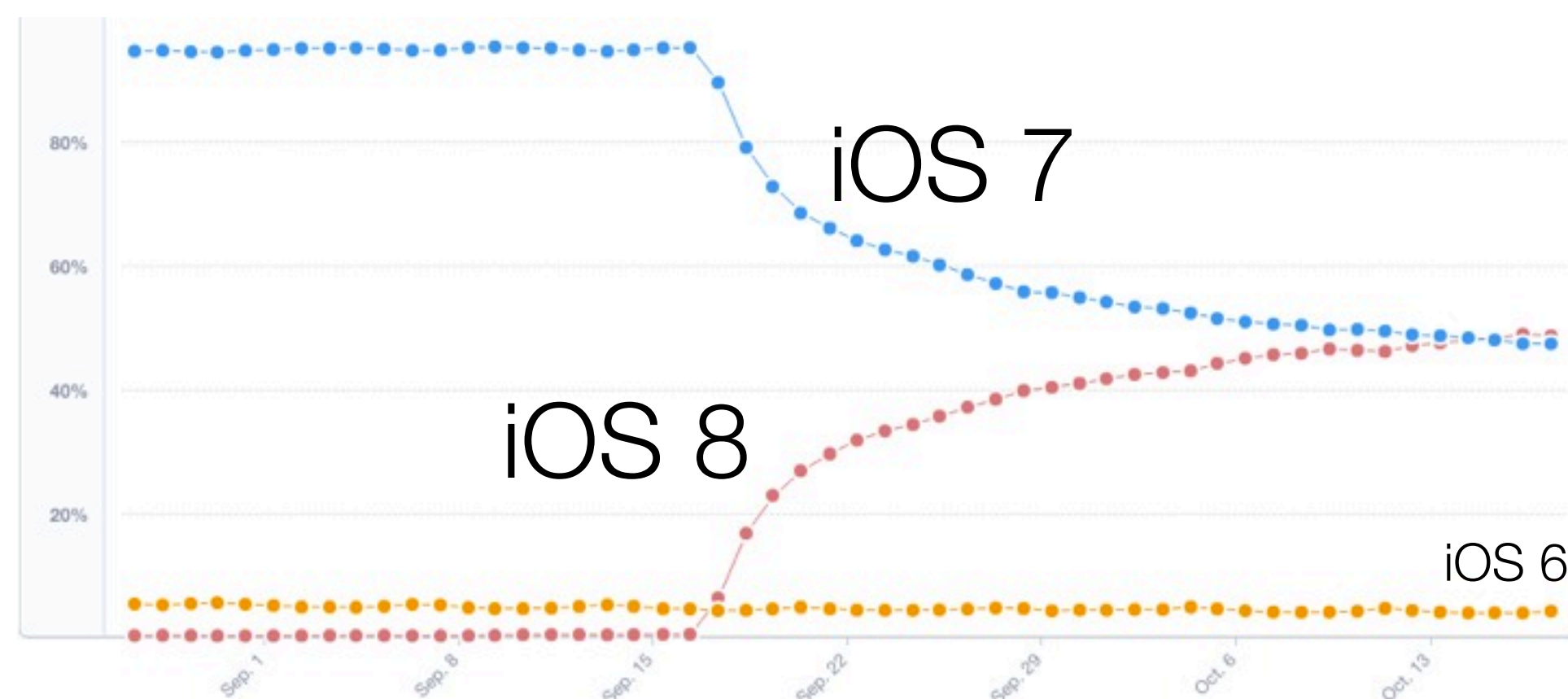
iOS Platform Distribution



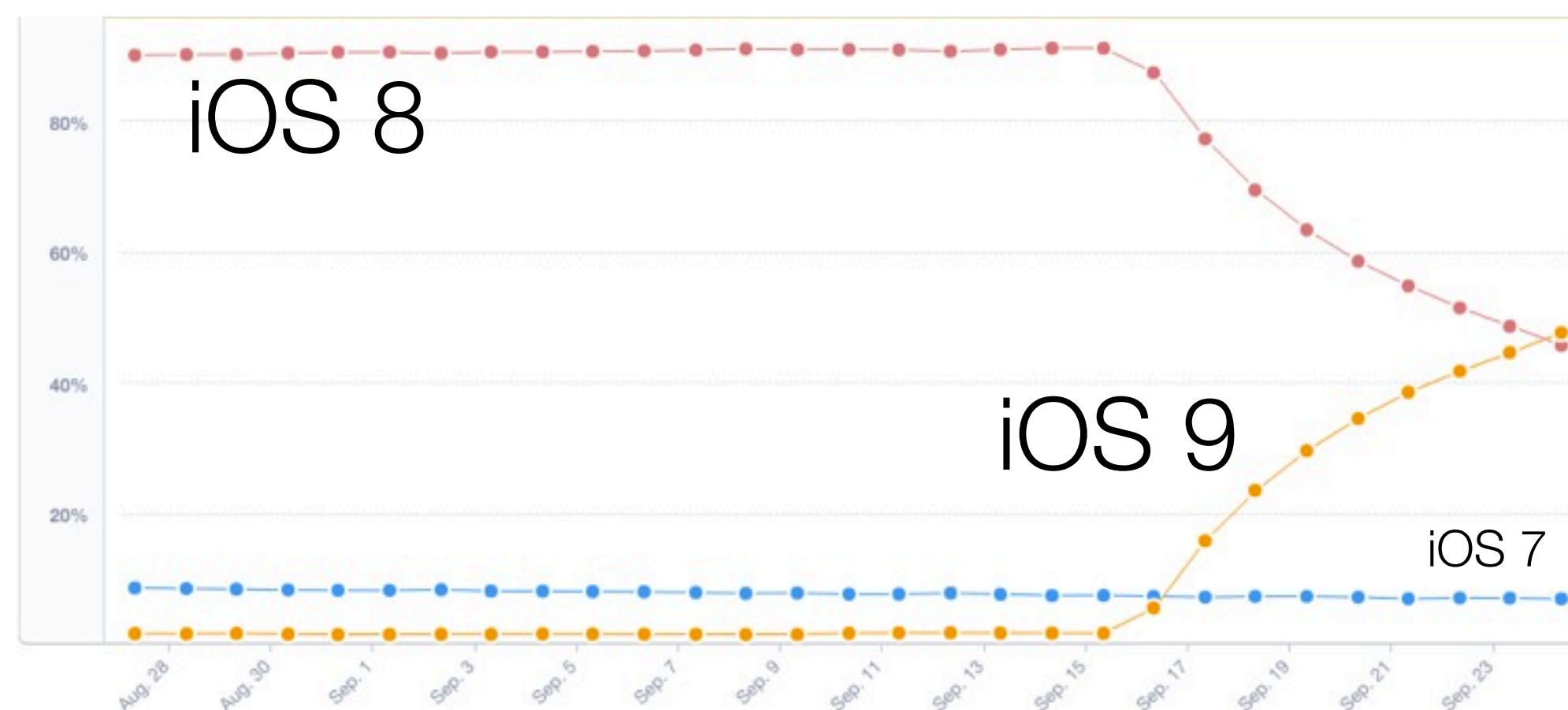
- The chart refers to the month of June from 2013 to 2015
- Apple pushes for the adoption of newer versions of iOS
- iOS developers do not need to put extra effort to support several versions
- iOS developers must keep their apps up to date in order to best support the current version → the work is not over when the app is released but apps must be maintained constantly

Source: <http://venturebeat.com/2013/06/21/apple-fragmentation-what-fragmentation/>

Rate of adoption of iOS versions



In 2014, it took exactly one month to reach the same user base for iOS 7 and iOS 8

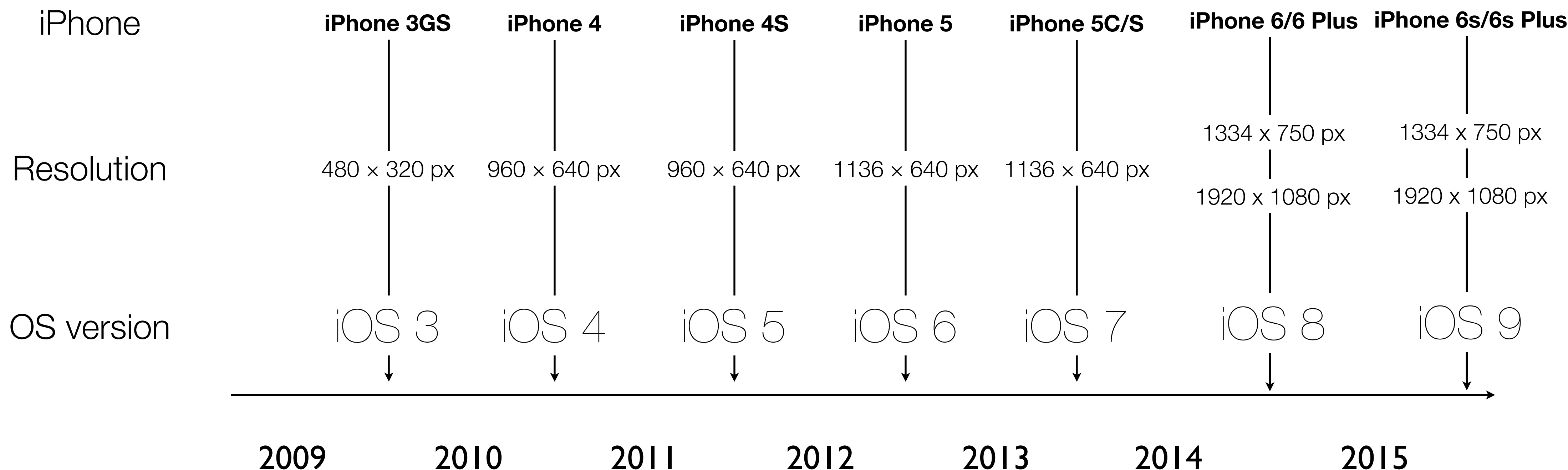


In 2015, it took less than 10 days for iOS 8 and iOS 9!

~25% of iOS devices move to latest iOS version in less than 3 days!

Source: https://mixpanel.com/trends/#report/ios_8

iPhone timeline



- As for Android, from the release of iPhone 5, iOS devices are starting to support different screen sizes, resolutions, and aspect ratios (3x2, 16x10)
- The same consideration can be applied to the iPad, which has a 1024x768 px **[2048x1536 px]** resolution

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Lecture 1

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