MONASH University

Information Technology

FIT5183: Mobile and Distributed Computing Systems (MDCS)

Lecture 5A
Mobile Computing Devices and Development Platforms

Outline

- Mobile Distributed Computing Motivations and Challenges
- History, present day and emerging trends
- Comparison of Mobile Operating Systems
- Development Environments

Mobile & Distributed Computing (from Week 1)

- Is a class of distributed computing systems
- It integrates mobile, portable computing devices into distributed systems
  - Wireless sensors
  - Wearables, watches
  - Mobile phones
  - Laptops, tables, iPads
  - Smart things (e.g. smart fridge)

- Some nodes can move in physical space
- Mobile computing is associated with mobility of hardware, users, data and software in computer applications
- Not limited to the wired network
  - WiFi, WiMAX, Bluetooth, ZigBee, NFC, RFID

Motivation for Mobile Computing

- Mobility was the requirement of the 90's, first in communications and then in computing
  - Rapidly growing demand by users
  - Many interested players
- Current advances in technology makes mobile computing feasible
- Goal is to enable people to communicate/compute effortlessly, where they want, when they want, without "Wires"

What Mobile Users Want

- All-in-one device
- Context-awareness (smart, efficient & proactive)
- Personalisation
- Network convergence
- Interoperability
- A User Interface which is

  Efficacious, Efficient and Enjoyable (ISO 9241)
- Secure and Private communications
- Reliable service

What Mobile Users Want (continued)

- Seamless mobility
  - "connect" from any location, at any time
  - convenience of use (no extra setup, "plug and play")
  - same computing environment, same services, consistent interfaces on the move
- Processing power. Mobile users willing to sacrifice some performance for mobility, but only *some*
- Online services. Increasing access to services available on the *Cloud* .. and in the *Fog;* a conception of the growing zones of interconnected devices residing at the edge of the Internet.

Mobile Computing Challenges

Mobile computing introducing new challenges to distributed computing systems

- Cost of Mobility and dynamic environments
- Connectivity and communications
  - Disconnections
  - Network protocols and technologies (old and new)

Mobile Computing Challenges (continued)

- Resource constraints
  - Processing capabilities (may be limited, although decreasingly important due to technology advances)
  - Energy management (battery and recharging technologies)
- Need for increased security

Mobility Today

"Mobility defines how we work and live and how organizations reach their customers. It requires a holistic view of many information technology disciplines."

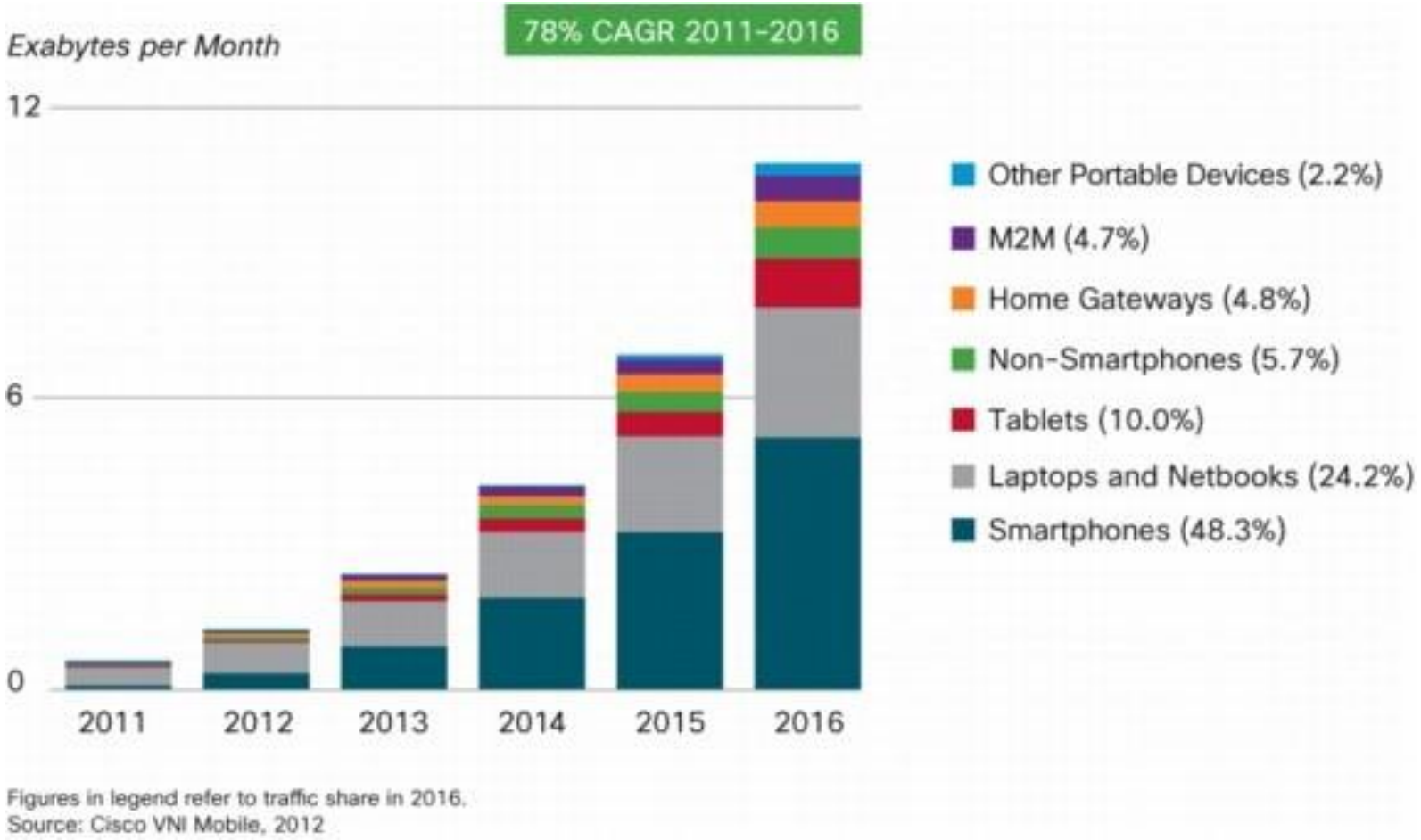
(Disabato, M., Gartner, 2016)

Bob Sutor on Mobile Enterprise at Impact 2012 (IBM)

Mobility Happening Everywhere

Bob Sutor on Mobile Enterprise at Impact 2012 (IBM)

Explosion of Devices and Data



Figures in legend refer to traffic share in 2016.
Source: Cisco VNI Mobile, 2012

Bring your own device (BYOD)

- Increased productivity: employees are more comfortable with their devices
- Employee satisfaction: people use the devices they have chosen rather than what was selected by IT
- Cost savings: sometimes save budget by shifting costs to the user
- Increasing the number of possible entry points for a potential security breach
- Complexity of supporting a variety of devices accessing and maintaining optimal network performance

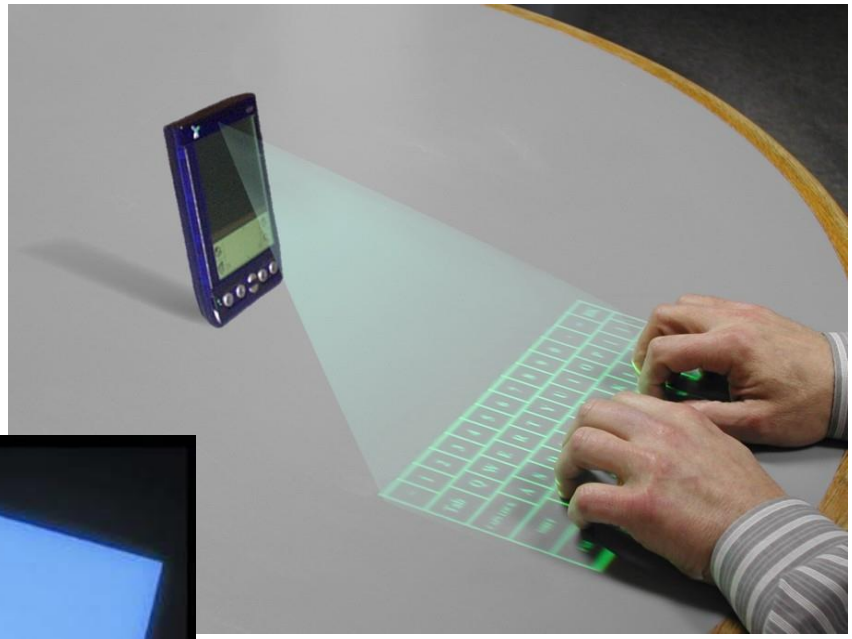
History: From the First Portable Computers..

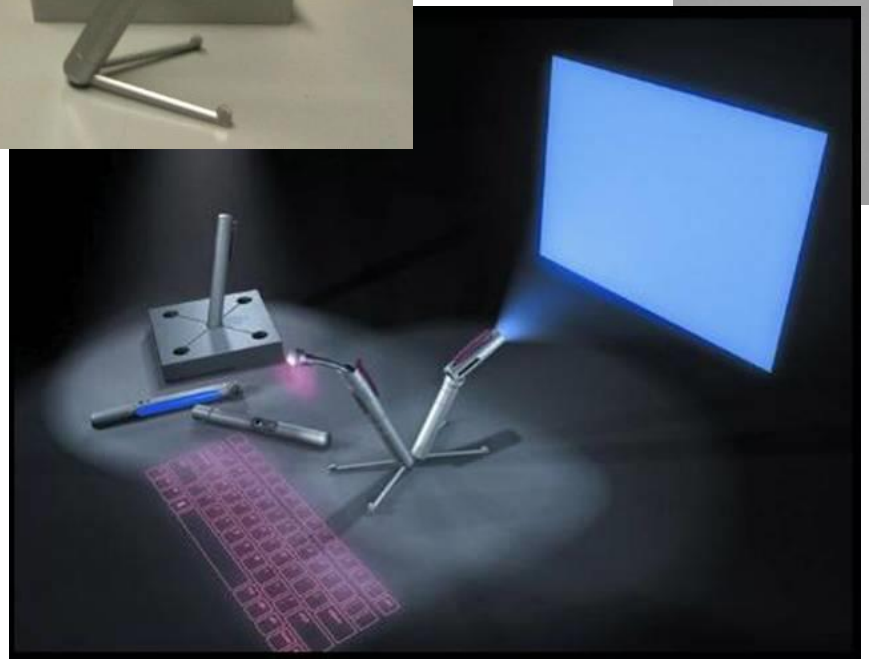
- Osborne 1
  - Introduced in 1981
  - 24 lbs (~ 11 kilos)
  - 64K (Kilobytes) RAM

- Epson HX-20
  - Released in 1982
  - 3.5 lbs (~1.6kg)
  - 16K RAM
  - 0.614MHz
  - built-in rechargeable batteries

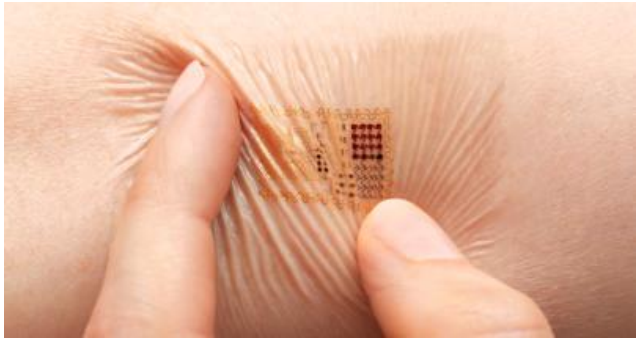
.. To Present Day Laptops

..and New Smart Devices





Wearable Devices and Smart Objects



Wearable Activity Tracker

- Jawbone Up – a MontionX powered activity tracker for health monitoring and management
- Also, FitBit – record sales over 2016-2017 Xmas period
- New entrants expected in increasing market

Smart watches

- Apple Watch – connects to iOS iPhone. Developing partnerships with leading watch and fashion brands
- Sony SmartWatch - A wearable device that connects to an Android phone and can display Twitter feeds, SMS, among other things. *It is compatible with most Android phones.*
- Samsung Galaxy Gear – serves as a companion for all Samsung Galaxy smartphones and tablets running Android
- Pebble Smartwatch: Economical wearable device that connects to an Android *or* iOS phone. It features a black and white e-paper display, vibrating motor, a magnetometer, ambient light sensors and an accelerometer.

Google Glass

- Google Glass is a wearable computer with an optical head-mounted display (OHMD).
- Google Glass displays information in a smartphone-like hands-free format. Wearers communicate with the Internet via natural language voice commands.
- It is featured by a Touchpad, a Camera and an LED illuminated display.
- Enabling technology for ***AR***

Mobile Operating Systems and Development Platforms

Mobile Operating Systems

- As oppose to control a PC or a Mac, a Mobile OS controls mobile devices
- Popular mobile operation systems
  - evolving from previously Windows CE, Windows Mobile, Palm OS and Symbian, to nowadays iOS, Android, Windows Phone 8, BlackBerry OS, WebOS, Bada etc.
- Programming languages
  - Java, C#, C++, Objective-C, JavaScript, Ruby, HTML etc.

Mobile Operating Systems

Common mobile OS include:

- Android from Google (free and open source)
- iOS from Apple (closed source, proprietary, on top of open source Darwin core OS)
- Windows Phone from Microsoft (closed source, proprietary)
- BlackBerry OS from RIM (closed source, proprietary)
- Symbian OS from Nokia and Accenture (open public license)
- WebOS from HP, initially developed by Palm (closed source, proprietary)
- Bada from Samsung Electronics (closed source, proprietary)

Mobile Operating Systems

a) Android

b) iOS

c) Windows

d) BlackBerry OS

e) HP webOS

f) Nokia Symbian

(a)

(b)

(c)

(d)

(e)

(f)

OS Specific Development Environments

- Google Android
  - Kernel based on Linux kernel v2.6
  - Middleware, libraries and APIs written in C
  - Application framework includes Java-compatible libraries based on Apache Harmony
  - Officially supported IDE: Eclipse + ADT plugin. Android Studio
- Apple iPhone iOS
  - Derived from OS X
  - Based on Native SDK (Objective-C) and Web Runtime
  - Four abstraction layers: Core OS, Core Services, Media, and Cocoa Touch
  - Dev Tools: iOS SDK + Xcode
- Windows Mobile
  - Based on WP7 specific version of Silverlight and XNA Framework
  - Development Tools: Visual Studio/Express + WP7 Add-in
- Mobile development environments also produced for Nokia Symbian, HP's webOS, Samsung Bada and Motorola Mobility.

Google Android

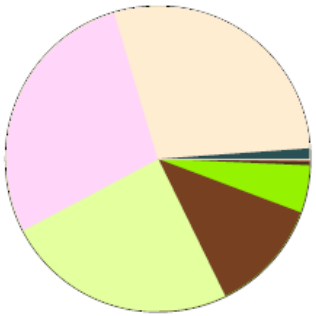
- Launched in 2007,
  - Most use version 7.1 Nougat (2016)
  - Latest version 8.1 Oreo (Dec 2017) with NN, ML Tensor Flow
  - Next Version 9 in 2018
- >1 Million Android apps
- Downloads in the 100 billions
- Billions of devices activated
- Millions more activations per day
- Kernel based on Linux kernel v2.6
- Middleware, libraries and APIs written in C
- Application framework includes Java-compatible libraries based on Apache Harmony
- Officially supported IDE: Eclipse + ADT plugin

"Jelly Bean" on the Nexus 4

Play Store on the Nexus 4

Latest Android Versions

Version	Code name	Release date	API level	DVM/ART	Distribution	First devices to run version
8.1	Oreo	December 5, 2017	**27**	ART	0.3%	Pixel, Pixel XL, Nexus 6P, Nexus 5X
8.0		August 21, 2017	**26**	ART	0.8%	N/A
7.1	Nougat	October 4, 2016	25	ART	6.2%	Pixel, Pixel XL
7.0		August 22, 2016	24	ART	22.3%	Nexus 5X, Nexus 6P
6.0	Marshmallow	October 5, 2015	23	ART	28.1%	
5.1	Lollipop	March 9, 2015	22	ART	19.2%	Android One
5.0		November 3, 2014	21	ART 2.1.0	5.4%	Nexus 6, Nexus 9
4.4	KitKat	October 31, 2013	19	DVM (and ART 1.6.0)	12.0%	Nexus 5
4.3	Jelly Bean	July 24, 2013	18	DVM	0.7%	Nexus 7 2013
4.2		November 13, 2012	17	DVM	2.6%	Nexus 4, Nexus 10
4.1		July 9, 2012	16	DVM	1.7%	Nexus 7
4.0	Ice Cream Sandwich	October 19, 2011	15	DVM	0.4%	Galaxy Nexus
2.3	Gingerbread	February 9, 2011	10	DVM 1.4.0	0.3%	Nexus S



As of 2017, more than 60% of devices have OpenGL ES 3.0 or higher.

Source: Wikipedia

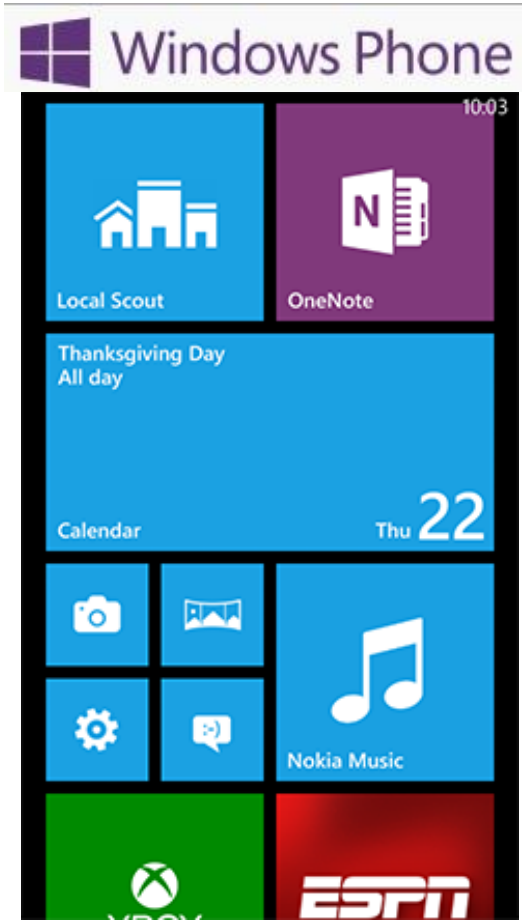
Apple iPhone

- Launch in 2007
  (concept only 10 years old!)
- Latest version 10
- >1 Million iOS Apps,
- Downloads in the 100 Billions
- >1 Billion devices activated
- Derived from OS X
- Based on Native SDK
  (Objective-C) and Web Runtime
- Four abstraction layers:
  Core OS, Core Services, Media and Cocoa Touch
- Dev Tools: iOS SDK + Xcode
- $99.00 annual developer fee

iOS

Windows Mobile

- Windows Mobile is the predecessor of Windows Phone with a final version 6.5.5
- Latest version Windows Phone 10
- 100,000+ apps
- With the Windows NT kernel found on many Windows 8 components
- NFC and Wallet support from WP8
- Based on
  - WP7 specific version of Silverlight, and
  - XNA Framework
- Development Tools:
  - Visual Studio + Add-in (WP7+), or
  - VS Express edition + Expression Blend for WP7 + XNA Game Video + Simulator
  - (This list may have been updated)



Blackberry (Research In Motion)

- OS which was discontinued after the release of BlackBerry
- BlackBerry 10 released in Jan 2013 with two devices, the Z10 (a full touchscreen device), and the Q10 (a device equipped with a physical keyboard)
- Based on QNX which was acquired by BlackBerry in April 2010

Nokia's Symbian

- The current form of Symbian is an open-source platform developed by Symbian Foundation in 2009, as the successor of the original Symbian OS.
- Symbian was used by many major mobile phone brands, like Samsung, Motorola, Sony Ericsson, and above all by Nokia.
- It was the most popular smartphone OS on a worldwide average until the end of 2010, when it was overtaken by Android.
- Famous Nokia S60
- Now use Windows Phone OS
- The Nokia 808 PureView was officially the last Symbian smartphone.

Home Screen of Nokia Belle (Updated version of Symbian)

HP’s webOS

- Launched by Palm in Jan. 2009 as the successor to Palm OS
- US$1.2 billion acquisition by HP, finalised in June 2010
- As of February 25, 2013 it was announced that HP is selling WebOS to LG Electronics for use on its web-enabled Smart TVs. LG Electronics shall be allowed access to the documentation, source code, developers and related websites.
- The US$99 HP tablet

Samsung Bada

- Released in 2010, and now used in parallel with Google Android OS and Microsoft Windows Phone, for Samsung's smartphones.
- With the release of the Samsung Wave, Samsung opened an international application store, Samsung Apps, for the Bada platform.
- Samsung Apps has 1000's of apps and the store is also available for Android and Samsung feature phones.

The Samsung Wave GT-S8500 (or "Samsung Wave") was the first touchscreen smartphone running the Bada Operating System designed by Samsung

Motorola Mobility

- Longest history of all mobile phone companies; origins can be traced back to WW2. (Still large presence in Security)
- Motorola Razr, released in 2004, the fashionable and thinnest flip phone at the time, sold more than 130 million units over the Razr four-year run, becoming the best-selling clamshell phone in the world to date
- Shifted its Operating systems from their proprietary software to Google's Android in 2009, with release of a ‘Droid’ range.
- Acquisition by Google, finalised in May 2012 at US$12.5 billion for the purpose of strengthening Google’s patent portfolio

Recent Worldwide Smartphone Sales to End Users by Vendor

Company	1Q16 Units	1Q16 Market Share (%)	1Q15 Units	1Q15 Market Share (%)
Samsung	81,186.9	23.2	81,122.8	24.1
Apple	51,629.5	14.8	60,177.2	17.9
Huawei	28,861.0	8.3	18,111.1	5.4
Oppo	16,112.6	4.6	6,585.1	2.0
Xiaomi	15,048.0	4.3	14,740.2	4.4
Others	156,413.4	44.8	155,561.4	46.3
Total	**349,251.4**	**100.0**	**336,297.8**	**100.0**

Press Release 2016 By http://www.gartner.com/newsroom/id/3323017m/id/3169417

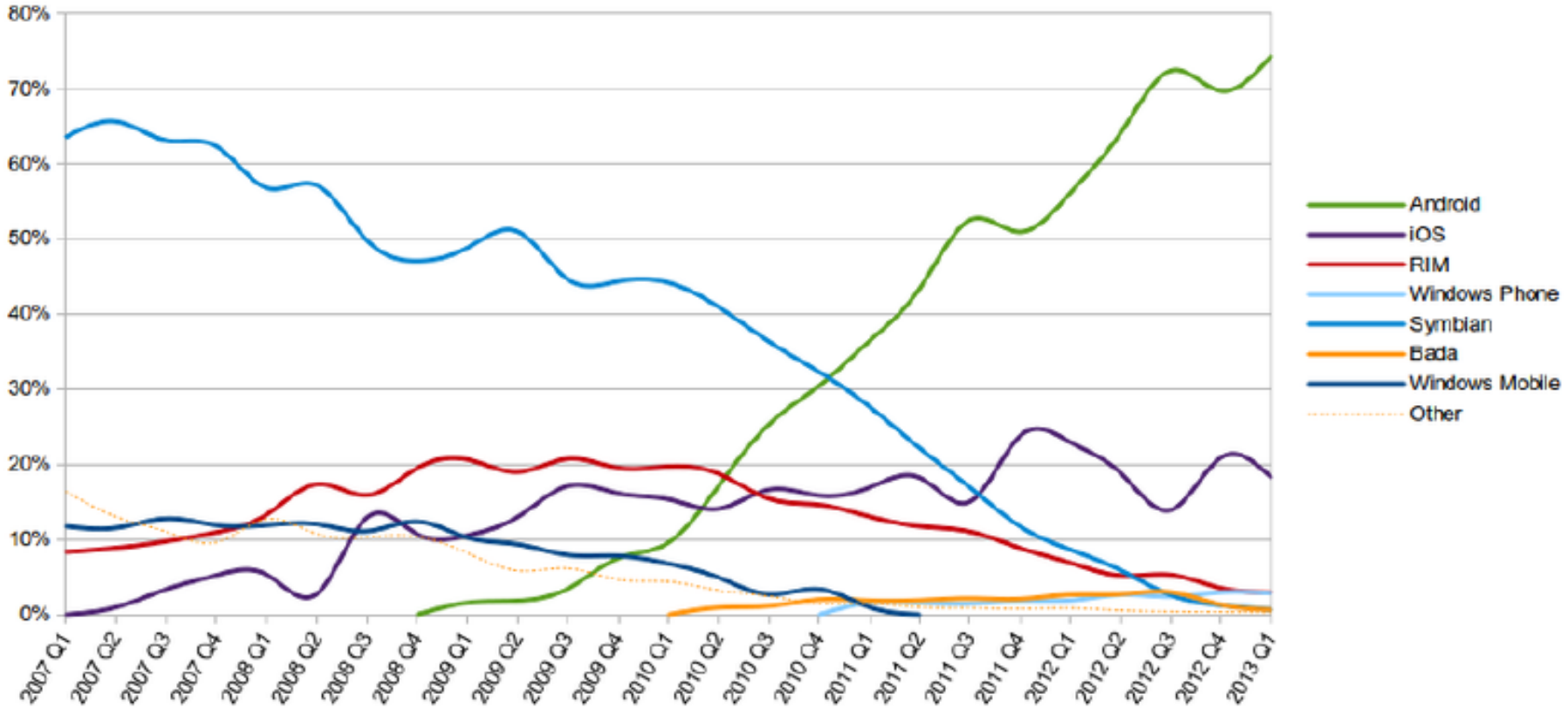
Recent Worldwide Smartphone Sales to End Users by Operating System

Operating System	1Q16 Units	1Q16 Market Share (%)	1Q15 Units	1Q15 Market Share (%)
Android	293,771.2	84.1	264,941.9	78.8
iOS	51,629.5	14.8	60,177.2	17.9
Windows	2,399.7	0.7	8,270.8	2.5
Blackberry	659.9	0.2	1,325.4	0.4
Others	791.1	0.2	1,582.5	0.5
Total	**349,251.4**	**100.0**	**336,297.8**	**100.0**

Press Release 2016 By http://www.gartner.com/newsroom/id/3323017m/id/3169417

Market Share (can be extrapolated to the present)

Based on Gartner, 2013



Development Platforms

Source: by Andri from http://www.dycode.co.id/