

# Mobile Phones Operating Systems

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- Mobile phone operating systems:
- Google Android
- BlackBerry
- iOS
- Windows Phone

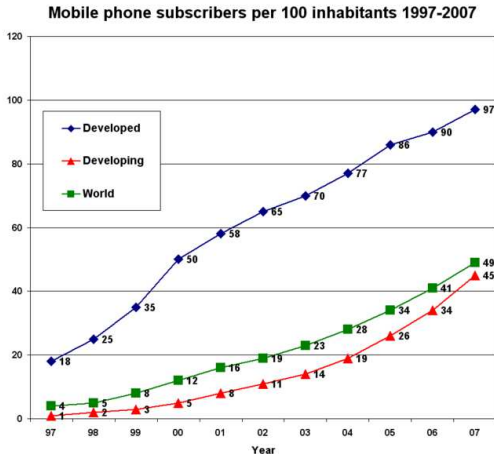


year	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012*	2013*
subs.	1159	1765	2,207	2,747	3,370	4,035	4,650	5,373	5,962	6,411	6,835
%	18.4	27.3	33.9	41.8	50.6	59.9	68.3	78.0	85.5	91.2	96.2

Subscriptions (in millions)

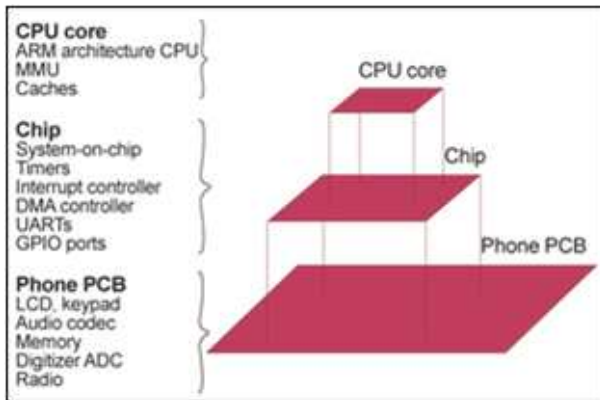
\* estimate

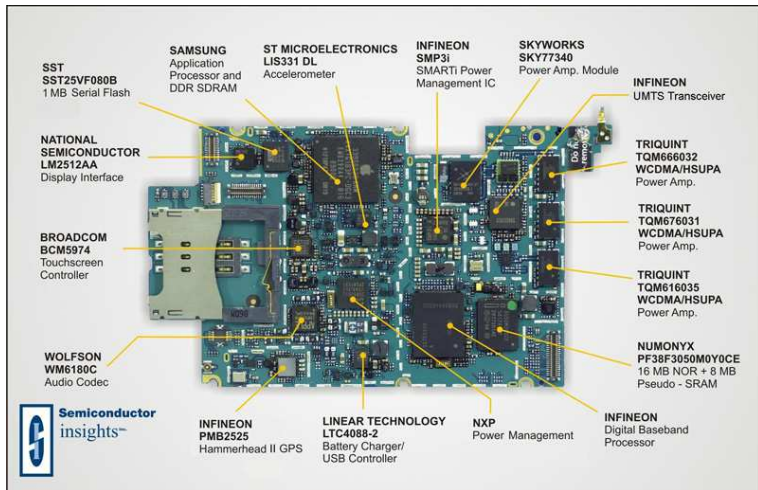
source: International Telecommunication Union



Numbers for 2011

- Developed nations: more than 1 phone per inhabitant
- Developing nations: 79 per 100 inhabitants





# Operating System Requirements in Mobile Phones

- Low memory footprint
- Low dynamic memory usage
- Efficient power management
- Real-time support for communication and telephony protocols
- Device and data integrity





Year	Android	iOS	Microsoft	RIM	Symbian	Other OSs
2014	81.5%	14.8%	2.7%	0.4%	-	0.6%
2013	78.4%	15.6%	3.2%	1.9%	-	0.9%
2012	66.4%	19.1%	2.5%	5%	1.2%	5.7%
2011	50.9%	23.9%	1.9%	8.8%	11.7%	2.9%
2010	22.7%	15.7%	4.2%	16.0%	37.6%	3.8%
2009	3.9%	14.4%	8.7%	19.9%	46.9%	6.1%
2008	0.5%	8.2%	11.8%	16.6%	52.4%	10.5%
2007	N/A	2.7%	12.0%	9.6%	63.5%	12.1%

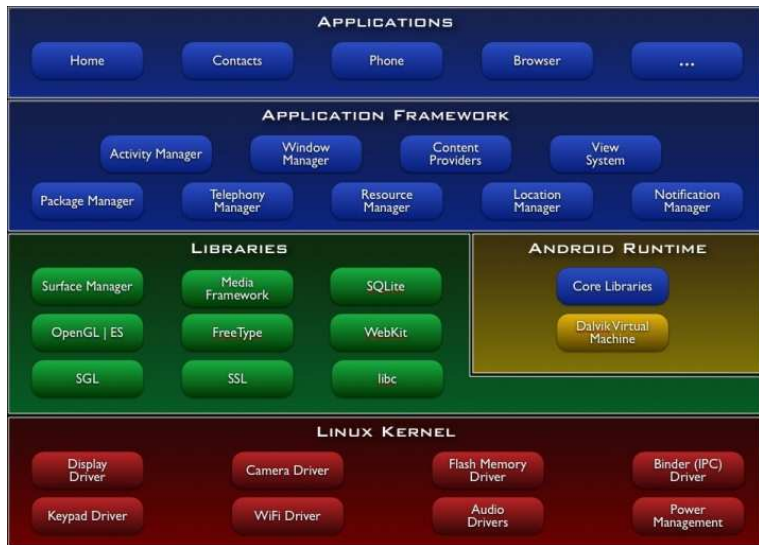
source: Gartner



- Software stack for mobile devices
  - Mobile operating system based on a modified Linux kernel (2.6)
  - Middleware
  - Key applications

Date		Code name
August 2005	Google acquires Android Inc.	
2006	Rumors of Google handset	
November 2007	Open Handset Alliance is formed	
October 2008	Android goes open-source	
October 22, 2008	HTC Dream released	
October 2009	Android 2.0 released	Eclair
May 2010	Android 2.2 released	Froyo
December 2010	Android 2.3 released	Gingerbread
October 2011	Android 4.0 released	Ice Cream Sandwich
October 2013	Android 4.4 released	Kitkat
November 2014	Android 5.0 release	Lollipop
October 2015	Android 6.0 release	Marshmallow

- Application framework enabling reuse and replacement of components
- Dalvik virtual machine optimized for mobile devices
- Integrated browser based on the open source WebKit engine
- Optimized graphics powered by a custom 2D graphics library; 3D graphics based on the OpenGL ES 1.0 specification
- SQLite for structured data storage
- Media support for common audio, video, and still image formats (MPEG4, H.264, MP3, AAC, AMR, JPG, PNG, GIF)
- GSM Telephony, Bluetooth, EDGE, 3G, and WiFi
- Camera, GPS, compass, and accelerometer
- Rich development environment: a device emulator, debugging tools, memory and performance profiling, and a plugin for the Eclipse IDE



- Applications
  - Core set: email client, SMS program, calendar, maps, browser, contacts, and others
  - Written using the Java programming language
- Application Framework
  - Same framework APIs used by the core applications
  - Designed to simplify the reuse of components
- Libraries
  - Set of C/C++ libraries exposed through the Android application framework

- Android Runtime
  - Provides most of the functionality of the Java core libraries
  - Every Android application runs in its own process with its own instance of the Dalvik VM
  - A device can run multiple VMs efficiently
  - VM is register-based, Java classes are transformed into .dex format using “dx” tool
  - Dalvik VM relies on Linux kernel for underlying functionality such as threading and low-level memory management
- Linux Kernel
  - Core system services such as security, memory management, process management, network stack, and driver model
  - Abstraction layer between the hardware and the rest of the software stack





- Smartphone devices developed by Research in Motion (RIM)
- Very popular in the corporate world
- Major selling point: instant, secure, mobile access to email
- Started as a two way pager

- Developed by Research In Motion for its BlackBerry line of smartphone handheld devices
- Provides multitasking
- Designed for use of track wheel, track ball, and track pad
- Provides support for Java MIDP 1.0 and WAP 1.2.
- Allows synchronization with almost everything
- Updates to the operating system may be automatically available from wireless carriers that support the BlackBerry over the air software loading (OTASL) service
- Third-party developers can write software using the available BlackBerry API classes, although applications that make use of certain functionality must be digitally signed.

- Released in January 2013
- Based on QNX operating system
- Some features
  - Multitasking
  - BlackBerry Balance
  - Time Shift Camera
  - Android Player
  - Keyboard

## Operating system – QNX Neutrino RTOS

### Advanced runtime technologies

Adaptive partitioning

Wireless and secure networking

Fast boot

Multi-core

High availability

POSIX utilities

File systems

HMI technologies

Device drivers

Networking

Memory protected applications

Messaging layer

Secure kernel space

QNX Neutrino RTOS microkernel

### QNX board support packages

#### Processor architectures

x86

SH-4

PowerPC

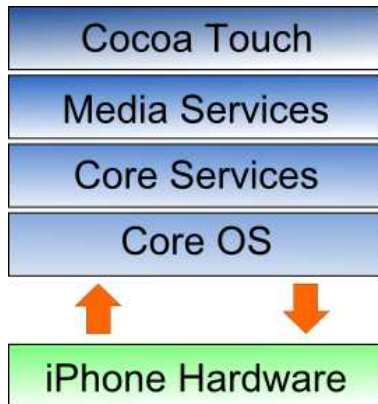
MIPS

ARM



- iPhone is released on June 29, 2007
- It's operating system was iPhone OS, later renamed iOS
- iOS runs on Apple Inc.'s mobile devices such as the iPhone, iPod Touch, and iPad
- Updates are released through iTunes

Version	Device	Date	Obs.
1.0	iPhone	June 29, 2007	
1.1	iPod Touch	September 14, 2007	
2.0	iPhone 3G	July 11, 2008	App Store
3.0	iPhone 3GS	June 17, 2009	Copy and paste, MMS
4.0	iPhone 4	June 21, 2010	Multitasking
5.0	iPhone 4S	October 12, 2011	
6.0	iPhone 5	September 12, 2012	
7.0	iPhone 5S	September, 18, 2013	
8.0	iPhone 6	September, 17, 2014	
9.0		September, 16, 2015	





- Sits at the top of the iPhone OS stack
- Contains the frameworks that are most commonly used by iPhone application developers.
- Primarily written in Objective-C
- Is based on the standard Mac OS X Cocoa API
- Has been extended and modified to meet the needs of the iPhone.
- Provides the following frameworks for iPhone app development:
  - UIKit Framework (UIKit.framework)
  - Map Kit Framework (MapKit.framework)
  - Push Notification Service
  - Message UI Framework (MessageUI.framework)
  - Address Book UI Framework (AddressUI.framework)
  - Game Kit Framework (GameKit.framework)

- Provides audio, video, animation and graphics capabilities
- Provides the following frameworks:
  - Core Graphics Framework (CoreGraphics.framework)
  - Quartz Core Framework (QuartzCore.framework)
  - OpenGL ES framework (OpenGLES.framework)
  - iPhone Audio Support
  - AV Foundation framework (AVFoundation.framework)
  - Core Audio Frameworks (CoreAudio.framework, AudioToolbox.framework and AudioUnit.framework)
  - Open Audio Library (OpenAL)
  - Media Player framework (MediaPlayer.framework)

- Is the foundation to the above layers
- Consists of the following frameworks:
  - Address Book framework (AddressBook.framework)
  - Core Data Framework (CoreData.framework)
  - Core Foundation Framework (CoreFoundation.framework)
  - Foundation Framework (Foundation.framework)
  - Core Location Framework (CoreLocation.framework)
  - Store Kit Framework (StoreKit.framework)
  - SQLite library

- Bottom layer of the iPhone OS stack
- Sits directly on top of the device hardware
- Provides a variety of services:
  - CFNetwork Framework (CFNetwork.framework)
  - External Accessory framework (ExternalAccessory.framework)
  - Security Framework (Security.framework)
  - System (LibSystem) (memory management, file system handling and threads)

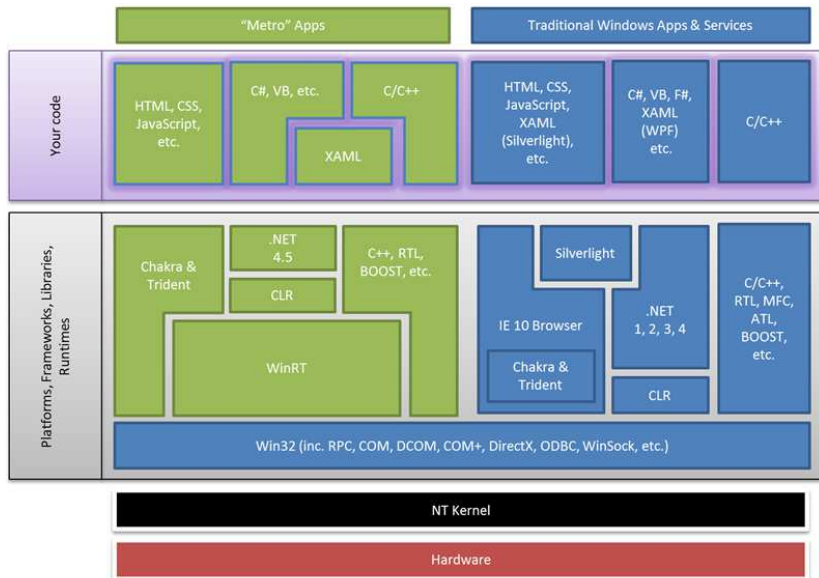
- iPhone apps are developed using the iPhone SDK in conjunction with Apple's Xcode development environment
- Xcode is an integrated development environment within which you will code, compile, test and debug your iPhone applications
- Xcode enables you to graphically design the user interface of your application



- Windows Phone 7 (and 8) is a mobile operating system developed by Microsoft
- Is the successor to its Windows Mobile platform
- Launched in Europe, Singapore, Australia and New Zealand on October 21, 2010, and in the US and Canada on November 8, 2010, Mexico on November 24, 2010, with Asia to follow in 2011
- Windows Phone become the primary smartphone operating system for Nokia

- Capacitive, 4-point multi-touch screen with WVGA (480x800) resolution
- ARM v7 “Cortex/Scorpion” – Snapdragon QSD8X50, MSM7X30, and MSM8X55
- DirectX9 rendering-capable GPU
- 256 MB of RAM with at least 8 GB of Flash memory
- Accelerometer with compass, ambient light sensor, proximity sensor, Assisted GPS, and Gyroscope
- 5-megapixel camera with an LED flash
- FM radio tuner
- 6 dedicated hardware buttons – back, Start, search, 2-stage camera, power/sleep and Volume Up and Down





- Applications developed in C# or Visual Basic

## Two applications development platforms

- Silverlight
  - application framework for writing and running browser plug-ins or other rich Internet applications
  - features and purposes similar to those of Adobe Flash.
- XNA
  - based on the native implementation of .NET Compact Framework 2.0 for Xbox 360 development and .NET Framework 2.0 on Windows
  - specific to game development

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- Sensor networks