

# Mobile Application Development

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Produced  
by

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# Introducing Android

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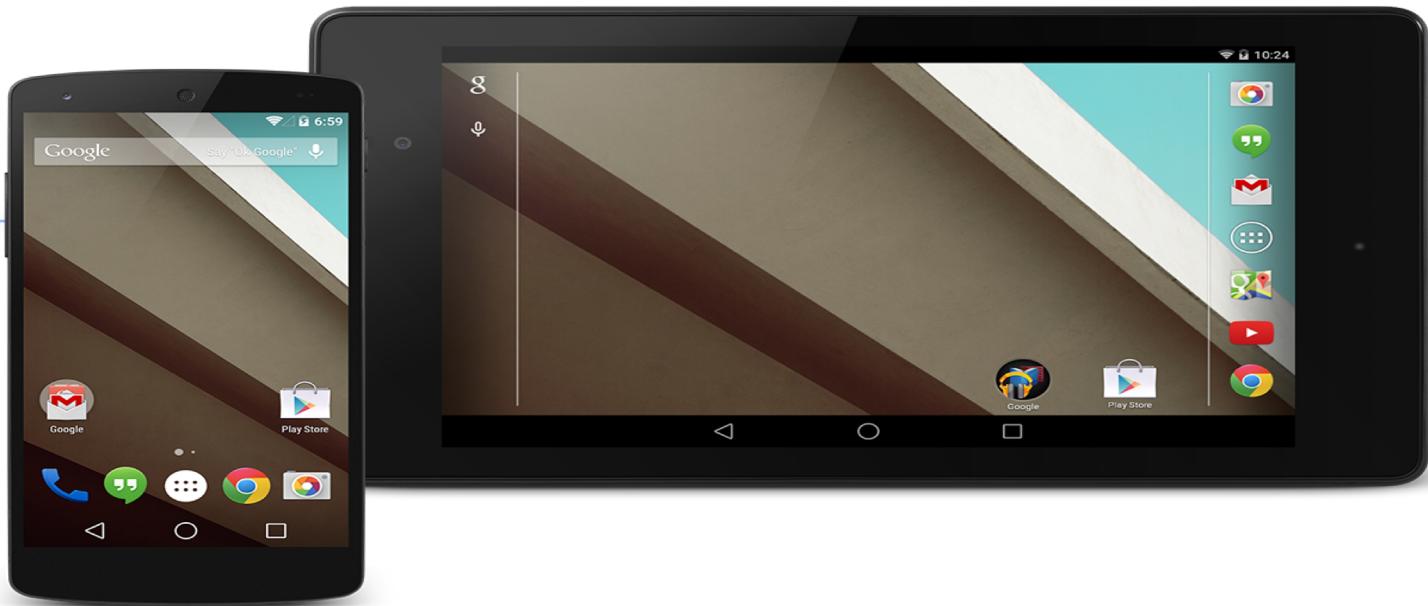


# Agenda

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- ❑ Background (and more)
- ❑ Quick tour of Android
- ❑ Setting up the Environment
- ❑ Android Apps vs iPhone Apps
- ❑ Books & References

# Background



- ❑ Android is a comprehensive open source platform designed for mobile devices (more in a bit)
- ❑ It is championed by Google and owned by the Open Handset Alliance (next Slide)
- ❑ The goal of the alliance is to “accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience.” (November 2007)



### Mobile Operators



### Software Companies



### Commercialization Companies



### ARM



### Semiconductor Companies

### GARMIN



### Handset Manufacturers

Open Handset Alliance  
<http://www.openhandsetalliance.com>



# Background

- ❑ Android, along with iOS, is revolutionising the mobile space.
- ❑ Unlike iOS however, Android is an open platform that separates the hardware from the software that runs on it.
- ❑ This allows for a much larger number of devices to run the same applications and creates a much richer ecosystem for developers and consumers.



ANDROID WEAR



PHONES



TABLETS



ANDROID TV



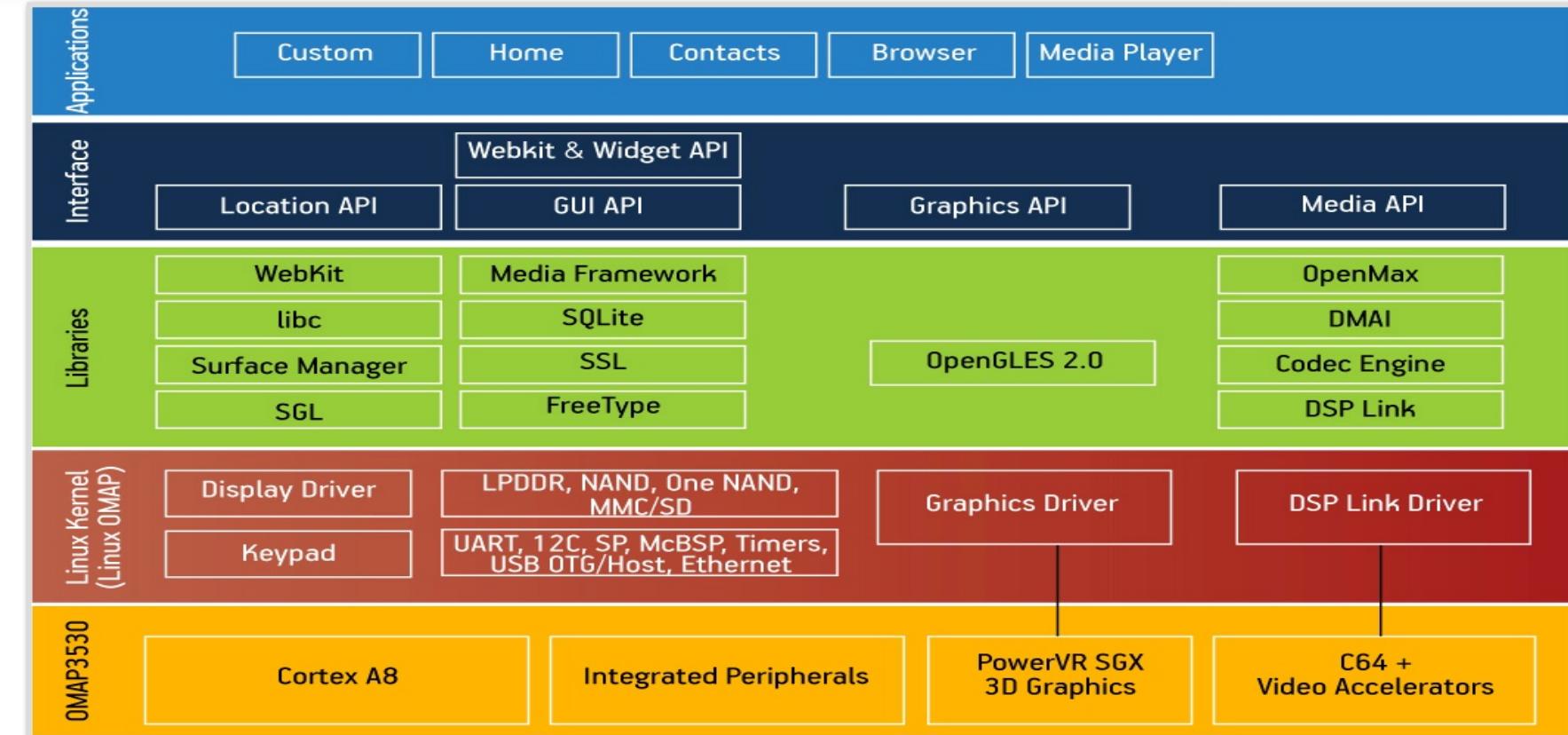
ANDROID AUTO



# Comprehensive

❑ Android is a comprehensive platform, which means it is a complete software stack for a mobile device.

❑ The Android SDK is all you need to start developing for Android; you don't even need a physical device.



❑ Users can customize their phone experience substantially.

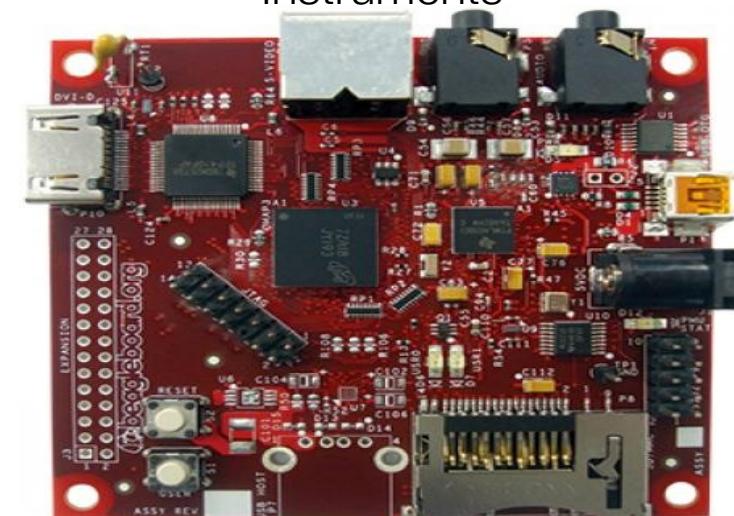
❑ Manufacturers can also customise the platform can substantial ways - even generating complete 'forks' of the original project (Amazon).



# Open Source

- ❑ Android is an open source platform.
- ❑ Aside from the Linux kernel itself, Android is licensed under business-friendly licenses (Apache/MIT/BSD) so that others can freely extend it and use it for variety of purposes.
- ❑ Manufacturers can port Android OS to specific hardware. with minimal legal issues.
- ❑ Android has many hooks at various levels of the platform, allowing anyone to extend it in unforeseen ways.

BeagleBoard, a low-power open-source hardware single-board computer produced by Texas Instruments



# Designed for Mobile Devices

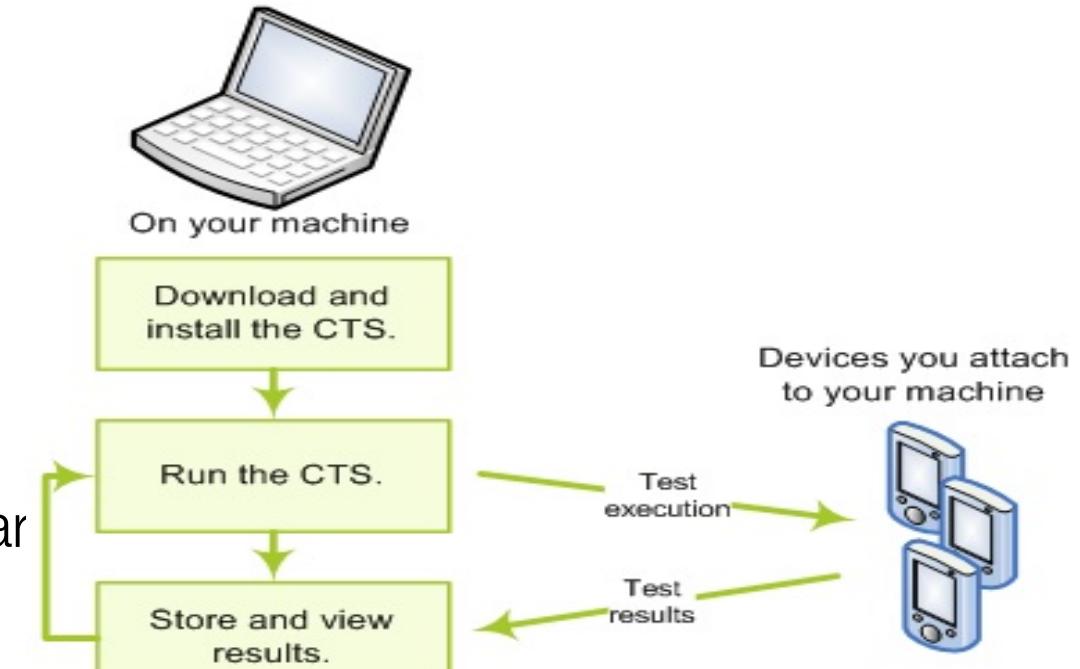
- ❑ When designing Android, the team looked at which mobile device constraints were likely *not going to change* for the foreseeable future:
  - *Battery power, and battery performance* is probably not going to get much better anytime soon.
  - In general, small size of mobile devices means that they will always be limited in terms of memory and speed.
  - However, a device's screen size, resolution, chipset may vary considerably
- ❑ These constraints have been taken into consideration throughout the platform.





# CTS

- ❑ The Compatibility Test Suite (CTS), defines what it means to be an Android-compatible device.
- ❑ CTS is a combination of automated tests as well as a document that specifies what an Android device must have, should have, or what features are simply optional.
- ❑ The goal of CTS is to ensure that, for a regular consumer, an average app from the market will run on an average Android device if that device claims to be supporting a certain version of Android.





# Compatibility is optional

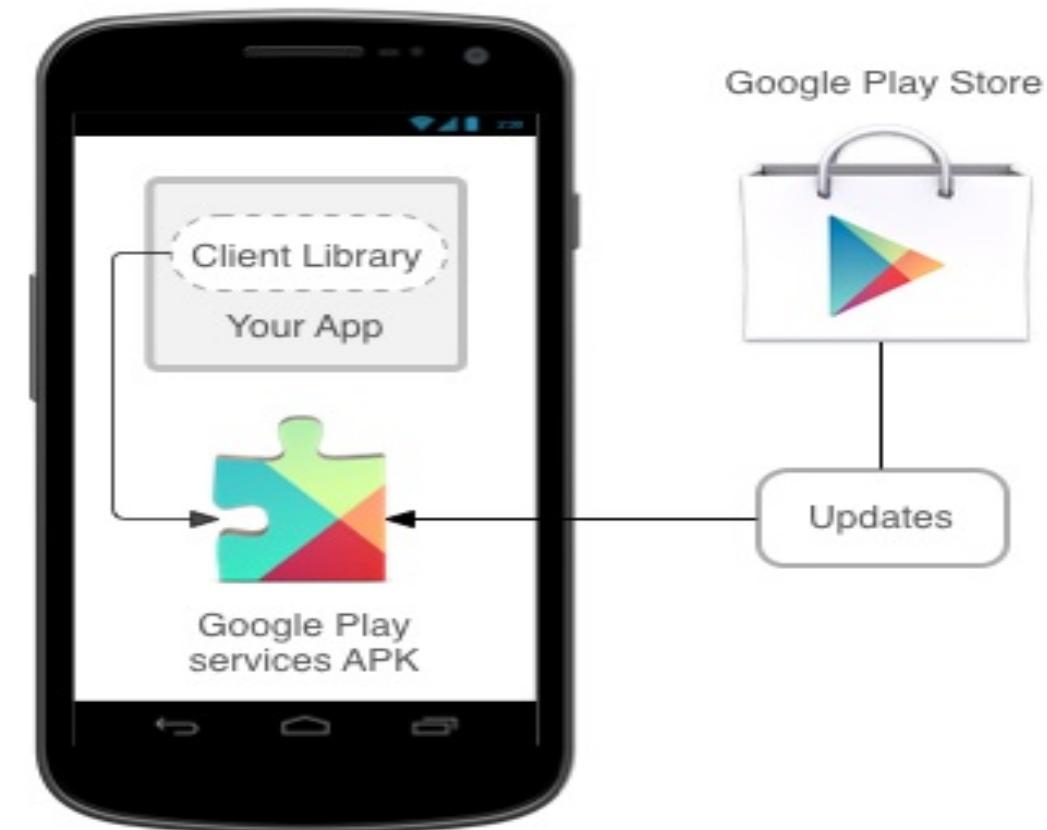
- ❑ CTS is being completely avoided by Amazon with the Kindle Fire and phone series of devices, built on top of the Android OS.
- ❑ Note that manufacturers by no means have to adhere to CTS.
- ❑ Anyone is welcome to download and “remix” Android in any way they see fit.
- ❑ Android has been customized for everything from cars to satellites, and from photocopiers to washing machines.

Area	Description
Signature tests	For each Android release, there are XML files describing the signatures of all public APIs contained in the release. The CTS contains a utility to check those API signatures against the APIs available on the device. The results from signature checking are recorded in the test result XML file.
Platform API Tests	Test the platform (core libraries and Android Application Framework) APIs as documented in the SDK <a href="#">Class Index</a> to ensure API correctness, including correct class, attribute and method signatures, correct method behavior, and negative tests to ensure expected behavior for incorrect parameter handling.
Dalvik VM Tests	The tests focus on testing the Dalvik VM.
Platform Data Model	The CTS tests the core platform data model as exposed to application developers through content providers, as documented in the SDK <a href="#">android.provider</a> package: contacts, browser, settings, etc.
Platform Intents	The CTS tests the core platform intents, as documented in the SDK <a href="#">Available Intents</a> .
Platform Permissions	The CTS tests the core platform permissions, as documented in the SDK <a href="#">Available Permissions</a> .
Platform Resources	The CTS tests for correct handling of the core platform resource types, as documented in the SDK <a href="#">Available Resource Types</a> . This includes tests for: simple values, drawables, nine-patch, animations, layouts, styles and themes, and loading alternate resources.



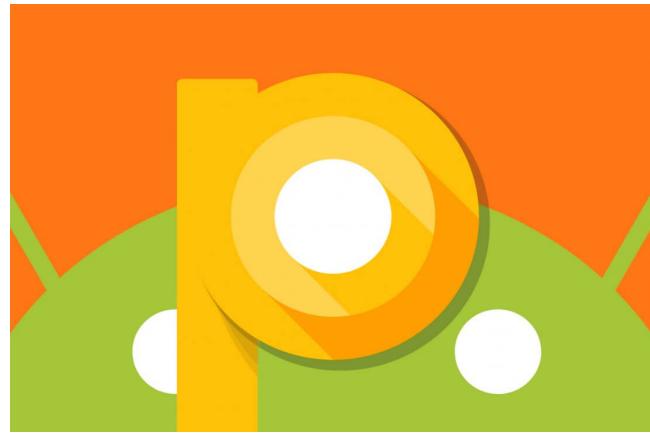
# Why Compatibility? - Google Play Services

- ❑ The major reason manufacturers would want to ensure Android compatibility is access to Google Play Services, and its rich set of apps.
- ❑ It allows apps to take advantage of the latest, Google-powered features such as Maps, Places, Google+, and more, with automatic platform updates distributed as an APK through the Google Play store.
- ❑ Makes it faster for phone to receive updates and easier for developers to integrate some new features into their apps.





# Android History / Versions so Far \*



Android 9.0  
Pie  
(API 28)



# Versions – API Level \*

- ❑ The Android version number itself partly tells the story of the software platform's major and minor releases. What is most important is the API level. Version numbers change all the time, sometimes because the APIs have changed, and other times because of minor bug fixes or performance improvements.
- ❑ As an application developer, you will want to make sure you know which API level your application is targeting in order to run. That API level will determine which devices can and cannot run your application.

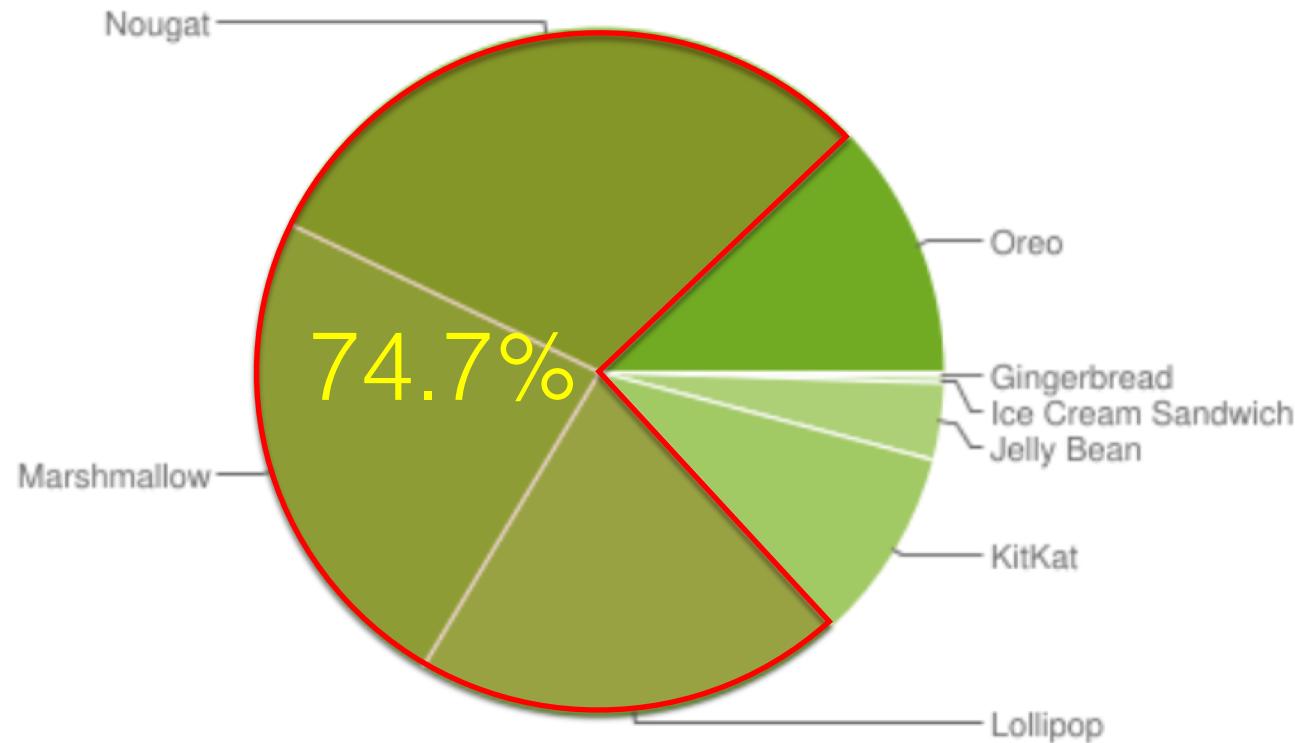
Version	Codename	API	Distribution
2.3.3 - 2.3.7	Gingerbread	10	0.2%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	0.3%
4.1.x	Jelly Bean	16	1.2%
4.2.x		17	1.9%
4.3		18	0.5%
4.4	KitKat	19	9.1%
5.0	Lollipop	21	4.2%
5.1		22	16.2%
6.0	Marshmallow	23	23.5%
7.0	Nougat	24	21.2%
7.1		25	9.6%
8.0	Oreo	26	10.1%
8.1		27	2.0%

*Data collected during a 7-day period ending on July 23, 2018.*

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



# Versions – Platforms \*



*Data collected during a 7-day period ending on July 23, 2018.*

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



# Target Version

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- ❑ A developer's objective may be to have an application run on as many devices as possible.
  - shoot for the lowest API level possible. Keep in mind the distribution of Android versions on real devices out there.
- ❑ You may notice that there are a lot of users (74.7%) of Android 5.x 6.x & 7.x. This places these few versions as the largest versions currently in the wild.
- ❑ This hasn't always been the case because OEMs tended to be very slow in upgrading their OS versions. However, this has changed with Google's strong push to get everyone onto the latest versions.
- ❑ However, there are still a small number of people (10%+) who have anything from the 2.3.3 version to the 4.3 version because they have yet to upgrade their phones to a phone with the hardware capable of handling the newer versions.



# Android Pie Version 9.0 - API level 28

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- ❑ Official Release Date August 6<sup>th</sup> 2018
- ❑ New Features
  - App Navigation
  - Notifications
  - Do Not Disturb
  - Digital Wellbeing
  - App Actions
  - Adaptive Battery / Adaptive Brightness modes
- ❑ Available for Google Pixel devices and the Essential Phone



# Adoption Rates

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- ❑ Android adoption traditionally lags behind Apple's because Apple can make its latest iOS available for all users at once because it makes all the hardware and the software.
- ❑ Android, on the other hand, is much more fragmented. Because Google lets many different hardware makers use its Android software, it can't control when all phones update to the latest software. So, the newest version of Android is always made available for Google's lineup of Nexus smartphones and tablets, but it can't release software updates to every single Android phone at once.
- ❑ Smartphone manufacturers often add their own modifications to Android, which means that the update needs to be approved by each individual carrier first.
- ❑ This means that depending on which phone you own, it could take ages to receive the latest software update.
- ❑ Here's the brutal chart:



# Adoption Rates

## Fragmentation Remains an Issue in the Android Universe

% of iOS/Android devices running the latest versions of iOS/Android

Released in

Earlier versions  
7%

iOS 10  
Sep 16  
28%

iOS

Earlier versions  
17%

iOS 11  
Sep 17  
65%

Lollipop  
Nov 14  
25%

Oreo  
Aug 17  
1%

Nougat  
Aug 16  
29%

Marshmallow  
Oct 15  
28%

android

Data collected by the App Store  
on January 18, 2018

Data collected during a 7-day period ending  
on February 5, 2018



@StatistaCharts Sources: Apple, Google

statista

[https://www.statista.com/  
chart/5930/adoption-of-  
ios-and-android-versions/](https://www.statista.com/chart/5930/adoption-of-ios-and-android-versions/)



# Quick Tour of Android (1)

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## ❑ Standard Features:

- User Interface
    - ◆ IO widgets (buttons, textboxes, lists etc.)
    - ◆ Images
    - ◆ 2D/3D drawing
    - ◆ ActionBar/ActionBarMode
    - ◆ ViewPager
    - ◆ NavDrawer
  - Database (Sqlite)
  - App Lifecycle
- ❑ (More Later on...)



# Quick Tour of Android (2)

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## ❑ More Advanced Features:

- Google Maps
- Google Sign-In
- FireBase
- Hardware APIs
  - ◆ GPS/Geo-location, calls, accelerometer, compass, bluetooth, camera
  - ◆ Fused Location Provider (latest addition)
- Multiple processes
  - ◆ Managed by ART (as of Kit Kat 4.4+)
  - ◆ Background Services (e.g. AsyncTasks/Volley)
  - ◆ Inter-process communications (e.g. Intents)
- No difference between third-party and native apps (2 lines of code to launch Camera on Device)



# Android Applications (re : the installation stuff)

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- ❑ Android applications get distributed in a .apk file
- ❑ APK == “Android Package”
  - It is simply a zip file that has a particular file structure (similar to JAR files that take snapshots of the file system)
  - An APK contains
    - ◆ The Android Manifest file (an XML file with lots of metadata)
    - ◆ A Resource bundle containing sounds, graphics, etc.
    - ◆ The ART bytecodes that make up your application



# What You need to Get started

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- ❑ The Android SDK supports several different integrated development environments (IDEs). Here we will focus on Android Studio because it is supported by Google, with the SDK and it's free (*and* Google aren't supporting Eclipse anymore!)
- ❑ No matter which operating system you are using, you will need essentially the same set of tools:
  - IDE
  - Sun's / ORACLE's Java Development Kit (JDK)
  - The Android Software Developer's Kit (SDK)
  - Phone driver (for specific device development)
- ❑ Android offer an “ADT Bundle” with everything you need  
<http://developer.android.com/sdk/index.html> just confirm your SDK with mine (next slide) re solutions.....



# Android SDK Setup for the Labs \*

Default Preferences

Appearance & Behavior > System Settings > Android SDK

Manager for the Android SDK and Tools used by Android Studio

Android SDK Location: /Users/ddrohan/env/appdev/android [Edit](#)

[Reset](#)

[SDK Platforms](#) [SDK Tools](#) [SDK Update Sites](#)

Each Android SDK Platform package includes the Android platform and sources pertaining to an API level by default. Once installed, Android Studio will automatically check for updates. Check "show package details" to display individual SDK components.

	Name	API Level	Revision	Status
<input type="checkbox"/>	Android API 28	28	6	Not installed
<input checked="" type="checkbox"/>	Android 8.1 (Oreo)	27	3	Installed
<input type="checkbox"/>	Android 8.0 (Oreo)	26	2	Not installed
<input type="checkbox"/>	Android 7.1.1 (Nougat)	25	3	Not installed
<input type="checkbox"/>	Android 7.0 (Nougat)	24	2	Partially installed
<input type="checkbox"/>	Android 6.0 (Marshmallow)	23	3	Not installed
<input type="checkbox"/>	Android 5.1 (Lollipop)	22	2	Not installed
<input type="checkbox"/>	Android 5.0 (Lollipop)	21	2	Not installed
<input type="checkbox"/>	Android 4.4W (KitKat Wear)	20	2	Not installed
<input type="checkbox"/>	Android 4.4 (KitKat)	19	4	Not installed
<input type="checkbox"/>	Android 4.3 (Jelly Bean)	18	3	Not installed
<input type="checkbox"/>	Android 4.2 (Jelly Bean)	17	3	Not installed
<input type="checkbox"/>	Android 4.1 (Jelly Bean)	16	5	Not installed
<input type="checkbox"/>	Android 4.0.3 (IceCreamSandwich)	15	5	Not installed
<input type="checkbox"/>	Android 4.0 (IceCreamSandwich)	14	4	Not installed
<input type="checkbox"/>	Android 3.2 (Honeycomb)	13	1	Not installed
<input type="checkbox"/>	Android 3.1 (Honeycomb)	12	3	Not installed
<input type="checkbox"/>	Android 3.0 (Honeycomb)	11	2	Not installed
<input type="checkbox"/>	Android 2.3.3 (Gingerbread)	10	2	Not installed
<input type="checkbox"/>	Android 2.3 (Gingerbread)	9	2	Not installed
<input type="checkbox"/>	Android 2.2 (Froyo)	8	3	Not installed
<input type="checkbox"/>	Android 2.1 (Eclair)	7	3	Not installed

Show Package Details

[Cancel](#) [Apply](#) [OK](#)



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Default Preferences

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Android SDK Location: /Users/ddrohan/env/appdev/android [Edit](#)

SDK Platforms **SDK Tools** SDK Update Sites

Below are the available SDK developer tools. Once installed, Android Studio will automatically check for updates. Check "show package details" to display available versions of an SDK Tool.

	Name	Version	Status
<input checked="" type="checkbox"/>	Android SDK Build-Tools		Installed
<input type="checkbox"/>	GPU Debugging tools		Not Installed
<input type="checkbox"/>	CMake		Not Installed
<input type="checkbox"/>	LLDB		Not Installed
<input checked="" type="checkbox"/>	Android Auto API Simulators	1.0.0	Installed
<input type="checkbox"/>	Android Auto Desktop Head Unit emulator	1.1	Not installed
<input checked="" type="checkbox"/>	Android Emulator	27.3.9	Installed
<input checked="" type="checkbox"/>	Android SDK Platform-Tools	28.0.0	Installed
<input checked="" type="checkbox"/>	Android SDK Tools	26.1.1	Installed
<input checked="" type="checkbox"/>	Android Support Library, rev 23.2.1	23.2.1	Installed
<input checked="" type="checkbox"/>	Documentation for Android SDK	1	Installed
<input checked="" type="checkbox"/>	Google Play APK Expansion Library, rev 3	3.0.0	Installed
<input type="checkbox"/>	Google Play APK Expansion library	1	Not installed
<input checked="" type="checkbox"/>	Google Play Billing Library, rev 5	5.0.0	Installed
<input type="checkbox"/>	Google Play Licensing Library	1	Not installed
<input checked="" type="checkbox"/>	Google Play Licensing Library, rev 2	2.0.0	Installed
<input checked="" type="checkbox"/>	Google Play services	49	Installed
<input checked="" type="checkbox"/>	Google Play services for Froyo, rev 12	12.0.0	Installed
<input type="checkbox"/>	Google Web Driver	2	Not installed
<input type="checkbox"/>	Instant Apps Development SDK	1.3.0	Not installed
<input checked="" type="checkbox"/>	Intel x86 Emulator Accelerator (HAXM installer)	7.2.0	Installed
<input type="checkbox"/>	NDK	17.1.4828580	Not installed
<input checked="" type="checkbox"/>	Support Repository		

Show Package Details

Cancel Apply OK



# Android Apps vs iPhone Apps



# Installing Apps

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## ❑ For Generic (on the market) apps

- iPhone has larger selection
- Android catching up

## ❑ For In-house-developed corporate apps

- iPhone apps can only (mostly) be installed via the App Store
  - ◆ iPhone requires you to submit app to the Apple App Store and get approval, even for apps from your own company
    - Unless you setup a Provisioning profile or
    - you use something like TestFlight or
    - jailbreak your phone of course.....
- Android apps can be installed through
  - ◆ Google App Store / Google Play
  - ◆ Amazon App Store
  - ◆ **USB connection from PC**
  - ◆ **Email**
  - ◆ **Corporate Web site**



# Languages for Apps

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## ❑ iPhone

- Objective-C
  - ◆ Similar to, but not exactly the same as, C++
  - ◆ Virtually no corporate presence for Objective-C, other than for mobile apps
  - ◆ However, **Swift** becoming more popular

## ❑ Android

- Java
  - ◆ The single most widely used language inside corporations
- C/C++
  - ◆ Can call native apps (with some difficulty) via an approach similar to JNI for desktop Java
- Kotlin gaining a lot of traction

# OS for Dev Apps

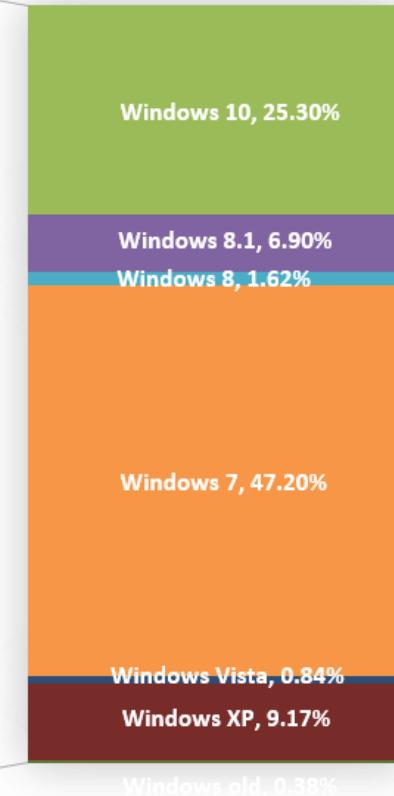
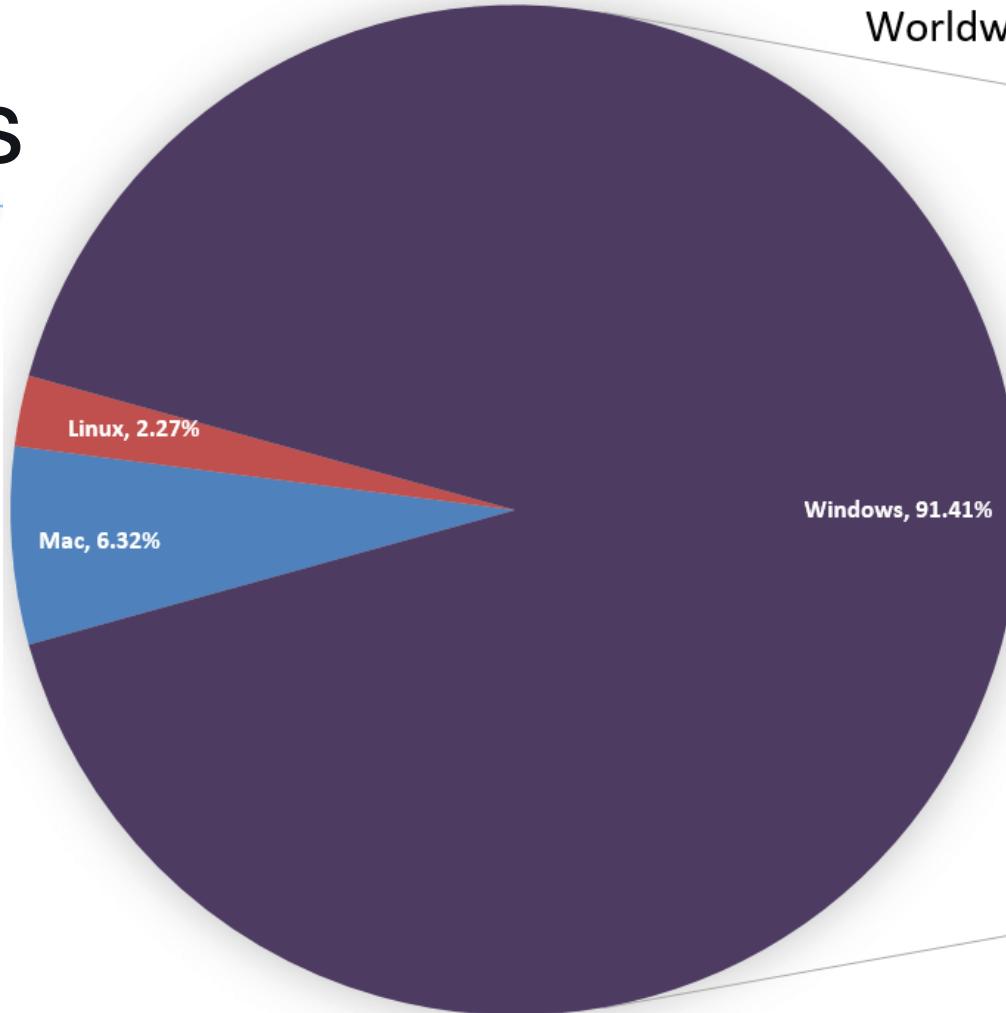
iPhone

- Macs

Android

- Anything with Java and Android Studio

- ◆ Macs
- ◆ PCs
- ◆ Linux
- ◆ Solaris



VB

Issue

- Not so much which is cooler and which you personally prefer, but rather which is already installed in corporate environments.

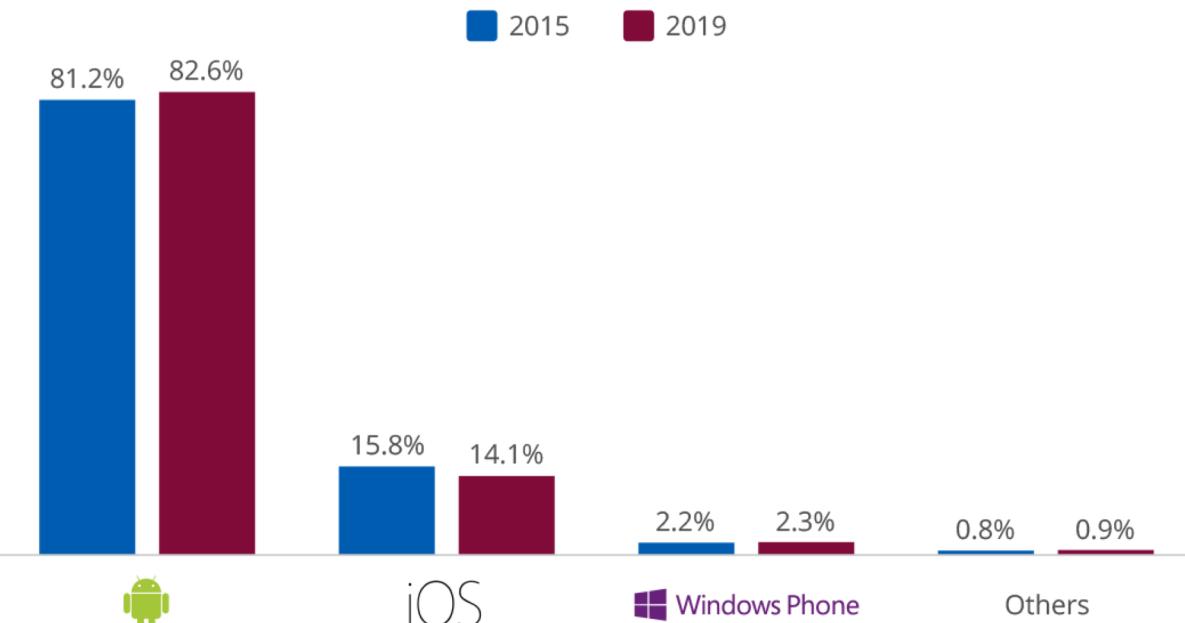


# Market Share Vs Operating Profits

Tech Chart of the Day

## Smartphone Platform Market Share

Worldwide smartphone operating system market share (% of new device shipments)\*



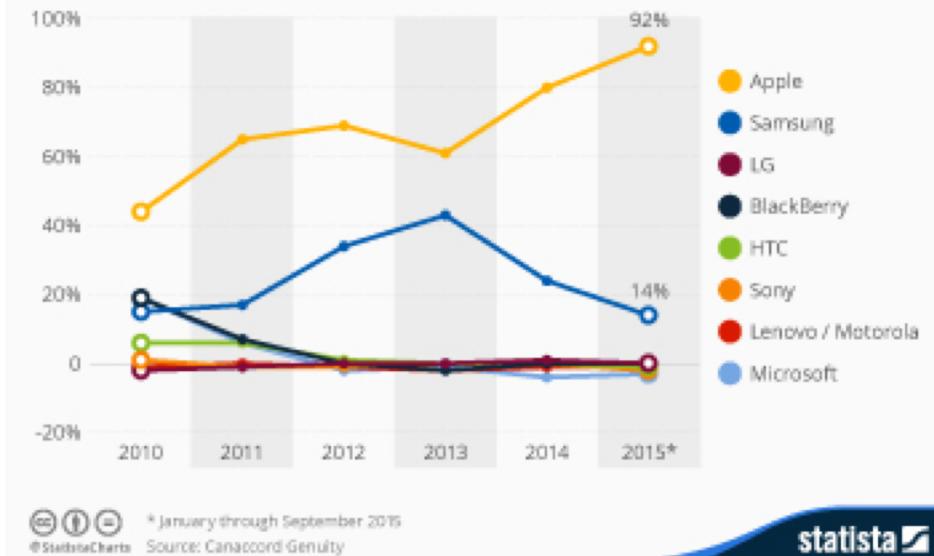
\* Forecast

BUSINESS INSIDER

Source: IDC statista

## Apple Claims 92% of Global Smartphone Profits

Estimated share of global smartphone operating profits



\* January through September 2015

Source: Canaccord Genuity

statista



# Other Issues

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- ❑ Phone features, quality of apps, customer loyalty and coolness factors
  - Matter of opinion, but iPhone very strong here
- ❑ Market presence based on sales / app downloads etc.



# Bottom Line: Android vs iPhone

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## ❑ Which to use personally

- iPhone has bigger app store, and more loyal users
- Android more open and growing more rapidly
- Bottom line: no clear winner, personal preferences prevail, but iPhone has the edge (for me anyway!)

## ❑ Which to use for in-house apps

- iPhone apps very hard/restrictive to install, Android very simple
- iPhone uses mainly Objective-C (Swift on the up), Android uses Java
- Bottom line: Android is clear winner      IMHO



# References

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## ❑ Books (in rough order of preference)

- Android Developer's Cookbook (Steele & To)
- Busy Coder's Guide to Android Development (Murphy)
  - ◆ Online only: <http://commonsware.com/Android/>
- Android in Action, 2<sup>nd</sup> Edition (Ableson, Sen, & King)
- Android Application Development for Dummies (Felker)

## ❑ Online references

- <http://developer.android.com/>
  - ◆ By far the most important single reference.
- Android forum on StackOverflow
  - ◆ <http://stackoverflow.com/questions/tagged/android>
- Android widget gallery
  - ◆ <http://www.droiddraw.org/widgetguide.html>
- Marty Hall's Tutorials
  - ◆ <http://www.coreservlets.com/android-tutorial/>



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# Questions?