CET325

Advanced Mobile Development

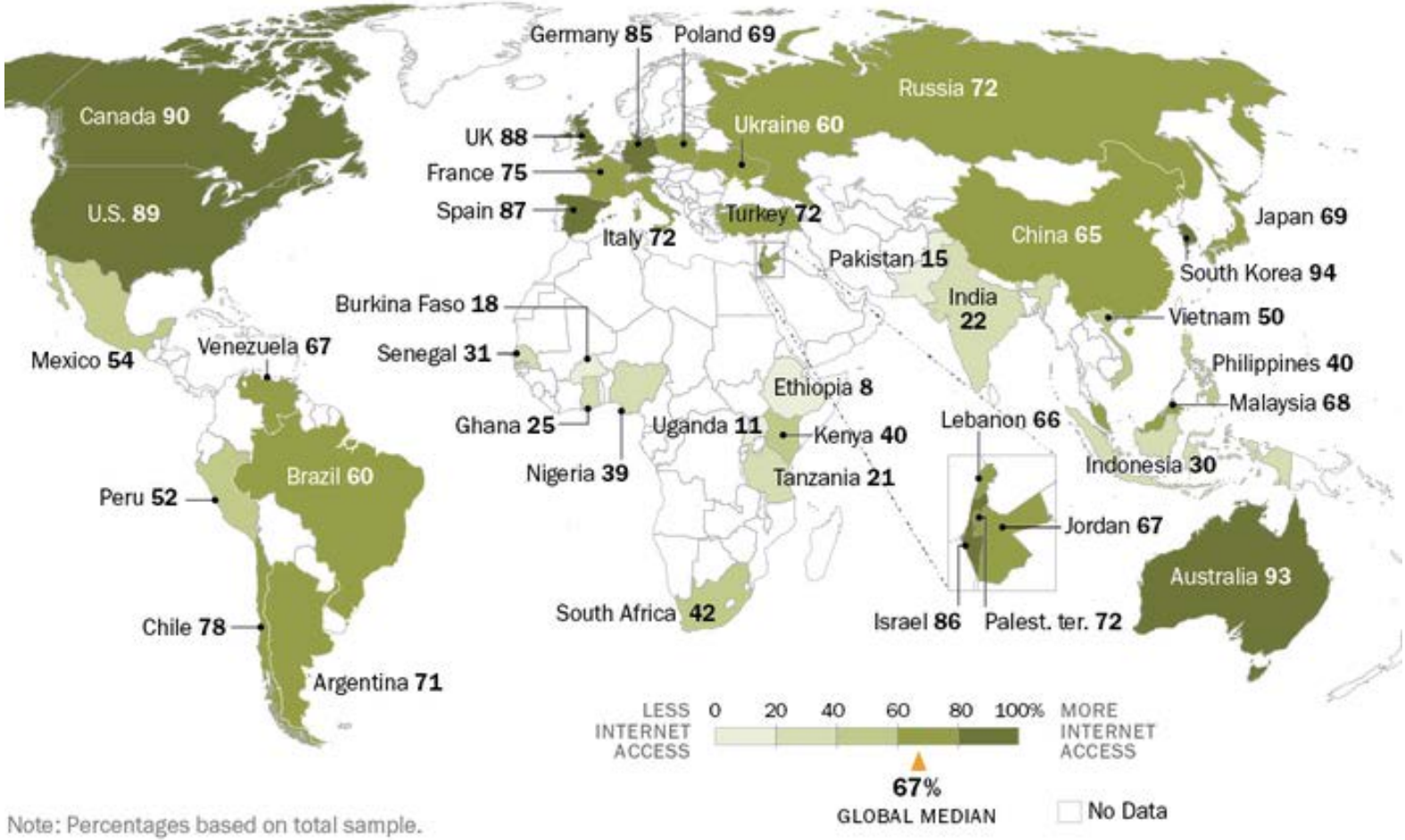
Lecture 2A

Agenda

- Android:
  - Internet/Smartphone user base
  - Options for Mobile development
  - Mobile OS
  - Android OS

Two-thirds worldwide use the internet, but fewer do in Africa and South Asia

Percent of adults who use the internet at least occasionally or report owning a smartphone



Note: Percentages based on total sample.

Source: Spring 2015 Global Attitudes survey. Q70 & Q72.

PEW RESEARCH CENTER

http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/

Smartphones are more common in Europe, U.S., less so in developing countries

Percent of adults who report owning a smartphone

Note: Percentages based on total sample.

Source: Spring 2015 Global Attitudes survey. Q71 & Q72.

PEW RESEARCH CENTER

Number of smartphones by country

Top 25 Countries, Ranked by Internet Users, 2013-2018
millions

	2013	2014	2015	2016	2017	2018
1. China*	620.7	643.6	669.8	700.1	736.2	777.0
2. US**	246.0	252.9	259.3	264.9	269.7	274.1
3. India	167.2	215.6	252.3	283.8	313.8	346.3
4. Brazil	99.2	107.7	113.7	119.8	123.3	125.9
5. Japan	100.0	102.1	103.6	104.5	105.0	105.4
6. Indonesia	72.8	83.7	93.4	102.8	112.6	123.0
7. Russia	77.5	82.9	87.3	91.4	94.3	96.6
8. Germany	59.5	61.6	62.2	62.5	62.7	62.7
9. Mexico	53.1	59.4	65.1	70.7	75.7	80.4
10. Nigeria	51.8	57.7	63.2	69.1	76.2	84.3
11. UK**	48.8	50.1	51.3	52.4	53.4	54.3
12. France	48.8	49.7	50.5	51.2	51.9	52.5
13. Philippines	42.3	48.0	53.7	59.1	64.5	69.3
14. Turkey	36.6	41.0	44.7	47.7	50.7	53.5
15. Vietnam	36.6	40.5	44.4	48.2	52.1	55.8
16. South Korea	40.1	40.4	40.6	40.7	40.9	41.0
17. Egypt	34.1	36.0	38.3	40.9	43.9	47.4
18. Italy	34.5	35.8	36.2	37.2	37.5	37.7
19. Spain	30.5	31.6	32.3	33.0	33.5	33.9
20. Canada	27.7	28.3	28.8	29.4	29.9	30.4
21. Argentina	25.0	27.1	29.0	29.8	30.5	31.1
22. Colombia	24.2	26.5	28.6	29.4	30.5	31.3
23. Thailand	22.7	24.3	26.0	27.6	29.1	30.6
24. Poland	22.6	22.9	23.3	23.7	24.0	24.3
25. South Africa	20.1	22.7	25.0	27.2	29.2	30.9
Worldwide* **	**2,692.9**	**2,892.7**	**3,072.6**	**3,246.3**	**3,419.9**	**3,600.2**

*Note: individuals of any age who use the internet from any location via any device at least once per month; *excludes Hong Kong; **forecast from Aug 2014; ***includes countries not listed*
Source: eMarketer, Nov 2014

181948 www.eMarketer.com

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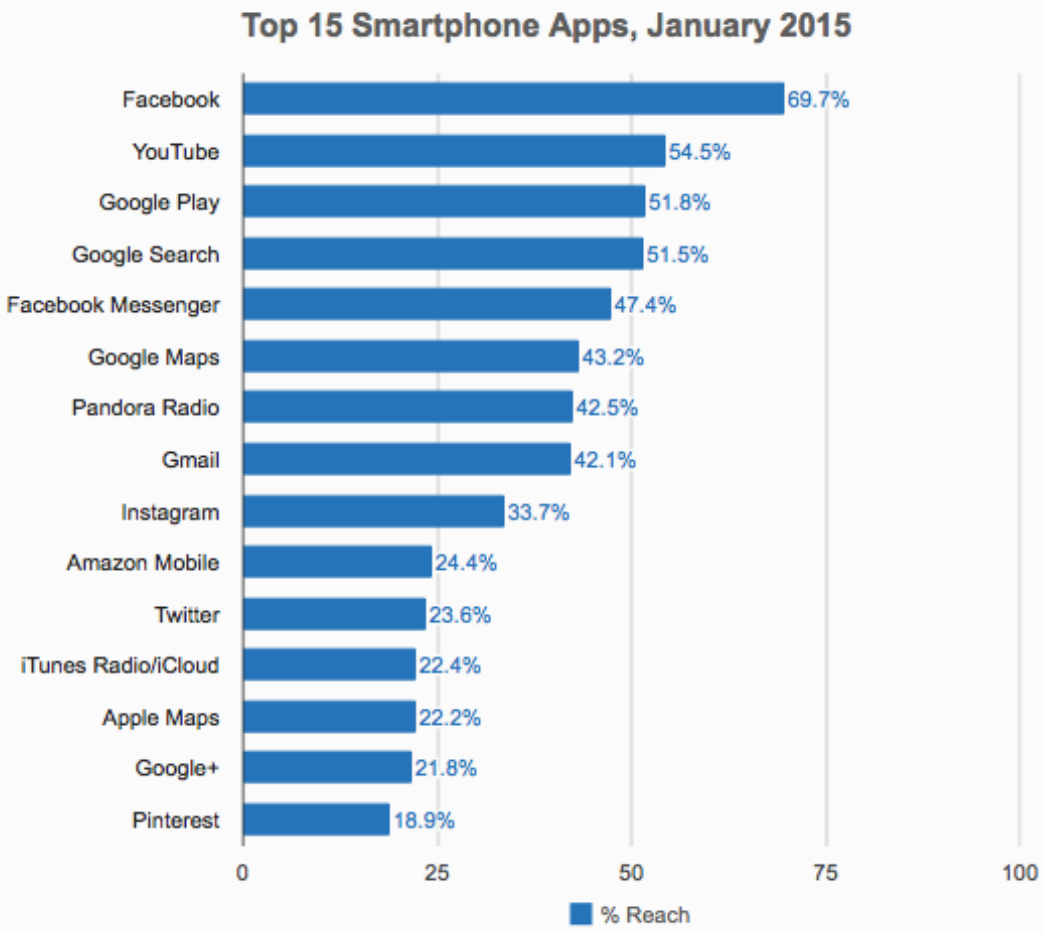
Demographic/Education/Economic Digital Divide

Country	Total %	Age			Education			Income		
		18-34 %	35+ %	Diff	Less %	More %	Diff	Lower %	Higher %	Diff
United States	**72**	92	65	+27	59	81	+22	64	84	+20
Canada	**67**	94	58	+36	58	73	+15	61	80	+19
France	**49**	85	35	+50	38	69	+31	37	59	+22
Germany	**60**	92	50	+42	48	68	+20	49	68	+19
Italy	**60**	88	52	+36	56	83	+27	46	74	+28
Poland	**41**	75	25	+50	12	47	+35	27	52	+25
Spain	**71**	91	64	+27	63	85	+22	63	81	+18
United Kingdom	**68**	91	60	+31	60	80	+20	59	84	+25
Russia	**45**	76	29	+47	**	**	**	25	53	+28
Ukraine	**27**	56	13	+43	6	28	+22	13	38	+25
Turkey	**59**	81	39	+42	34	86	+52	**	**	**
Jordan	**51**	60	41	+19	32	72	+40	34	64	+30
Lebanon	**52**	74	37	+37	17	79	+62	20	85	+65
Palestinian territories	**57**	73	39	+34	38	74	+36	47	66	+19
Israel	**74**	87	67	+20	68	80	+12	63	83	+20
Australia	**77**	95	70	+25	67	85	+18	62	88	+26
China	**58**	85	43	+42	40	86	+46	49	75	+26
India	**17**	27	9	+18	7	29	+22	7	22	+15

Source: PEW Research Centre, Spring 2015

Top Smartphone Apps

Top 15 Smartphone Apps
January 2015
Total U.S. Smartphone Mobile Media Users, Age 18+ (iOS and Android Platforms)
Source: comScore Mobile Metrix



Android

What are the options for mobile application development?

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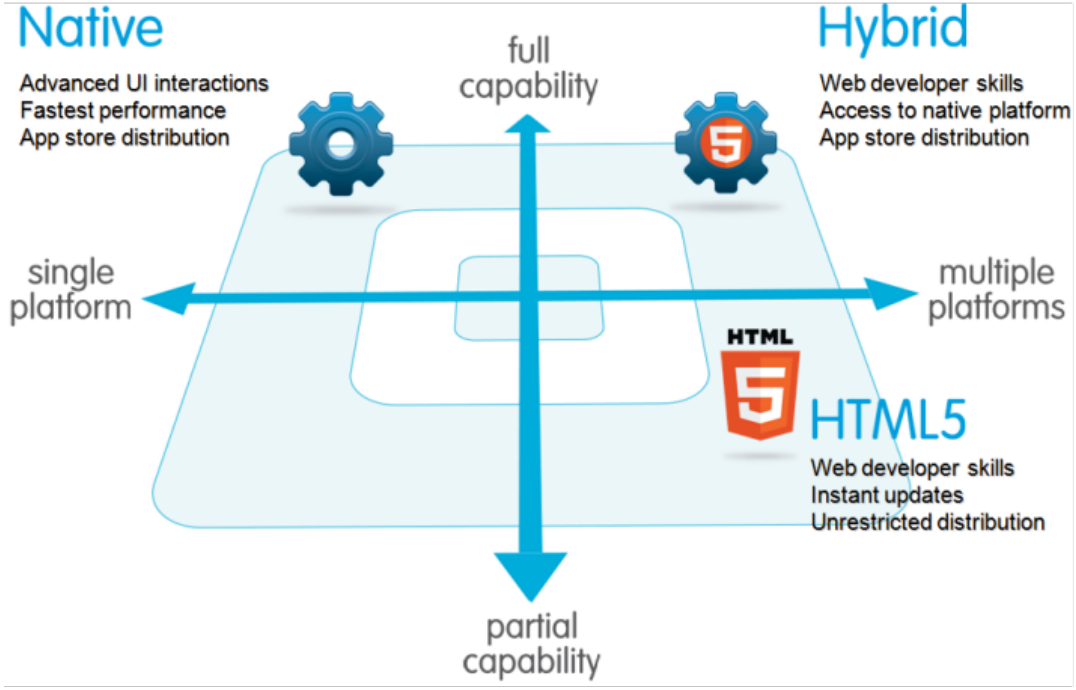
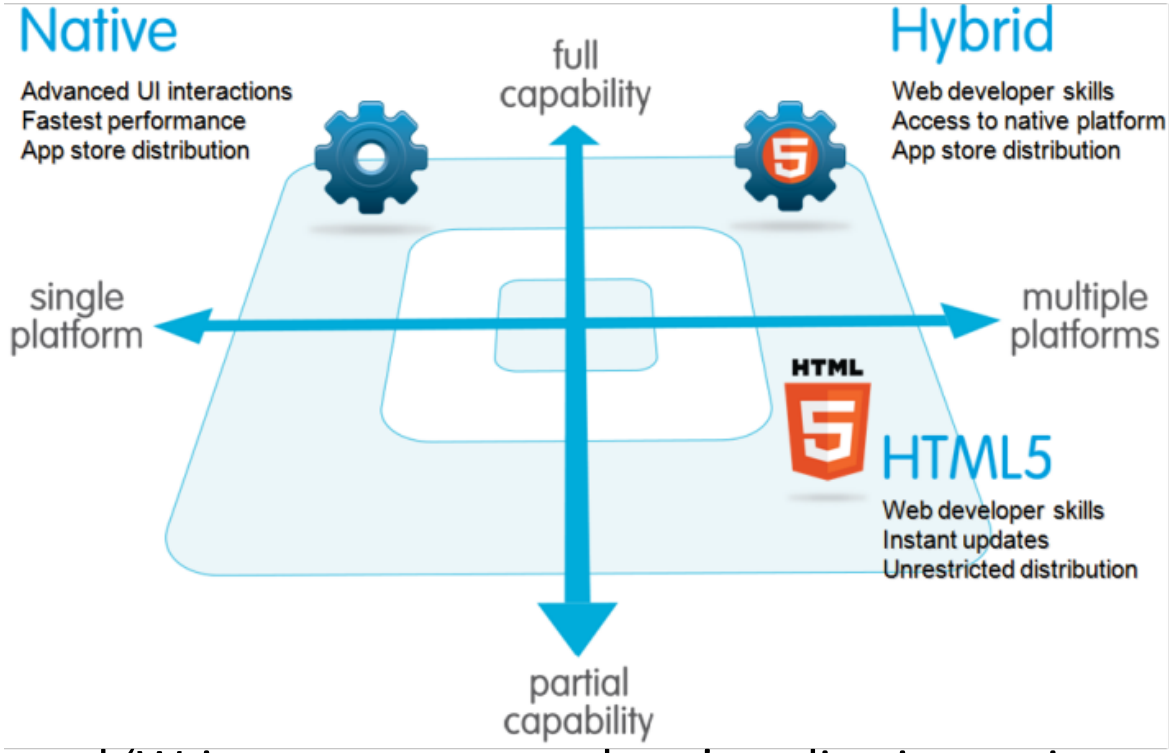
Mobile Ecosystem: Native, HTML5 or Hybrid?



Native:

- Platform specific (e.g. iOS, Android, Blackberry).
- Uses OS-supported language and development tools.
  - Xcode and Objective C with iOS
  - Eclipse or Android Studio and Java for Android

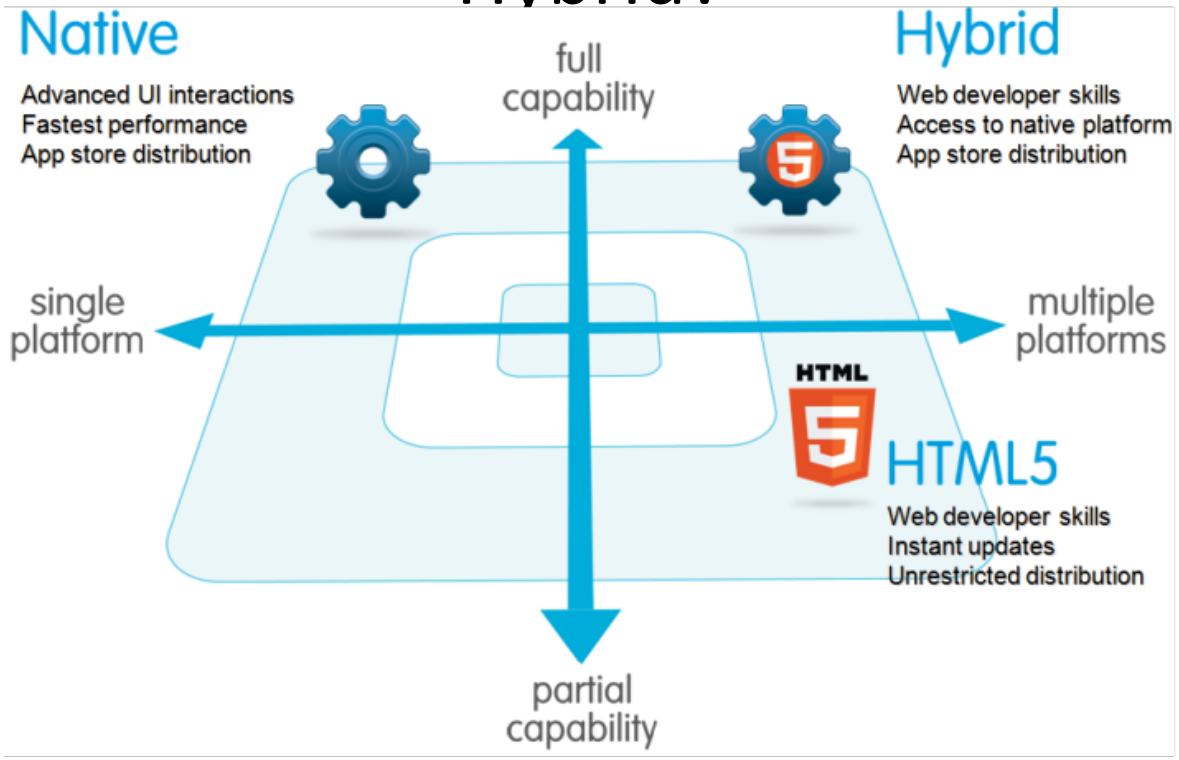
Mobile Ecosystem: Native, HTML5 or Hybrid?



HTML5:

- Sophisticated 'Write-once-run-anywhere' applications using standard web technologies, HTML5, CSS and JavaScript.
- Issues: session management, secure offline storage, access to hardware

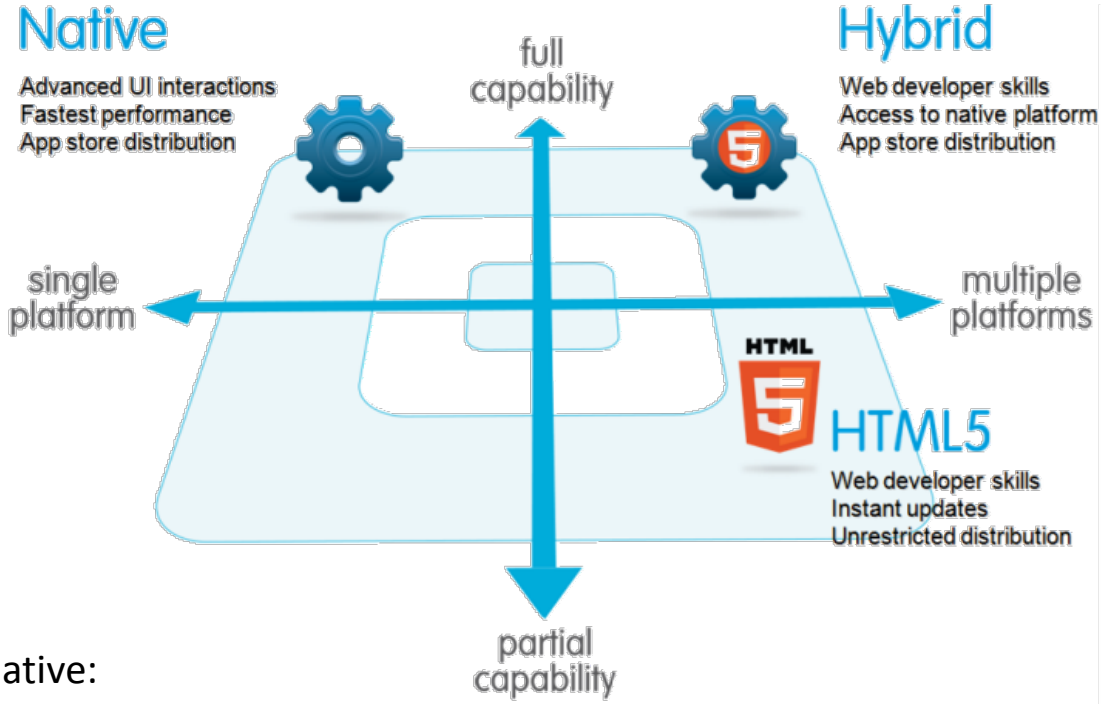
The Mobile Ecosystem: Native, HTML5 or Hybrid?



Hybrid:

- Primarily built using HTML and JavaScript then wrapped inside a thin native container.
- Thin native container provides access to platform features.
- Combine the best and worst elements of native and HTML5
- IONIC, Mobile Angular UI, Accelerator Titanium, Kendo UI

Mobile Ecosystem: Native, HTML5 or Hybrid?



Hybrid Versus Native:

- Hybrid Easier to develop. Code base is reusable between mobile platforms.
- Lower cost? Faster to market.
- Do not offer the same control over UI (especially advanced features) as native versions, and can appear less smooth / natural.
- Requires distinct web view implementations per platform
- Slow compared to native apps

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Ecosystem Summary

App Features	Native	HTML	Hybrid
Graphics	Native APIs	HTML, Canvas, SVG	HTML, Canvas, SVG
Performance	**Fast**	**Slow**	**Slow**
Native look and feel	Native	Emulated	Emulated
Distribution	AppStore	Web	AppStore
Device Access			
Camera	**Yes**	No	Yes
Notifications	**Yes**	No	Yes
Contacts, calendar	**Yes**	No	Yes
Offline storage	Secure file storage, SQL	Shared SQL	Secure file system, shared SQL
Geolocation	Yes	Yes	Yes
Gestures			
• Swipe	Yes	Yes	Yes
• Pinch, spread	Yes	No	Yes
Connectivity	Online and offline	Mostly online	Online and offline
Development skills	**Objective C, Java**	HTML5, CSS, Javascript	HTML5, CSS, JavaScript

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Why native development?

- Usability, Features, Experience.

- Multi touch – double tap, pinch spread, etc.
- Fast graphics API – native will always be faster. Important if your applications are graphic intensive.
- Fluid animation – esp. important in gaming.
- Built-in components – camera, address book, geolocation. Integration is more seamless with native.
- Ease of use and access through mobile store
- Good online resources & documentation

Mobile OS

- What is a mobile operating system?
- What mobile operating systems do you know of?

Mobile OS

- Mobile OS:
  - A software platform that allows applications to be ran over it.

symbian OS

Worldwide Smartphone OS Market Share

Period	Android	iOS	Windows Phone	Others
2015Q3	84.3%	13.4%	1.8%	0.5%
2015Q4	79.6%	18.6%	1.2%	0.5%
2016Q1	83.4%	15.4%	0.8%	0.4%
2016Q2	87.6%	11.7%	0.4%	0.3%

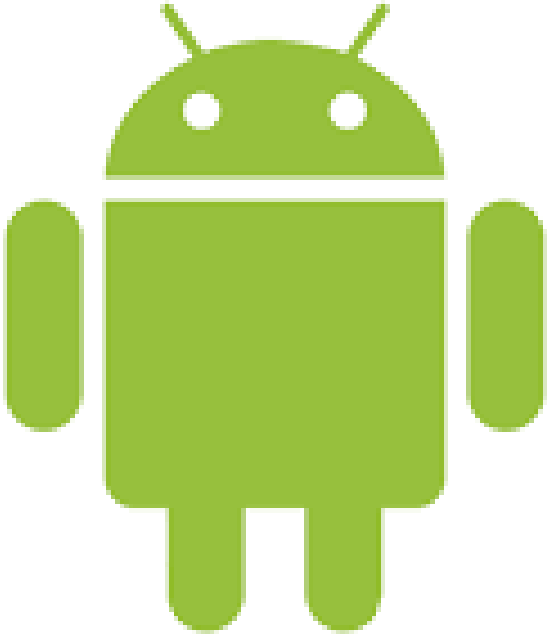
Source: IDC, Aug 2016

https://www.idc.com/prodserv/smartphone-os-market-share.jsp

Comparison of Mobile OS

OS	Company	Development Environment	License	OS Family	Programming Language
iOS	Apple Inc	Xcode	Partially proprietary, partially open source.	Darwin (Unix/BSD)	C, C++, Objective-C, Swift
Android	Open Handset Alliance / Google	Android Studio	Open Source	Linux	C, C++, Java
Blackberry	Blackberry Ltd	Momentics IDE	Proprietary	QNX (Unix-like)	C/ C++: Native SDK; Java
Windows	Microsoft	Visual Studio. Net	Proprietary	Windows NT	C, C++, C#, Visual Basic

CET325 FOCUS
- Can you tell me anything about Android?



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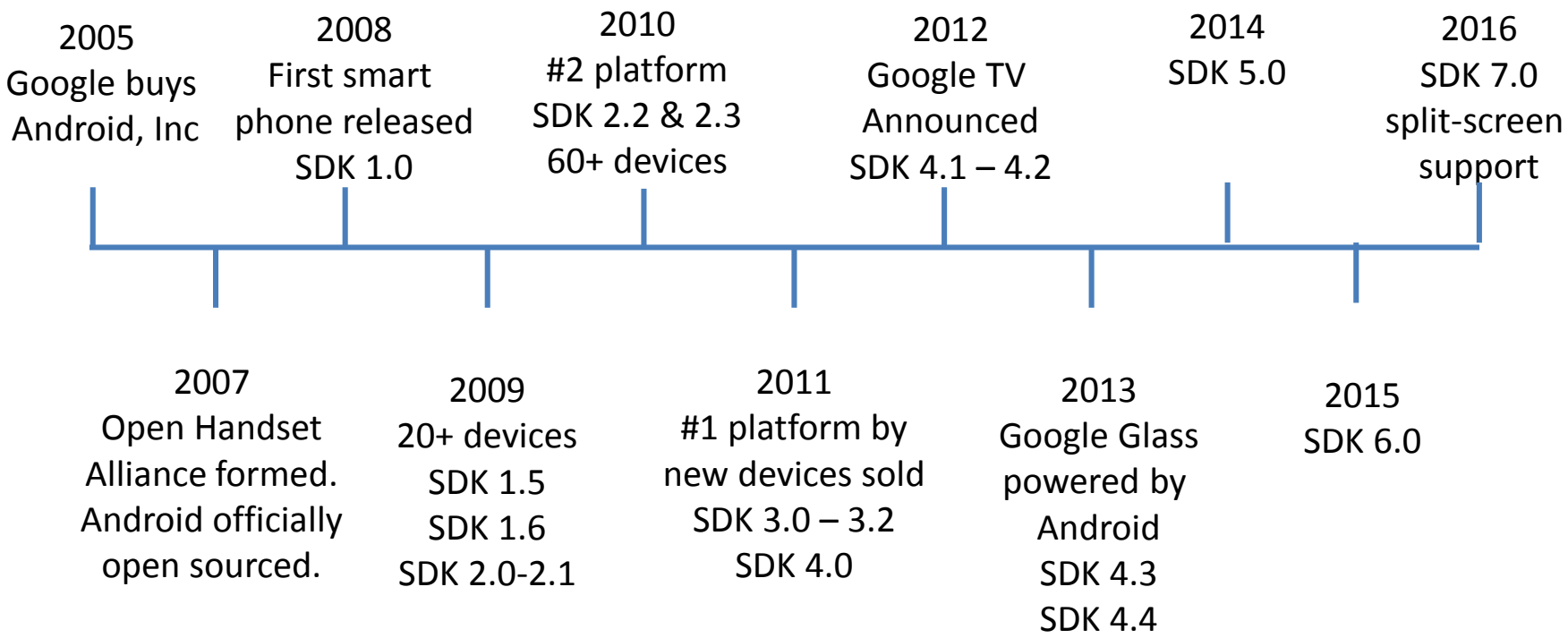
History of Android



2005

- Google acquires Android, Inc
  - 22 month old startup

- Based on Linux technology (open source)
  - Linux core controls the mobile device's memory, internal devices and processes.
  - The Android libraries control telephony, video, graphics, and the user interface.

2007 – Open Handset Alliance

- Non-profit organisation
- Google, Motorola, Toshiba, Texas Instruments, T-Mobile (to name a few)
- A significant amount of IP released into open source (the Android platform)

Open Handset Alliance

Android Versions

- Incremental releases over time.
- Can be referenced by both version number and API level.

Android Versions

- Which are real??

Cupcake	Crunchie	Cookie	Caramel	Caramac
KitKat	Bassets	Honeycomb	Dairy Milk	Mint Tea
Bounty	Gingerbread	Ice Cream Sandwich	Iced Tea	Marshmallow
Froyo	Jango	Donut	Diam Bar	Lollipop
Éclair	Jelly Bean	Jelly Baby	Vodka Jelly	Marmalade
M&Ms	Snickers	Mars Bar	Marathon	Peppermint Cream

Android Versions

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Cupcake	Crunchie	Cookie	Caramel	Caramac
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Bounty	**Gingerbread**	**Ice Cream Sandwich**	Iced Tea	**Marshmallow**
Froyo	Jango	**Donut**	Diam Bar	**Lollipop**
Éclair	**Jelly Bean**	Jelly Baby	Vodka Jelly	Marmalade
M&Ms	Snickers	Mars Bar	Marathon	Peppermint Cream

Summary of versions and API level

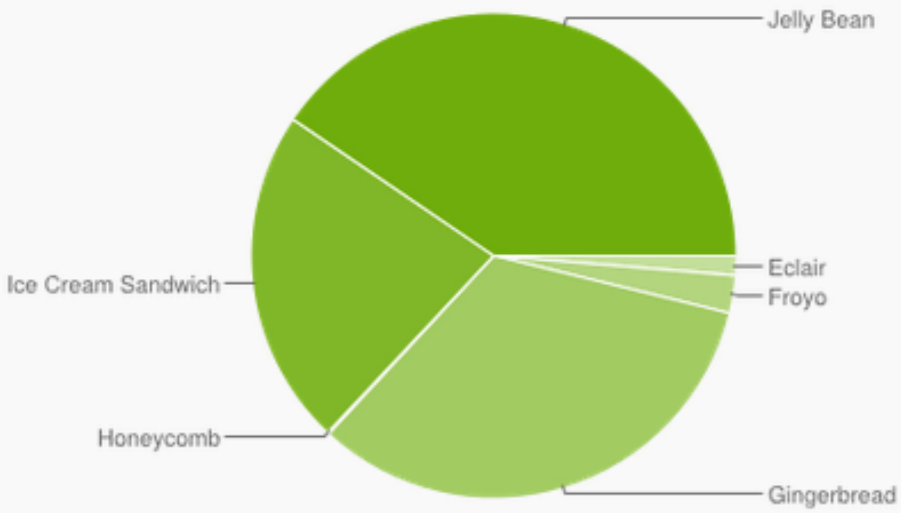
Code name	Version number	Initial release date	API level
N/A	1.0	23 September 2008	1
N/A	1.1	9 February 2009	2
Cupcake	1.5	27 April 2009	3
Donut	1.6	15 September 2009	4
Eclair	2.0 – 2.1	26 October 2009	5–7
Froyo	2.2 – 2.2.3	20 May 2010	8
Gingerbread	2.3 – 2.3.7	6 December 2010	9–10
Honeycomb	3.0 – 3.2.6	22 February 2011	11–13
Ice Cream Sandwich	4.0 – 4.0.4	18 October 2011	14–15
Jelly Bean	4.1 – 4.3.1	9 July 2012	16–18
KitKat	4.4 – 4.4.4	31 October 2013	19–20
Lollipop	5.0 – 5.1.1	12 November 2014	21–22
Marshmallow	6.0 – 6.0.1	5 October 2015	23
Nougat	7.0	22 August 2016	24

Notable updates

- **Donut** (1.6/4) – addition of **google maps**
- **Froyo** (2.2/8) – the first version to allow **external memory storage**. It also introduced the Android cloud to device messaging service. This allowed app developers to send data from their servers to applications installed on devices. It's now been replaced by Google cloud messaging
- **Gingerbread** (2.3/9) – improved **navigation** and increased **power efficiency**. Added developer features for communications, multimedia and gaming. Also support for NFC
- **Honeycomb** (3.0/11) – Improvements in **user interface**, specifically for large screen devices. Fragments, persistent action bar, large screen layouts
- **Ice Cream Sandwich** (4.0/14) – face detection, virtual **camera** operator.
- **Jelly Bean** (4.1/16) – improved **security**, **performance** improvements, new **tracking** and **debugging** features
- **KitKat** (4.4/19) – more **performance**, **security** and **accessibility** enhancements, improved graphics/multimedia capabilities
- **Lollipop** (5.0/19) – Android RunTime replaces Dalvik VM. One of the biggest redesigns with respect to look and feel. New card style **user interface**.
- **Marshmallow** (6.0/23) – **permissions, appearance, mobile payments.**
- **Nougat** (7.0/24) – split-screen display mode, OpenJDK

Historical Android version distribution, 2013

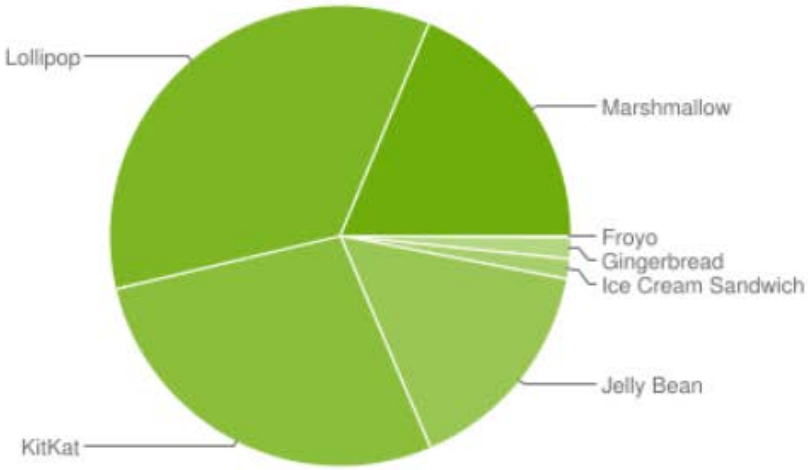
Version	Codename	API	Distribution
1.6	Donut	4	0.1%
2.1	Eclair	7	1.2%
2.2	Froyo	8	2.5%
2.3 - 2.3.2	Gingerbread	9	0.1%
2.3.3 - 2.3.7		10	33.0%
3.2	Honeycomb	13	0.1%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	22.5%
4.1.x	Jelly Bean	16	34.0%
4.2.x		17	6.5%



Data collected during a 14-day period ending on August 1, 2013.
Any versions with less than 0.1% distribution are not shown.

Historical Android version distribution, 2016

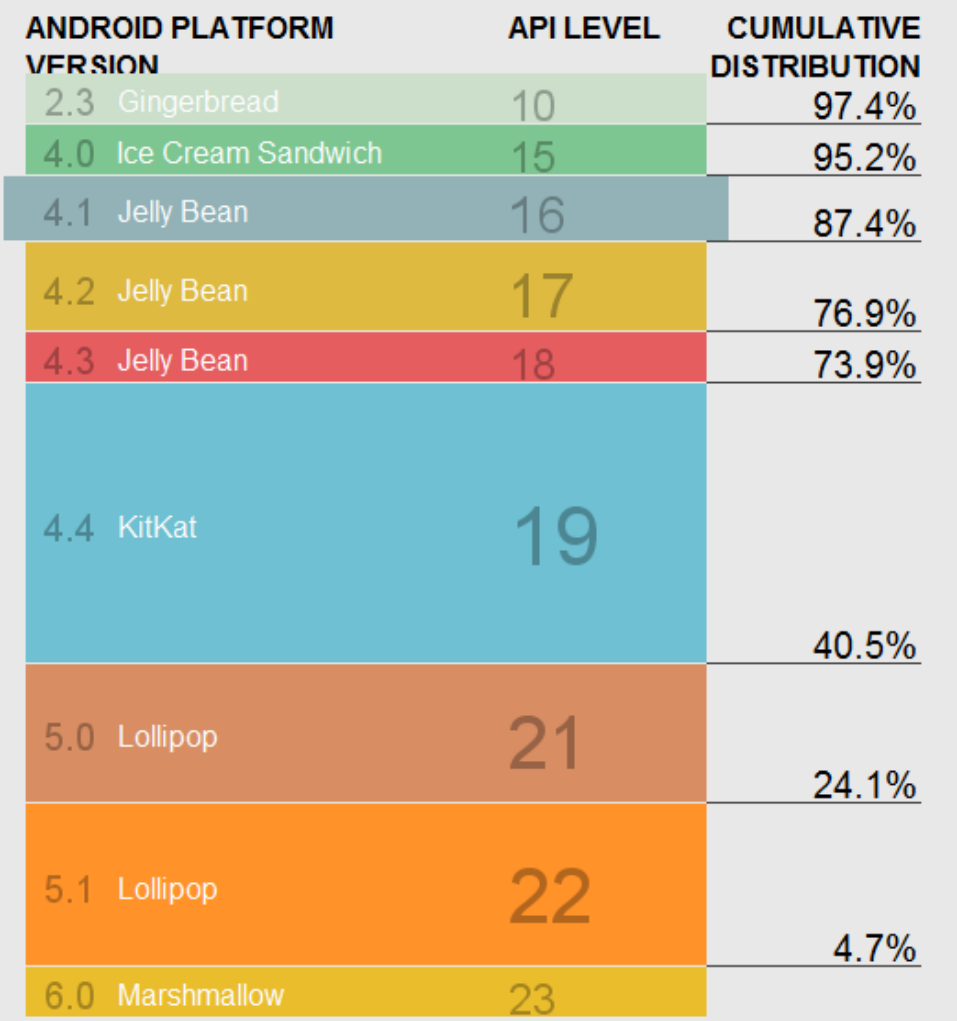
Version	Codename	API	Distribution
2.2	Froyo	8	0.1%
2.3.3 - 2.3.7	Gingerbread	10	1.5%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	1.4%
4.1.x	Jelly Bean	16	5.6%
4.2.x		17	7.7%
4.3		18	2.3%
4.4	KitKat	19	27.7%
5.0	Lollipop	21	13.1%
5.1		22	21.9%
6.0	Marshmallow	23	18.7%



Data collected during a 7-day period ending on September 5, 2016.

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

Historical Android version distribution, 2016



ANDROID PLATFORM VERSION	API LEVEL	CUMULATIVE DISTRIBUTION
2.3 Gingerbread	10	97.4%
4.0 Ice Cream Sandwich	15	95.2%
4.1 Jelly Bean	16	87.4%
4.2 Jelly Bean	17	76.9%
4.3 Jelly Bean	18	73.9%
4.4 KitKat	19	40.5%
5.0 Lollipop	21	24.1%
5.1 Lollipop	22	4.7%
6.0 Marshmallow	23	

Android 6.0 (M)

- Successor to Lollipop (5.0)
- Released 3Q 2015
- Features
  - Android Pay
  - Android standardized fingerprint support
  - Improved voice interaction API

Task

- A software development company is willing to enter the mobile development market. The company is seeking your independent advice on this matter. You should submit a short report, covering the currently available Mobile Operating systems and compare them considering:

  a. market share
  b. availability in 2-3 years
  c. features
  d. computational and energy efficiency
  e. mono vs multivendor hardware availability
  f. restrictions in term of copyright, patents, availability of source code
  g. security
  h. development tool support
  i. learning curve for developers
  j. availability of updates on older devices, (in particular security updates)

- Conclude your report with a “Recommendations” sections (10 lines) stating which mobile OS you recommend and why.