Lecture

Internet Trends and Web Basics

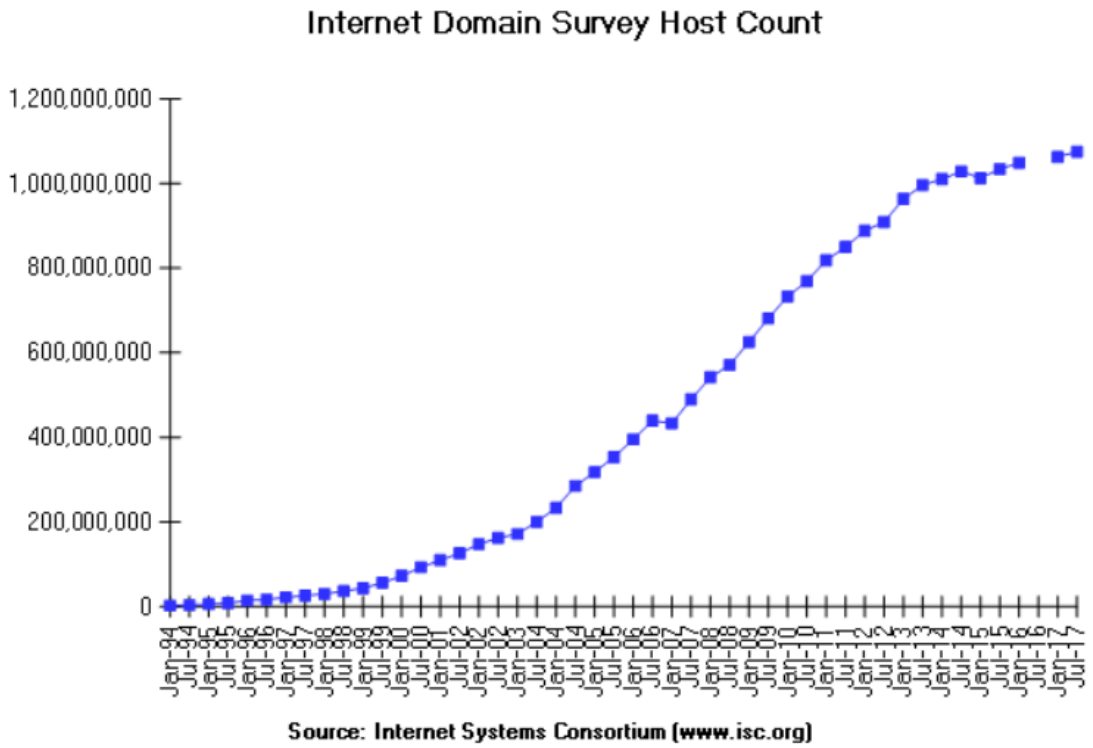
The Internet and the WWW are Different

- The *Internet* is a global digital infrastructure that connects hundreds of millions of computers and people
- The *World Wide Web* is a mechanism that unifies the retrieval and display of a subset of data on the Internet
- An *intranet* is a local/global information structure that connects an organization internally. Intranets today often make use of Web technologies
- An *extranet* is a private network that uses the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses.

Recent Trends in Internet Development

- Growth in number of users connected
- Growth in Smartphone use, particularly iOS and Android
- Growth in digital data, especially photos and video
- Growth in Social Media
- Growth in Internet use from Mobile over desktop/laptop
- Growth in tablet usage over desktops/laptops
- Decreased dominance of Microsoft Windows
- Growth in use of the cloud

How Big is the Internet - https://www.isc.org/network/survey



Date	HostCount
Jul 17	1,074,971,748
Jan 17	1,062,660,523
Jan 16	1,048,766,623
Jul 15	1,033,836,245
Jan 15	1,012,706,608
Jul 14	1,028,544,414
Jan 14	1,010,251,829
Jul 13	996,230,757
Jan 13	963,518,598
Jul 12	908,585,739
Jan 12	888,239,420
Jul 11	849,869,781
Jan 11	818,374,269
Jul 10	768,913,036
Jan 10	732,740,444
Jul 09	681,064,561
Jan 09	625,226,456
Jul 08	570,937,778
Jan 08	541,677,360
Jul 07	489,774,269
Jan 07	433,193,199
Jul 06	439,286,364
Jan 06	394,991,609
Jul 05	353,284,187
Jan 05	317,646,084
Jul 04	285,139,107
Jan 04	233,101,481
Jan 03	171,638,297
Jul 02	162,128,493
Jan 02	147,344,723
Jul 01	125,888,197
Jan 01	109,574,429
Jul 00	93,047,785
Jan 00	72,398,092
Jul 99	56,218,000
Jan 99	43,230,000
Jul 98	36,739,000
Jan 98	29,670,000
Jul 97	19,540,000
Jan 97	16,146,000
Jul 96	12,881,000
Jan 96	9,472,000
Jul 95	6,642,000
Jan 95	4,852,000
Jul 94	3,212,000
Jan 94	2,217,000
Jul 93	1,776,000
Jan 93	1,313,000

hosts were doubling every 18 months, but growth has slowed
See the survey background at: http:///www.isc.org/network/survey

It counts the number of IP addresses that have been assigned a name. The survey queries the domain name system for the name assigned to every possible IP address. But rather than sending a query to every one of the 4.3 billion possible IP addresses, the survey starts with a list of all network numbers that have been delegated within the IN-ADDR.ARPA domain.

As of 2014 there are 2.8 billion Internet users, with yearly growth at 8%; China and the USA have the largest number of Internet users and the penetration of the population in China remains small

Countries with Internet Penetration >45%, 2014

Rank	Country	2014 Internet Users (MM)	2014 Internet User Growth	2013 Internet User Growth	Population Penetration	Total Population (MM)	Per Capita GDP ($000)
1	China	632	7%	10%	47%	1,356	$13
2	United States	269	2	2	84	319	$55
3	Japan	110	0	9	86	127	$37
4	Brazil	105	4	12	52	203	$16
5	Russia	87	15	9	61	142	$25
6	Germany	68	0	1	84	81	$46
7	United Kingdom	57	4	1	90	64	$40
8	France	54	-1	5	82	66	$40
9	Iran (I.R.)	49	8	16	60	81	$17
10	Egypt	43	15	13	50	87	$11
11	Korea (Rep.)	42	1	1	85	49	$35
12	Turkey	38	4	6	46	82	$20
13	Italy	36	1	2	58	62	$35
14	Spain	34	0	7	72	48	$34
15	Canada	30	0	5	86	35	$45
	Top 15	1,653	5%	7%	59%	2,800	
	World	2,793	8%	10%	39%	7,176	

@KPCB Source: United Nations / International Telecommunications Union, US Census Bureau. Internet user data is as of mid-year. Internet user data for: China from CNNIC, India from IAMAI, Iran from Islamic Republic News Agency, citing data released by the National Internet Development Center, Indonesia from APJII / eMarketer. 193

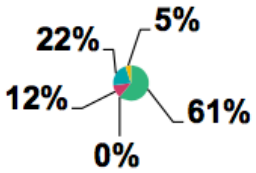
The following slides are based upon a presentation by Mary Meeker of Kleiner Perkins Caufield and Byers, see http://www.kpcb.com/insights/2014-internet-trends and http://www.kpcb.com/insights/2015-internet-trends, http://www.kpcb.com/internet-trends

Internet Users – 1995 → 2014...
<1% to 39% Population Penetration

1995

35MM+ Internet Users

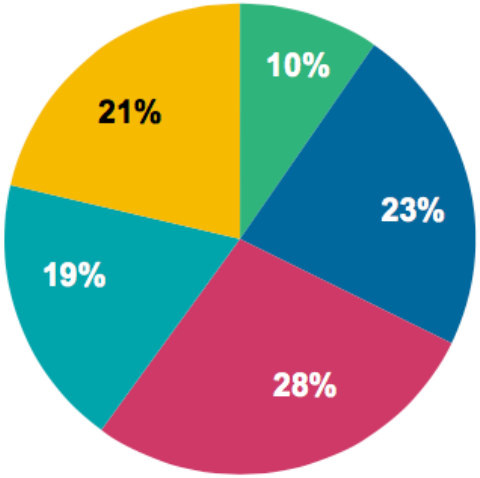
0.6% Population Penetration



2014

2.8B Internet Users

39% Population Penetration

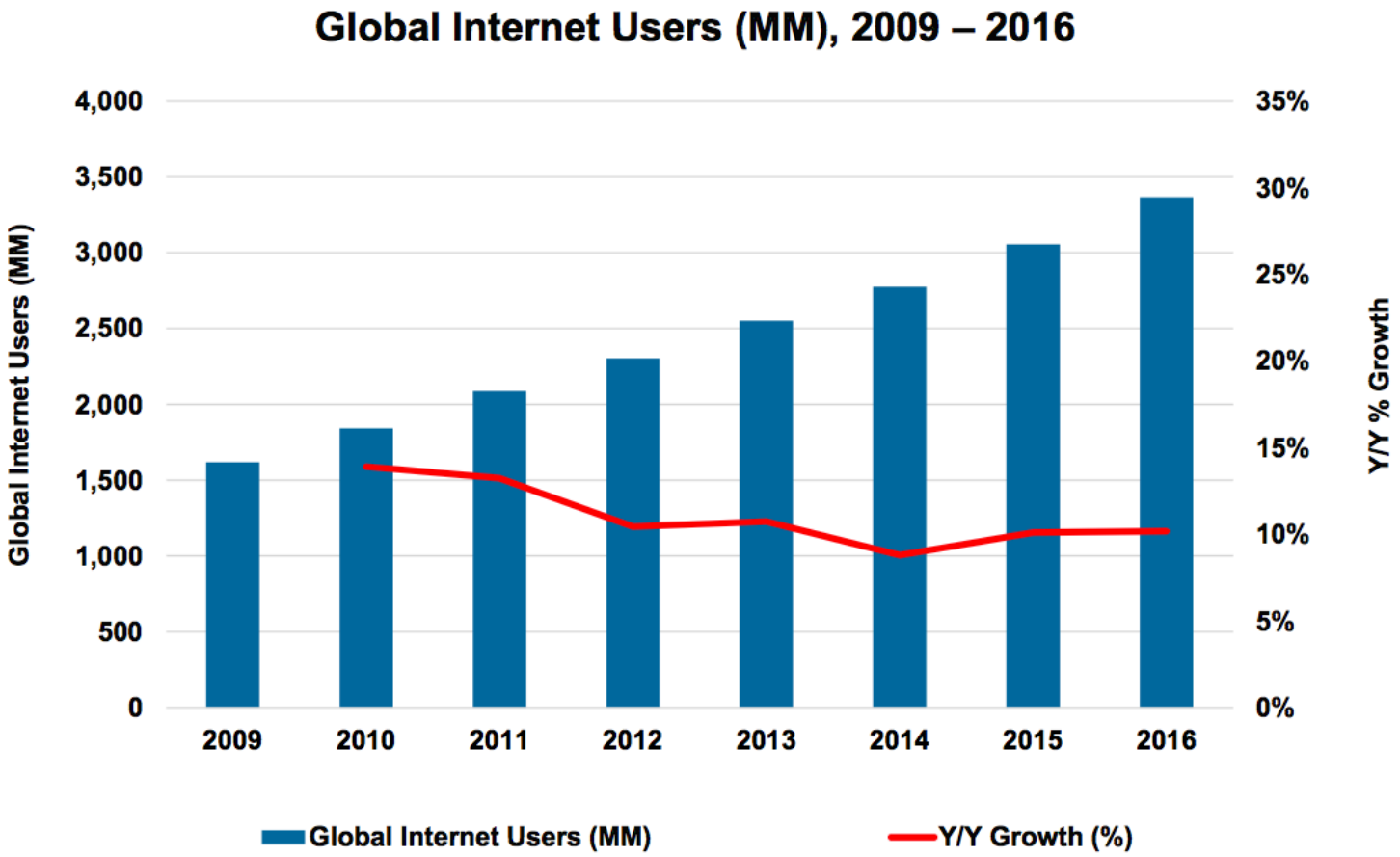


USA China Asia (ex. China) Europe Rest of World

@KPCB Source: Euromonitor, ITU, US Census.

4

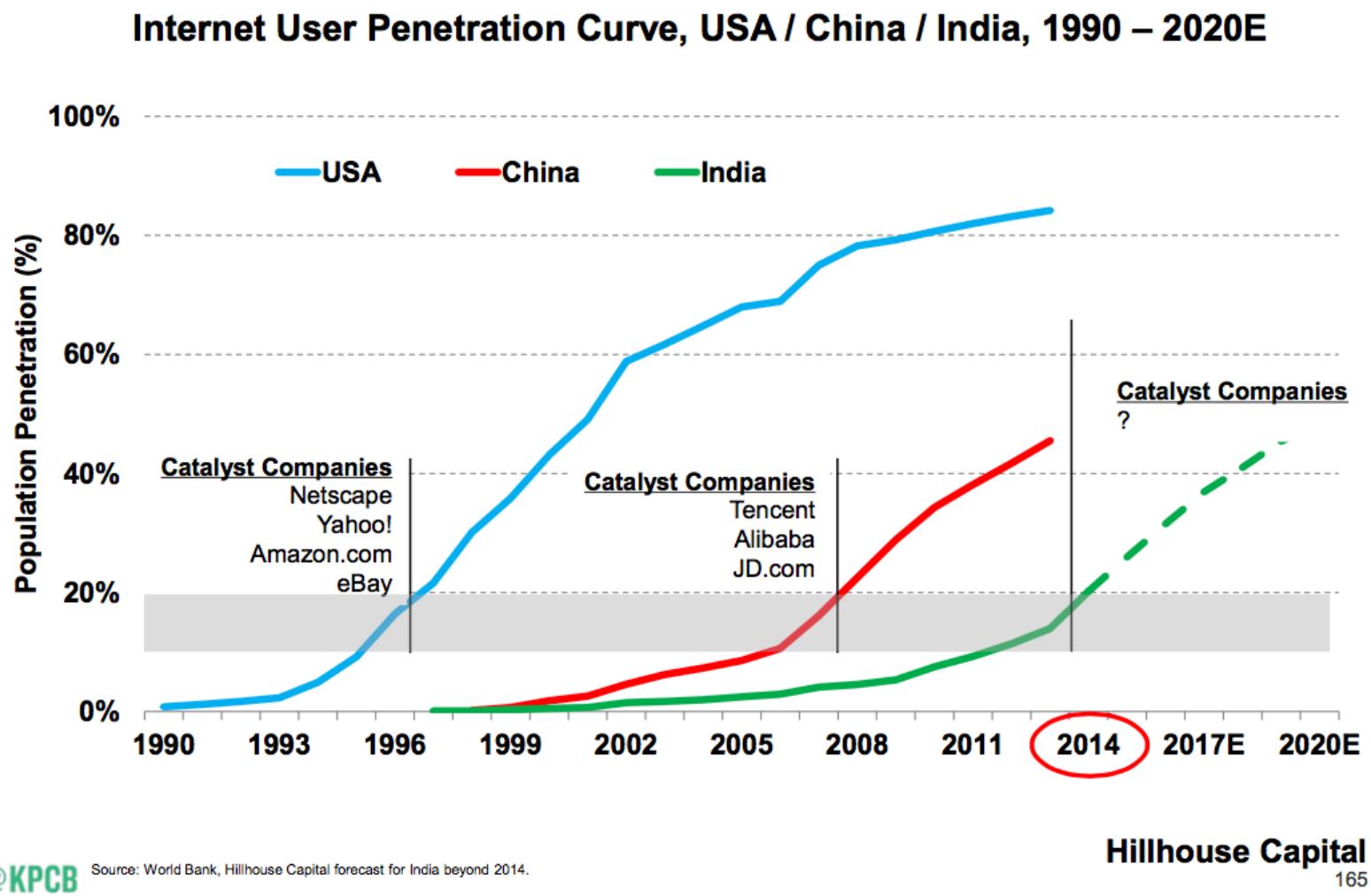
Global Internet Users = 3.4B @ 46% Penetration... +10% Y/Y vs. +10%...+8% Y/Y vs. +8% (Ex-India)



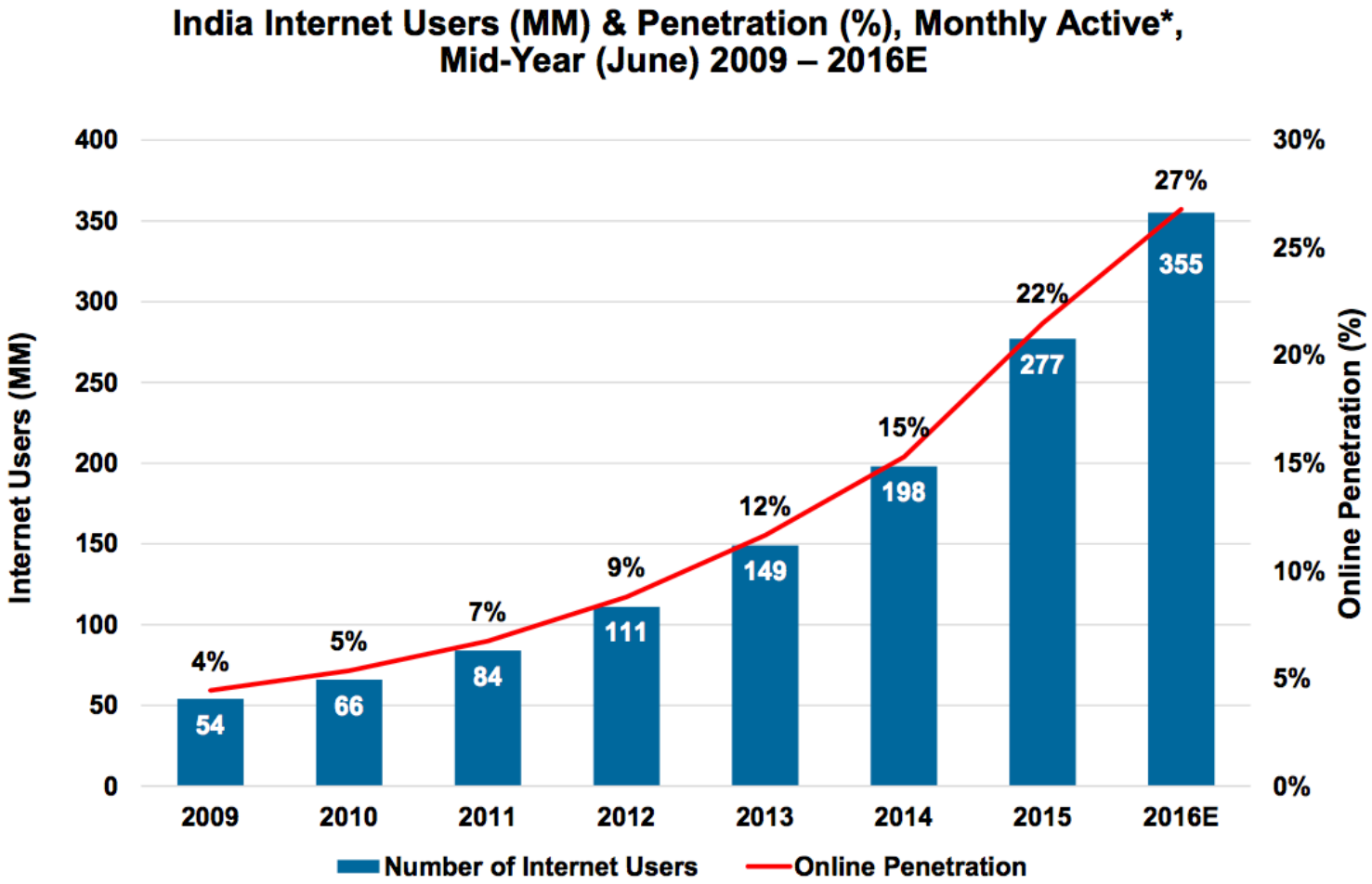
KLEINER PERKINS

Source: United Nations / International Telecommunications Union, US Census Bureau. Internet user data is as of mid-year. Internet user data for: USA from Pew Research, China from CNNIC, Iran from Islamic Republic News Agency / InternetWorldStats / KPCB estimates, India from KPCB estimates based on IAMAI data, Indonesia from APJII.

India = Appears to Be @ Internet Penetration Growth Inflection



India Internet Users = +28% (2016-June) vs. 40% Y/Y Growth @ 27% Penetration 355MM Users #2 Behind China



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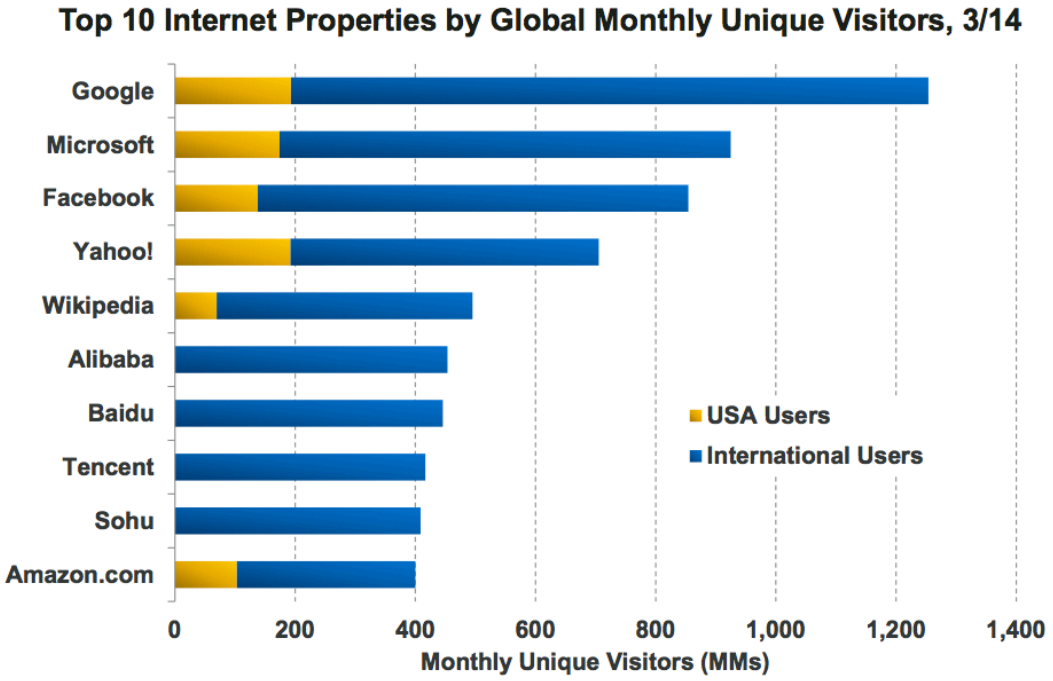
Source: IAMAI. UN Population Division, Worldometer, KPCB estimates based on IAMAI data. Uses mid-year figures.
*Note that "Monthly Active Users" are distinct from "Ever" users, which IAMAI defines as anyone who has ever accessed the internet. Owing to increasing activity levels, the number of "Monthly Active Users" may grow faster than "Ever" users.

The US leads in the development of highly popular Internet websites;

Baidu is a Chinese search engine

Tencent is a Chinese holding company of Internet properties, among the most popular being, QQ, for chatting;
***Sohu**.com Inc. is a Chinese online media, search, gaming, community and mobile service group.*

3/14 – 6 of Top 10 Global Internet Properties 'Made in USA'... >86% of Their Users Outside America...China Rising Fast

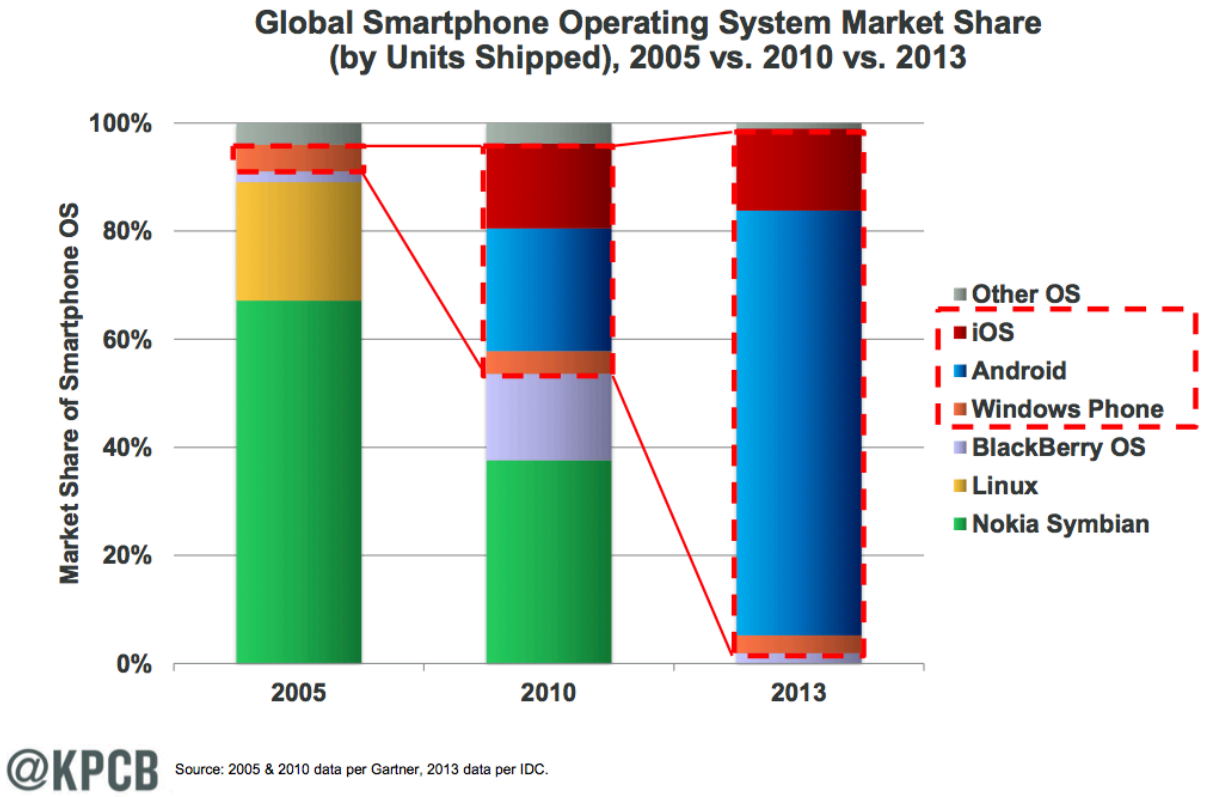


@KPCB Source: comScore, 3/14.

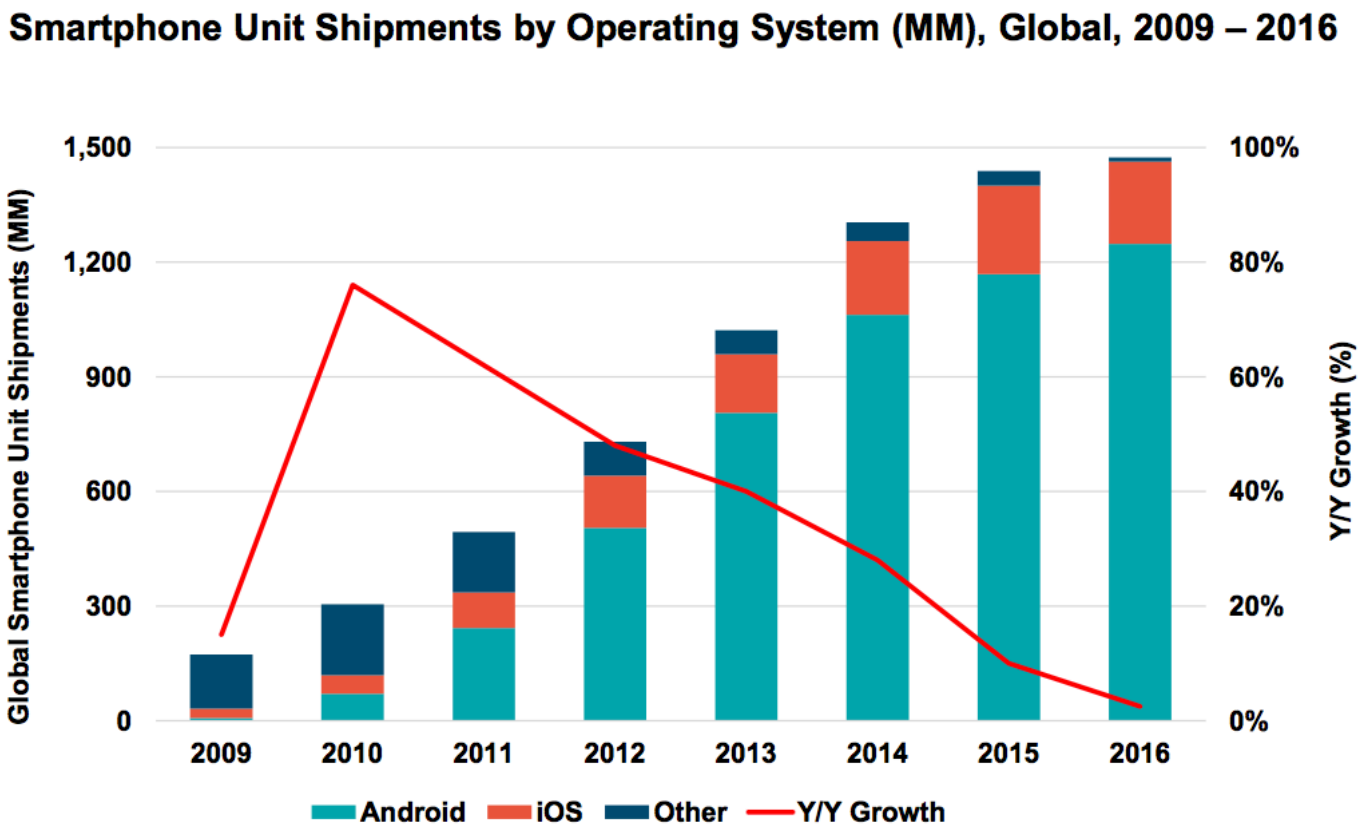
131

Global Smartphone Operating Systems 'Made in USA'... 97% Share from 5% Eight Years Ago

Examining smartphone operating systems, over the past seven years, iOS and Android have made major gains with Nokia slipping greatly and Linux a very small piece of the pie



Global Smartphone Unit Shipments = Continue to Slow... @ +3% Y/Y vs. +10% (2015) / +28% (2014)



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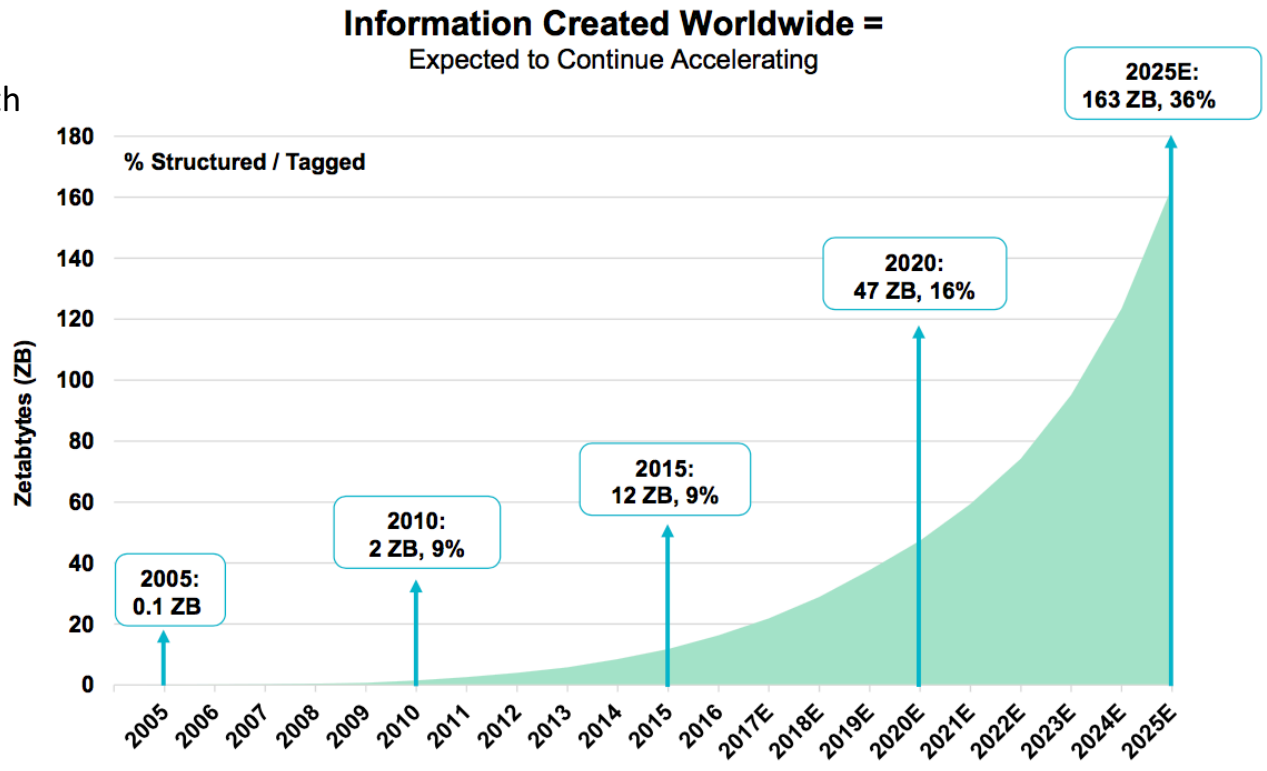
Source: Morgan Stanley Research (5/17)

Data Volume Growth Continues @ Rapid Clip
% Structured / Tagged (~10%) Rising Fast

There has been exponential growth in online information;
1 Zettabyte = 1,024 Exabytes
1 Exabyte = 1,024 Petabytes
1 Petabyte = 1,024 Terabytes
1 Terabyte = 1,024 Gigabytes
or
1 Zettabyte = 1,000,000,000,000 gigabytes



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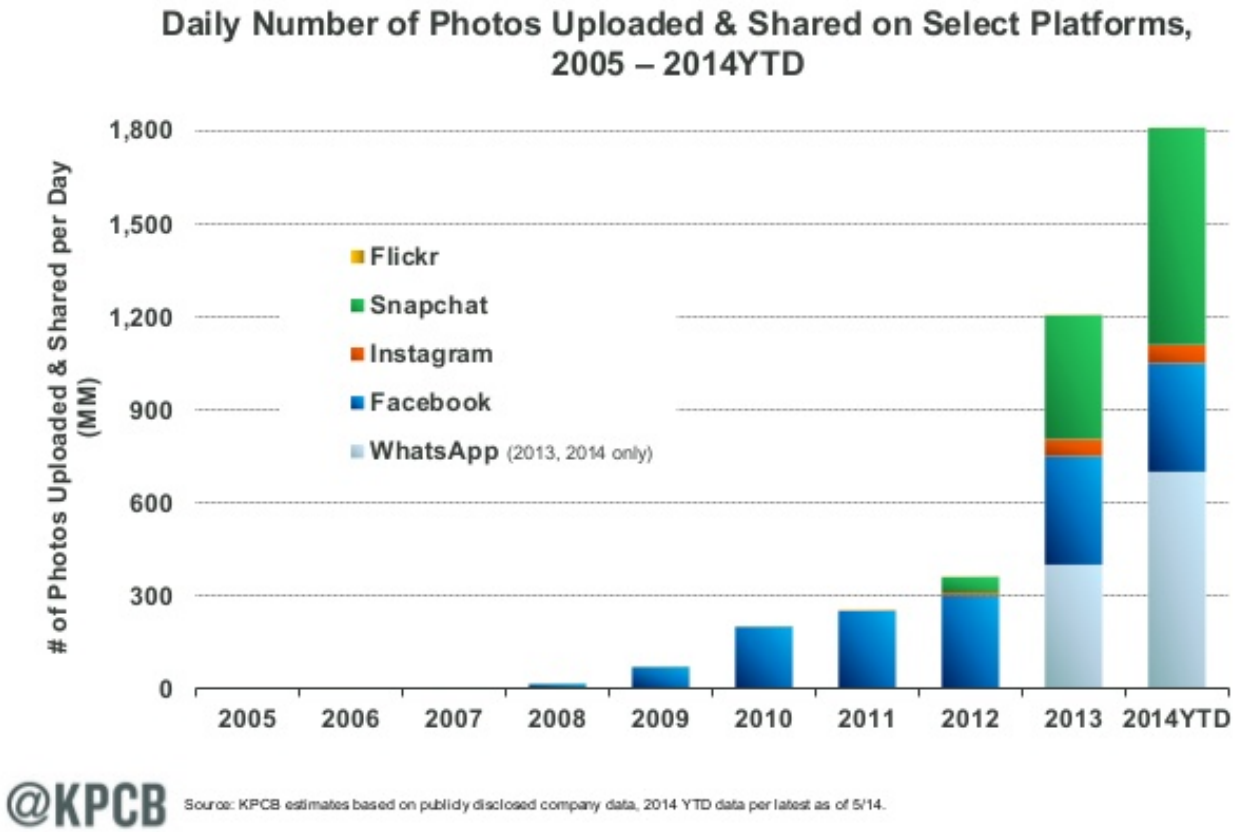
Source: IDC DataAge 2025 Study, sponsored by Seagate (3/17)
Note: 1 petabyte = 1MM gigabytes, 1 zeta byte = 1MM petabytes

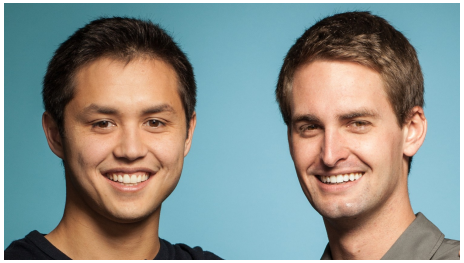
Photos Alone = 1.8B+ Uploaded & Shared Per Day...
Growth Remains Robust as New Real-Time Platforms Emerge



500 million photos are uploaded every day and that number is doubling every year

Instagram was recently (2010) purchased by Facebook for $1 billion

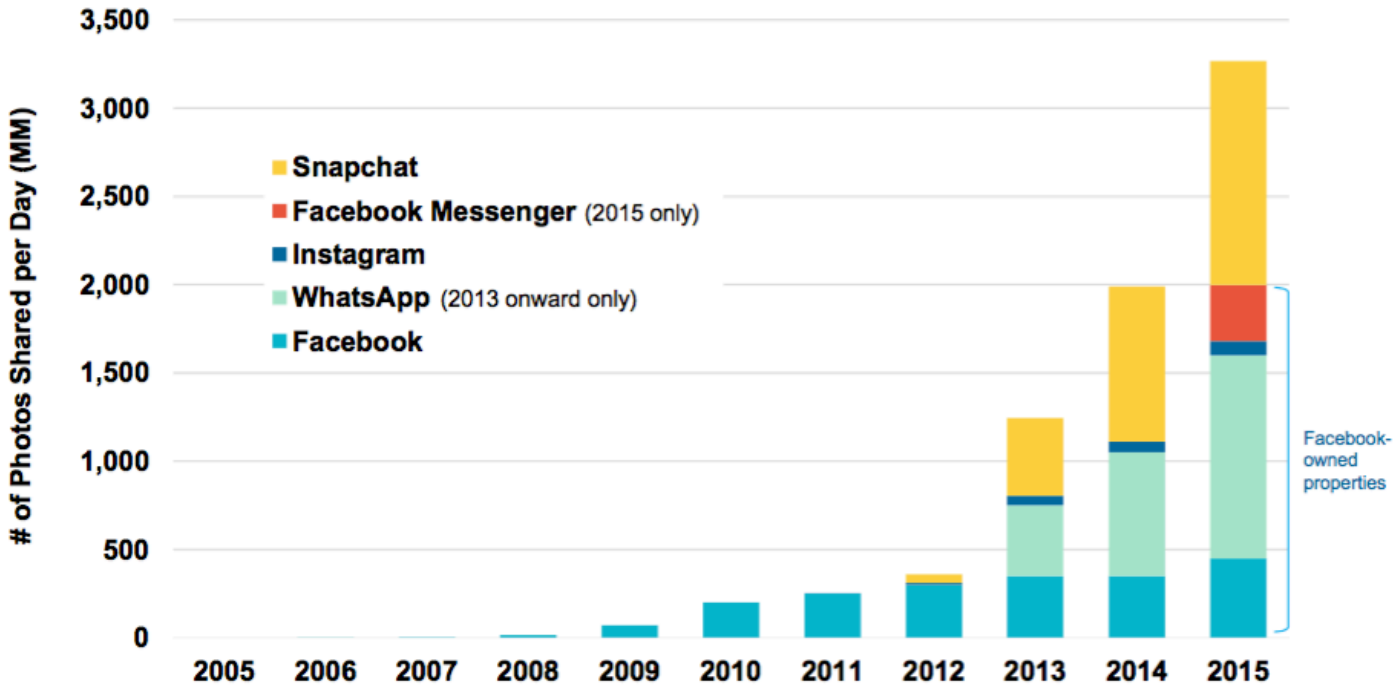
Snapchat is a photo messaging application developed by two Stanford students (IPO March 2017, $17B valuation);



bobby Murphy - Evan Spiegel

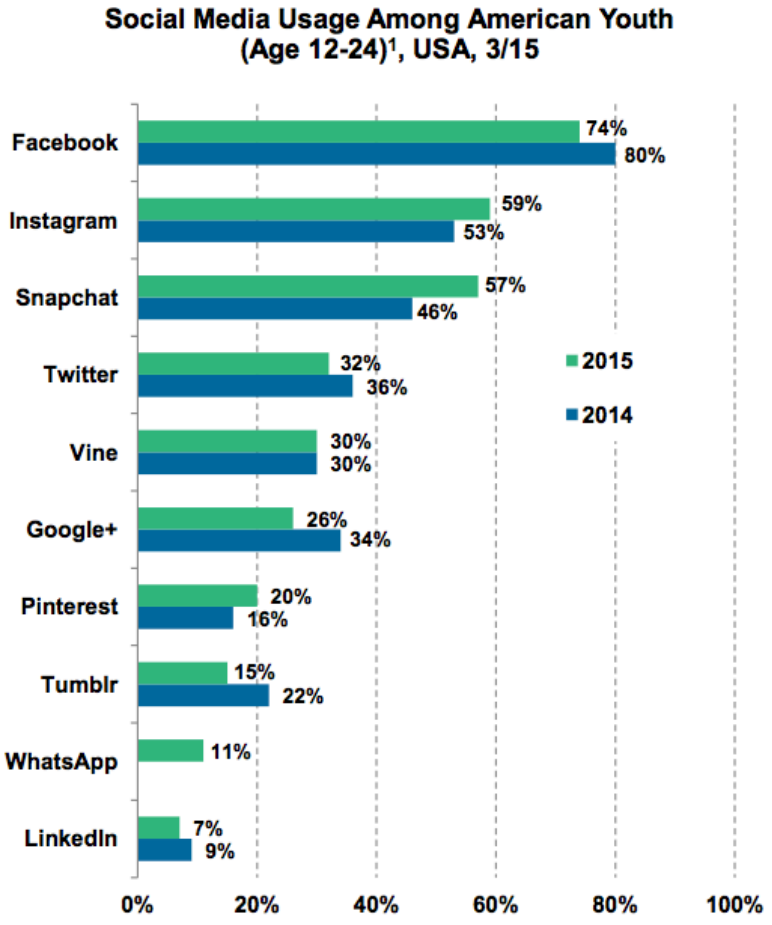
Image Growth Remains Strong

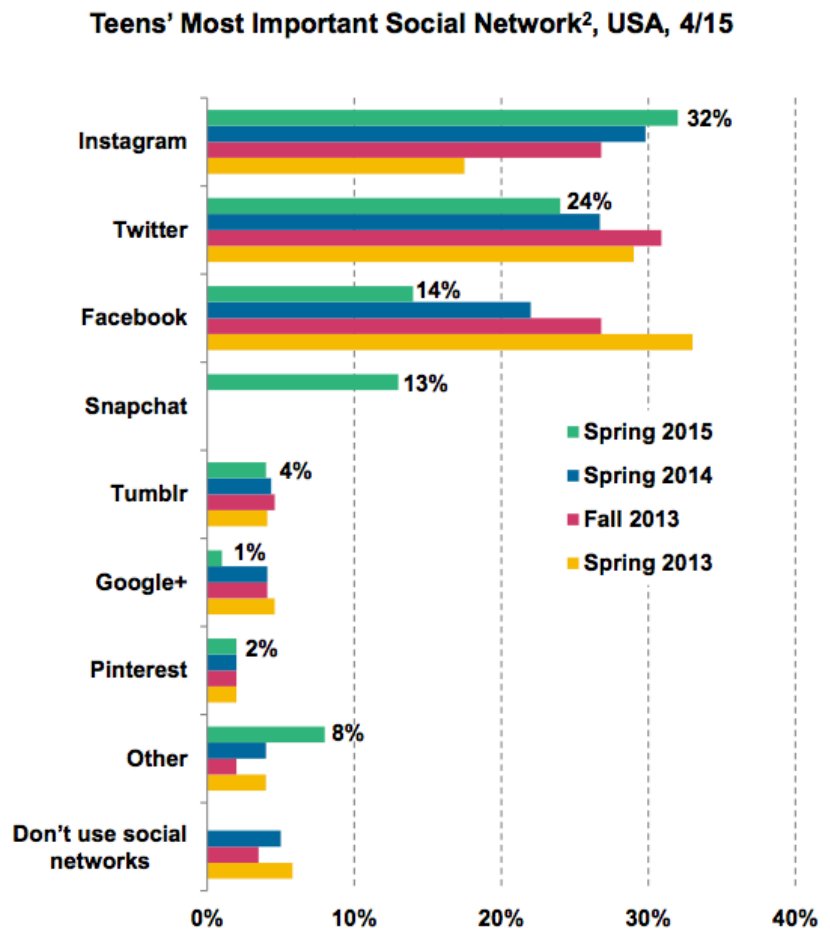
Daily Number of Photos Shared on Select Platforms, Global, 2005 – 2015



Source: Snapchat, Company disclosed information, KPCB estimates
Note: Snapchat data includes images and video. Snapchat stories are a compilation of images and video. WhatsApp data estimated based on average of photos shared disclosed in Q1:15 and Q1:16. Instagram data per Instagram press release. Messenger data per Facebook (~9.5B photos per month). Facebook shares ~2B photos per day across Facebook, Instagram, Messenger, and WhatsApp (2015).

12-24 Year Olds Internet Usage = Visual Stuff (In & Out) Rules... Instagram + Snapchat + Pinterest = Continue to Rise

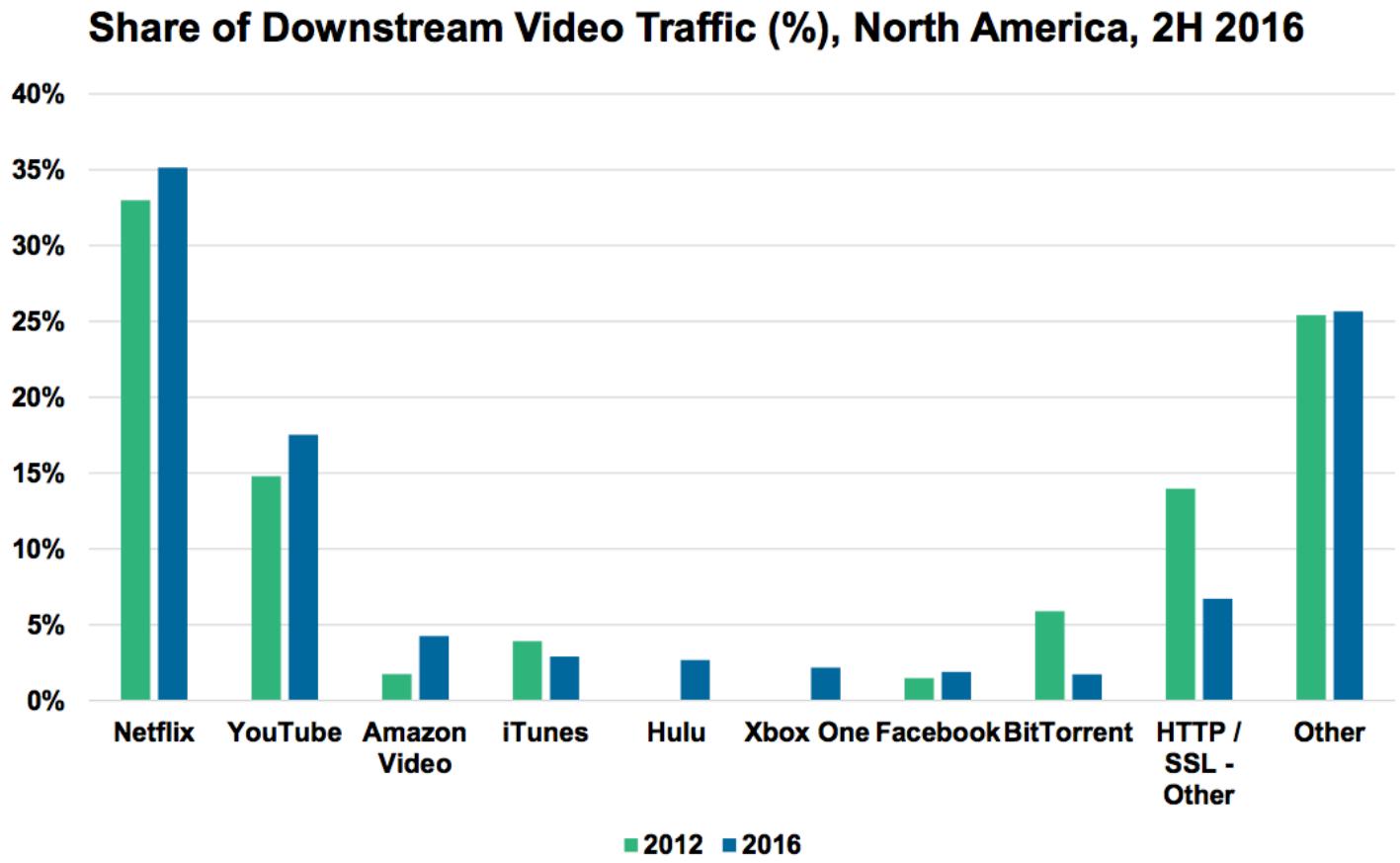




@KPCB Source: Edison Research / Triton Digital, Piper Jaffray.
Note: (1) 12-24 year olds who currently ever use social networking sites/services. (2) Based on survey of US teens with an average age of 16.3 years.

68

Netflix / YouTube = *Fixed-Access* Video Traffic Share Leaders



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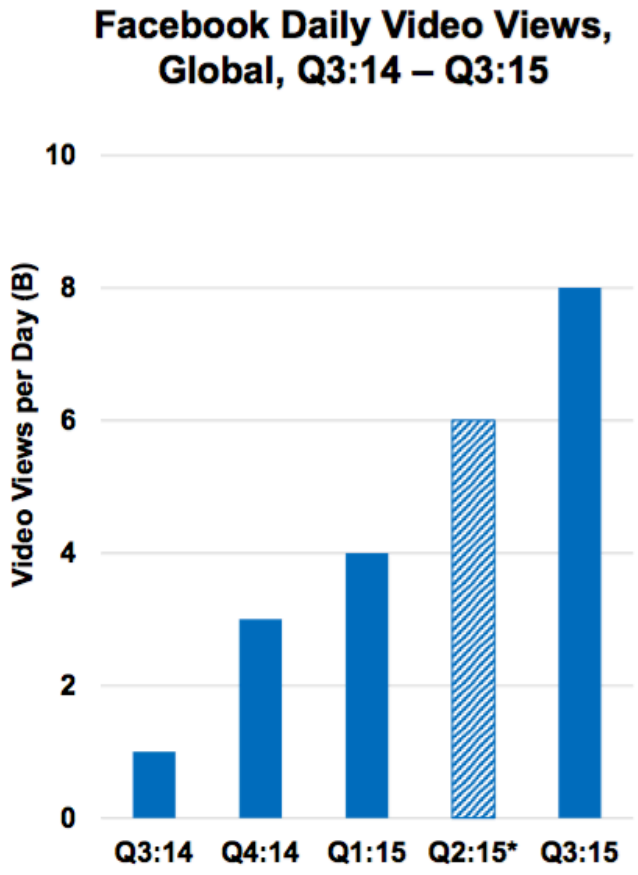
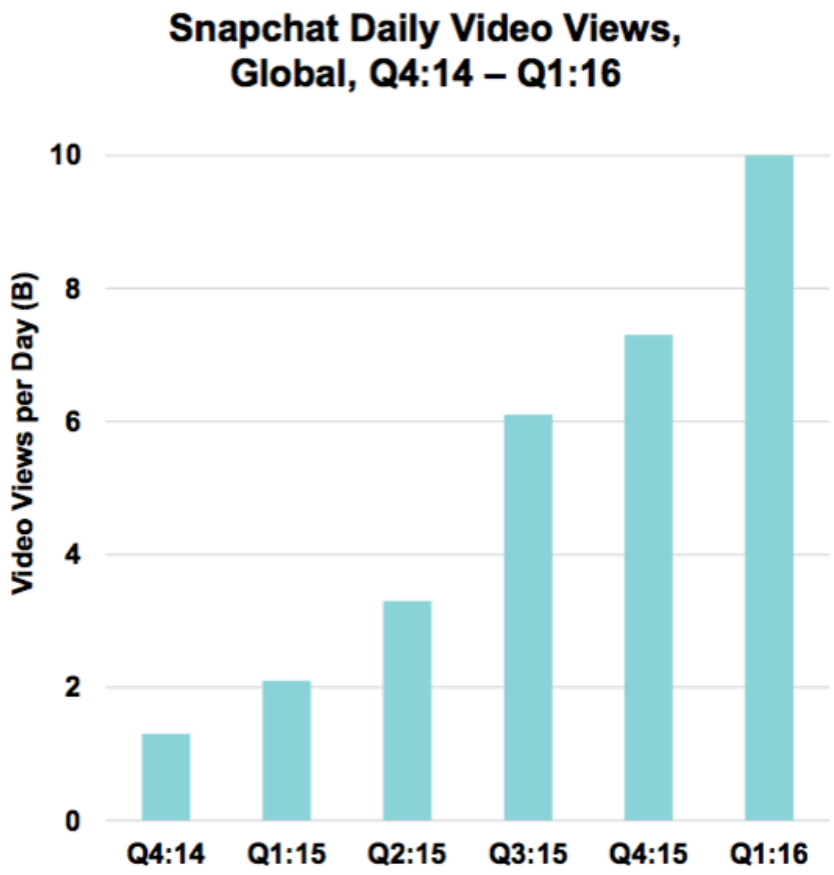
Source: Sandvine Global Internet Phenomena Report (2H 2012 and 2016)

User-Shared Video Views on Snapchat & Facebook = Growing Fast





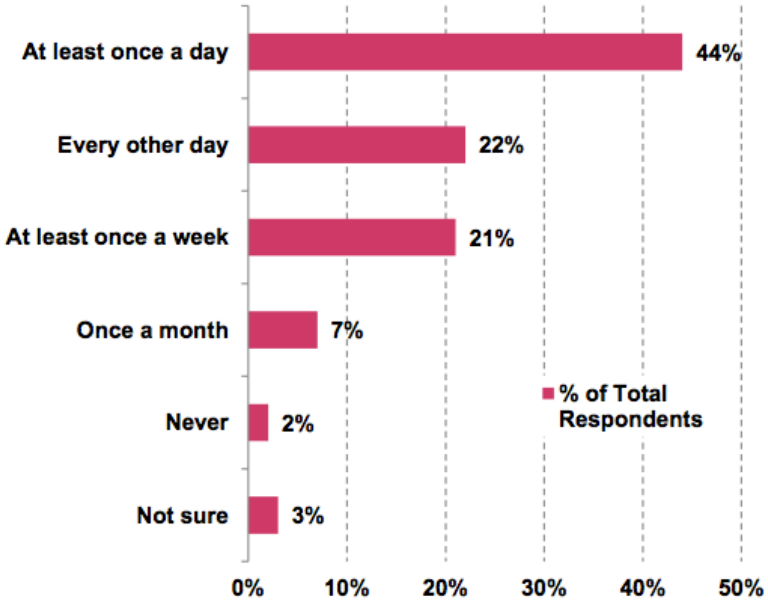
@KPCB

Source: Facebook, Snapchat. Q2:15 Facebook video views data based on KPCB estimate.
Facebook video views represent any video shown onscreen for >3 seconds (including autoplay). Snapchat video views counted instantaneously on load.

Millennials Love Their Smartphone Cameras...
44% Use Camera / Video Function Daily...76% Post on Social Media

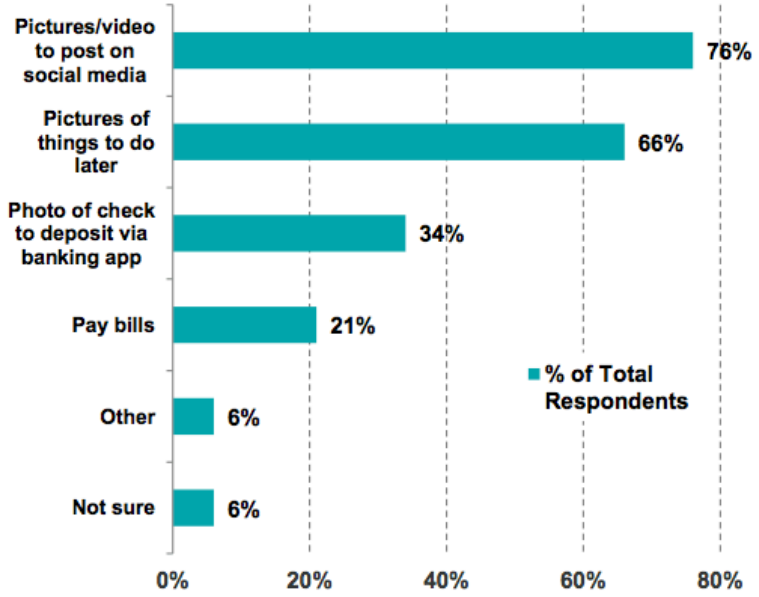
Millennial Smartphone Camera Usage*, USA, 2014

How often do you use your device's camera/video function?



Millennial Smartphone Camera Use Cases, USA, 2014

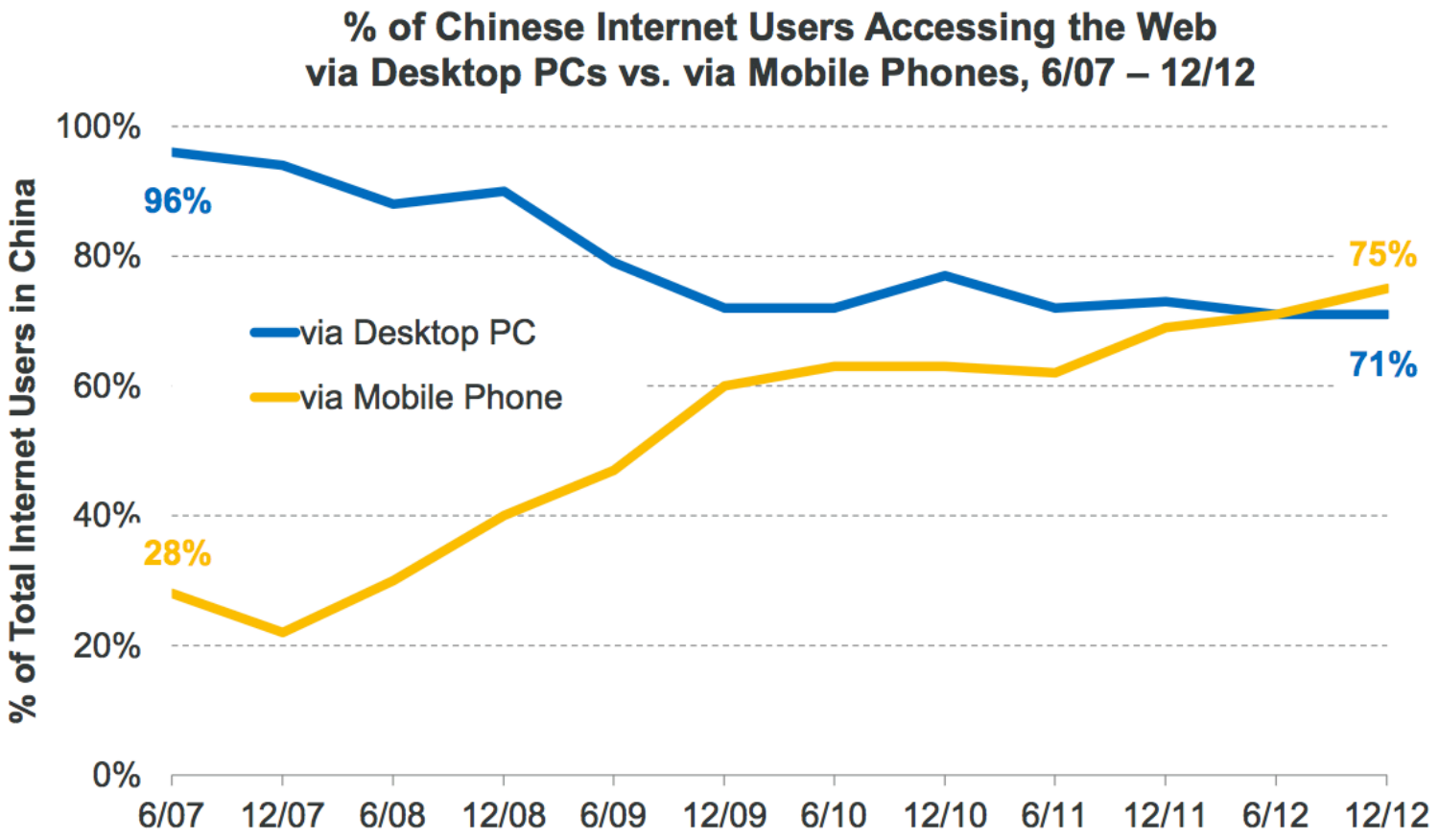
For what things do you use your smartphone camera?



@KPCB

Source: Zogby Analytics.
*18-24 year olds.
Note: Zogby Analytics was commissioned by Mitek Systems, Inc. to conduct an online survey of 1,019 millennials who have a smartphone. For the purposes of this survey, "millennials" are defined as adults between the ages of 18-34. All interviews were completed May 30 through June 6, 2014.

China –
Mobile Internet Access Surpassed PC, Q2:12



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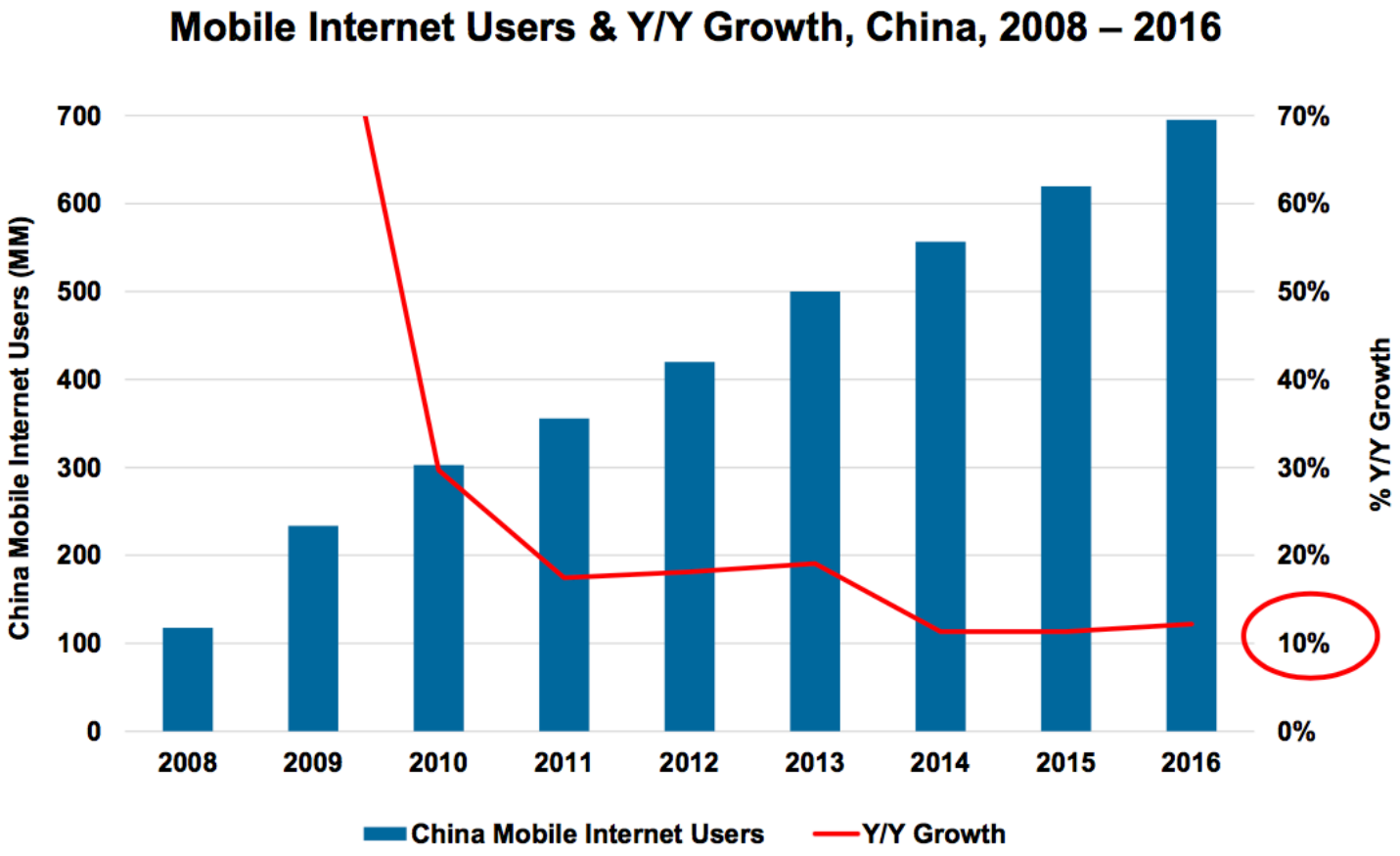
Source: CNNIC, 1/13.

33

China Mobile Internet Users = @ ~700MM, +12% Y/Y vs. 11% in 2015



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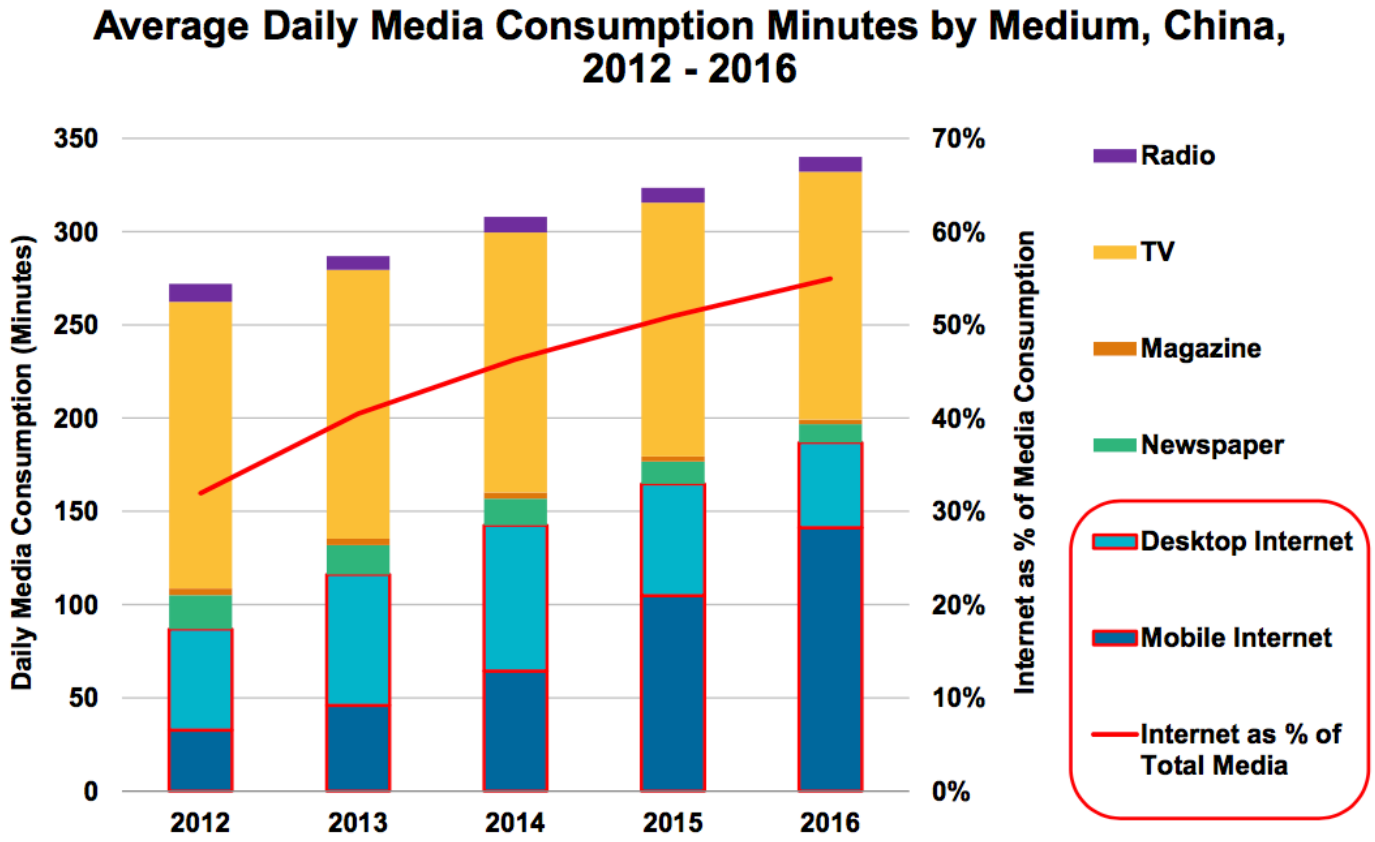
Source: CNNIC
Note: Internet user data is as of year-end.

Hillhouse Capital

China Media =
Internet @ 55% of Time Spent Mobile > TV (2016)



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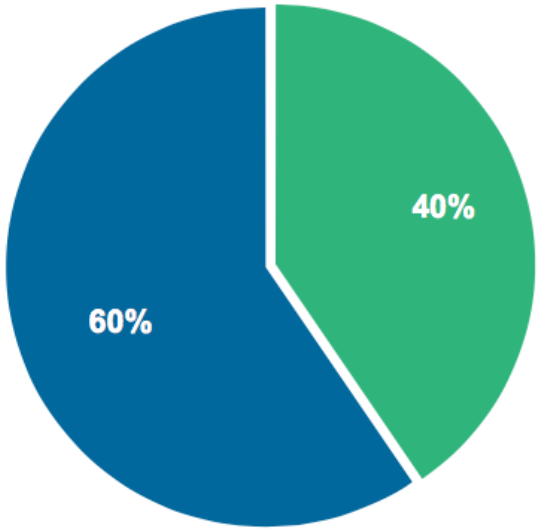
Source: Zenith Optimedia

Hillhouse Capital

Mobile Phone Users – 1995 → 2014...
1% to 73% Population Penetration

1995
80MM+ Mobile Phone Users
1% Population Penetration

2014
5.2B Mobile Phone Users
73% Population Penetration



■ Smartphone ■ Feature Phone

@KPCB Source: Informa, World Cellular Information Service (WCIS). Assumes in 1995, one mobile phone subscription per unique user (no duplication).
Note: In 2014, user base per KPCB estimates based on Morgan Stanley Research and ITU data. Smartphone users & mobile phone users represent unique individuals owning mobile devices; mobile subscribers based on number of connections & may therefore overstate number of mobile users.

5

Technology Cycles – Still Early Cycle on Smartphones + Tablets, Now Wearables Coming on Strong, Faster than Typical 10-Year Cycle

Technology Cycles Have Tended to Last Ten Years

Mainframe Computing 1960s	*Mini* Computing 1970s	*Personal* Computing 1980s	*Desktop Internet* Computing 1990s	*Mobile Internet* Computing 2000s	*Wearable / Everywhere* Computing 2014+
					 Others?

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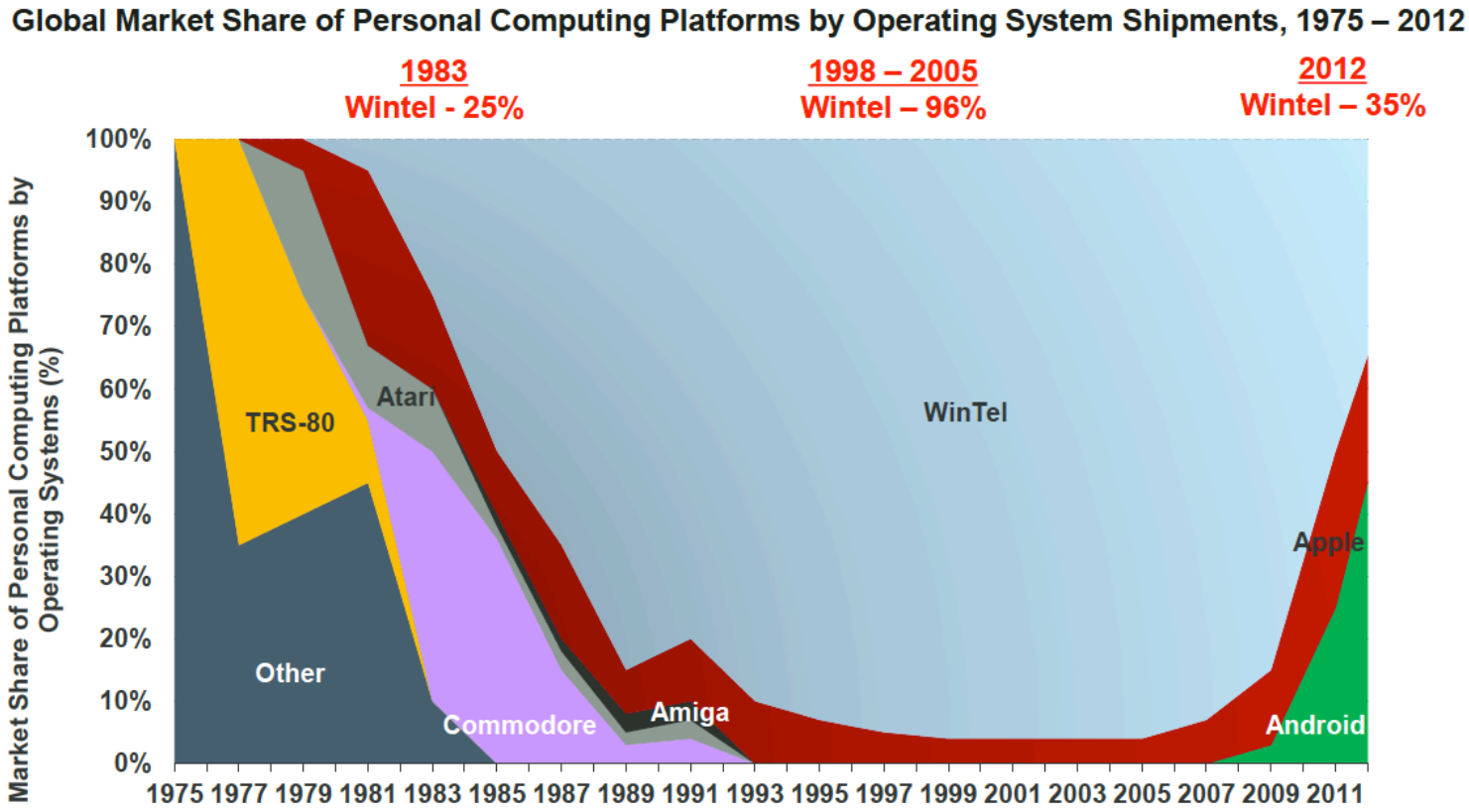
49

Image Source: Computersciencelab.com, Wikipedia, IBM, Apple, Google, NTT docomo, Google, Jawbone, Pebble.

Re-Imagination of Computing Operating Systems - iOS + Android = 60% Share vs. 35% for Windows



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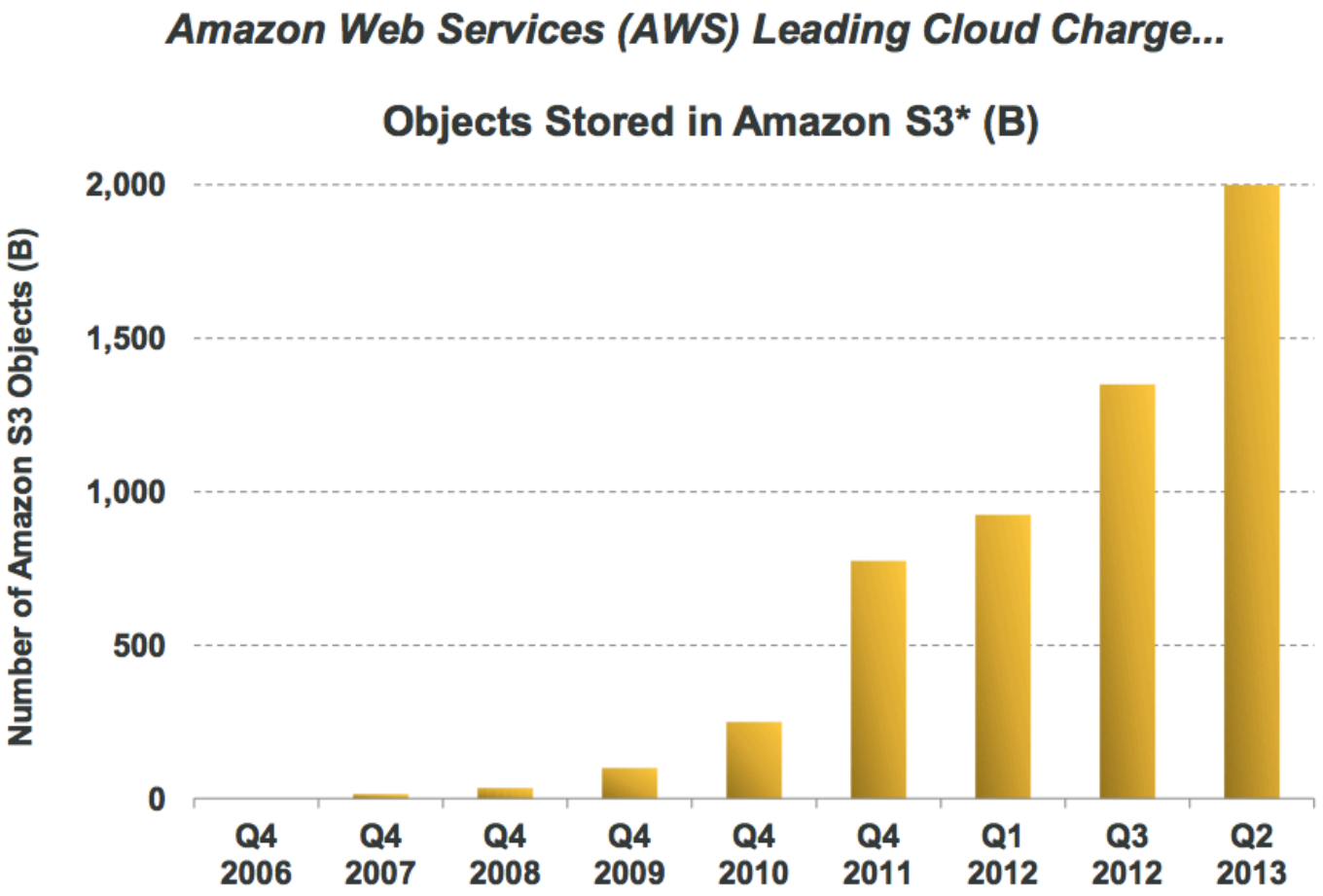
Source: Asymco.com (as of 2011), Public Filings, Morgan Stanley Research, Gartner for 2012 data. 109

...While The Cloud Rises



@KPCB

*Note: S3 is AWS' storage product and used as proxy for AWS scale / growth .
Source: Company data.

74

Cloud Evolution / Tools = Paving Way for Innovation Across Infrastructure Landscape

New Methods of Software Delivery =

APIs / Browser Extensions creating new wave of capabilities (+ companies) for both companies and end users

Containers / Microservices =

Simplify software development process / improve consistency between testing & production environments / reduce complexity of managing & updating apps due to modular approach

Elastic Analytical Databases =

Likes of Google BigQuery / Snowflake / AWS Redshift Spectrum nearly infinitely scalable / usage based + have minimal maintenance requirements

Edge Computing =

Pushing compute away from centralized nodes & closer to sources of data addresses many IT challenges when running data-centric workloads in cloud – reduces latency / can have security + compliance benefits

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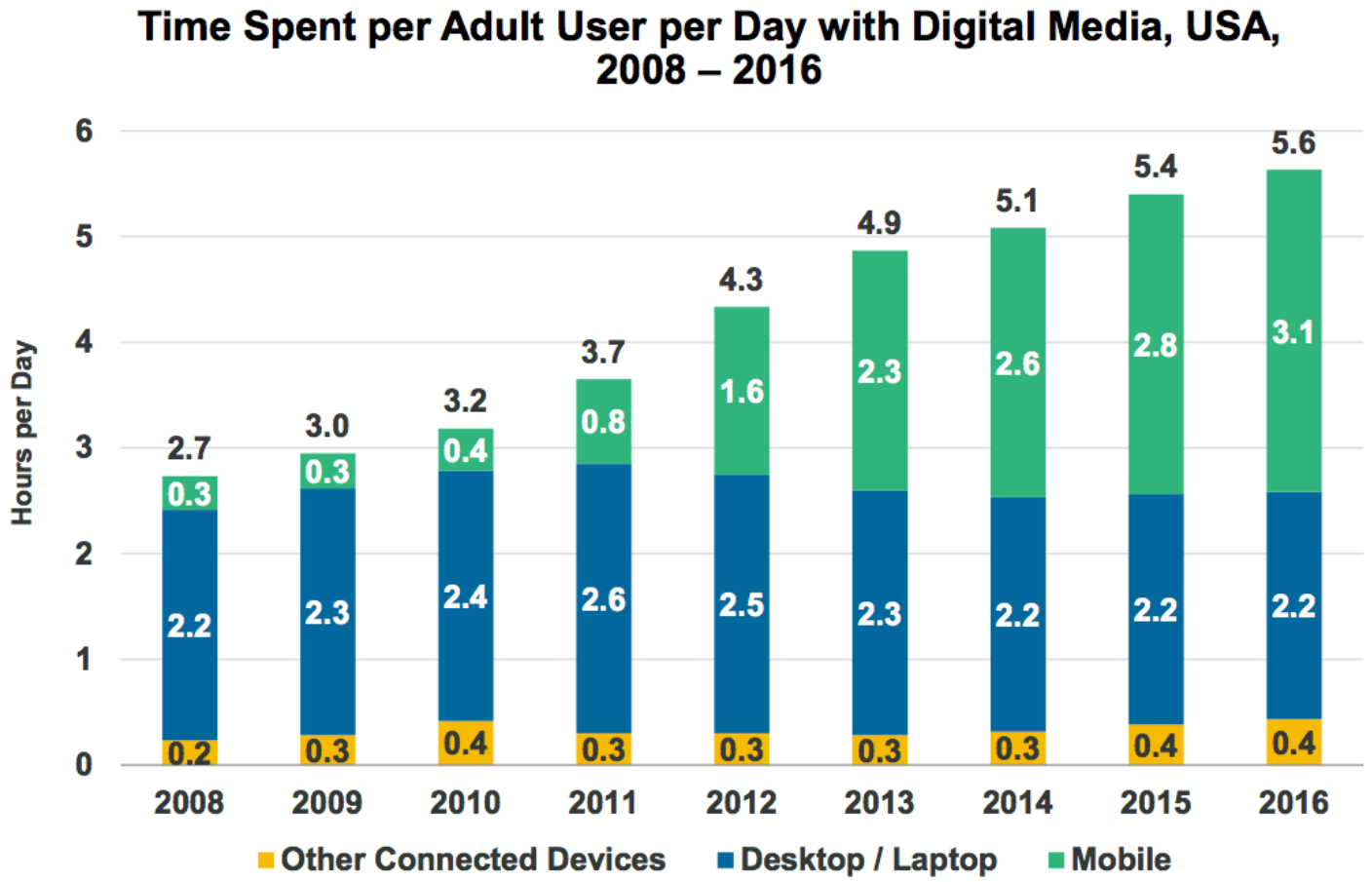
Source: Lloyd Tabb, Looker Founder & CTO; Happiest Minds; Azuqua; TheServerSide; Forbes

Internet Usage (Engagement) = Solid Growth +4% Y/Y
Mobile >3 Hours / Day per User vs. <1 Five Years Ago, USA



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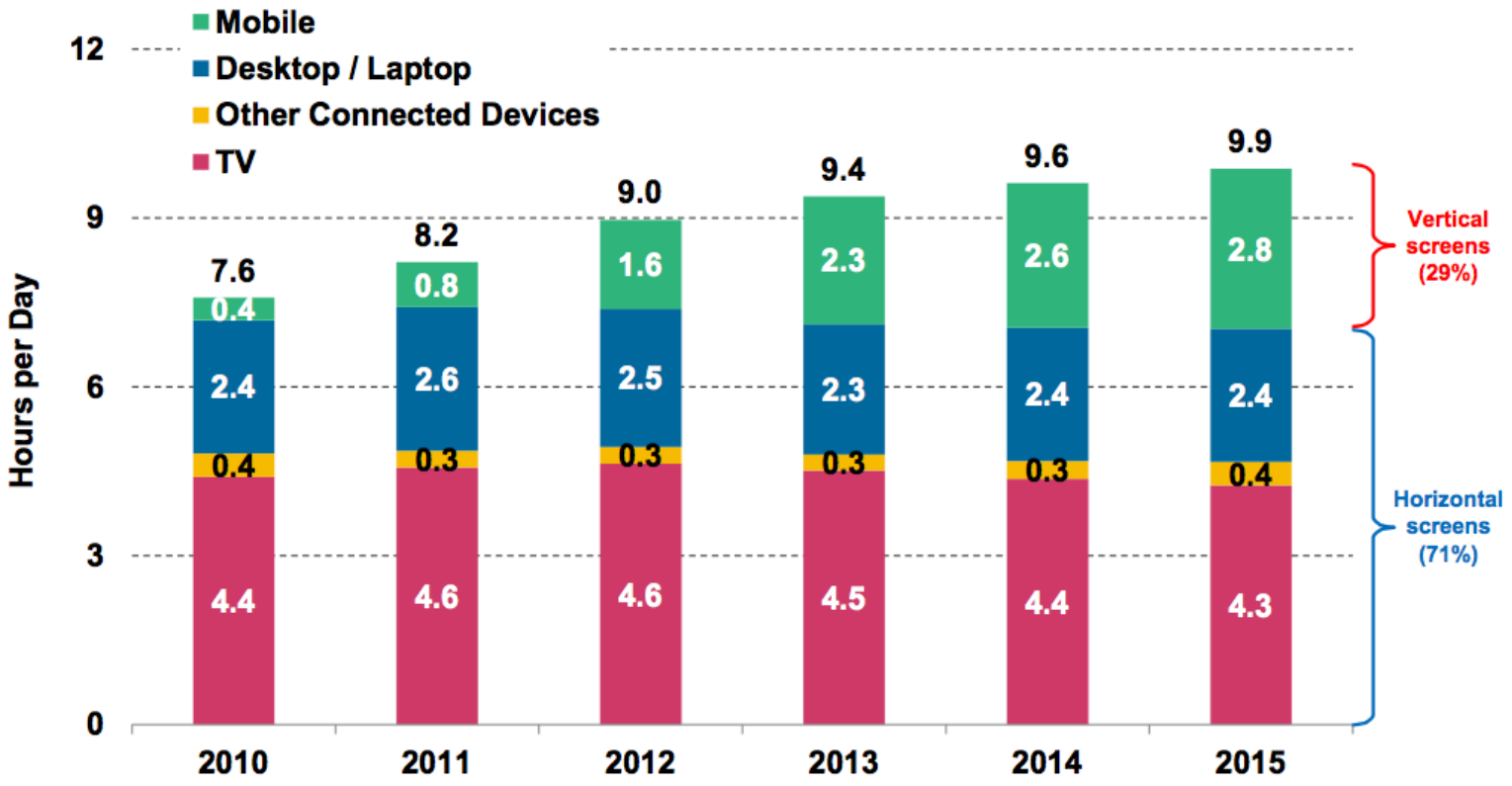
Source: eMarketer 9/14 (2008-2010), eMarketer 4/15 (2011-2013), eMarketer 4/17 (2014-2016). Note: Other connected devices include OTT and game consoles. Mobile includes smartphone and tablet. Usage includes both home and work. Ages 18+; time spent with each medium includes all time spent with that medium, regardless of multitasking.

...Vertical Viewing = 29% of View Time (Multi-Platform) vs. 5% Five Years Ago, USA...

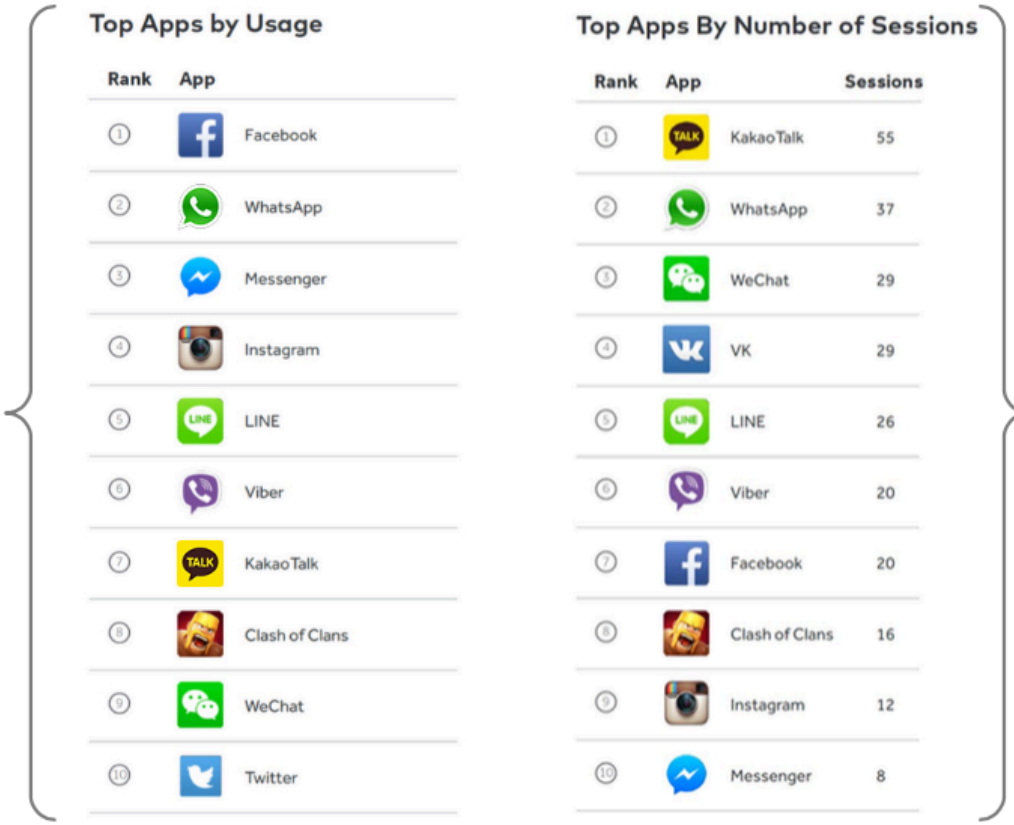
Time Spent on Screens by Orientation (Hours / Day), USA, 2010 – 2015



@KPCB Source: eMarketer 4/15, Coatue analysis. Note: Other connected devices include OTT and game consoles. Mobile includes smartphone and tablet. Usage includes both home and work. Ages 18+; time spent with each medium includes all time spent with that medium, regardless of multitasking; for example, 1 hour of multitasking on desktop/laptop while watching TV is counted as 1 hour for TV and 1 hour for desktop/laptop. 24

Messaging Apps = Top Global Apps in Usage + Sessions

6+ of Top 10 most used apps globally = Messaging Apps



Top Apps by Usage

Rank	App
1	Facebook
2	WhatsApp
3	Messenger
4	Instagram
5	LINE
6	Viber
7	KakaoTalk
8	Clash of Clans
9	WeChat
10	Twitter

Top Apps By Number of Sessions

Rank	App	Sessions
1	KakaoTalk	55
2	WhatsApp	37
3	WeChat	29
4	VK	29
5	LINE	26
6	Viber	20
7	Facebook	20
8	Clash of Clans	16
9	Instagram	12
10	Messenger	8

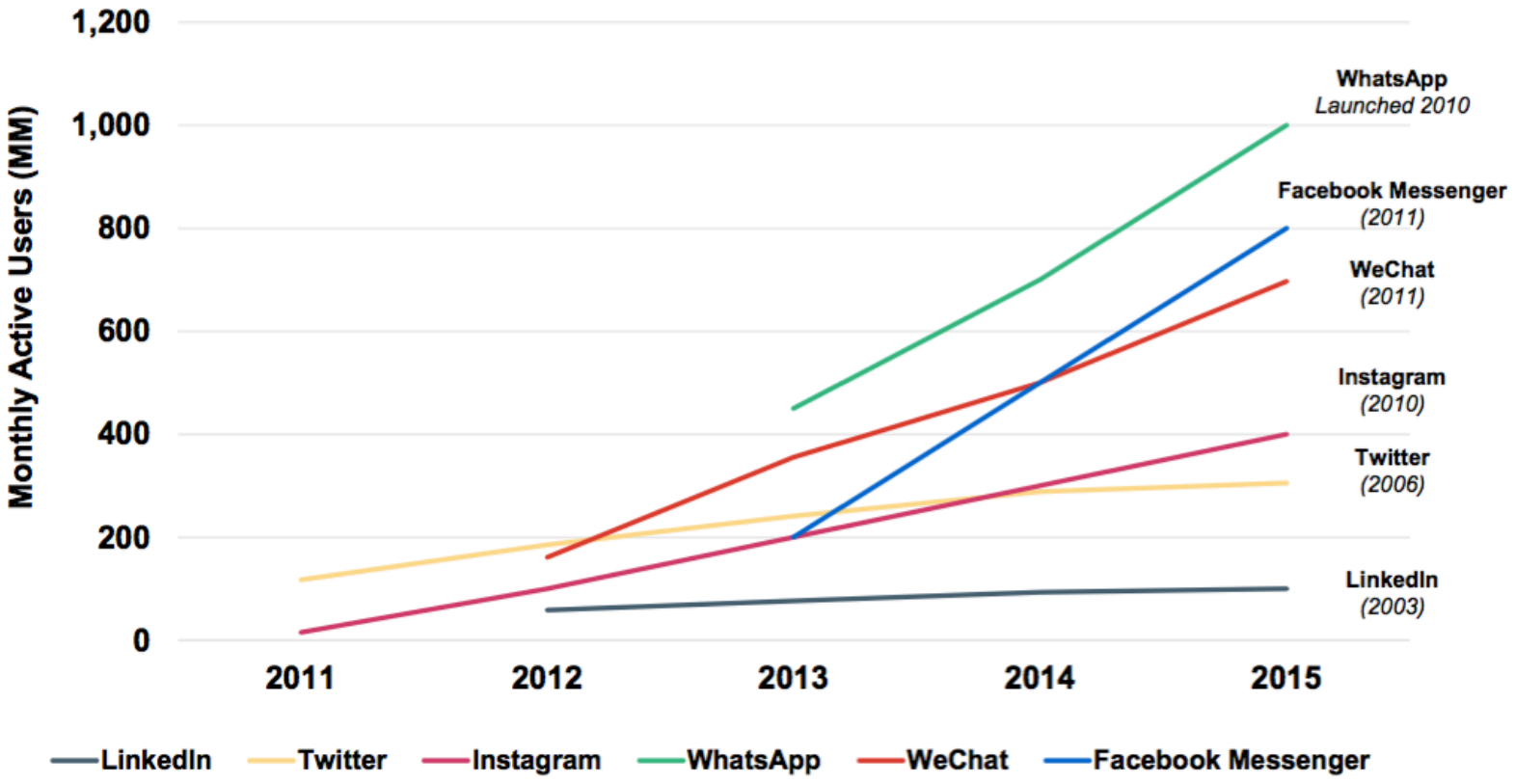
Messaging Apps → significant app sessions

@KPCB Source: Quettra, Q1:15. Data ranked based on usage.
Quettra analyzes 75MM+ Android users spread out in more than 150 countries, collecting install and usage statistics of every application present on the device. Q1:15 data analyzed three months of data starting from 1/1/15. Data excludes Google apps and other commonly pre-installed apps to remove biases. Only apps with 10K+ installs worldwide and 100+ DAU are counted.

47

Messaging Continues to Grow Rapidly...
Leaders = WhatsApp / Facebook Messenger / WeChat

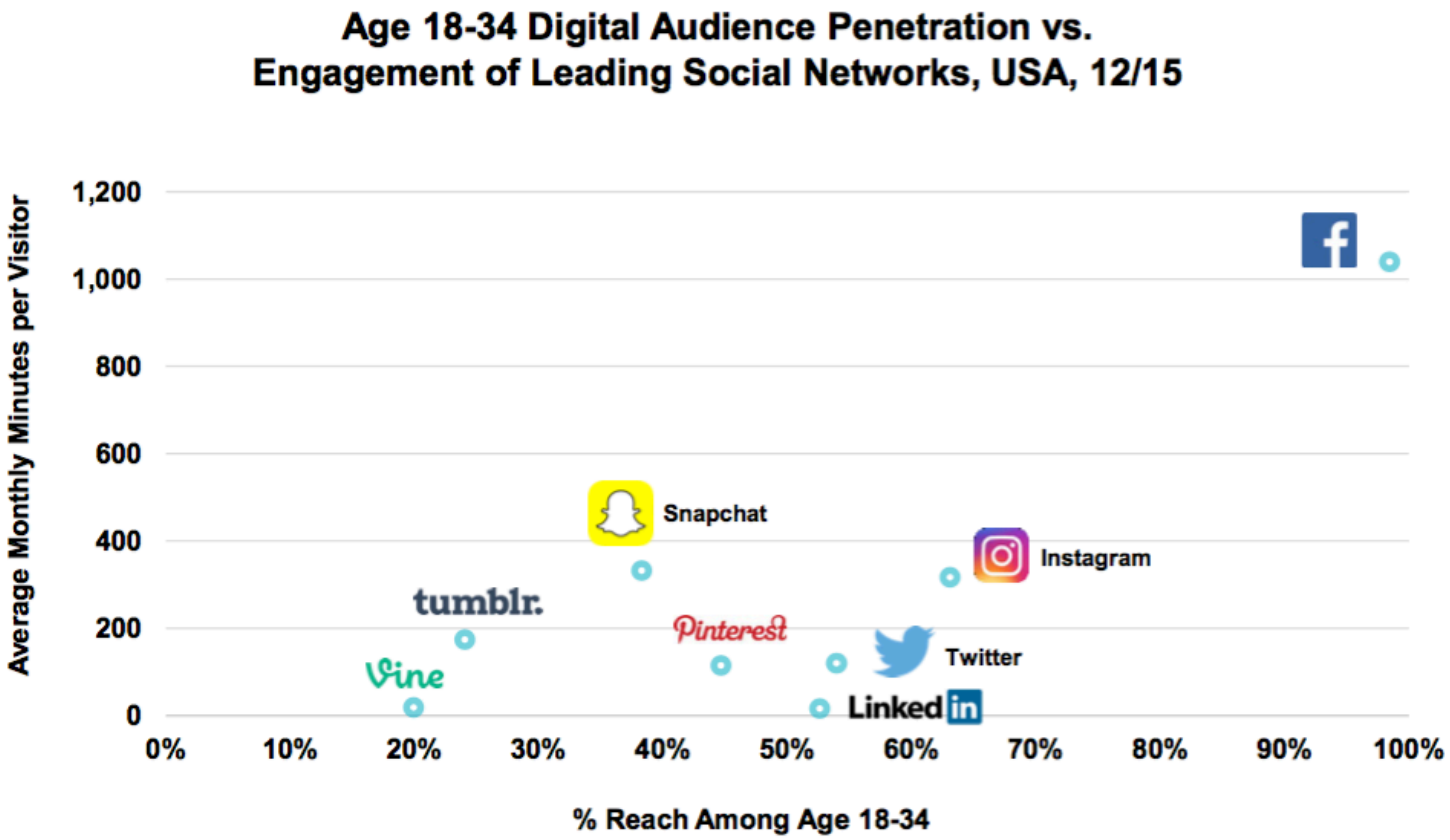
Monthly Active Users on Select Social Networks and Messengers, Global, 2011 – 2015



@KPCB

Source: Facebook, WhatsApp, Tencent, Instagram, Twitter, LinkedIn, Morgan Stanley Research
Note: 2013 data for Instagram and Facebook Messenger are approximated from statements made in early 2014. Twitter users excludes SMS fast followers.

Millennial Social Network Engagement Leaders = Visual... Facebook / Snapchat / Instagram...



@KPCB Source: ComScore Media Metrix Multi-Platform, 12/15.

Asia-Based Messaging Leaders = Continue to Expand Uses / Services Beyond Social Messaging

	KakaoTalk	WeChat	LINE
Name	KakaoTalk	WeChat	LINE
Launch	March 2010	January 2011	June 2011
Primary Country	Korea	China	Japan
Banking / Financial Services	Kakao Bank (11/15)	WeBank (1/15)	Debit Card (2016)
Enterprise	✘	Enterprise WeChat (3/16)	✘
Online-To-Offline (O2O)	Kakao Hairshop (1H:16E) Kakao Driver (1H:16E)	✓	Grocery Delivery (2015)
TV	Kakao TV (6/15)	✓	Line Live & Line TV (2015)
Video Calls / Chat	(6/15)	✓	✓
Taxi Services	Kakao Taxi (3/15)	✓	✓
Messaging	✓	✓	✓
Group Messaging	✓	✓	✓
Voice Calls	Free VoIP calls (2012)	WeChat Phonebook (2014)	✓
Payments	KakaoPay (2014)	(2013)	Line Pay (2014)
Stickers	(2012)	Sticker shop (2013)	(2011)
Games	Game Center (2012)	(2014)	(2011)
Commerce	Kakao Page (2013)	Delivery support w / Yixun (2013)	Line Mall (2013)
Media	Kakao Topic (2014)	✓	✓
QR Codes	✓	QR code identity (2012)	✓
User Stories / Moments	Kakao Story (2012)	WeChat Moments	Line Home (2012)
Developer Platform	KakaoDevelopers	WeChat API	Line Partner (2012)

New Services Added 2015 -16*

Previous Existing Services

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Source: Company websites, press releases, Morgan Stanley Research.
*Blue shading denotes that at least one of the platforms listed has added new features since 2015. Some features for other platforms may have been added in prior years.
Note: Enterprise denotes product made specifically for messaging or social networking within the enterprise, which is distinct from B2C messaging where businesses engage with current or potential customers.

Average Global Mobile User = ~33 Apps...12 Apps Used Daily... 80% of Time Spent in 3 Apps

Day in Life of a Mobile User, 2016

	Average # Apps Installed on Device*	Average Number of Apps Used Daily	Average Number of Apps Accounting for 80%+ of App Usage	Time Spent on Phone (per Day)	Most Commonly Used Apps
USA	37	12	3	5 Hours	Facebook Chrome YouTube
Worldwide	33	12	3	4 Hours	Facebook WhatsApp Chrome

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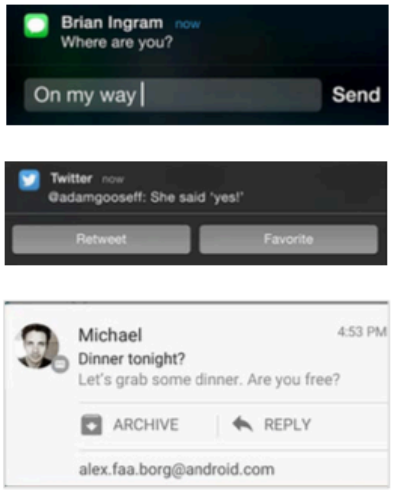
Source: SimilarWeb, 5/16.
*Apps installed does not include pre-installed apps. Most commonly used apps includes preloads.

Notifications = Growing Rapidly & Increasingly Interactive... Driving New Touch Points with Messaging Platforms + Other Apps

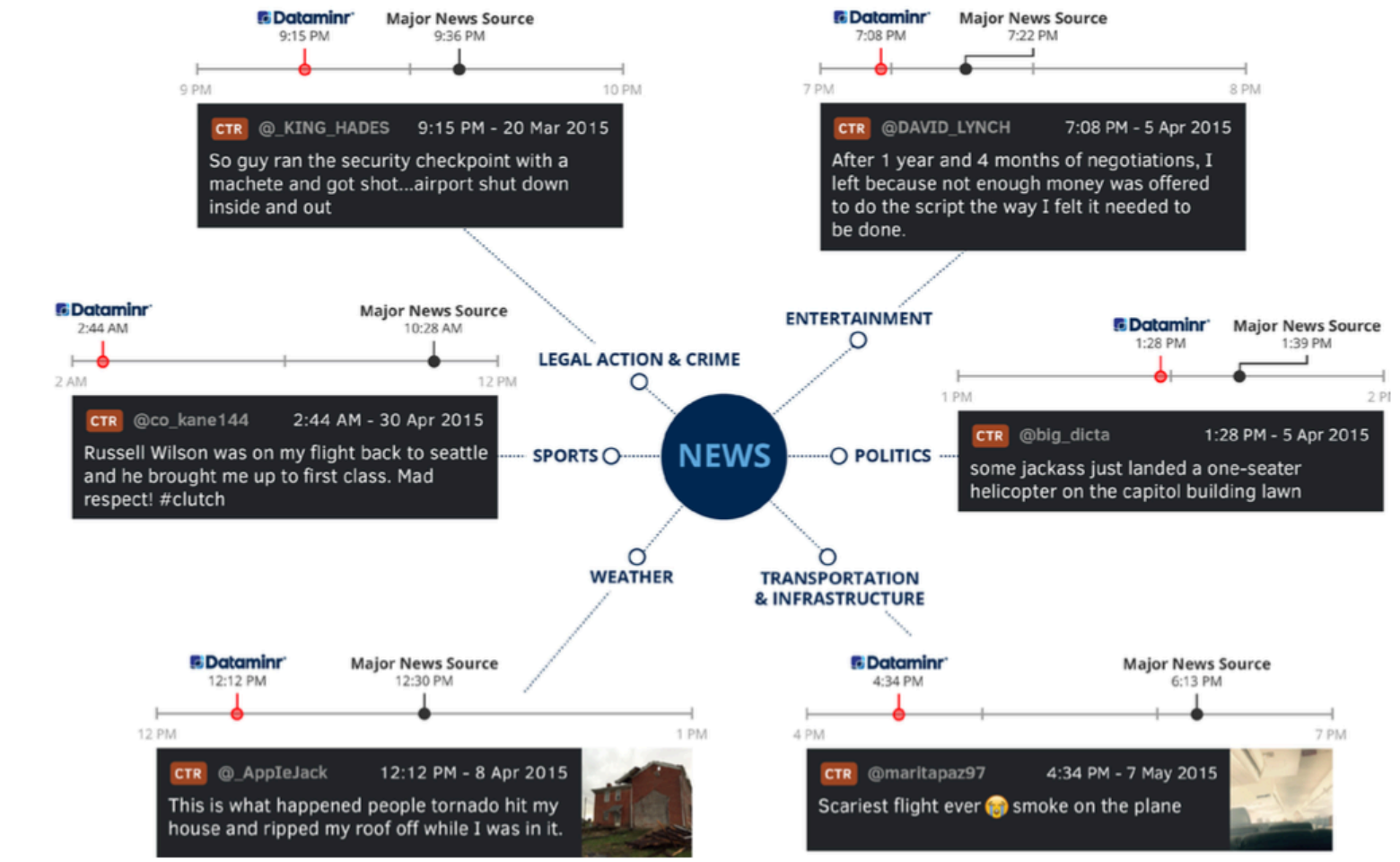
Direct Interaction on Notification Panel – without users interrupting what they're doing...



...More Up Close & Personal – as notifications appear on more & more mobile devices

@KPCB Images: Apple, Android Wear.

Users Increasingly First Source for News via Twitter / Dataminr



@KPCB Source: Dataminr, 5/15.

65

Video Evolution = Accelerating
Live (Linear) → On-Demand → Semi-Live → Real-Live

Live (Linear)

Traditional TV
1926

Tune-In or
Miss Out

Mass Concurrent
Audience

Real-Time Buzz

On-Demand

DVR / Streaming
1999

Watch on
Own Terms

Mass Disparate
Audience

Anytime Buzz

NETFLIX

Semi-Live

Snapchat Stories
2013

Tune-In Within 24
Hours or Miss Out

Mostly Personal
Audience

Anytime Buzz

Real-Live

Periscope + Facebook Live
2015 / 2016

Tune-In / Watch
on Own Terms

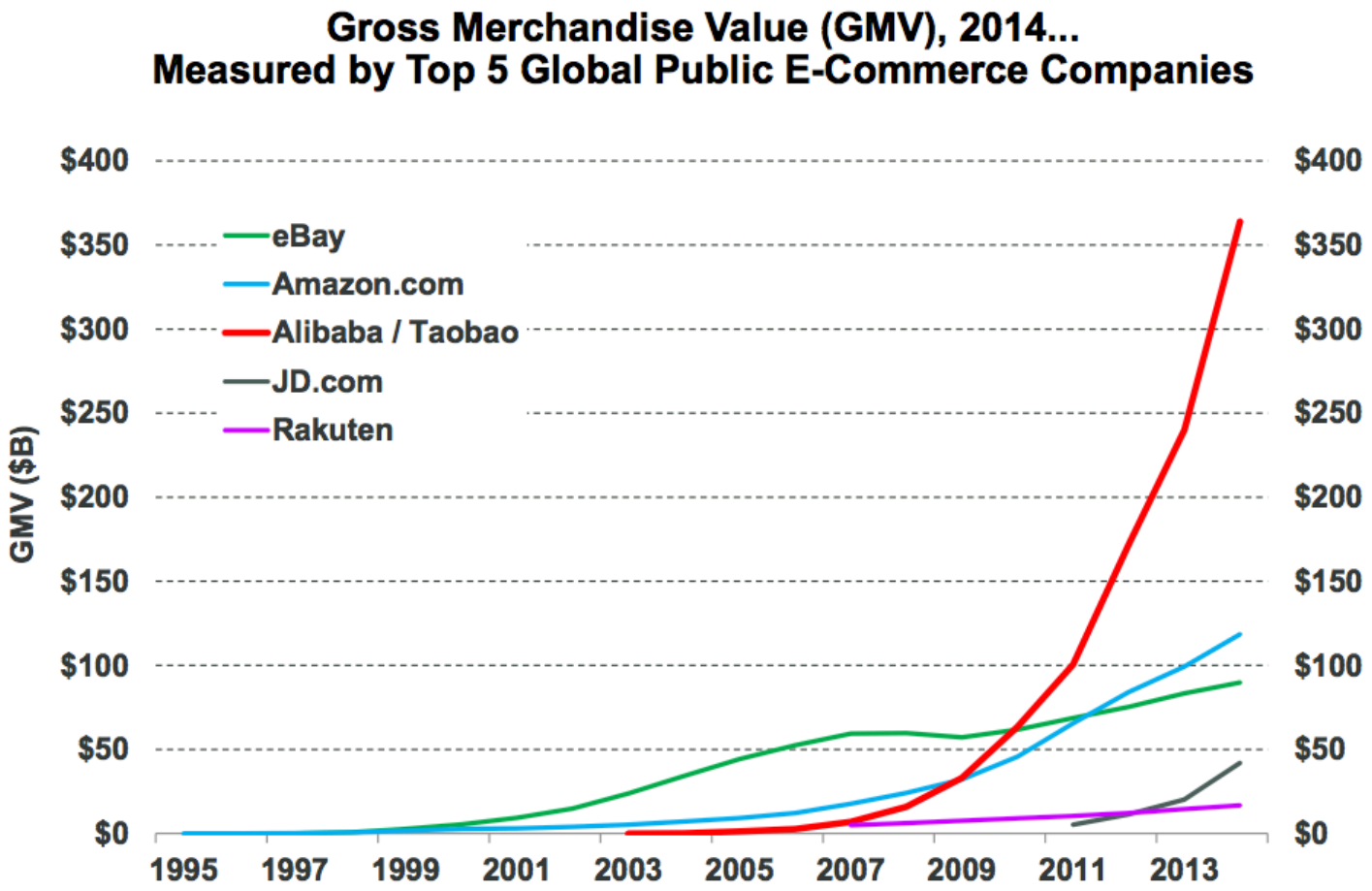
Mass Audience,
yet Personal

Real Time + Anytime Buzz

@KPCB

Images: Facebook, Twitter, Snapchat, Netflix, TiVopedia, BT.com
1926 - First television introduced by John Baird to members of the Royal Institution. 1999 - First DVR released by Tivo. 2013 – Snapchat Stories launched.

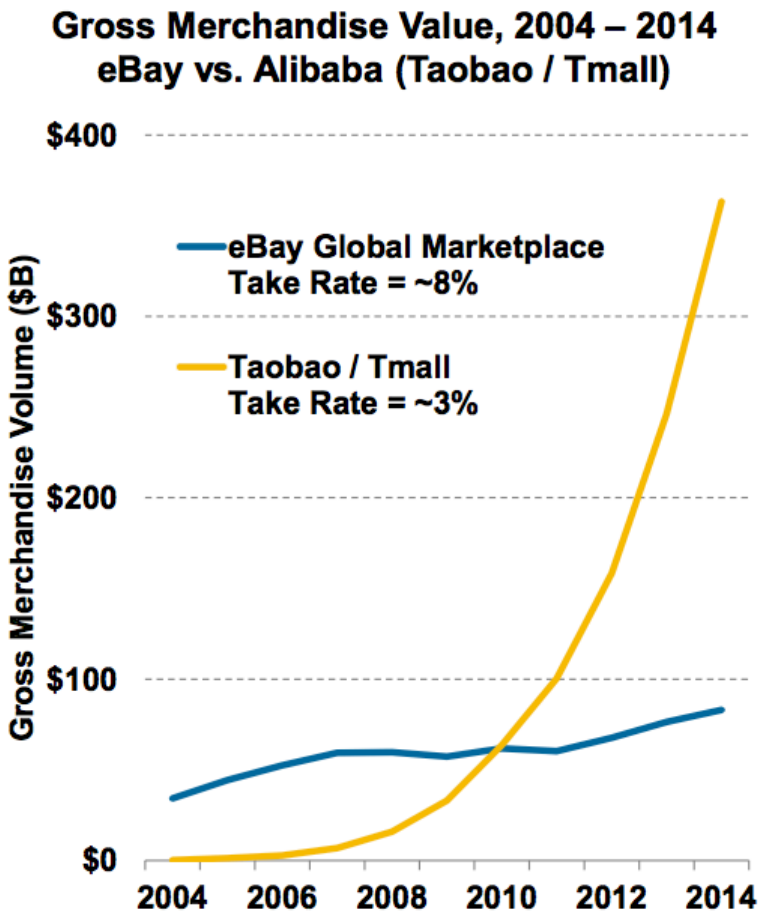
1st Generation 'Online Platforms / Marketplaces for *Products* Rising = Optimized for Desktop Internet + Traditional Shipping Delivery

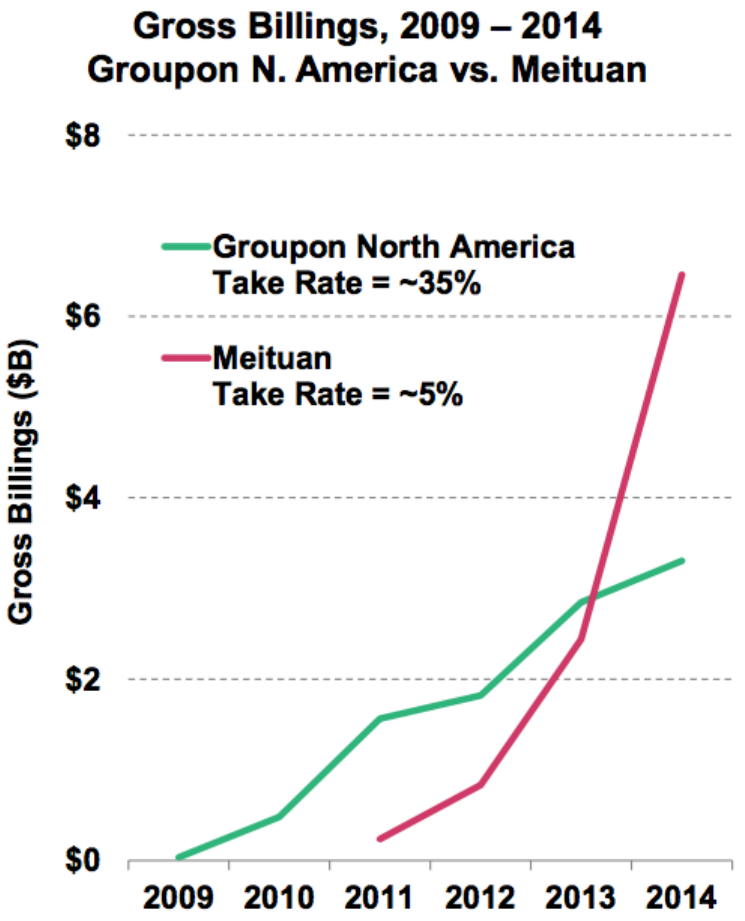


@KPCB Source: Companies are eBay, Amazon, Alibaba, JD.com, and Rakuten. Per publicly available company data, Morgan Stanley Research.

121

China E-Commerce =
Low Take Rates* Helped China Marketplace Leaders Pass USA Peers





@KPCB

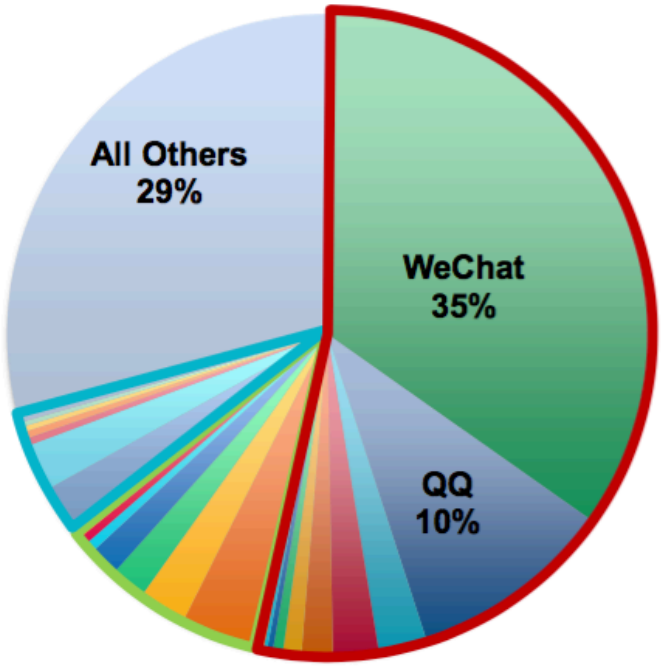
Source: Meituan gross billings data are estimates by Tuan800.com, eBay, Groupon, Alibaba GMV data per company.
Note: Take rate defined as net revenue divided by gross merchandise value or gross billings. eBay marketplace take rate excludes PayPal (~3%), eBay, Alibaba GMV data per company. Meituan take rate is estimate per media report.

Hillhouse Capital

158

China Mobile Internet Usage Leaders...
Tencent + Alibaba + Baidu = 71% of Mobile Time Spent

Share of Mobile Time Spent, April 2016
Daily Mobile Time Spent = ~200 Minutes per User, Average



Tencent
- WeChat
- QQ
- QQ Browser
- Tencent Video
- Tencent News
- Tencent Games
- QQ Music
- JD.com
- QQ Reading

Alibaba
- UCWeb Browser
- Taobao
- Weibo
- YouKu Video
- Momo
- Shuqi Novel
- AliPay
- AutoNavi

Baidu
- Mobile Baidu
- iQiyi / PPS Video
- Baidu Browser
- Baidu Tieba
- 91 Desktop
- Baidu Maps

- All Other

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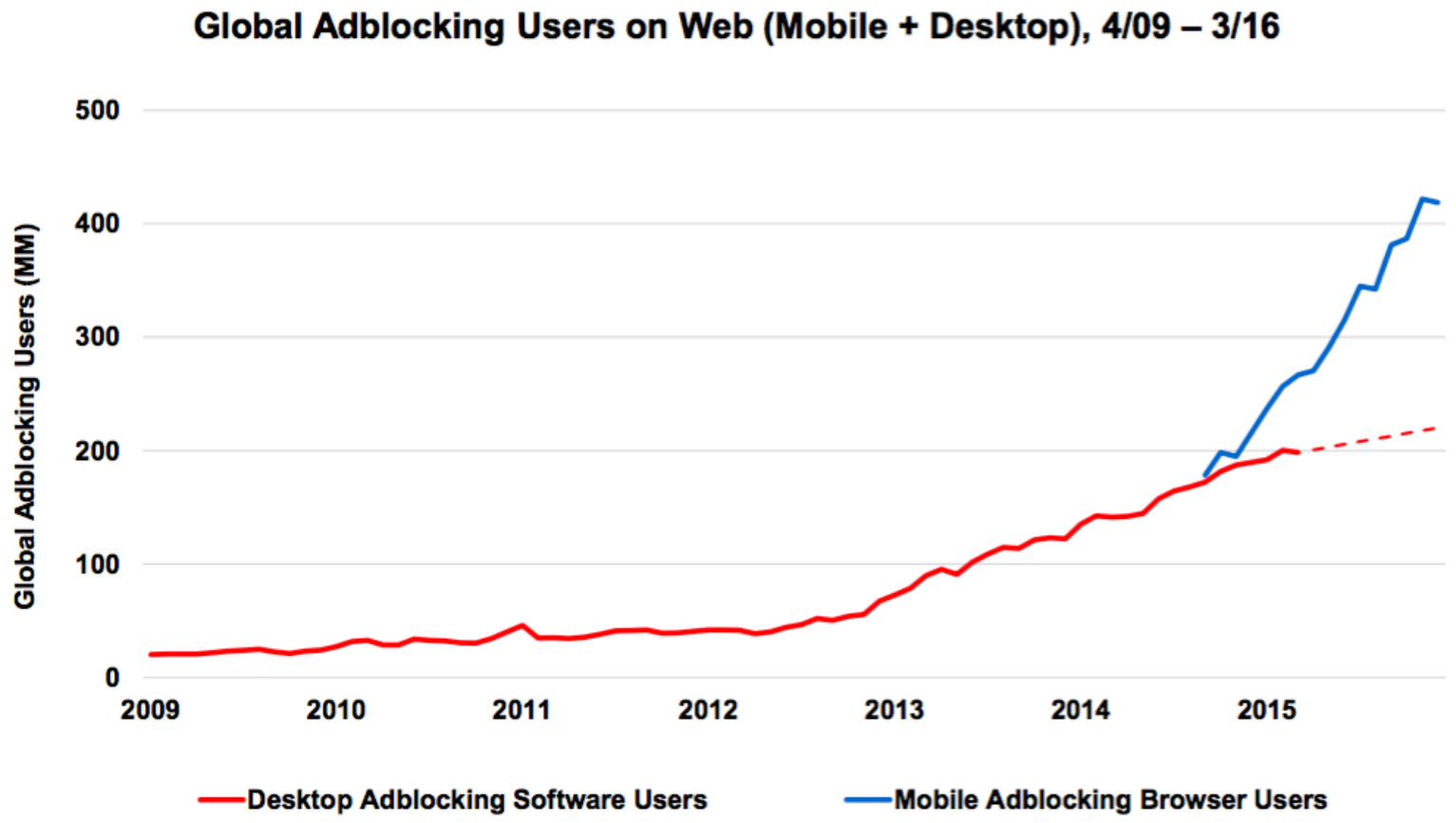
Note: Grouping of apps include strategic investments made by Tencent, Alibaba and Baidu. Only apps in top 50 by time spent share are called out. Source: QuestMobile, Trustdata, and Hillhouse estimates.

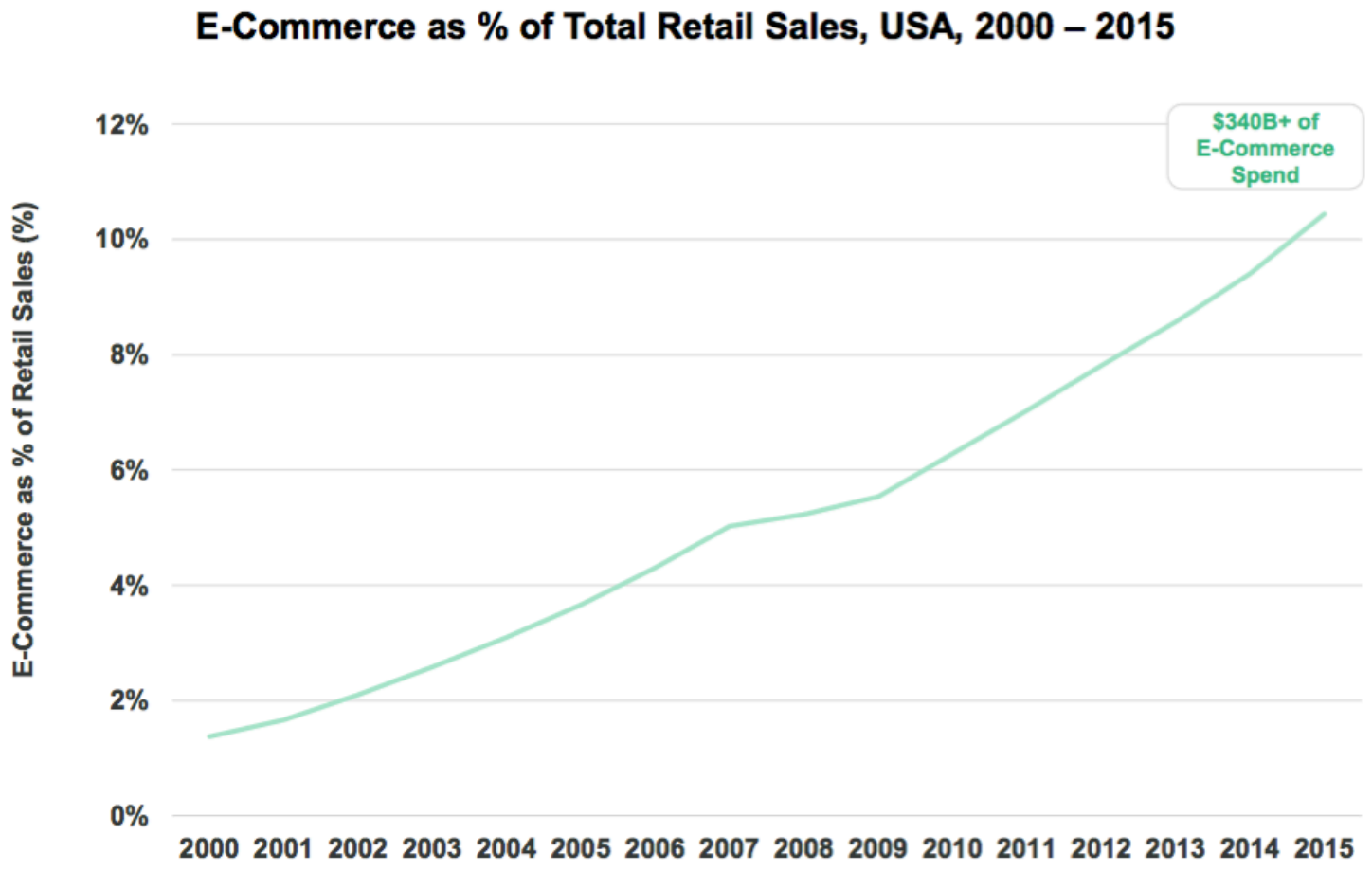
Hillhouse Capital | PAGE 167

Adblocking @ ~220MM Desktop Users (+16% Y/Y)...~420MM+ Mobile (+94%)... Majority in China / India / Indonesia = Call-to-Arms to Create Better Ads, per PageFair



Source: PageFair, 5/16. Dotted line represents estimated data. These two data sets have not been de-duplicated. The number of desktop adblockers after 6/15 are estimates based on the observed trend in desktop adblocking and provided by PageFair. Note that mobile adblocking refers to web / browser-based adblocking and not in-app adblocking.
Desktop adblocking estimates are for global monthly active users of desktop adblocking software between 4/09 – 6/15, as calculated in the PageFair & Adobe 2015 Adblocking Report. Mobile adblocking estimates are for global monthly active users of mobile browsers that block ads by default between 9/14 – 3/16, including the number of Digicel subscribers in the Caribbean (added 10/15), as calculated in the PageFair & Priori Data 2016 Adblocking Report.

Internet Continues to Ramp as Retail Distribution Channel = 10% of Retail Sales vs. <2% in 2000

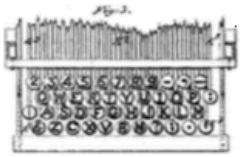


@KPCB

Source: U.S. Census Bureau, Federal Reserve Bank of St. Louis (5/16)
Note: E-commerce and retail sales data are seasonally adjusted. Retail sales exclude food services, retail trade from gasoline stations, and retail trade from automobiles and other motor vehicles.

Human-Computer Interaction (1830s – 2015), USA = Touch 1.0 → Touch 2.0 → Touch 3.0 → Voice

Punch Cards for Informatics
1832



QWERTY Keyboard
1872

Electromechanical Computer (Z3)
1941

Electronic Computer (ENIAC)
1943

Paper Tape Reader (Harvard Mark I)
1944

Mainframe Computers (IBM SSEC)
1948

Trackball
1952

Joystick
1967

Microcomputers (IBM Mark-8)
1974

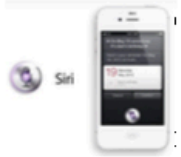
Portable Computer (IBM 5100)
1975

Commercial Use of Window-Based GUI (Xerox Star)
1981

Commercial Use of Mouse (Apple Lisa)
1983

Commercial Use of Mobile Computing (PalmPilot)
1996

Touch + Camera - based Mobile Computing (iPhone 2G)
2007



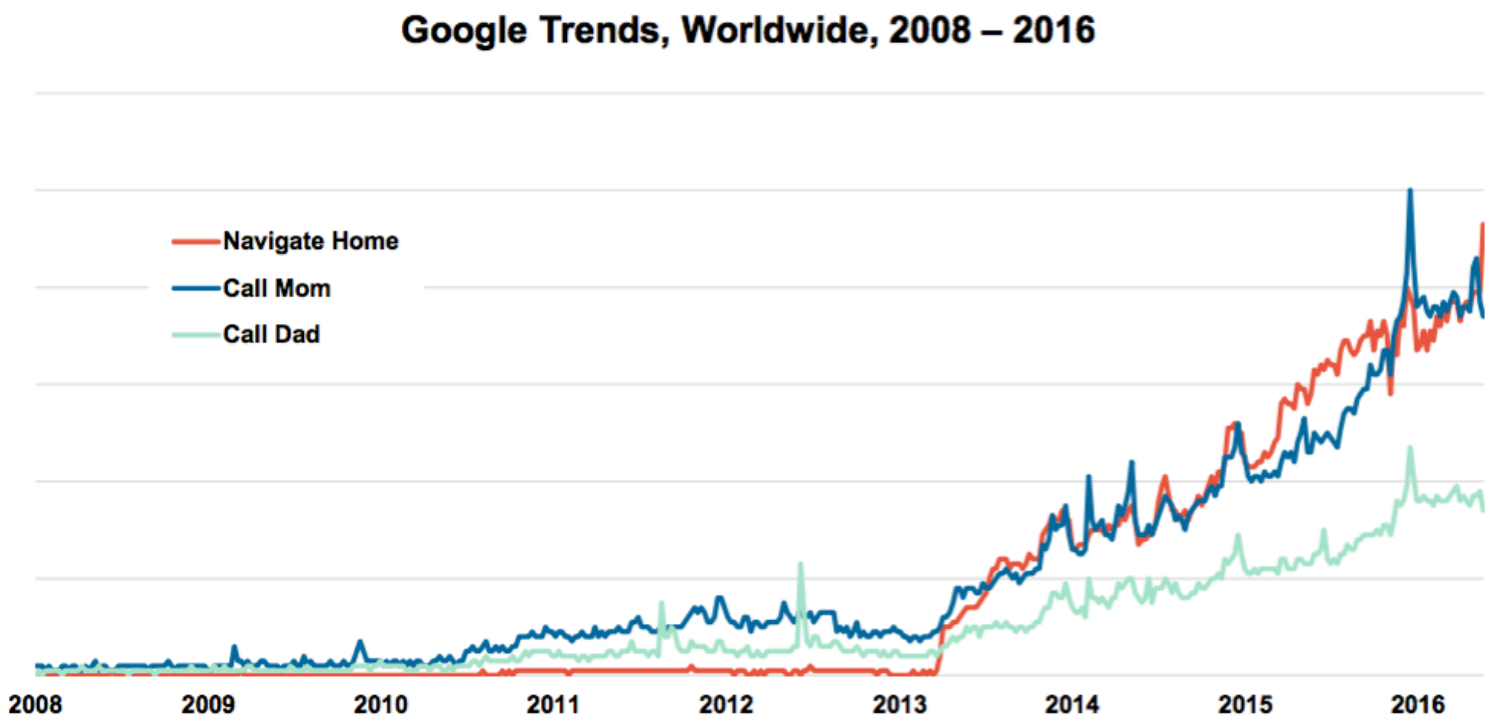
Voice on Mobile (Siri)
2011

Voice on Connected / Ambient Devices (Amazon Echo)
2014

@KPCB Source: University of Calgary, "History of Computer Interfaces" (Saul Greenberg)

Google Voice Search Queries = Up >35x Since 2008 & >7x Since 2010, per Google Trends

Google Trends imply queries associated with voice-related commands have risen >35x since 2008 after launch of iPhone & Google Voice Search



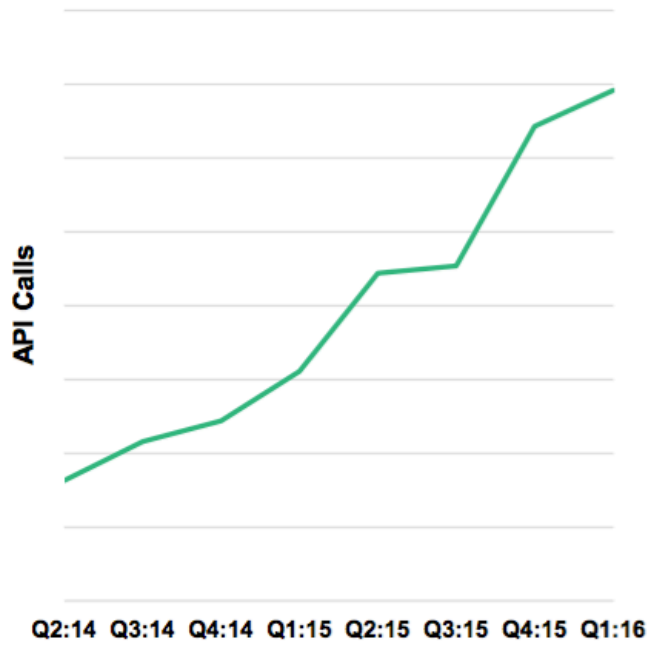
@KPCB

Source: Google Trends
Note: Assume command-based queries are voice searches given lack of relevance for keyword-based search. Aggregate growth values determined using growth in Google Trends for three queries listed above.

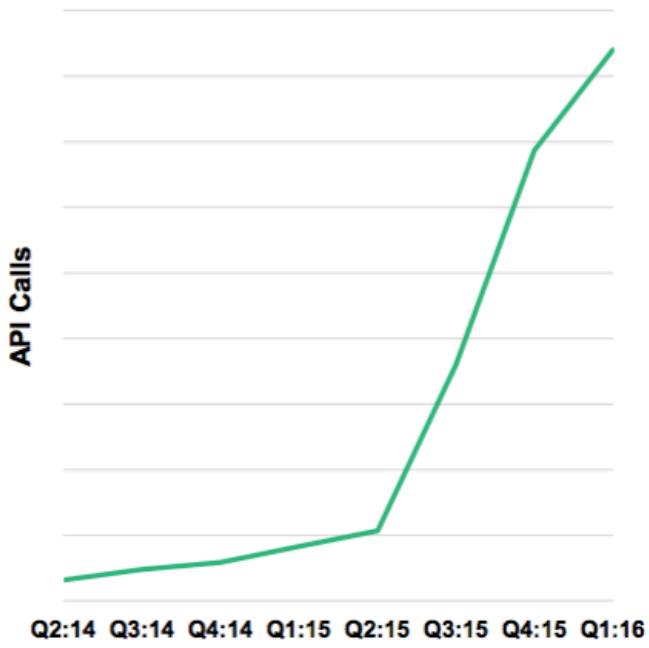
Baidu Voice =
Input Growth >4x...Output >26x, Since Q2:14

Usage across all Baidu products growing rapidly...typing Chinese on small cellphone keyboard even more difficult than typing English...Text-to-Speech supplements speech recognition & key component of man-machine communications using voice

Baidu Speech Recognition Daily Usage by API Calls, Global, 2014 – 2016[1]



Baidu Text to Speech (TTS) Daily Usage by API Calls, Global, 2014 – 2016[2]



@KPCB

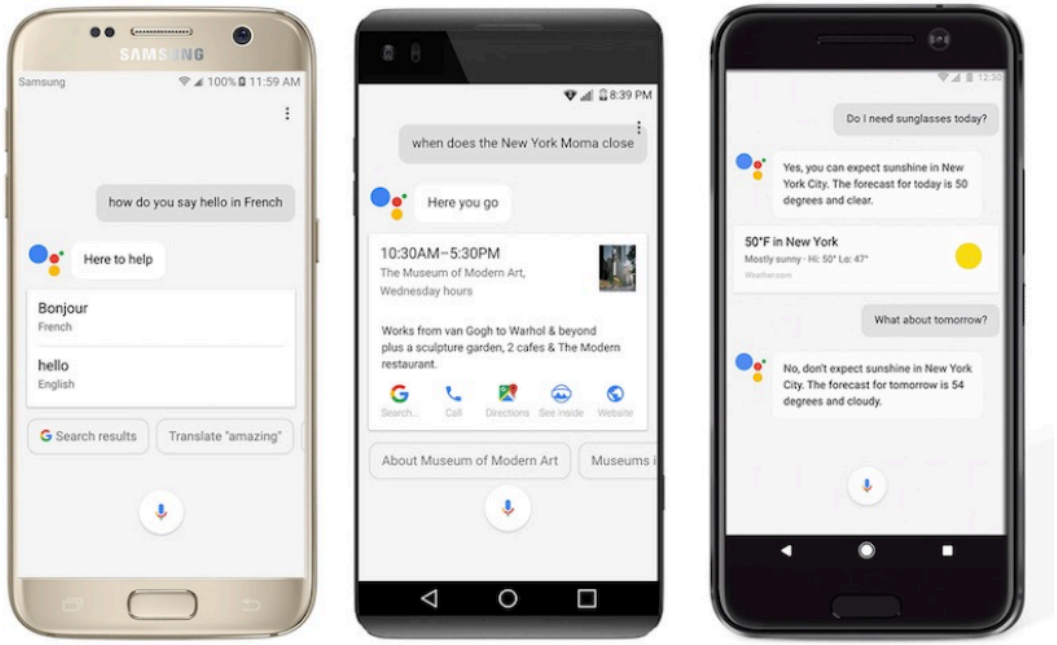
Source: Baidu
Note: (1) Data shown is growth of speech recognition at Baidu, as measured by the number of API calls to Baidu's speech recognition system across time, from multiple products. Most of these API calls were for Mandarin speech recognition. (2) Data shown is growth of TTS (text to speech) at Baidu, in terms of the total number of API calls to Baidu's TTS system across time, from multiple products. Most of these API calls were for Mandarin TTS.

Voice-Based *Mobile* Platform *Front-Ends* = Voice Can Replace Typing

Google Assistant

Nearly 70% of Requests are Natural / Conversational Language, 5/17

20% of Mobile Queries Made via Voice, 5/16



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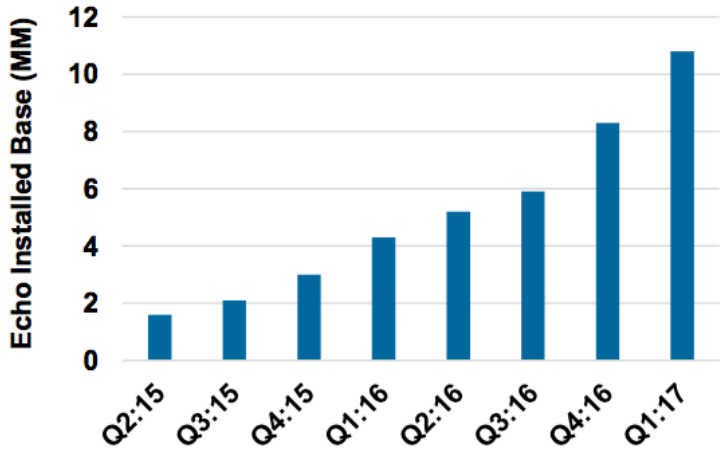
Source: Google I/O (5/16), Image: Macrumors (2/17)

Voice-Based *In-Home* Platform *Front-Ends* = Voice Can Replace Typing

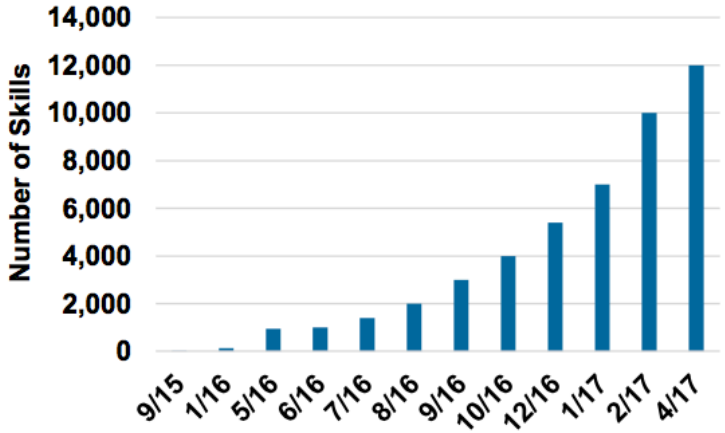
Amazon Echo Evolution, 11/14 – 5/17

Echo = Shopping + Media
Echo Look = Shopping + Recommendations
Echo Show = Video + Voice Calls

Amazon Echo Device Installed Base, USA



Amazon Echo Skills
Broadening Use Cases



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Source: Image: Amazon, Consumer Intelligence Research Partners LLC, Geekwire, Technology Review, Wired, Fast Company

Papa 1999-2018

Is it a Car...Is it a Computer?...

Is it a Phone...Is it a Camera?

Is it a Car...Is it a Computer?

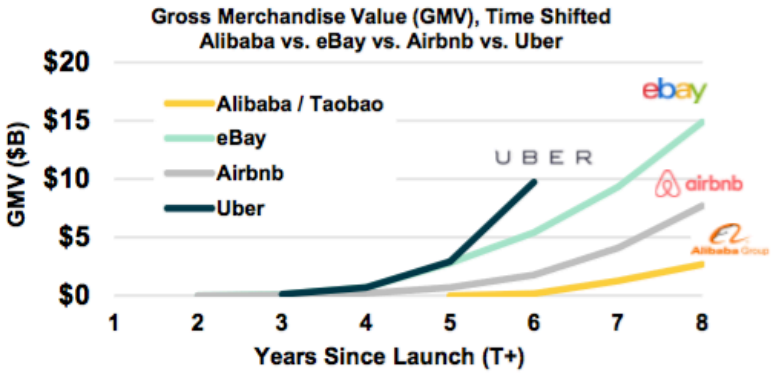
@KPCB Source: Apple, Tesla

...One Can...
Lock / Monitor / Summon One's Tesla from One's Wrist

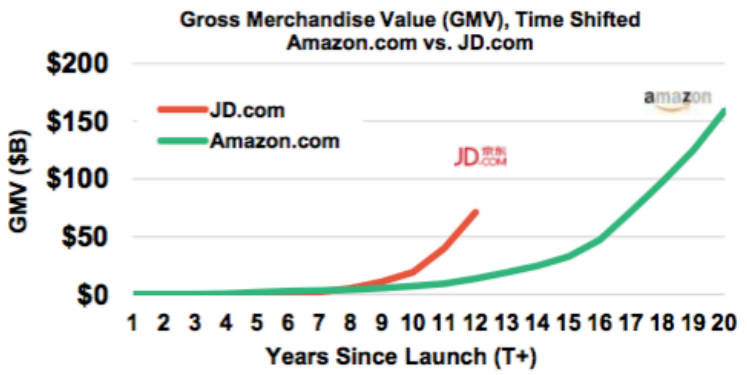
@KPCB Source: Tesla, The Verge, Redmond Pie

Current Generation of Internet Leaders = Growing Faster than Previous Generation

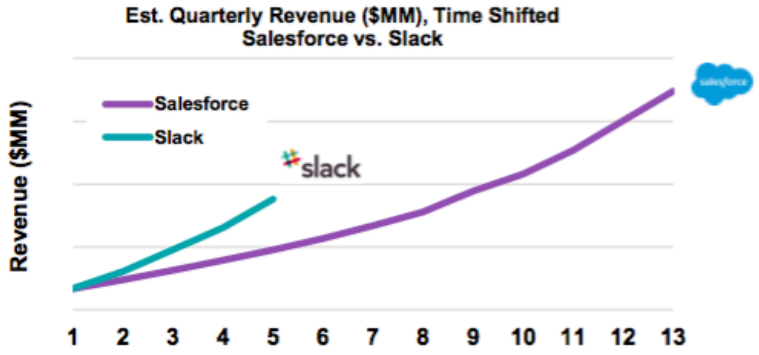
Marketplaces



Commerce



Enterprise



@KPCB

Marketplaces Source: Company data, Morgan Stanley Research. eBay founded in 1995. Amazon founded in 1995. Alibaba.com founded in 1999 as B2B portal connecting Chinese manufacturers and overseas buyers. Uber launched 2009, gave first ride in 2010. Airbnb founded in 2008.
Commerce Source: Publicly available company data, Morgan Stanley Research. JD.com launched B2C shipments in 2004, founded 1998 as an online magneto-optical store. Amazon founded in 1995.
Enterprise Source: Slack. Graph starting point based on similar est. revenue figures. Salesforce quarterly revenue approximated from publicly disclosed annual GAAP revenues.

2017 Global Market Capitalization Leaderboard = Tech = 40% of Top 20 Companies 100% of Top 5

Rank	Company	Region	Industry Segment	Current Market Value ($B)	2016 Revenue ($B)
1	Apple	USA	Tech – Hardware	$801	$218
2	Google / Alphabet	USA	Tech – Internet	680	90
3	Microsoft	USA	Tech – Software	540	86
4	Amazon	USA	Tech – Internet	476	136
5	Facebook	USA	Tech – Internet	441	28
6	Berkshire Hathaway	USA	Financial Services	409	215
7	Exxon Mobil	USA	Energy	346	198
8	Johnson & Johnson	USA	Healthcare	342	72
9	Tencent	China	Tech – Internet	335	22
10	Alibaba	China	Tech – Internet	314	21
11	JP Morgan Chase	USA	Financial Services	303	90
12	ICBC	China	Financial Services	264	85
13	Nestlé	Switzerland	Food / Beverages	263	88
14	Wells Fargo	USA	Financial Services	262	85
15	Samsung Electronics	Korea	Tech – Hardware	259	168
16	General Electric	USA	Industrial	238	120
17	Wal-Mart	USA	Retail	237	486
18	AT&T	USA	Telecom	234	164
19	Roche	Switzerland	Healthcare	233	51
20	Bank of America	USA	Financial Services	231	80
Total				$7,207	$2,497

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Source: CapIQ. Market value data as of 5/26/17
Note: For public companies, colors denote current market value relative to Y/Y market value. Green = higher, red = lower.

IoT is …

a proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data.

Google Definition

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.

Gartner

The **Internet of Things (IoT)** has been defined in Recommendation ITU-T Y.2060 (06/2012) as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

ITU

[6 slides from Al Brown, CTO of 1 For 1]

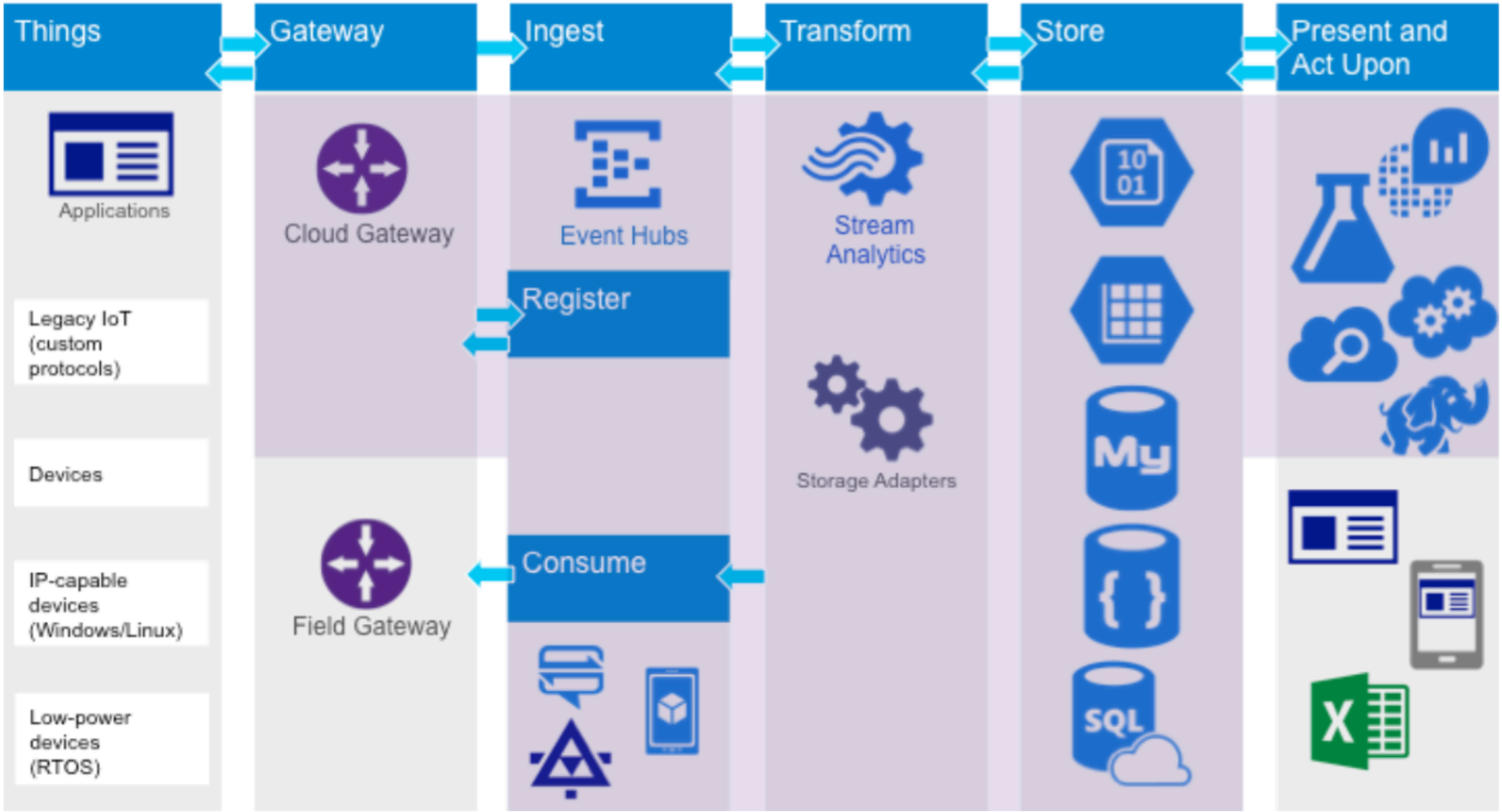
Types of IoT

Consumer

Health

Industrial

(NORMAL) IoT Layers



IoT Protocols

Networks and protocols are mostly not reliable and slow. Plan for it.

Device/Thing to Gateway:

- ZigBee - Wireless sensors
- BLE – Wireless sensors
- ModBus (Serial or TCP)

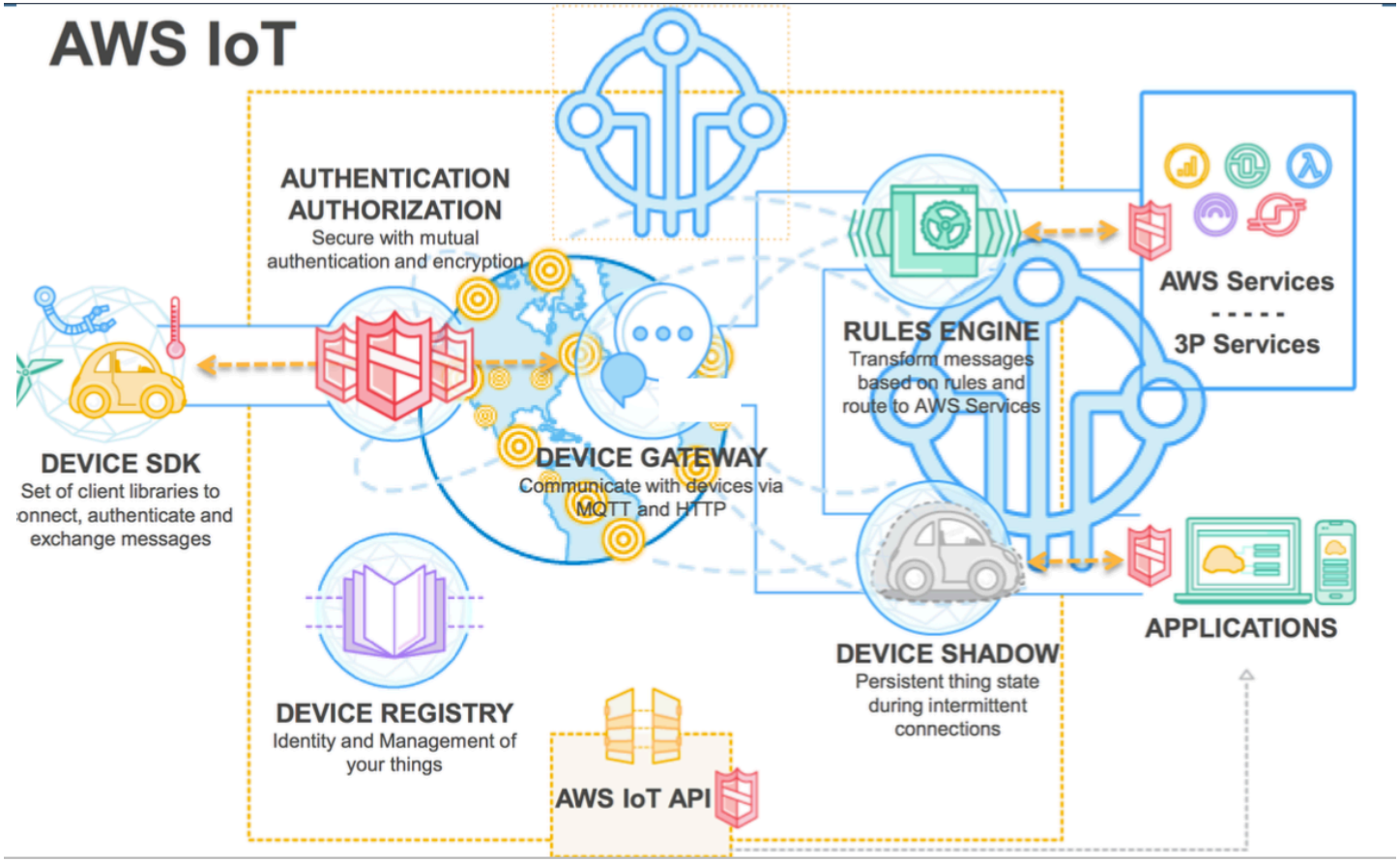
Gateway to Server:

- ModBus TCP – Common
- OPC - Common for industrial assets
- HTTP – JSON over HTTP
- MQTT - Consumer oriented, promising

IoT Platforms

- Amazon IoT
  - Physical/Shadow Device (Persisted JSON State)
  - MQTT Endpoint
  - Rules
  - AWS Connectivity
- GE Predix 2.0 (PaaS)
  - CloudFoundry, HDP
  - Asset Model, Machine Connectivity, Time Series DB, Analytics Plugin (BPMN)
- PTC ThingWorx
  - Originally HMI for TCP-connected devices
- Xively
  - Device connectivity, time series database, connectivity to applications
  - Popular with Arduino developers

AWS IoT



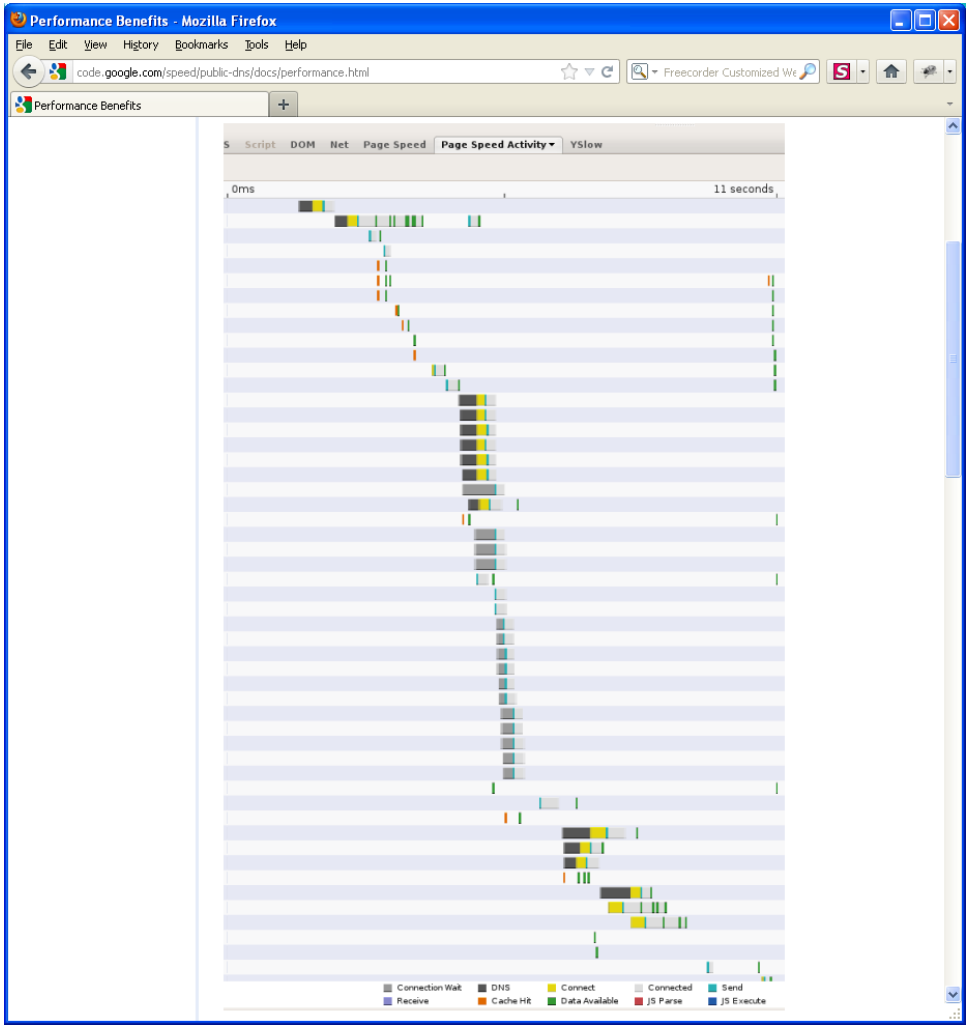
Domain Name System

- Lets focus on one important aspect of the Internet, the domain name system

DNS (Domain Name System) Resolution

- The DNS protocol is an important part of the web's infrastructure
- Every time you visit a website, your computer performs a DNS lookup
- Complex pages often require multiple DNS lookups before they start loading, so your computer may be performing hundreds of lookups a day
- DNS latency is mainly due to
  - The round-trip time to make the request and get the response, due to network congestion, overloaded servers, denial-of-service attacks
  - Cache misses which cause recursive querying of other name servers
- Google has introduced **Google Public DNS**
  - Configure your network to use 8.8.8.8 and 8.8.4.4
  - Google handles more than 70 billion requests ***a day!***
  - Google also has IPv6 addresses
    - 2001:4860:4860::8888 and 2001:4860:4860::8844
  - http://code.google.com/speed/public-dns/docs/intro.html
- Another alternative is **opendns.com**
  - They have a global network of DNS resolvers to speed resolution
  - The base service is free, but upgrades cost

DNS Resolution is a Critical Component of Efficient Web Page Downloading



- The chart shows the times spent loading a page where
  - black represents DNS resolution,
  - Gray represents Connection waiting,
  - Yellow represents connection,
  - red is JavaScript parsing, and
  - blue is JavaScript execution.
- There are 13 calls to the DNS resolver and 5 of them are serial lookups accounting for several seconds of the total 11 seconds spent loading the page

http://code.google.com/speed/public-dns/docs/performance.html

Internet Domain Names

- The Domain Name System is a mapping to/from IP addresses to domain names
  - defined in RFC 1034, 1035, see e.g.
  - http://www.faqs.org/rfcs/rfc1035.html
  - Invented in 1983 by Paul Mockapetris ***while at USC***, see http://en.wikipedia.org/wiki/Domain_name_system
- There are 13 top level root name servers, see http://en.wikipedia.org/wiki/Root_name_server
- Founded in 1998,ICANN is the organization in charge of maintaining the DNS system, see www.icann.com

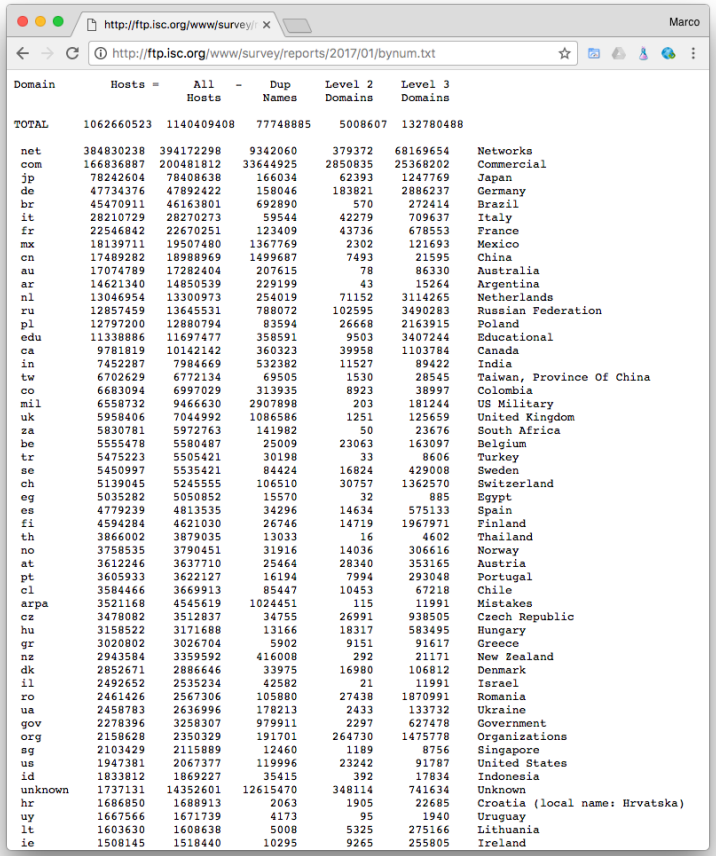
Internet Corporation for Assigned Names and Numbers

Top Level Domain Names

- **In 1984** Top level domains were **originally** divided into the following logical categories
  - com commercial and industrial organizations
  - edu educational institutions
  - gov non-military, government affiliated organizations
  - mil military organizations
  - net network operations
  - org other organizations and user groups
- **In 2001** new top level domains were added
  - .biz, .info, .name, .museum, .coop, .aero, .pro, .xxx
  - www.internic.net/faqs/new-tlds.html
- **In 2009** ICANN agreed to accept internationalized domain names, encoded as Unicode. See:
  - http://www.icann.org/en/resources/idn/fast-track
- **In 2011** ICANN announced a huge expansion of TLDs, giving requirements for anyone wanting to establish one
  - As of 9/12 they have received 2,000 applications
  - http://www.icann.org/en/news/announcements/announcement-13jun12-en.htm

Domain Name Statistics

Distribution of Top-Level Domain Names
by Host Count, January 2017,
at http://ftp.isc.org/www/survey/reports/2017/01/bynum.txt



http://ftp.isc.org/www/survey/ Marco

http://ftp.isc.org/www/survey/reports/2017/01/bynum.txt

Domain	Hosts	All Hosts	Dup Names	Level 2 Domains	Level 3 Domains	
TOTAL	1062660523	1140409408	77748885	5008607	132780488	
net	384830238	394172298	9342060	379372	68169654	Networks
com	166836887	200481812	33644925	2850835	25368202	Commercial
jp	78242604	78408638	166034	62393	1247769	Japan
de	47734376	47892422	158046	183821	2886237	Germany
br	45470911	46163801	692890	570	272414	Brazil
it	28210729	28270273	59544	42279	709637	Italy
fr	22546842	22670251	123409	43736	678553	France
mx	18139711	19507480	1367769	2302	121693	Mexico
cn	17489282	18988969	1499687	7493	21595	China
au	17074789	17282404	207615	78	86330	Australia
ar	14621340	14850539	229199	43	15264	Argentina
nl	13046954	13300973	254019	71152	3114265	Netherlands
ru	12857459	13645531	788072	102595	3490283	Russian Federation
pl	12797200	12880794	83594	26668	2163915	Poland
edu	11338886	11697477	358591	9503	3407244	Educational
ca	9781819	10142142	360323	39958	1103784	Canada
in	7452287	7984669	532382	11527	89422	India
tw	6702629	6772134	69505	1530	28545	Taiwan, Province Of China
co	6683094	6997029	313935	8923	38997	Colombia
mil	6558732	9466630	2907898	203	181244	US Military
uk	5958406	7044992	1086586	1251	125659	United Kingdom
za	5830781	5972763	141982	50	23676	South Africa
be	5555478	5580487	25009	23063	163097	Belgium
tr	5475223	5505421	30198	33	8606	Turkey
se	5450997	5535421	84424	16824	429008	Sweden
ch	5139045	5245555	106510	30757	1362570	Switzerland
eg	5035282	5050852	15570	32	885	Egypt
es	4779239	4813535	34296	14634	575133	Spain
fi	4594284	4621030	26746	14719	1967971	Finland
th	3866002	3879035	13033	16	4602	Thailand
no	3758535	3790451	31916	14036	306616	Norway
at	3612246	3637710	25464	28340	353165	Austria
pt	3605933	3622127	16194	7994	293048	Portugal
cl	3584466	3669913	85447	10453	67218	Chile
arpa	3521168	4545619	1024451	115	11991	Mistakes
cz	3478082	3512837	34755	26991	938505	Czech Republic
hu	3158522	3171688	13166	18317	583495	Hungary
gr	3020802	3026704	5902	9151	91617	Greece
nz	2943584	3359592	416008	292	21171	New Zealand
dk	2852671	2886646	33975	16980	106812	Denmark
il	2492652	2535234	42582	21	11991	Israel
ro	2461426	2567306	105880	27438	1870991	Romania
ua	2458783	2636996	178213	2433	133732	Ukraine
gov	2278396	3258307	979911	2297	627478	Government
org	2158628	2350329	191701	264730	1475778	Organizations
sg	2103429	2115889	12460	1189	8756	Singapore
us	1947381	2067377	119996	23242	91787	United States
id	1833812	1869227	35415	392	17834	Indonesia
unknown	1737131	14352601	12615470	348114	741634	Unknown
hr	1686850	1688913	2063	1905	22685	Croatia (local name: Hrvatska)
uy	1667566	1671739	4173	95	1940	Uruguay
lt	1603630	1608638	5008	5325	275166	Lithuania
ie	1508145	1518440	10295	9265	255805	Ireland

Graph | Data

Top-level Domains (TLDs) Overview — For the day of **December 26, 2017**

TLD	New	Deleted	Transferred	Current Total
.COM	83,513	107,254	87,277	131,923,564
.NET	121	20	0	14,846,742
.ORG	3,509	8,370	4,999	10,406,968
.INFO	3,177	3,807	12,562	6,496,580
.BIZ	792	1,425	1,110	2,027,316
.US	1,045	3,732	3,381	2,126,457
TOTALS	**92,157**	**124,608**	**109,329**	**167,827,627**

Above shows 131 million .com sites out
Of a total 167 million; see
http://www.dailychanges.com

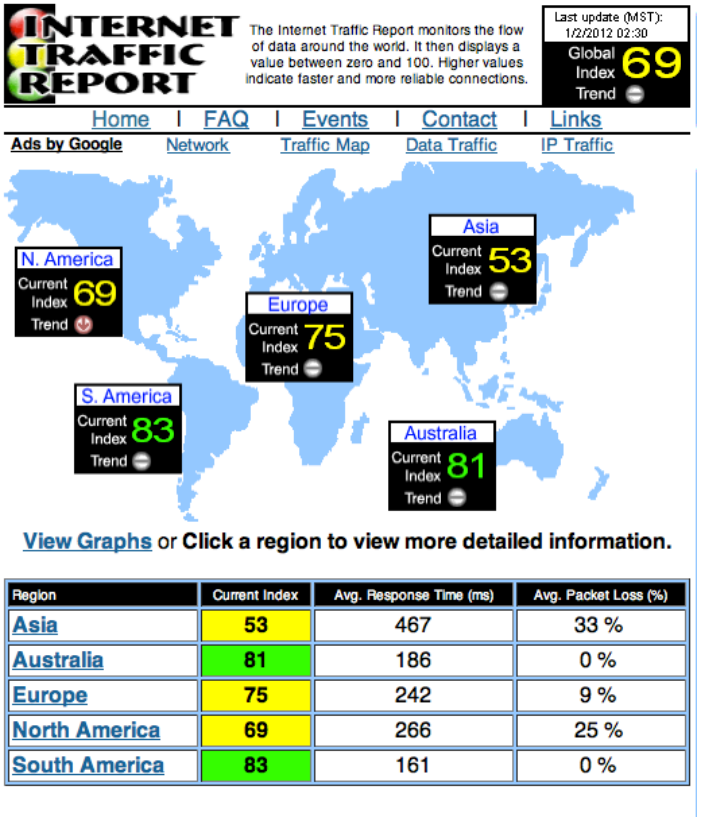
Try also:

http://research.domaintools.com/statistics/tld-counts/

Conclusion: the .net and .com categories are the largest followed by Japan, Germany and Brazil

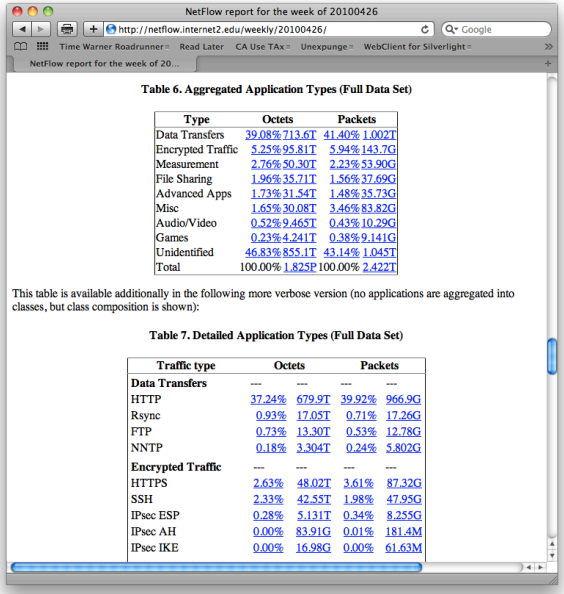
Internet Traffic

- How efficiently is the Internet working now
  - http://www.internettrafficreport.com/
  - http://www.internet2.edu/



Region	Current Index	Avg. Response Time (ms)	Avg. Packet Loss (%)
Asia	53	467	33 %
Australia	81	186	0 %
Europe	75	242	9 %
North America	69	266	25 %
South America	83	161	0 %

internet2 is a project to develop new technologies for high-performance computer networking. It is led by a consortium of 206 universities. While specifically developed to facilitate research and educational purposes, the involvement of research, commercial and government organizations also aims to distribute these technology into the wider community. The tables below is the latest available and it shows the type and amount of traffic



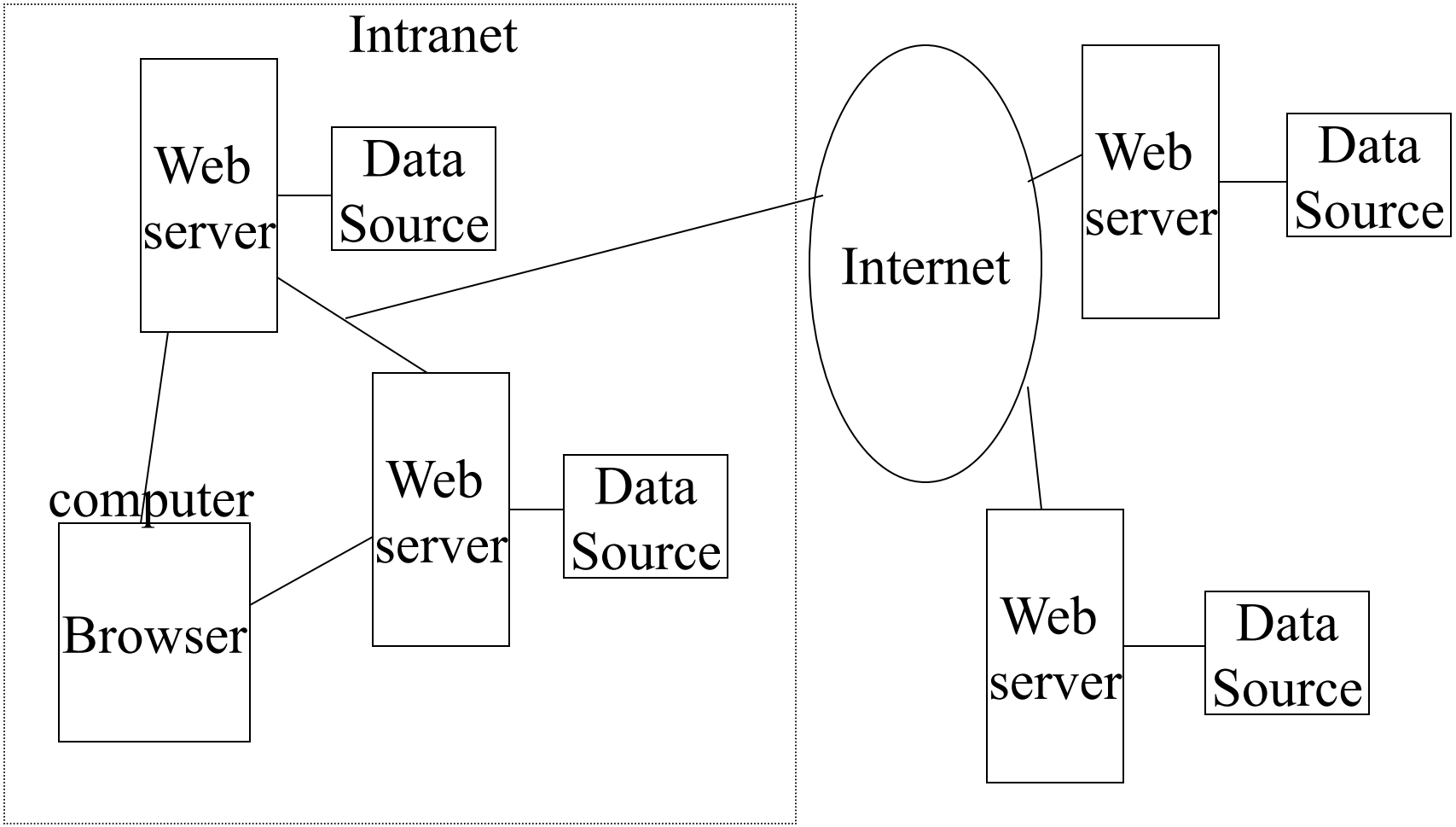
In April 2010:
Data Transfers was 41%

HTTP was approx 39%
HTTPS was approx 48% of encrypted traffic

Defining the World Wide Web

- A wide-area hypertext, multimedia information retrieval system that provides access to a large universe of documents
- A uniform way of accessing and viewing some information on the Internet
- The WWW
  - creates a world in which information has a reference by which it can be accessed
  - subsumes the capabilities of ftp, gopher, wais and news

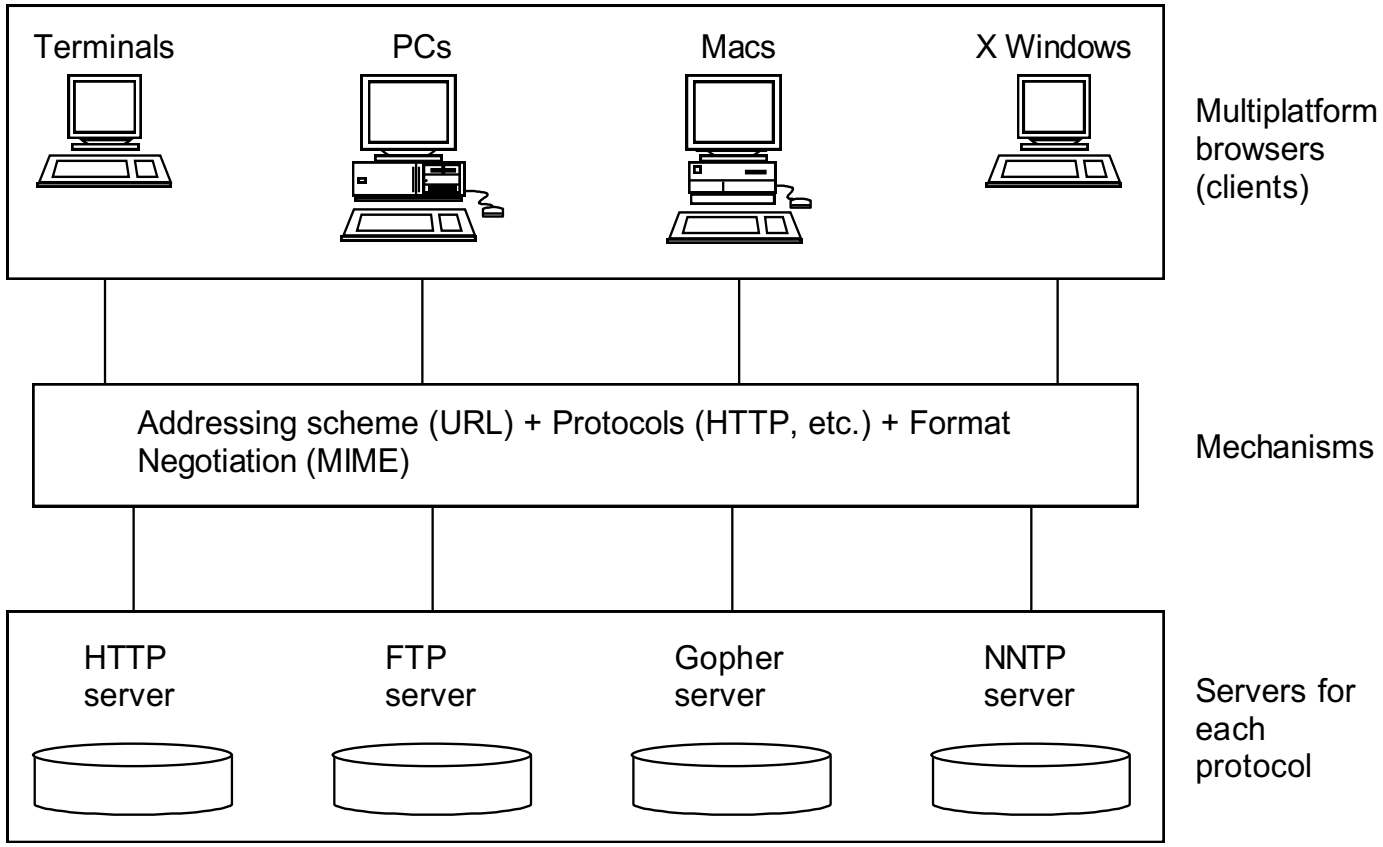
Graphical View of the WWW



Major Technology Components

- **Client/server architecture**
  - where client programs interact with web servers
- **Network protocol**
  - HTTP, Hypertext Transfer Protocol, is the language understood by browsers and web servers
  - designed to move quickly from document to document
- **Addressing system** (Uniform Resource Locators)
  - http://domain/directory/file.html
- **Markup Language**
  - every web server understands and every browser displays
  - includes support for HyperText and multimedia

Client/Server Architecture Model



The WWW Server

- Web browsers and Web servers communicate according to a protocol known as HTTP (HyperText Transfer Protocol)
  - The current HTTP protocol is version 1.1
- The Web server is a software system running on a machine often called the Web server, don't confuse them
- A web server can
  - receive and reply to HTTP requests
  - retrieve documents from specified directories
  - run programs in specified directories
  - handle limited forms of security
- A web server does not
  - know about the contents of a document, links in a document, images in a document or whether a particular file, e.g. a *.gif file, is in the correct format

Uniform Resource Locator (URL)

- A mechanism whereby an Internet resource can be specified in a single line of ASCII text
- See RFC 1738: http://www.faqs.org/rfcs/rfc1738.html

URL	Refers to:
file://pub/xt.ps	a PostScript file in directory pub on your local machine
ftp://usc.edu/docs/sweng.txt	file sweng.txt in directory docs on usc.edu, an anonymous ftp site
http://nunki.usc.edu/mydocs/book.doc	a file in directory mydocs on machine nunki.usc.edu, a WWW site
news:comp.compilers	the newsgroup computers.compilers
mailto:horowitz@usc.edu	an e-mail address

General Description of a URL

1. Scheme followed by a colon
   http:,ftp:,gopher:,news:,mailto:,wais:,telnet:
2. Double slash (only for http, ftp, gopher, wais) //
3. Internet domain name e.g., pollux.usc.edu
4. Port number (this field is optional; e.g., pollux.usc.edu:8081)

   Standard or default port numbers:

---	ftp is 21	gopher is 70
---	telnet is 23	http is 80
---	smtp is 25	nntp is 119
---	imap is 143	secure nntp is 563
---	pop3 is 110	secure pop3 is 995

5. Path e.g., /pub/docs

URL Character Set

- RFC 1738, Dec. 1994 defines the URL character set as

"...Only alphanumerics [0-9a-zA-Z], the special characters "$-_.+!*'()," **[not including the quotes]**, and reserved characters used for their reserved purposes may be used unencoded within a URL."

- However, HTML supports ISO-8859-1 (ISO-Latin) character set
  - HTML 4.x extends the character set to all of Unicode
- Therefore, in URLs an escape mechanism is used, % followed by two hex digits
- Characters that should be encoded include:
  %, /, ., .., #, ?, ;, :, $, +, @, &, =
- Here are some encoded values for so-called “unsafe” characters

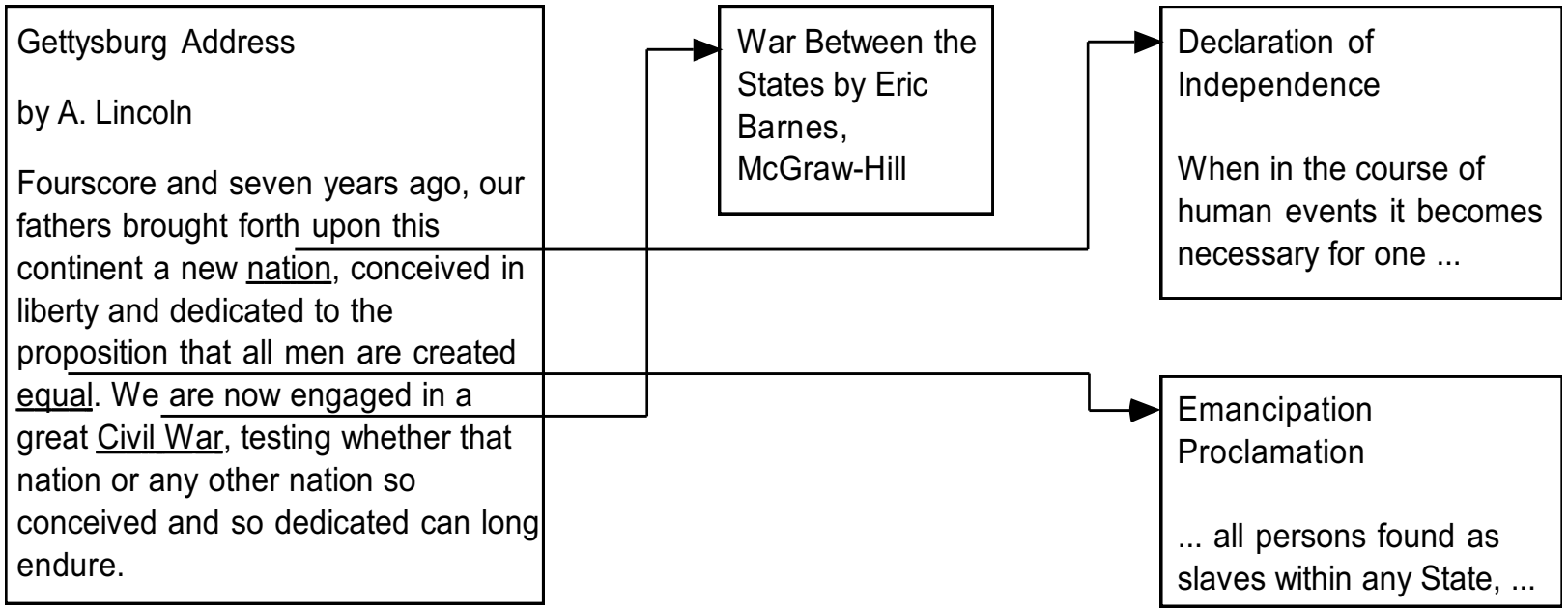
~	%7E	|	%7C
SPACE	%20	\	%5C
%	%25	^	%5E
&	%26	[	%5B
=	%3D	]	%5D
?	%3F	#	%23
{	%7B	>	%3E
}	%7D	<	%3C

Markup Languages

- HTML - hypertext markup language, specifies document layout and the specification of hypertext links to text, graphics and other types of objects
- Browsers display text and graphics using the markup as guidance
- However, HTML is *not* like a word processing program, e.g. Microsoft Word or WordPerfect, and *not* like a page description languages, e.g. postscript
  - as a result, translation into HTML can produce a result that does not look exactly like the original

What is HyperText?

- Regular text, with the additional feature of links to related documents
- As you read documents and follow links, you traverse a "web" of interconnections

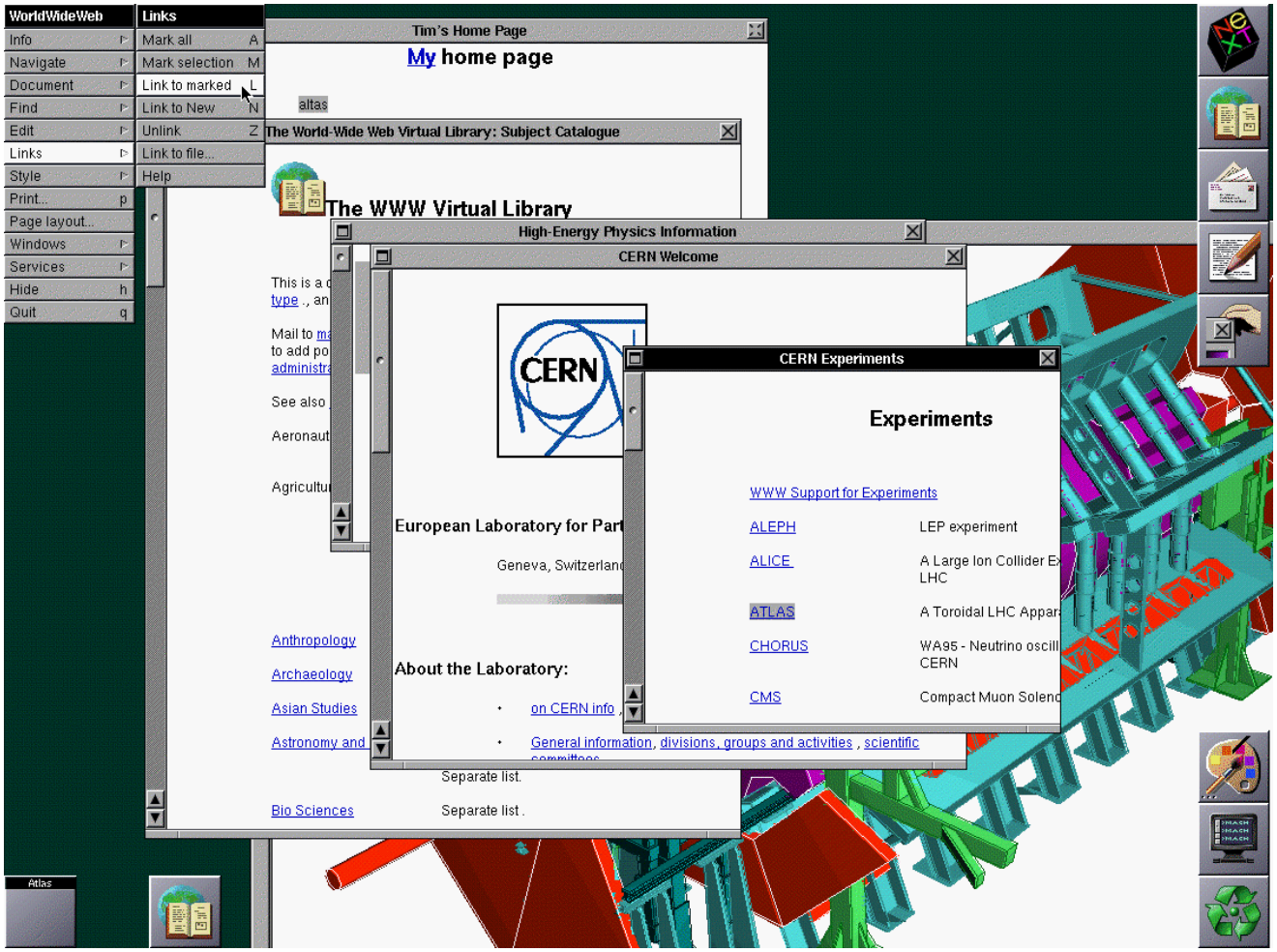


Early History of the WWW

- 1989-1990 Tim Berners-Lee conceives the WWW at CERN in Geneva
- 1990 Berners-Lee releases WWW prototype on NeXt computer
- 1992 Release of source code for line mode browser, lynx and HTTP
- 1993 Mosaic browser from NCSA is released
- 1993 WWW internet traffic now measures 1% of NSF backbone
- 12/94 Netscape Navigator 1.0 is released
  World Wide Web Consortium formed
- 1995 Microsoft Windows 95 and Internet Explorer 1.0 released
- 1995 Java is released
- 1998 Google is started
- 1999-2001 A burst of Internet start-up companies which flamed out because they were not profitable. Also known as he "Internet Bubble."
- 2004 Firefox 1.0 is released
- 2005 YouTube is founded
- 2008 Google Chrome 1.0 is released

First Web Communication (Dec 1990)

See http://www.w3.org/History.html and tim Berners-Lee's presentation at the 10th anniversary, http://www.w3.org/2004/Talks/w3c10-HowItAllStarted/?n=1



London Olympics (July 2012)

See http://www.zdnet.com/article/web-inventor-tim-berners-lee-stars-in-olympics-opening-ceremony/

https://www.youtube.com/watch?v=KW6ivwDcOY4

Sir Tim Berners-Lee live-tweets during the 2012 Olympics opening ceremony, with a NeXT Cube by his side

WWW Consortium

- Founded in 1994, headed by Tim Berners-Lee, http://www.w3.org
- Goal: “to lead the World Wide Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability.”
- Many of the technologies guided by the WWW consortium will be discussed this semester:
  - HTML, Style Sheets, Document Object Model, international character sets, HTTP, XML, etc.