In Tech We Trust:
The next five years of the Internet

Lucie Burgess, Digital Catapult

BSI Standards Matter, Edinburgh, 22nd June 2017

1. A history lesson
2. Trust and value in the internet today
3. Five trends that will shape trust and value
4. A vision for the next-generation internet

A brief history of the web

1960s – Packet switching invented; ARPANet launched

1970s – Internet protocols developed. Email invented. Phrase "The Internet" is coined

1980s – Domain name system created. Routing protocols developed

1989 – Tim Berners Lee invents the World Wide Web at CERN

1991 – WWW open to the public as the "Information Superhighway"

1994 – Amazon.com is founded

1998 – Google is incorporated by Larry Page and Sergey Brin. 60M web pages indexed

2001 – Jimmy Wales launches Wikipedia. 0.5M internet users.

2004 - Facebook is launched by Mark Zuckerberg.

2006 – Apple launches the iPhone is launched.

2010 - China dominates global internet usage with over 450 million internet users.

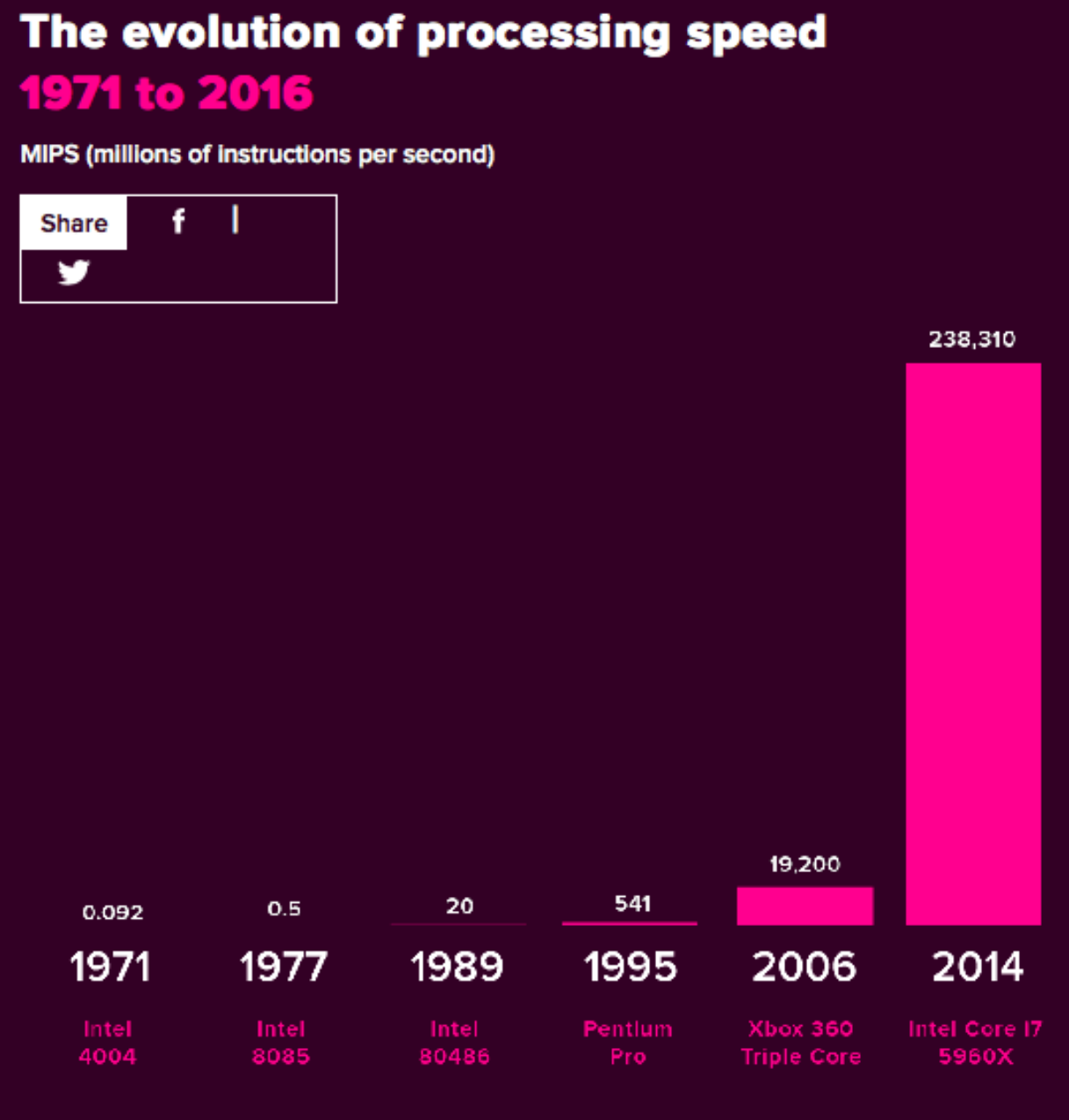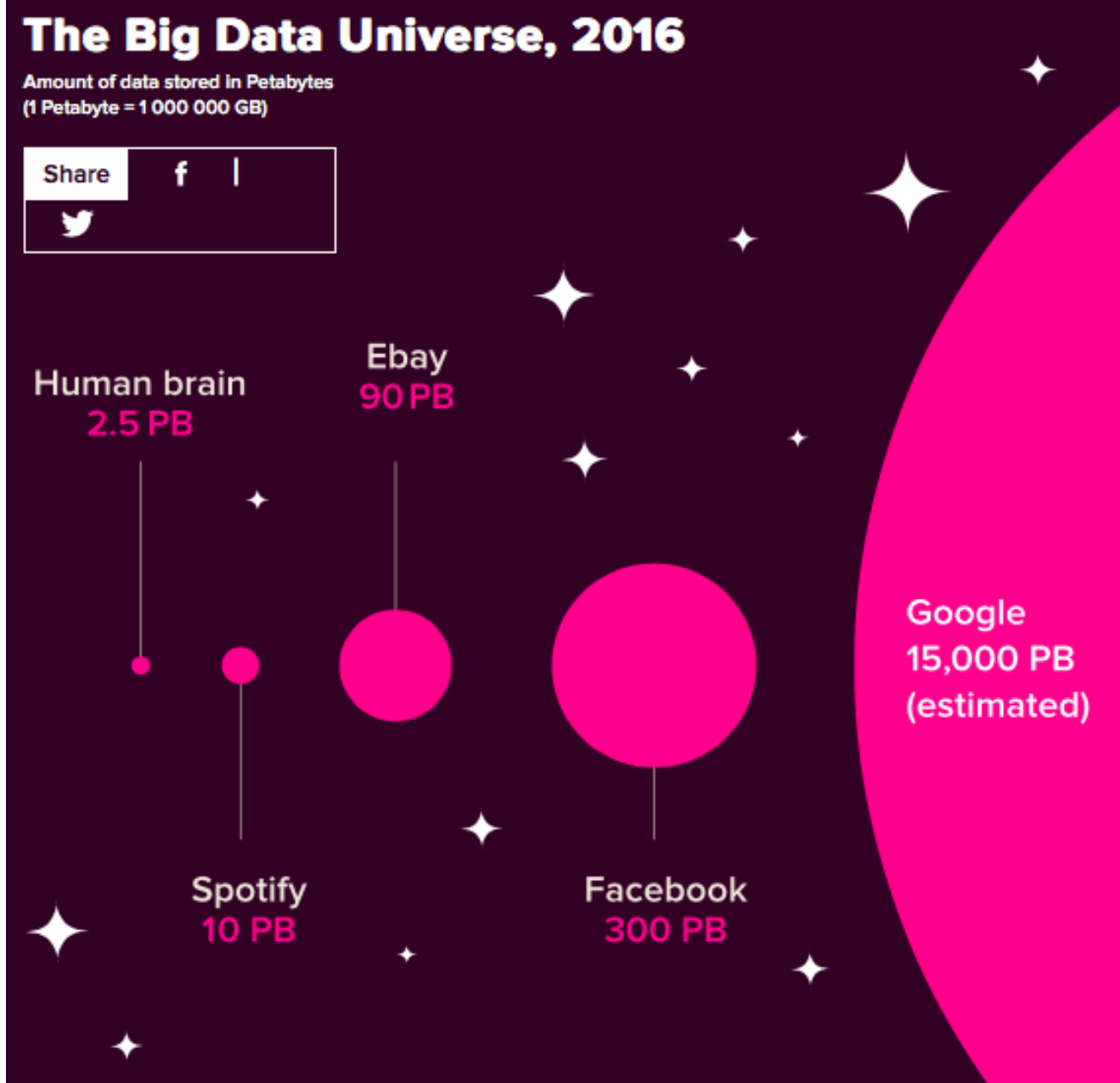2011 - Live streaming of the Royal Wedding is the biggest internet event ever.

2016 - The WWW celebrates its 25th birthday.

Founding principles of the early Internet

- **Decentralisation**

- **Non-discrimination**

- **Bottom-up design**

- **Universality of code**

- **Consensus through standardisation**

Today: big data and compute

The Big Data Universe, 2016

Amount of data stored in Petabytes
(1 Petabyte = 1 000 000 GB)

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Human brain
2.5 PB

Ebay
90 PB

Spotify
10 PB

Facebook
300 PB

Google
15,000 PB
(estimated)

The evolution of processing speed
1971 to 2016

MIPS (millions of instructions per second)

Share f |

0.092	0.5	20	541	19,200	238,310
1971	1977	1989	1995	2006	2014
Intel 4004	Intel 8085	Intel 80486	Pentium Pro	Xbox 360 Triple Core	Intel Core I7 5960X

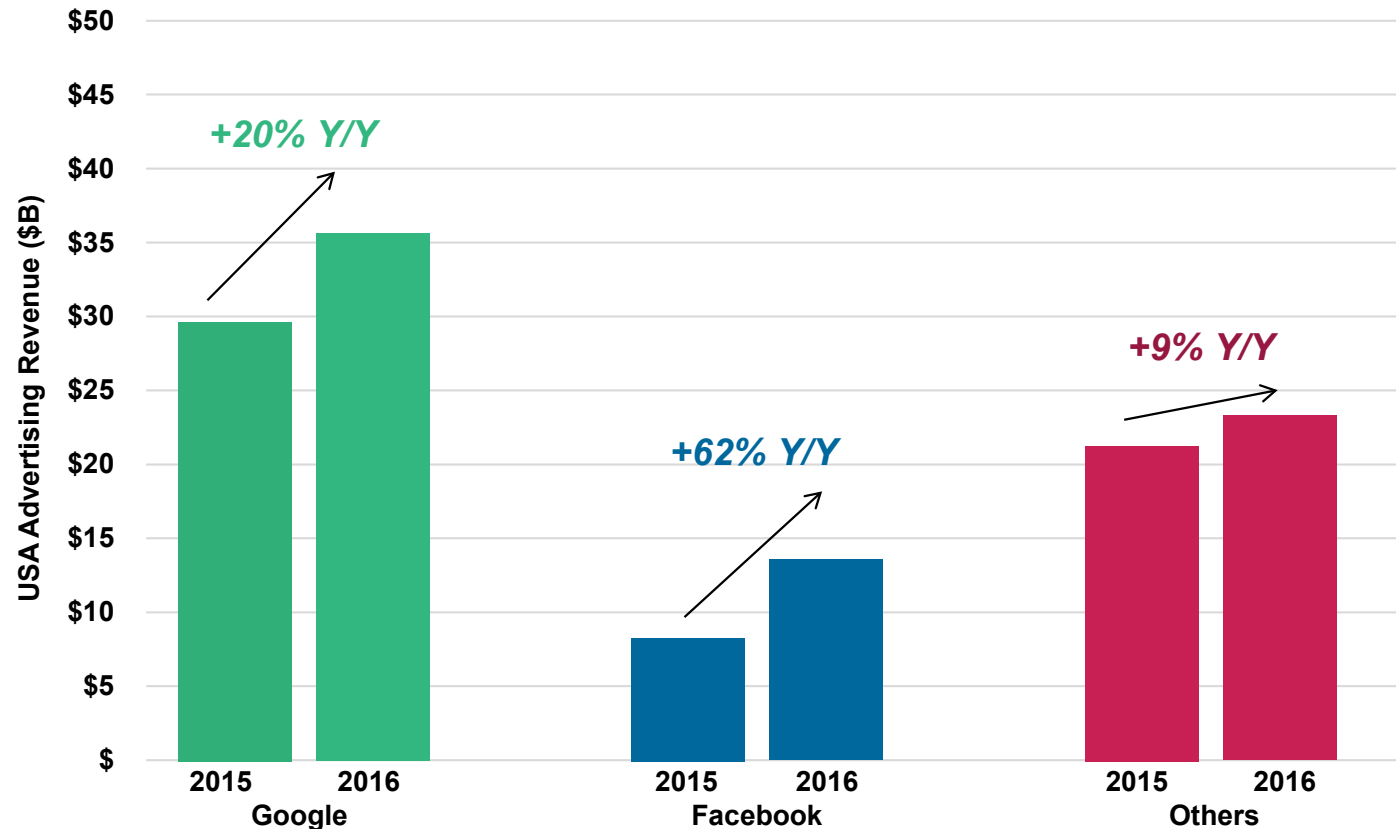# The web today is dominated by a few major players

Google + Facebook =
85% (& Rising) Share of Internet Advertising Growth, USA

Advertising Revenue ($B) and Growth Rates (%) of Google vs. Facebook vs. Other, USA, 2015 – 2016

+20% Y/Y

+62% Y/Y

+9% Y/Y

2015 | 2016
Google

2015 | 2016
Facebook

2015 | 2016
Others

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Silicon Valley: the largest innovation ecosystem in the world

Source: the global startup ecosystem report 2015/2016: Compass

Who owns your data? (Hint: not you)

Source: HubOfAllThings, Warwick Manufacturing Group, University of Warwick
 https://www.youtube.com/watch?v=y1txYjoSQQc

Cookies: "Comprehensive privacy invaders"

- Canvas fingerprinting

- Cookie re-spawning
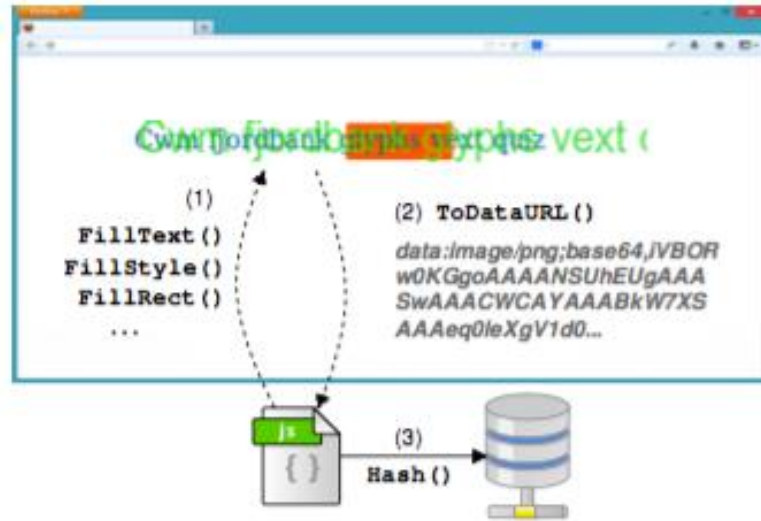
- Cookie re-syncing

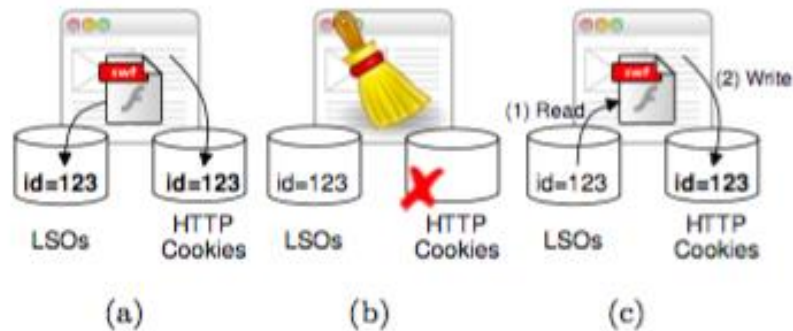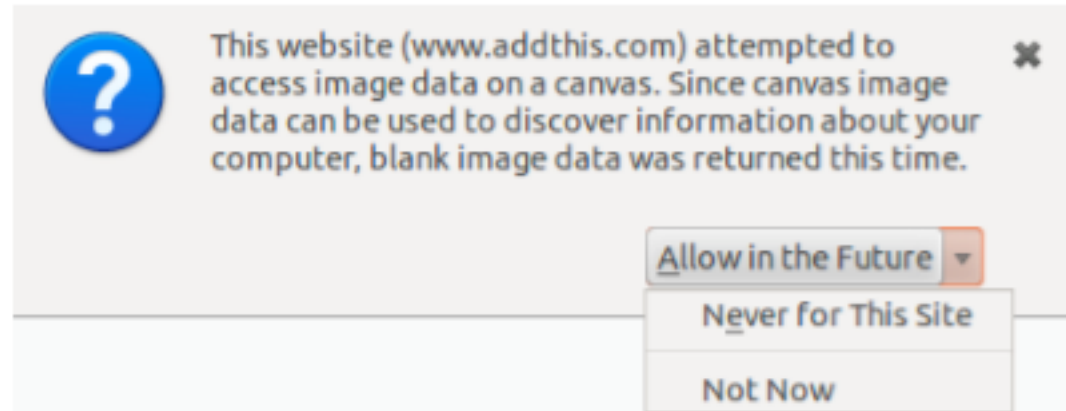Figure 1: Canvas fingerprinting basic flow of operations

Figure 2: Respawning HTTP cookies by Flash evercookies: (a) the webpage stores an HTTP and a Flash cookie (LSO), (b) the user removes the HTTP cookie, (c) the webpage respawns the HTTP cookie by copying the value from the Flash cookie.

This website (www.addthis.com) attempted to access image data on a canvas. Since canvas image data can be used to discover information about your computer, blank image data was returned this time.

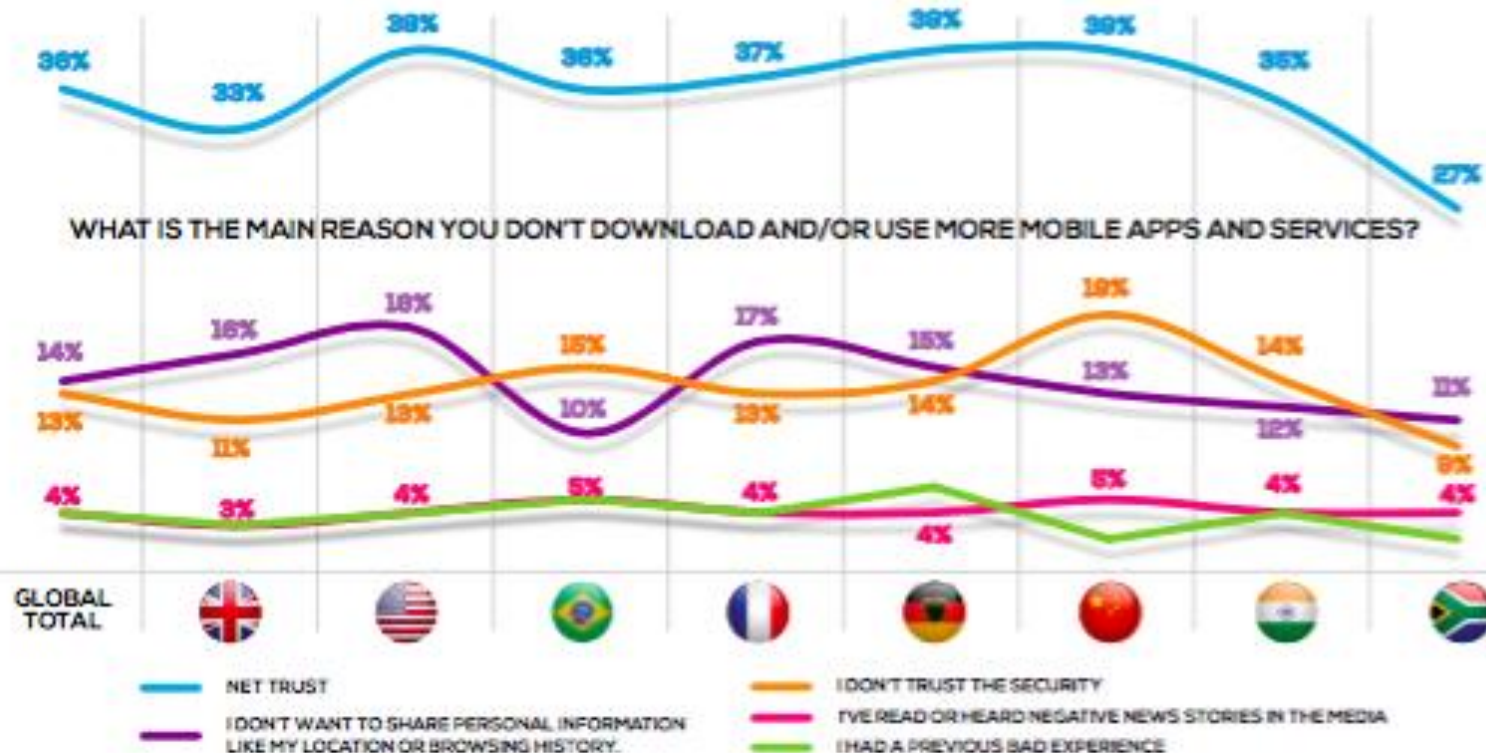Allow in the Future
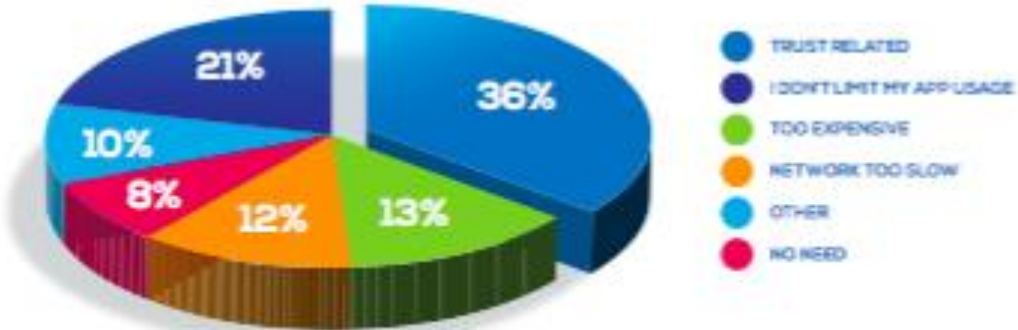
Never for This Site

Not Now

Source: The Web Never Forgets: Persistent Tracking Mechanisms in the Wild. Gunes Acar, Christian Eubank, Steven Englehardt, Marc Juarez Arvind Narayanan, Claudia Diaz, Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security - CCS '14

Consumer trust in the internet today

Source: Mobile Ecosystem Forum, Consumer Trust report 2016

The Internet today

- **Global internet users > 50% global population**
- **Still decentralised and neutral (just about)**
- **Age of network effects**
- **Age of walled gardens and technical lock-in**
- **Low marginal cost, platforms dominate**
- **= New age of monopoly**

Five trends that will shape trust and value

Trend 1. Privacy-aware and data-empowered consumers

Ad Blocking = Growth Continues…Especially in Developing Markets…
Users Increasingly Opt Out of Stuff They Don't Want

**Adblocking *Users* on Web
(Mobile + Desktop), Global, 4/09 – 12/16**

Legend:
— Desktop Adblocking Software Users
— Mobile Adblocking Browser Users

Y-axis: Global Adblocking Users (MM); values 0, 100, 200, 300, 400
X-axis: 2009 2010 2011 2012 2013 2014 2015 2016
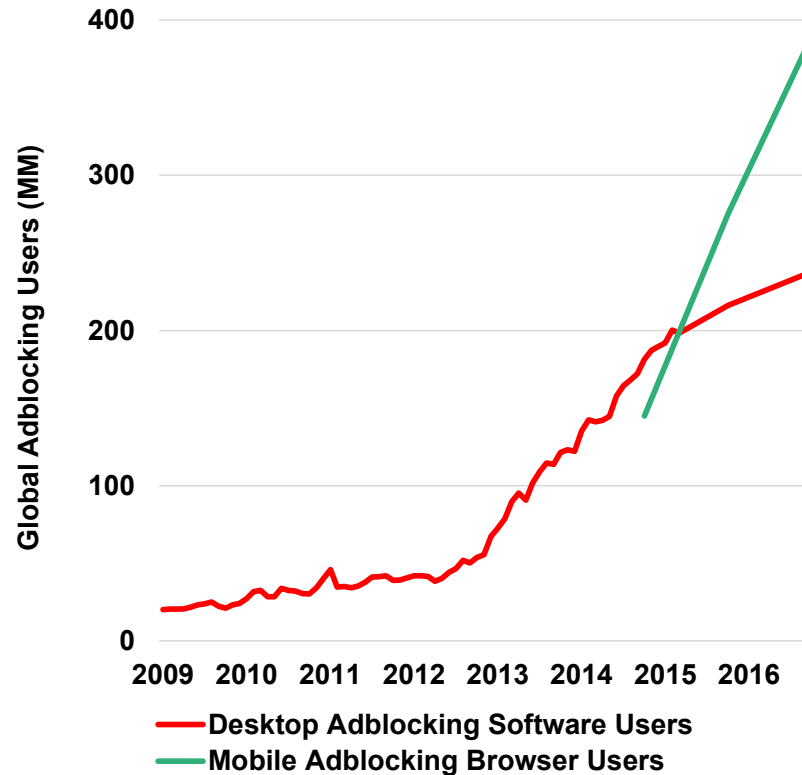
**Adblocking *Penetration*
(Mobile + Desktop), Selected
Countries, 12/16**

Country	Desktop	Mobile
China	1%	13%
India	1%	28%
USA	18%	1%
Brazil	6%	1%
Japan	3%	--
Russia	6%	3%
Germany	28%	1%
Indonesia	8%	58%
UK	16%	1%
France	11%	1%
Canada	24%	--

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Trend 1. Privacy-aware and data-empowered consumers

…Wearables =
Consumer Health + Wellness Data Capture Rising Rapidly…

Wearables = Gaining Adoption
~25% of Americans own a Wearable, +12% Y/Y, 2016

Global Wearable Shipments

Year	Global Wearable Shipment Volumes (MM)
2014	26
2015	82
2016	102
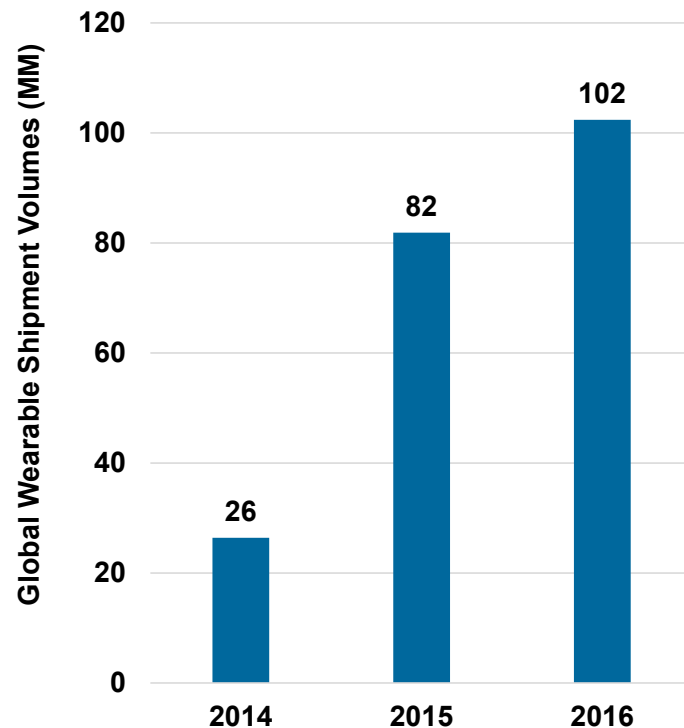
Sensors in Wrist Wearables, 9/16

Sensor	% of Wrist Wearables*
Accelerometer	86%
Heart Rate	33%
GPS	28%
Gyroscope	26%
Compass	19%
Microphone	18%
Ambient Light	12%
Barometer	7%
Altimeter	6%
Camera	6%
Thermometer	5%
Others	13%

% of Wrist Wearables*
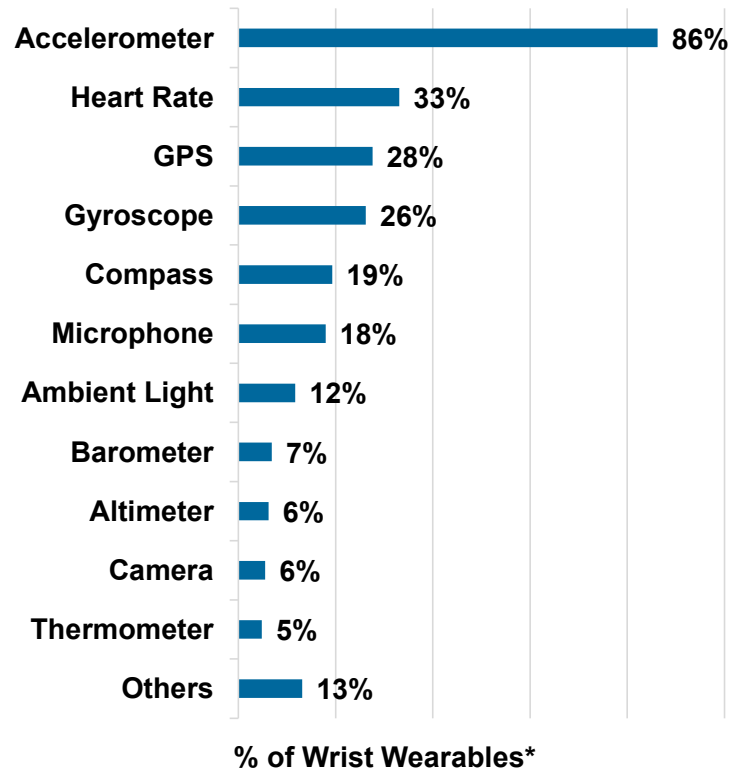
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Who would you trust with your health data?

Leading Tech Brands Positioned Well for Digital Health, 2016

With which tech company would you share your data?

Bar chart — % of Consumers Willing to Share Health Data:
- Google: 60%
- Microsoft: 56%
- Samsung: 54%
- Apple: 50%
- Amazon: 39%
- Facebook: 39%
- IBM: 37%

Source: Rock Health 2016 Consumer Survey
Note: Based on consumer survey with 4,015 participants; as % of respondents willing to share their health data with tech company at all.

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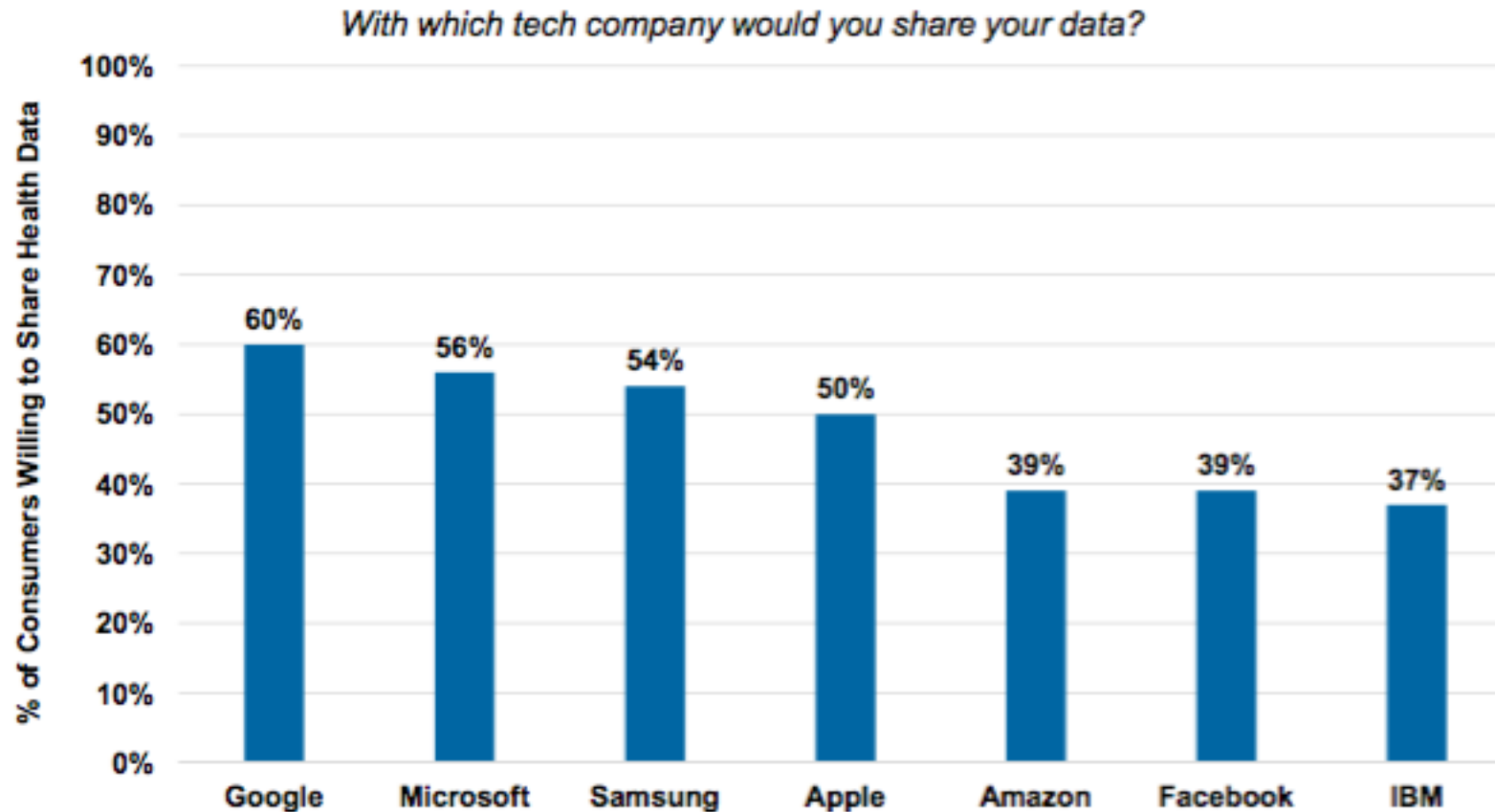
Trend 2. The Internet of Things

Currently 6.4 Billion – 9 Billion connected devices

Automotive, consumer electronics, utilities, health, smart cities, intelligent buildings …

18.6Billion microcontrollers shipped in 2014, 10.4 Billion RFID tags in 2015

Over 20 different types of connectivity

Growth 10% - 30% p.a.

Trust in the Internet of Things

TechUK/ Digital Catapult
IoT trust principles

BitBarista:
https://www.petrashub.org/bitbarista-goes-out-to-work/
Bitbarista: Exploring Perceptions of Data Transactions in the Internet of ThingsLarissa Pschetz, Ella Tallyn, Rory Gianni, Chris Speed ACM CHI, May 2017

Polly Put the Kettle On:
https://www.petrashub.org/design-fiction-internet-of-things-and-object-orientated-ontology/

Trend 3. Artificial intelligence and machine learning

- Models that learn by example from training data: text, images, audio, numerical data etc
- Statistical techniques, neural networks, deep learning
- Healthcare: breast cancer diagnoses, retinopathy, kidney disease, managing stress ...
- Transport: autonomous vehicles, flow analytics
- Industry: robotics, predictive analytics in supply chain
- Retail: Digital assistants, avatars, bots
- May 2017: Google declared itself an 'AI first' company

How much should we trust algorithms?

- How transparent are algorithms? Can we trust a 'black box'?

- To what extent do machine learning models incorporate systematic bias?

- What rights do people have to opt out of their use?

- To what extent might algorithms violate our privacy?

Harvard Business Review

BUSINESS LAW

How Pricing Bots Could Form Cartels and Make Things More Expensive

by Maurice E. Stucke and Ariel Ezrachi

OCTOBER 27, 2016

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oct16-27-138704353

How competitive is our market economy? Not as much as it ought to be. And the growth of big data threatens to make things even worse. Antitrust regulators already struggle to keep markets competitive. How will they fare in a world where intelligent pricing algorithms subtly collude with one another?

BERKELEY TECHNOLOGY LAW JOURNAL
University of California, Berkeley, School of Law

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Who Wouldn't Want a Digital Butler?

April 14, 2017 in 2017 Online Forum: Platform Law

Maurice E. Stucke[1] & Ariel Ezrachi[2]

Personal digital assistants are alluring. Many of us already benefit from basic digital assistants such as Google Assistant, Apple's Siri, Facebook's M, and Amazon.com's Alexa. They can read to our children, order beer and pizza, update us on traffic and news, and stump us with Star Wars trivia.

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2016 (4)
2015 (3)
2014 (5)
2013 (4)
2012 (4)

Trend 4. Distributed ledgers and smart contracts

- **Distributed ledger technologies enable parties without trust to transact**
- **Permissioned and non-permissioned systems**
- **Growing use in financial systems and insurance**
- **Supply chain applications in digital manufacturing, food, retail**
- **Potential applications tracking consent in digital health**
- **Applications tracking IP distribution in creative industries**

Blockchain: what price for trust?

- When might it be better to use other forms of secure data access?

- For very secure systems (e.g. NHS data) are public ledgers appropriate?

- How well can smart contracts encode agreements which are nuanced by design?

- Distributed ledgers/ smart contracts, like all code, are subject to bugs …

> There is little doubt that smart contracts will find compelling use cases and achieve those objectives in many instances. But equally, it is important to realise the limitations of smart contracts and understand that there are many elements of contractual relations that are not suitable for performance through deterministic computer logic embodied in a smart contract. If there are unrealistic expectations for what the technology can achieve, early adopters may find that they frustrate, rather than simplify, their dealings with others.

Chapter
Banking Beyond Banks and Money
Part of the series New Economic Windows pp 97-120

Date: 01 September 2016

Features or Bugs: The Seven Sins of Current Bitcoin

Nicolas T. Courtois ✉

Paolo Tasca
Tomaso Aste
Loriana Pelizzon
Nicolas Perony   Editors

Banking
Beyond Banks
and Mo

A Guide to Banking S
Twenty-First Century

Look Inside

blb
Oxford
Business Law
Blog

Trend 5: Importance of innovation and the economy

- Following the financial crisis and global recession, the economy is central

- Recognition that entrepreneurship can help to solve global problems

- Innovation brings together a perfect storm of disruptive technologies

- New applications in smart cities, robotics, autonomous vehicles, data markets, energy sustainability, retail, digital manufacturing, creative industries, finance …

- New business models are as important as technology

" *I want you to get rich, but you don't get to be greedy and selfish because our societies don't accept that anymore.* **"**

— Emmanuel Macron

https://techcrunch.com/2017/06/16/emmanuel-macron-proves-that-he-still-cares-about-startups/?ncid=rss

So what next for the Internet?

Our vision is of an Internet that is more inclusive, participatory, human-centred, trusted, socially-driven and economically beneficial for all

DRIVING THE
UK ECONOMY
THROUGH
DIGITAL
INNOVATION

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