

CSE508 Network Security

5/2/2016 **Privacy**

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# Privacy

*“The right of an entity (normally a person), acting in its own behalf, to determine the degree to which it will interact with its environment, including the degree to which the entity is willing to share information about itself with others.” [RFC2828]*

# Real-world Privacy

## Large-scale data collection examples

Credit cards, Metrocards, Loyalty cards

Street/public space cameras

E-ZPass

Named tickets

...

Part of our everyday activities and personal information is (voluntarily or compulsorily) recorded

Information from different sources can be **correlated**

*Did you buy your Metrocard with your credit card?*

The same happens in the online world...

## **Third parties have access to...**

Our email (Gmail, Yahoo, ...)

Our files (Dropbox, Google Drive, ...)

Our finances (e-banking, credit reporting, Mint, ...)

Our communication (Skype, Facebook, ...)

Our traffic (WiFi hotspots, ISPs, ...)

Our location (3/4G, GPS, WiFi, ...)

Our activities (browsing history, daily routine, ...)

Our preferences ("Likes," Amazon, Netflix, ...)

Our health (Fitbit, iWatch, 23andMe, ...)

...

BUSINESS DAY

# Millions of Anthem Customers Targeted in Cyberattack

By REED ABELSON and MATTHEW GOLDSTEIN FEB. 5, 2015



Outside the Anthem facility in Indianapolis. Anthem said it detected a data breach on Jan. 29, and that it was working with the Federal Bureau of Investigation. Aaron P. Bernstein/Getty Images

Anthem, one of the nation's largest health insurers, said late

# Hacking of Government Computers Exposed 21.5 Million People

By JULIE HIRSCHFELD DAVIS JULY 9, 2015



Katherine Archuleta, director of the Office of Personnel Management, right, at hearing before the House Oversight and Government Reform Committee last month. Mark Wilson/Getty Images

✉️ Email

WASHINGTON — The Obama administration on Thursday revealed that 21.5 million people were swept up in a colossal breach of government computer systems that was far more damaging than

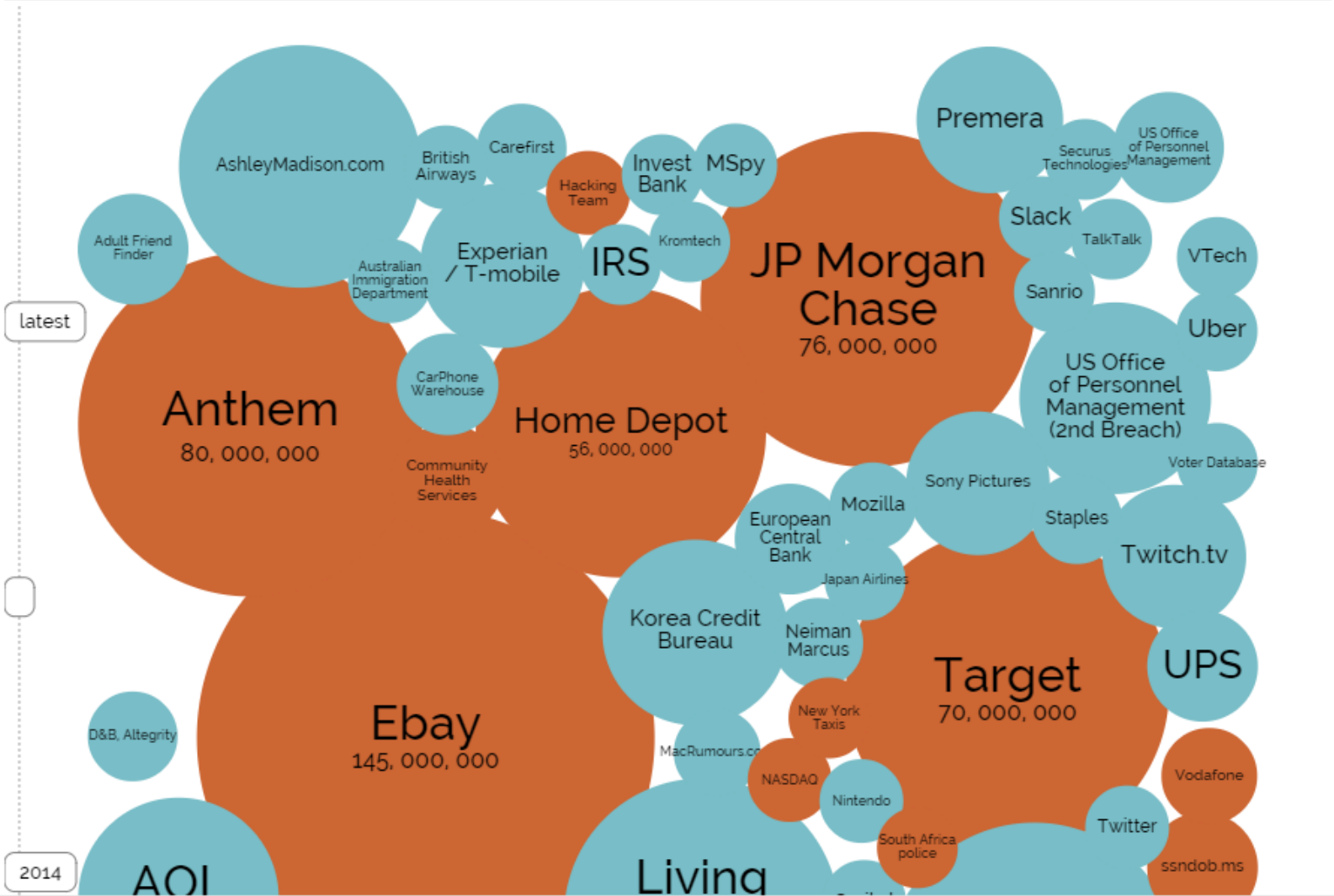


# World's Biggest Data Breaches

Selected losses greater than 30,000 records  
(updated 2nd October 2015)

interesting story

YEAR     BUBBLE COLOUR     YEAR     METHOD OF LEAK     BUBBLE SIZE     NO OF RECORDS STOLEN     DATA SENSITIVITY      SHOW FILTER





New Rules in China Upset Western Tech Companies



STATE OF THE ART Uber's Business Model Could Change Your Work



ECONOMIC SCENE Job Licenses in Spotlight as Uber Rises



DEALBOOK After Alibaba Spinoff, Yahoo May Become a Takeover Target

# Bits

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SEARCH

## SECURITY

# Apple Says It Will Add New iCloud Security Measures After Celebrity Hack

By BRIAN X. CHEN SEPTEMBER 4, 2014 11:32 PM 21 Comments

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Microsoft Introduces Three New Smartphones

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Daily Report: Apple Expected to Unveil Smartwatch and Larger iPhones

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UBER BLOG | A new study released by the ride-hailing company claims it is having a "measurable impact on driving down alcohol-related crashes." - *Mike Isaac*





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By Jeffrey Goldberg



The Effects of Forgiveness  
By Olga Khazan



Rural America's Silent Housing Crisis  
By Gillian B. White



Introducing the Supertweet  
By Ian Bogost

# Armed With Facebook 'Likes' Alone, Researchers Can Tell Your Race, Gender, and Sexual Orientation

REBECCA J. ROSEN | MAR 12 2013, 2:59 PM ET

*But the deeper aspects of your personality remain hard to detect.*



## VIDEO



### How to Build a Tornado

A Canadian inventor believes his tornado machine could solve the world's energy crisis.

## MORE IN TECHNOLOGY



Introducing the Supertweet  
IAN BOGOST



My Parents' Facebook Will  
JAKE SWEARINGEN



LGBT Obamacare Videos Climate Pets Fun Stuff Author Archives

Like 6.6k

Follow @americablog 48.1K followers

HOME > GAY > FACEBOOK KNOWS YOU'RE GAY BEFORE YOU DO

## Facebook knows you're gay before you do

3/20/13 4:29pm by Jon Green 39 Comments

Like 2k Tweet 761 3 points 8+1 39

Am I the only one creeped out that Facebook is now guessing, sometimes correctly, if its users are gay?

In the world of Big Data, our private lives are increasingly becoming intermingled with the shadowy, yet public, world of cyberspace.

Whenever we go online we are providing data that can be used to market to us; from Google searches to Facebook likes to eBay purchases, we are inputting data into a series of mathematical models which make *incredibly* educated guesses about the kinds of people we are.

### Facebook creepily offers help to a gay guy thinking of “coming out”

Enter Matt. As [BuzzFeed](#) notes, Matt was your typical Facebook user who suddenly found an ad in his news feed for help in coming out. The weird thing was that Matt “did” need help coming out, and understandably he was more than a bit curious as to how Facebook knew.

At first, Matt wondered if Facebook had accessed his text messages, as he had confided in a close friend the previous



LATEST COMMENTS TAGS



Let's slow down this race, together: Starbuc and a bad hashtag

3/20/15 12:00pm 7 Comments



It's time to make college free

3/20/15 10:00am 19 Comments



Rick Perry's new adviser has suggested that God isn't #ReadyForHillary. Technically, he right.

3/20/15 8:00am 14 Comments



Fatwas, gay sex tourism and the Indonesian LGBT underground

3/19/15 10:00am 6 Comments

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## Facebook

# Facebook users unwittingly revealing intimate secrets, study finds

Personal information including sexuality and drug use can be correctly inferred from public 'like' updates, according to study



### Most popular in US



Barcelona v Real Madrid: El Clásico - live! Jacob Steinberg



The eight best young adult books - and why grownups should read them, too



Singapore's Lee Kuan Yew dies aged 91



TECH 2/16/2012 @ 11:02AM | 2,698,356 views

# How Target Figured Out A Teen Girl Was Pregnant Before Her Father Did

[+ Comment Now](#) [+ Follow Comments](#)

Every time you go shopping, you share intimate details about your consumption patterns with retailers. And many of those retailers are studying those details to figure out what you like, what you need, and which coupons are most likely to make you happy. [Target](#), for example, has figured out how to data-mine its way into your womb, to figure out whether you have a baby on the way long before you need to start buying diapers.



*Target has got you in its aim*

Charles Duhigg outlines in the [New York Times](#) how Target tries to hook parents-to-be at that crucial moment before they turn into rampant — and



Share



Next Post

# Web Browsing Tracking

Webpages are often mashups of content loaded from different sources

Ads, images, videos, widgets, ...

IMG URLs, IFRAMEs, JavaScript, web fonts, Flash/applets, ...

Hosted on third-party servers: CDNs, cloud providers, ad networks, ...

A third party involved in many different websites can track user visits across all those websites

2+ third parties may collude to expand their collective “view”

Need to learn two key pieces of information

***What webpage was visited***

***Who visited it***

# Microsoft Announces Turning Windows 10 Phones Into Desktops

Posted 2 hours ago by Kyle F

1,769 SHARES    



## DISCONNECT

Show list view

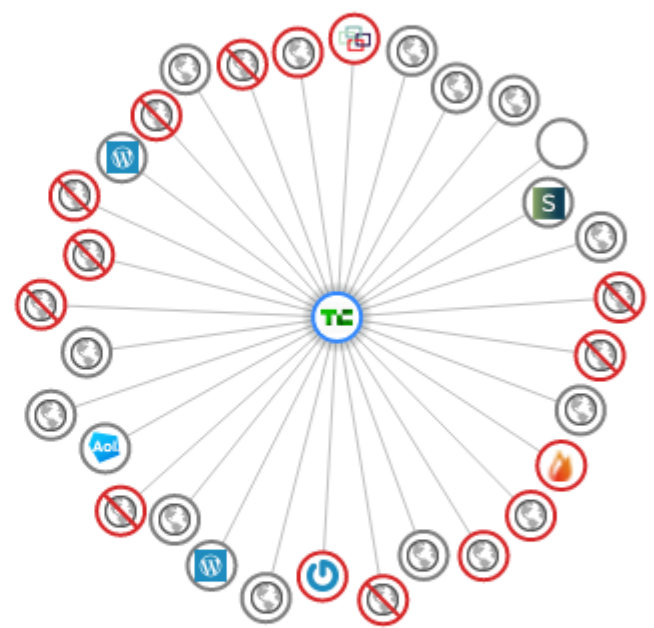
Browse the web normally. As you do, the graph in this popup and the counter in the toolbar will update. Each circle in the graph represents a site that's been or would've been sent some of your personal info.

Circles with a halo are sites you've visited. Circles without a halo are sites you haven't.

Red circles are known tracking sites. Gray circles aren't but may still track you.

Mouse over a circle to view that site's tracking footprint. Click a red circle to block or unblock that site.

- Unblock tracking sites
- Hide sidebar



# What webpage was visited?

## HTTP Referer [sic] header

The URL of the webpage from which a link was followed

Useful for statistics/analytics, bad for privacy

Can be turned off through browser options/extensions

HTML5 `rel="noreferrer"` anchor attribute to indicate to the user agent not to send a referrer when following the link

## Page-specific, session-specific, user-specific URLs

Unique URL per page (even for the same resource) → track what page was visited

Unique URL per session/user → distinguish between visits from different users

Tracking URLs are also commonly used in promotional emails

## Embedded image loading

This is an active email address!

Detect the time a user viewed a message

The request reveals much more: user agent, device, location, ...

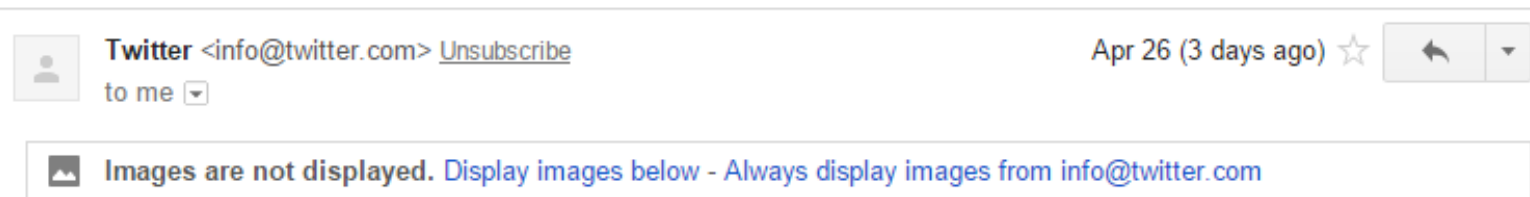
## Embedded links

Learn which email addresses resulted in visits (click-through rate)

## Default behavior of email clients varies

Gmail used to block images by default, now uses image proxy servers

Tracking through unique images still possible: senders can track the first time a message is opened (user's IP is not exposed though)





## Who visited the page?

*Browsing to a web page reveals a wealth of information*

Source IP address

Not very accurate (e.g., NAT, DHCP, on-the-go users) but still useful

Third-party cookies: precise user tracking

Easy to block (configurable in most browsers, defaults vary)

“Evercookies:” exploit alternative browser state mechanisms

Flash/Silverlight/other plugin-specific storage, ETags, HTML5 session/local/global storage, caches, ...

Browser/device fingerprinting: recognize unique system characteristics

Browser user agent, capabilities, plugins, system fonts, screen resolution, time zone, and numerous other properties

# What do web tracking techniques really track?

Distinguish between different visitors

*Track anonymous individuals*

Actually: track the pages visited by a particular browser running on a particular device

Better: distinguish between different *persons*

***Track named individuals***

The transition is easy...

Personally identifiable information (PII) is often voluntarily provided to websites:

Social networks, cloud services, web sites requiring user registration, ...

Cookies/sessions are associated with PII

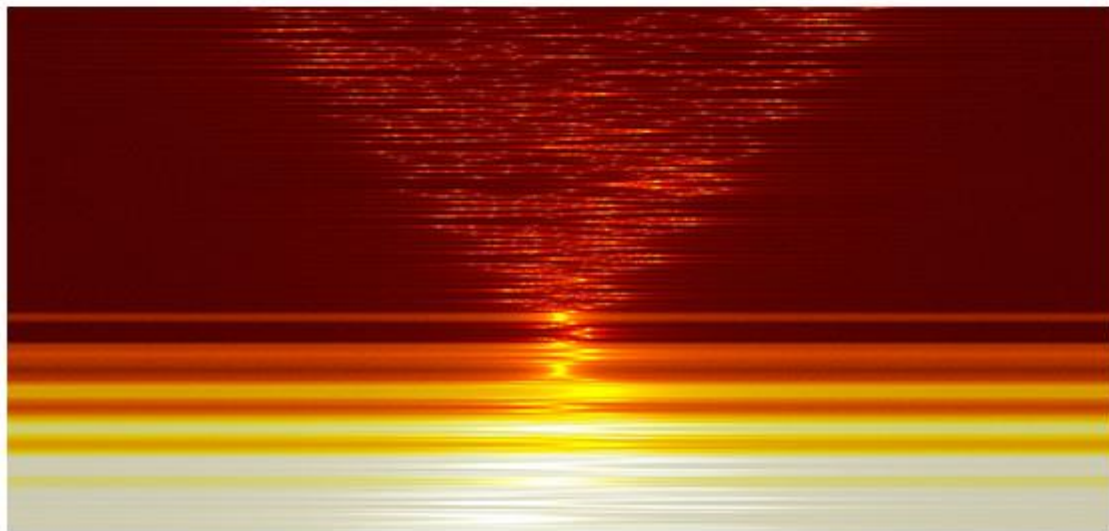
Contamination: trackers may collude with services

Previously “anonymous” cookies/fingerprints can be associated with named individuals



ROBERT MCMILLAN 10.27.14 6:30 AM

# VERIZON'S 'PERMA-COOKIE' IS A PRIVACY-KILLING MACHINE



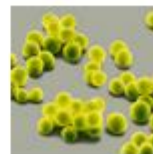
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Landscapes from the Edge  
of the Earth  
3 MINS



SPACE  
Jeff Bezos' Blue Origin  
Just Launched Its Flagship  
Rocket  
14 MINS



SCIENCE  
An Atlas of the Bacteria  
and Fungi We Breathe  
Every Day  
1 HOUR



DESIGN  
The Age of Drone

## MINISTRY OF INNOVATION / BUSINESS OF TECHNOLOGY

# AT&T charges \$29 more for gigabit fiber that doesn't watch your Web browsing

AT&T goes head to head against Google in KC on fiber and targeted ads.

by Jon Brodtkin - Feb 16, 2015 12:38pm EST

Share Tweet 205



AT&T

AT&T's gigabit fiber-to-the-home service has just **arrived in Kansas City**, and the price is the same as Google Fiber—if you let AT&T track your Web browsing history.

## LATEST FEATURE STORY



FEATURE STORY (2 PAGES)

## Battlefield Hardline review: an odd, cops-and-robbers facade

New twists on old formula help in multiplayer, baffle in single player.

## WATCH ARS VIDEO



# Users register on trackers!

## Social plugins are prevalent

1.65+ billion Facebook users

33% of the top 10K websites have Like Buttons

Twitter, Google+, LinkedIn, Pinterest, AddThis, ...

OS/app integration

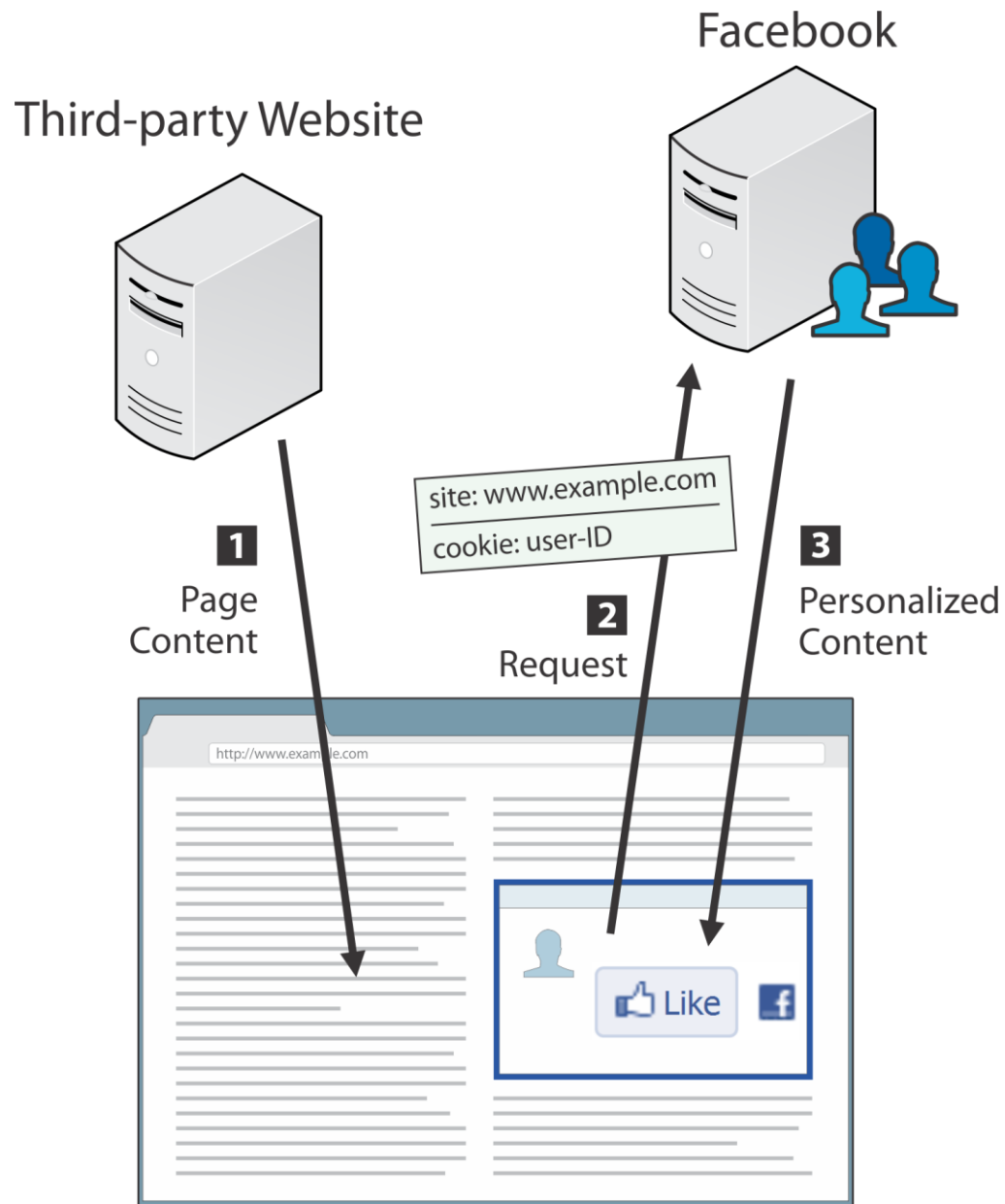
## A growing part of our browsing history can be tracked

Not as merely anonymous visitors, but as ***named persons***

Just visiting the page is enough (no interaction needed)

Cross-device tracking





# Existing Solutions

## Log out

Some cookies persist

## Block third-party cookies

Not always effective

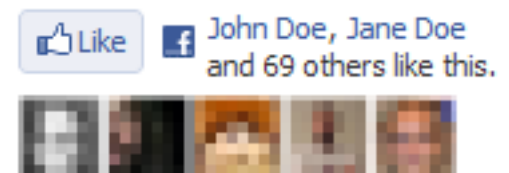
## Block social widgets completely

## Incognito mode

## All existing solutions disable content personalization

Privacy vs. functionality dilemma

- (a)  43 likes. Sign Up to see what your friends like.
- (b)  43 people like this.
- (c)  Jane Doe, John Doe and 41 others like this.



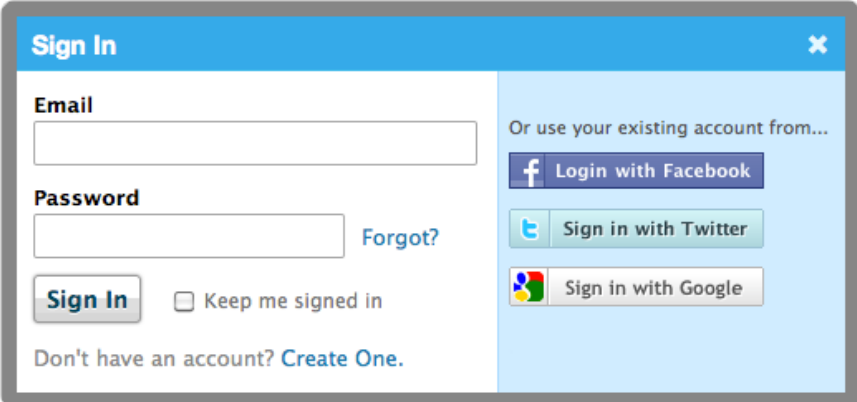
# Single Sign-on/Social Login

## Pros

- Convenience – fewer passwords to remember
- Rich experience through social features
- Outsource user registration and management

## Cons

- Same credentials for multiple sites
- User tracking
- Access to user's profile



The image shows a 'Sign In' form with a blue header and a light blue background. On the left, there are input fields for 'Email' and 'Password', a 'Forgot?' link, a 'Sign In' button, and a checkbox for 'Keep me signed in'. At the bottom left, it says 'Don't have an account? [Create One.](#)'. On the right, under the heading 'Or use your existing account from...', there are three social login buttons: 'Login with Facebook', 'Sign in with Twitter', and 'Sign in with Google'.









Request for Permission - Google Chrome

https://www.facebook.com/dialog/permissions.request?api\_key=d2730cb3e9daeef4b171f669af4231e5&app\_id=d2730cb3e9d

**f Request for Permission**

surfingneighbors.com is requesting permission to do the following:

-  **Access my basic information**  
Includes name, profile picture, gender, networks, user ID, list of friends, and any other information I've made public.
-  **Send me email**  
surfingneighbors.com may email me directly at diego.ridaz@yahoo.com · [Change](#)
-  **Post to Facebook as me**  
surfingneighbors.com may post status messages, notes, photos, and videos on my behalf
-  **Access posts in my News Feed**
-  **Access my data any time**  
surfingneighbors.com may access my data at any time for the application
-  **Access my profile information**  
Birthday and Facebook Status

[Report App](#)

Logged in as Diego Ridaz · [Log Out](#)

**surfingneighbors.com**

**Take it or leave it**

**Allow** **Don't Allow**

# Location Tracking

IP addresses reveal approximate location information

MaxMind statistics: 99.8% accurate on a country level, 90% accurate on a state level in the US, and 81% accurate for cities in the US within a 50 kilometer radius

Mobile devices allow for precise location tracking

Cell tower triangulation/trilateration

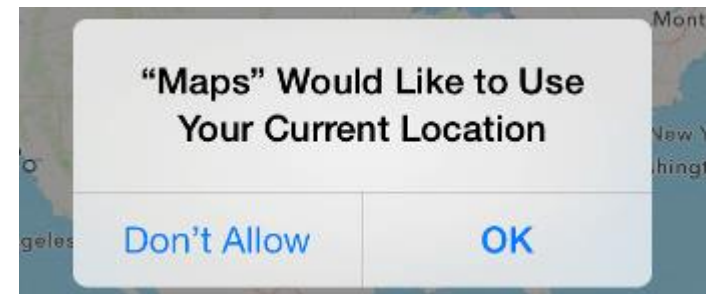
GPS

WiFi access points in known locations

Per-app permissions

Android vs. iOS:

installation vs. usage time



BUSINESS DAY

410 COMMENTS

# Attention, Shoppers: Store Is Tracking Your Cell

By STEPHANIE CLIFFORD and QUENTIN HARDY JULY 14, 2013

Email

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Save

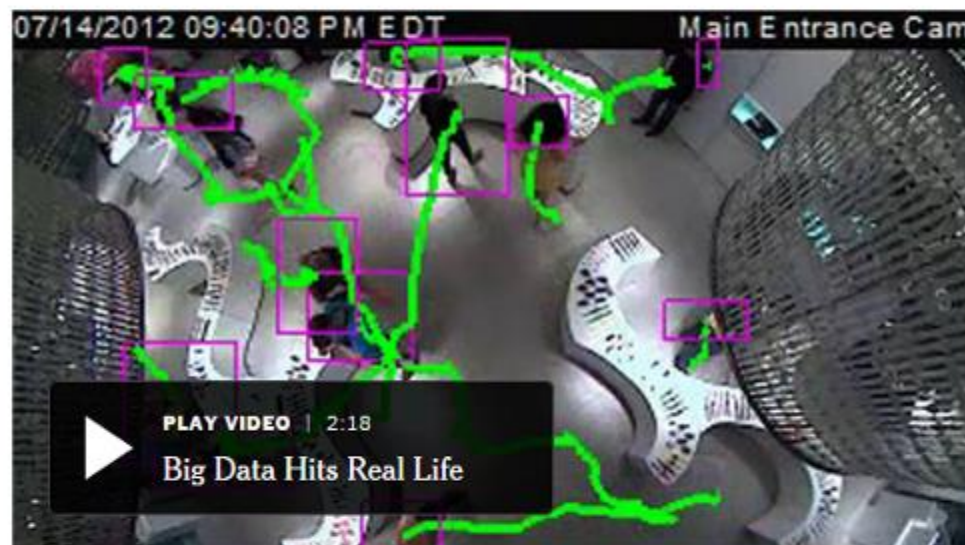
More

Like dozens of other brick-and-mortar retailers, [Nordstrom](#) wanted to learn more about its customers — how many came through the doors, how many were repeat visitors — the kind of information that e-commerce sites like Amazon have in spades. So last fall the company started testing new technology that allowed it to track customers' movements by following the Wi-Fi signals from their smartphones.

But when Nordstrom posted a sign telling customers it was tracking them, shoppers were unnerved.

"We did hear some complaints," said Tara Darrow, a spokeswoman for the store. Nordstrom ended the experiment in May, she said, in part because of the comments.

Nordstrom's experiment is part of a movement by retailers to gather data about in-store shoppers' behavior and moods, using video surveillance and signals from their cellphones and apps to learn



Brick-and-mortar stores are looking for a chance to catch up with their online competitors by using software that allows them to watch customers as they shop, and gather data about their behavior. Video by Erica Berenstein on July 14, 2013.

# Online Behavioral Tracking

An increasing part of our daily activities are recorded

What we are interested in (Searches, Likes, ...)

What we read (News, magazines, blogs, ...)

What we buy (Amazon, Freshdirect, ...)

What we watch (Netflix, Hulu, ...)

What we eat (Seamless, GrubHub, ...)

Where we eat (Opentable, Foursquare, ...)

Where we go (online travel/hotel/event booking)

What we own/owe (e-banking, credit services, Mint, ...)

Mobile apps make behavioral tracking easier and more accurate

Behavioral profiles have desirable and not so desirable uses

Recommendations, content personalization, ...

Targeted advertising, price discrimination (e.g., insurance premiums based on past behavior, higher prices for high-end device users), ...

# Health and Activity

## Health records

How securely are they handled and stored?

## Devices track our activities and health

Activity tracking devices

Health monitoring devices

Mobile phones

## Many upload all data to the “cloud”...

Who can access them?