Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Tracking and Targeting: State-of-the-art Advertisements

Erik Sy

About me

Research on security, privacy, online tracking, and geolocation methods

2016 Master of Physics
University of Rostock

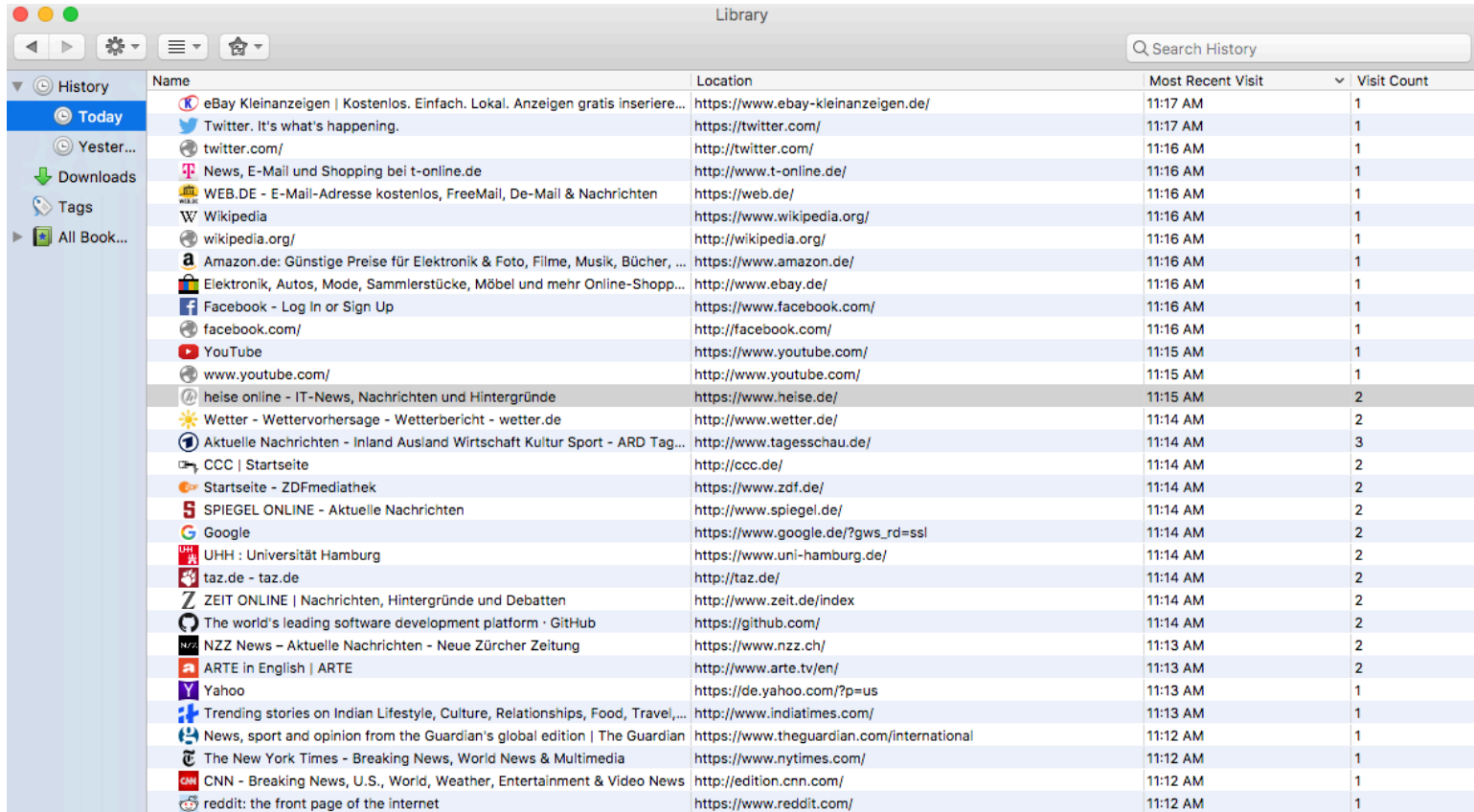Since 2016 researcher
University of Hamburg

Coordinator of the
research project AppPETs

Outline

- Extend of the data collection
- Motivation for data collection
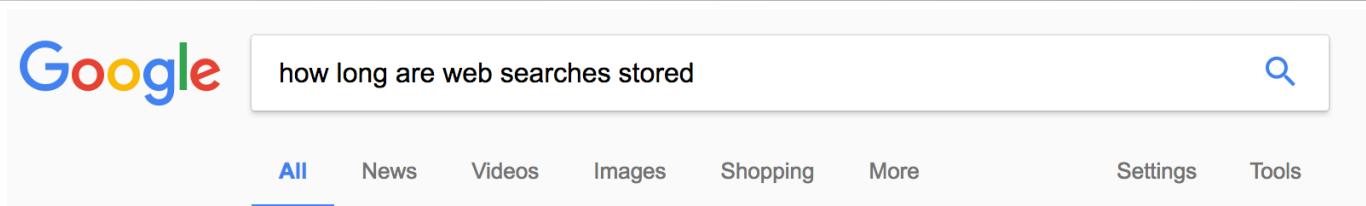- Ad exchanges and real-time bidding
- Targeting methods
- Tracking methods

Extend of the data collection: browsing history

Library

Name	Location	Most Recent Visit	Visit Count
eBay Kleinanzeigen | Kostenlos. Einfach. Lokal. Anzeigen gratis inseriere...	https://www.ebay-kleinanzeigen.de/	11:17 AM	1
Twitter. It's what's happening.	https://twitter.com/	11:17 AM	1
twitter.com/	http://twitter.com/	11:16 AM	1
News, E-Mail und Shopping bei t-online.de	http://www.t-online.de/	11:16 AM	1
WEB.DE - E-Mail-Adresse kostenlos, FreeMail, De-Mail & Nachrichten	https://web.de/	11:16 AM	1
Wikipedia	https://www.wikipedia.org/	11:16 AM	1
wikipedia.org/	http://wikipedia.org/	11:16 AM	1
Amazon.de: Günstige Preise für Elektronik & Foto, Filme, Musik, Bücher, ...	https://www.amazon.de/	11:16 AM	1
Elektronik, Autos, Mode, Sammlerstücke, Möbel und mehr Online-Shopp...	http://www.ebay.de/	11:16 AM	1
Facebook - Log In or Sign Up	https://www.facebook.com/	11:16 AM	1
facebook.com/	http://facebook.com/	11:16 AM	1
YouTube	https://www.youtube.com/	11:15 AM	1
www.youtube.com/	http://www.youtube.com/	11:15 AM	1
heise online - IT-News, Nachrichten und Hintergründe	https://www.heise.de/	11:15 AM	2
Wetter - Wettervorhersage - Wetterbericht - wetter.de	http://www.wetter.de/	11:14 AM	2
Aktuelle Nachrichten - Inland Ausland Wirtschaft Kultur Sport - ARD Tag...	http://www.tagesschau.de/	11:14 AM	3
CCC | Startseite	http://ccc.de/	11:14 AM	2
Startseite - ZDFmediathek	https://www.zdf.de/	11:14 AM	2
SPIEGEL ONLINE - Aktuelle Nachrichten	http://www.spiegel.de/	11:14 AM	2
Google	https://www.google.de/?gws_rd=ssl	11:14 AM	2
UHH : Universität Hamburg	https://www.uni-hamburg.de/	11:14 AM	2
taz.de - taz.de	http://taz.de/	11:14 AM	2
ZEIT ONLINE | Nachrichten, Hintergründe und Debatten	http://www.zeit.de/index	11:14 AM	2
The world's leading software development platform · GitHub	https://github.com/	11:14 AM	2
NZZ News – Aktuelle Nachrichten - Neue Zürcher Zeitung	https://www.nzz.ch/	11:13 AM	2
ARTE in English | ARTE	http://www.arte.tv/en/	11:13 AM	2
Yahoo	https://de.yahoo.com/?p=us	11:13 AM	1
Trending stories on Indian Lifestyle, Culture, Relationships, Food, Travel,...	http://www.indiatimes.com/	11:13 AM	1
News, sport and opinion from the Guardian's global edition | The Guardian	https://www.theguardian.com/international	11:12 AM	1
The New York Times - Breaking News, World News & Multimedia	https://www.nytimes.com/	11:12 AM	1
CNN - Breaking News, U.S., World, Weather, Entertainment & Video News	http://edition.cnn.com/	11:12 AM	1
reddit: the front page of the internet	https://www.reddit.com/	11:12 AM	1

Q Search History

History
- Today
- Yester...
- Downloads
- Tags
- All Book...

4

Extend of the data collection: web searches

Extend of the data collection: spendings

- Enterprises share transaction data for conversion tracking
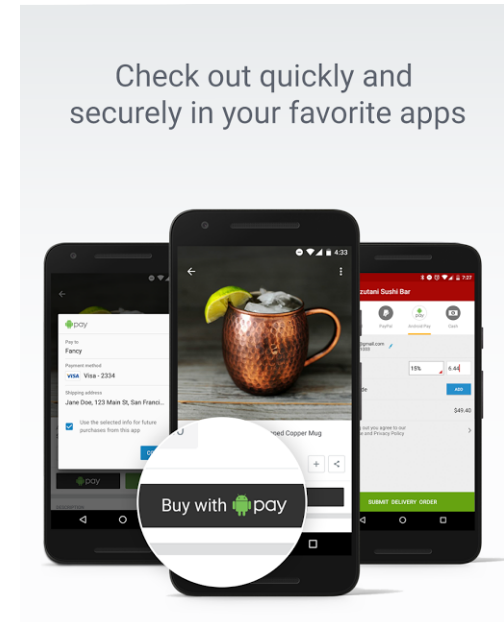
Extend of the data collection: location and social data
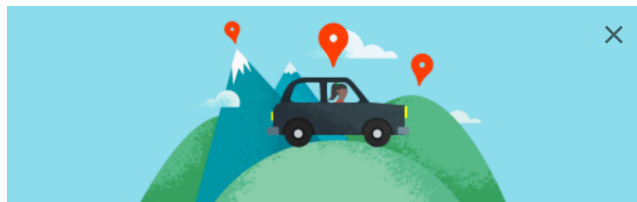
Turn on Location History?

Location History helps you get useful information, such as commute predictions, improved search results, and more useful ads on and off Google. It does this by creating a private map of where you go with your signed-in devices.

To create this map, Google regularly obtains location data from devices for which you've turned on Location History. This data is collected even when you aren't using a specific Google product. Learn more

Remember, location data may be saved from any signed-in devices for which you've turned on Location History. You can always control and review your activity at My Account.

CANCEL   TURN ON

Facebook
needs access to

Device & app history

Identity

Calendar

Contacts

Location

SMS

Phone

Photos/Media/Files

Camera

Google play   ACCEPT

The data broker Acxiom

- data sets on approx.
  700 million consumers[1]

- over 3000 propensities
  for U.S. consumer[1]

Risk of data leakage!

[1] Acxiom Corporation Annual Report 2014

Motivation for data collection

Evidence for effectivity	Evidence for efficency	Detection of click fraud

Example for a campaign in Google AdWords

	Budget	Cost	Impressions	Clicks	Conver.	Ø Cost per click	Ø Cost per conver.
1	5 €/ day	120,02 €	7.149	246	140	0,49 €	0,86 €
2	5 €/ day	11,57 €	1.250	47	23	0,25 €	0,50 €

Validation of statistics difficult for advertiser

Ad exchanges and real-time bidding

2. Information flow

1. Advertising space

3. Auction

4. Advertisement

User   Publisher   Supply-side platform   Ad exchange   Demand-side platform   Advertiser
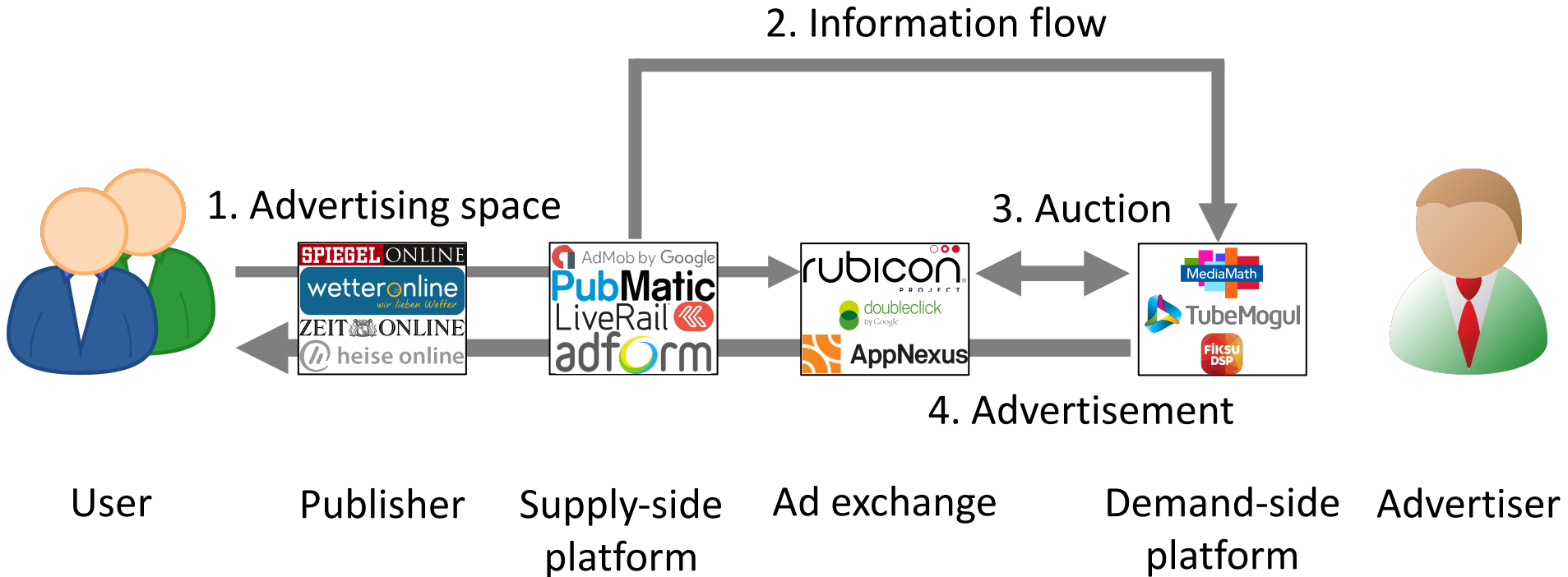
Behavioral targeting

- Intent to increase the conversions-rate
- Statistical methods such as A/B-test lead to an identification of relevant characteristics
- More precise user profiles allow to test more characteristics
- Higher bids, if a higher conversion-rate is assumed

Example:

Correlation between gender and conversions-rate?
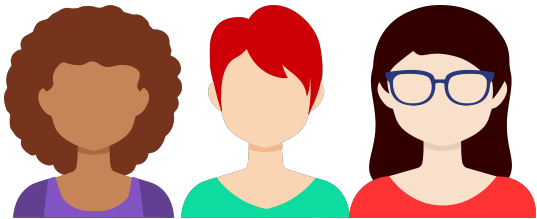
Test group 1
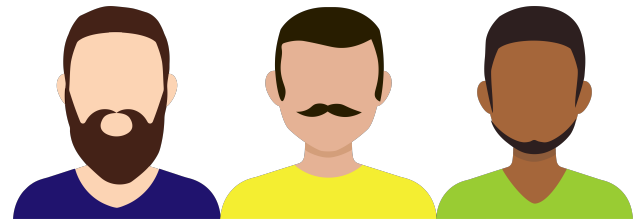
Test group 2

Targeting by an email address

- Email addresses are used to define the audience of an ad campaign (see AdWords Customer Match)

User

1. visits

You Tube

Publisher

2. Advertisement

Advertiser defines audience by their email addresses

Online tracking

Customer data are shared with trackers

Tracking based on cookies

The following cookies are stored on your computer:

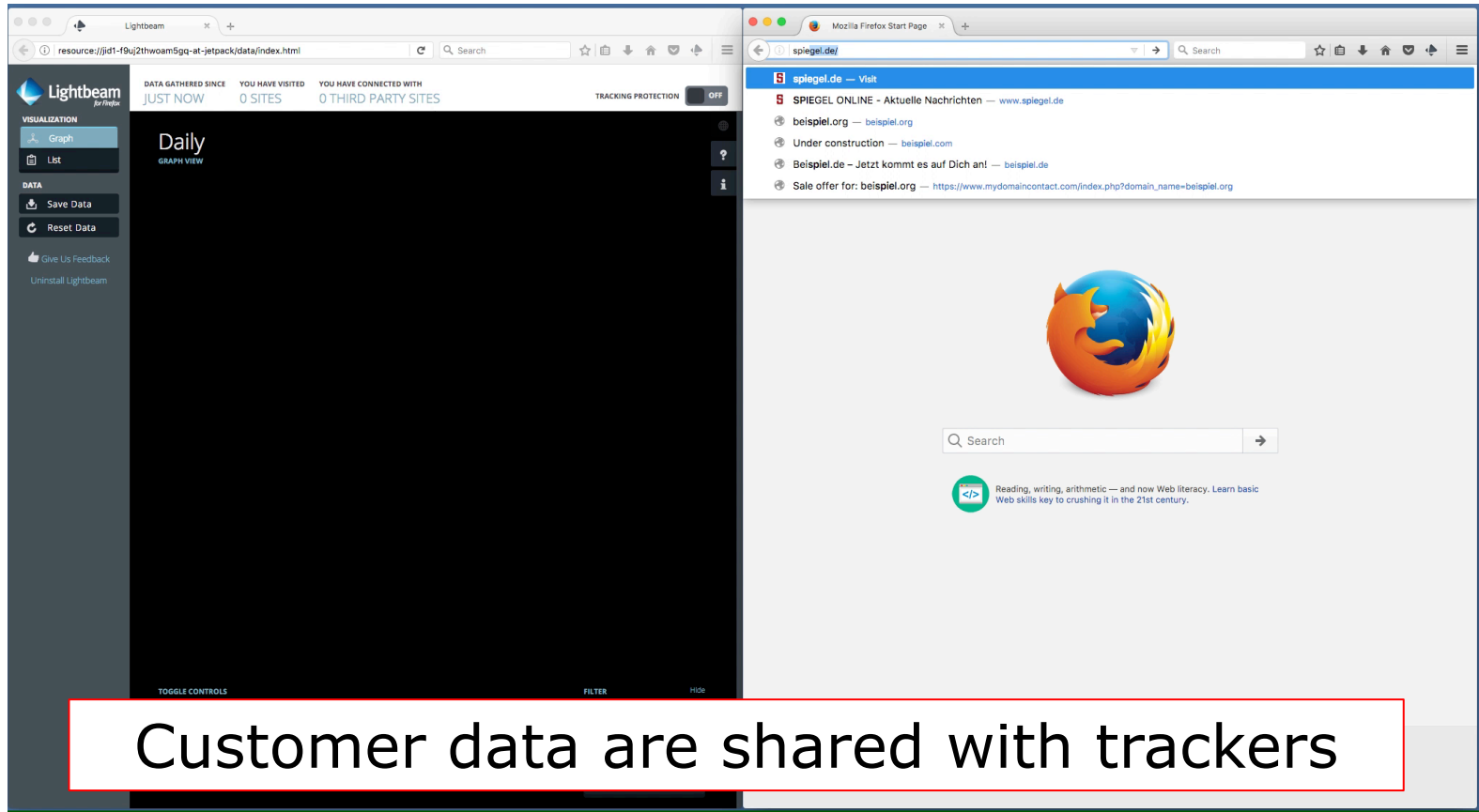| Site	Cookie Name
▸ github.com	
▸ go.sonobi.com	
▼ google.com	
google.com	NID
google.com	NID
▼ google.de	
google.de	NID
google.de	CONSENT
▸ googlesyndication.com	
▸ gwallet.com	

Name: NID

Content: 102=JM3GgFyb_bDQERHVm2ZxltdHgrGQPXzrhAvlJe39jyfMucFbiazXNYSk82qcAhWGXNO9gH-Mma(

Domain: .google.de

Path: /

Send For: Any type of connection

Expires: October 27, 2017, 4:01:50 PM

„Here are some examples of the device information we collect:" [1]

language
browser type
software types
file types
software names
GPS
Wifi signals
device settings
hardware version
Bluetooth signals
operating system
mobile operator
ISP IP
file names
phone number
time zone

[1] Facebook Data Policy
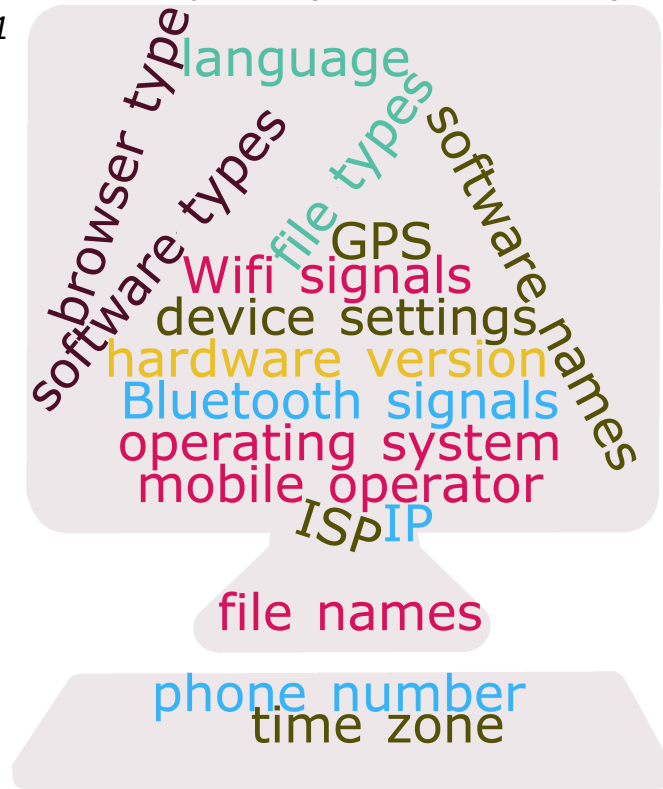
Cross-device and cross-user tracking

Behavior-based tracking

8th June

Website visits

9th June

Website visits
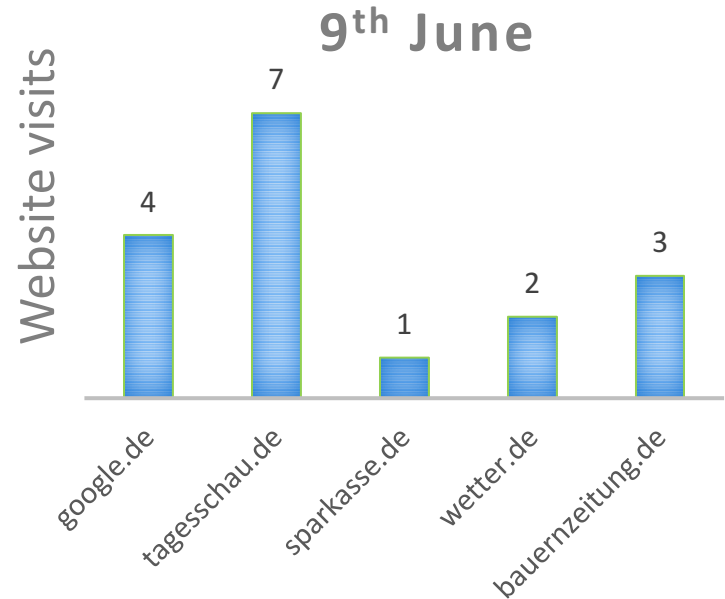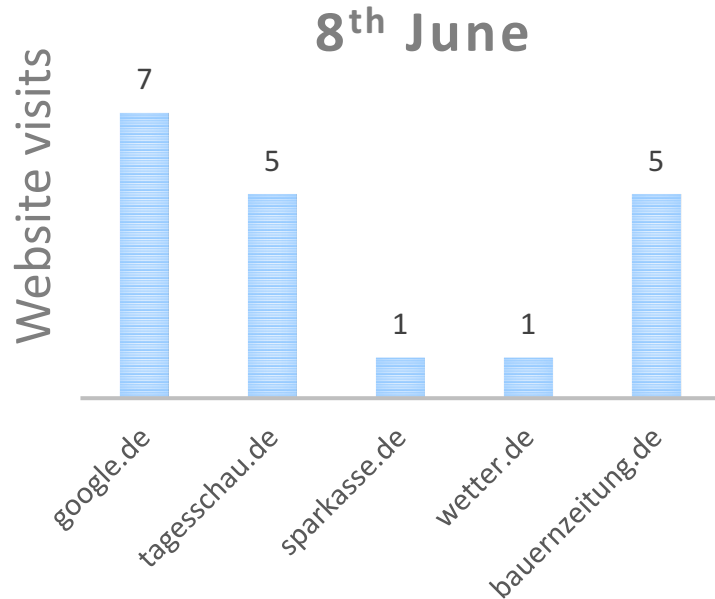
- **Experimental results**
  - Up to 85% of all browsing sessions can be linked to specific users[1]

[1] Dominik Herrmann, Christian Banse, and Hannes Federrath. "Behavior-based tracking: Exploiting characteristic patterns in DNS traffic." *Computers & Security* 39 (2013).

Thrid-parties such as
VPN services, ISP, …

http://
www.
example.
com

HTTP-request
of a user

Tracking
Header

User profiles

Online service
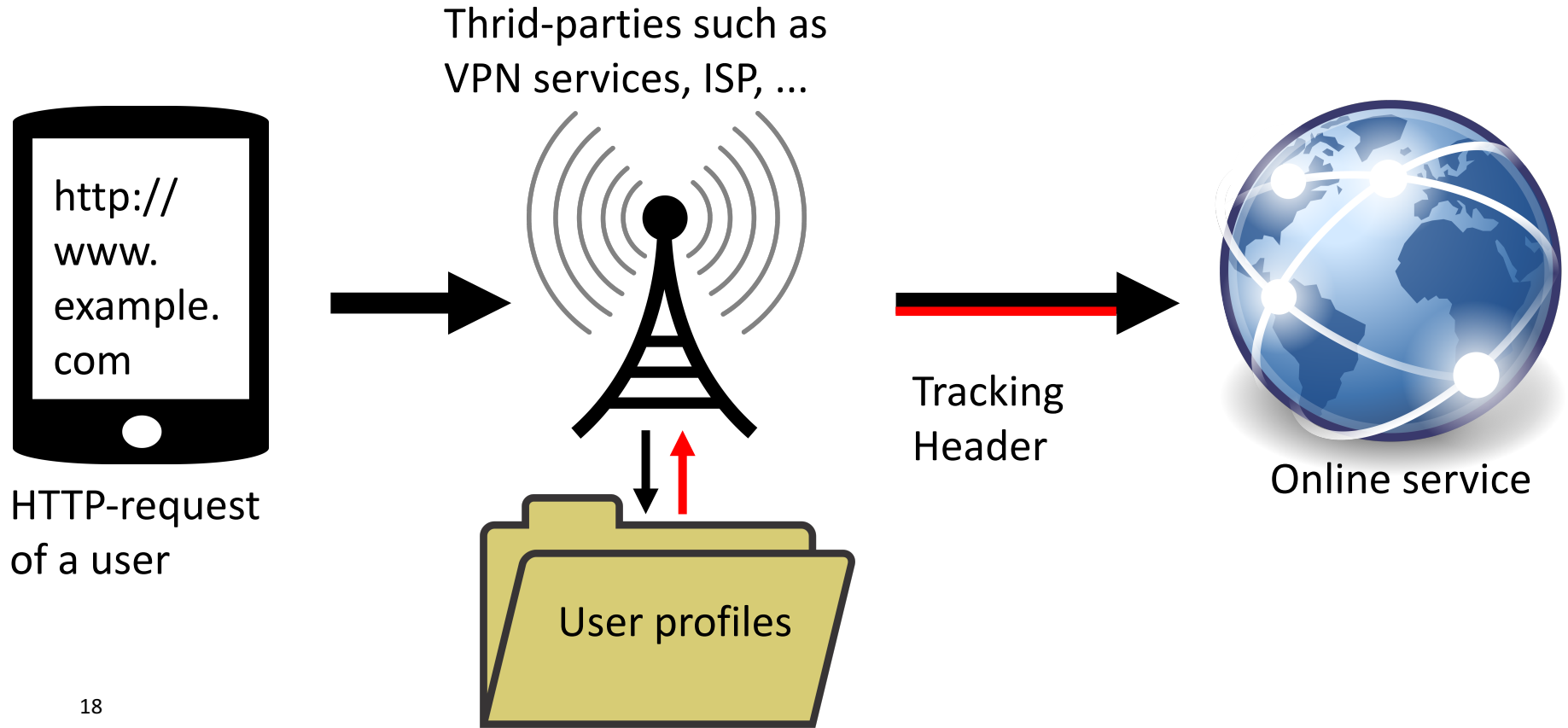
Offline tracking

Offline tracking: Calls

Online Campaign 1   📞 040123…

Online Campaign 2   📞 040456…

Flyer Campaign   📞 040789…

User

Multiple marketing campaigns

Unique trackable phone numbers

Advertiser such as locksmith or delivery service
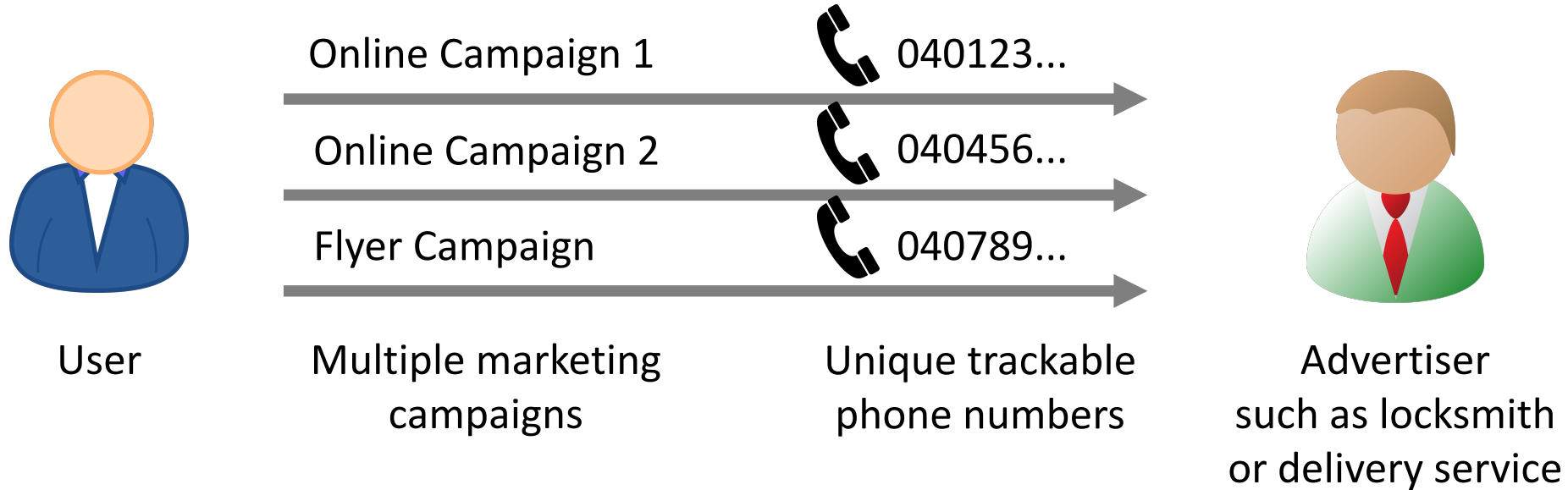
- Call statistic allows an campaign-level performance analysis

Offline tracking: store visits

1. Online advertisment

Google AdWords

facebook for business

2. Report of store visits

User
(location tracked)

Data broker

Advertiser
with
local store
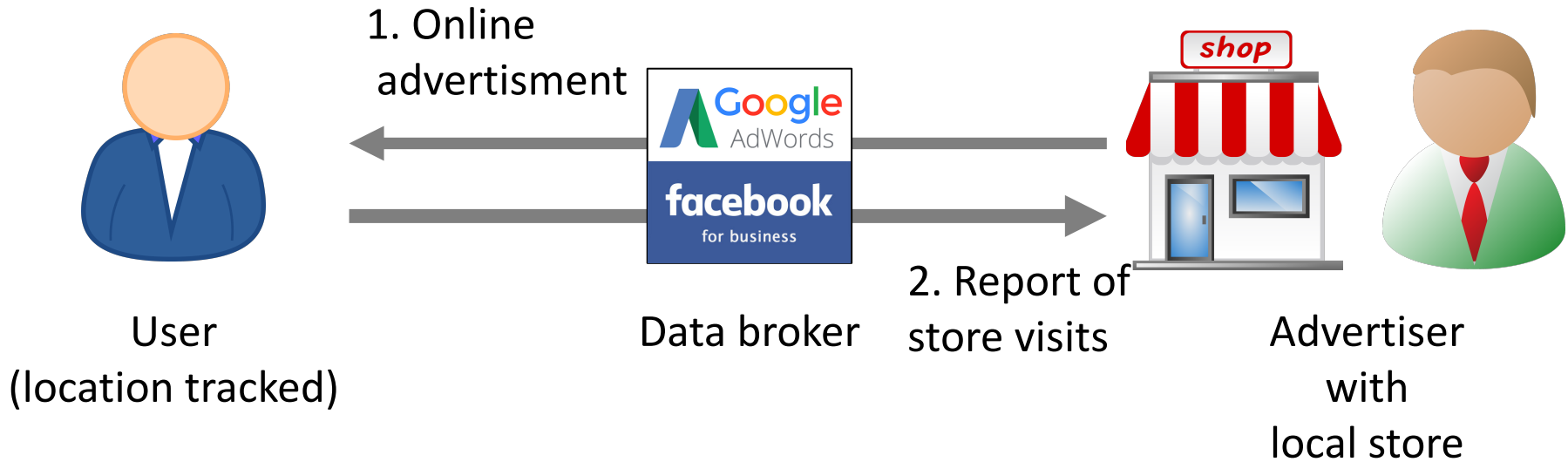
- Data broker tracks geolocation of user
- Data broker matches store visits with displayed ads

21

Offline tracking: store sales

1. Online advertisment

User
(known payment credentials)

Data broker

2. Analysis of customer transactions

Advertiser with local store
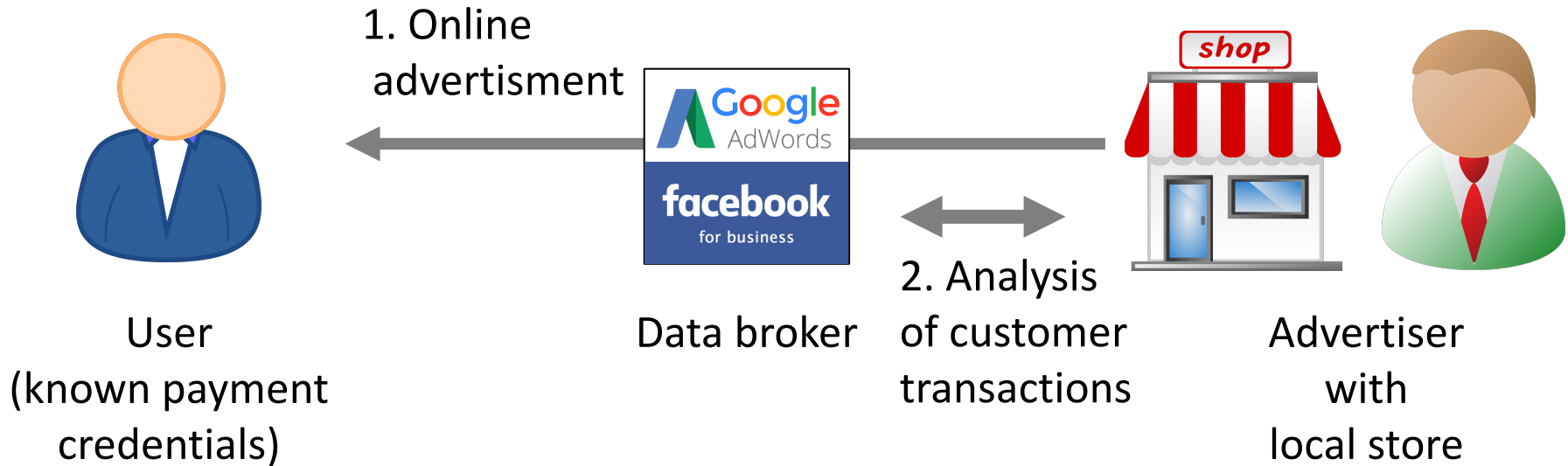
- Data broker matches customer transactions with displayed ads

Conclusion

- Precise user profiles increase the performance of advertisements

- Selection of single users by identifiers such as email addresses

- Tracking arrives in local stores

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