

Online tracking Technologies

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About me



- **Senior scientist RU Nijmegen, the Netherlands**
 - Privacy enhancing technologies
 - Applied cryptography
 - Internet of Things
- **Scientific director Privacy & Identity Lab**



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Agenda



- **Identity, identifiers,...**
- **PC's, browsers**
 - Online tracking
- **Mobile devices, apps**
 - Online tracking
 - Physical tracking
- **Advanced issues**
 - Cross device ; multiple users
- **Closing remarks**

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Identity



- **Name**
 - Not good pointer: Bill Stewart
- **Social Security Number**
- **“Technical numbers”**
 - Online: IP, cookies
 - Physical world : MAC, Rfid, Bluetooth

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L-, R-, C-, and S-identifiability



- **Look-up identifiability**
 - There is a register that links the identifier to the named individual (civil identity)
 - Names, telephone numbers, passport numbers, social security numbers, and IP addresses
- **Recognition identifiability**
 - Individual can be recognised, but not linked to civil identity
 - Cloak-room tokens, cookies
- **Classification identifiability**
 - Individual can be classified to belong to predetermined group/profile
 - Not typically issued to a user – only used in “backoffice”
- **Session identifiability**
 - Individual can be recognised, but only during lifetime of a “session”
 - Session cookie

R.E. Lorenz Do They Know Me? Deconstructing Identifiability, University of Ottawa Law & Technology Journal, Vol. 4, No. 1-2, p. 135, 2007

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I. PC's/browsers



- **Cookies**
- **Fingerprinting**
- **IP address**

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Cookies

- **HTTP is stateless**
 - So how to maintain a session?
 - Logged-in user
 - Shopping cart
- **Cookies solve this**
 - Name / value pairs
- **Set by website**
- **Stored and sent by browser**
 - Different browsers have different cookies

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Cookies

- **Fields**
 - The name of the cookie
 - The value of the cookie
 - The expiry of the cookie
 - The path the cookie is good for
 - The domain the cookie is good for
 - The need for a secure connection to use the cookie
 - Whether or not the cookie can be accessed through other means than HTTP (i.e. JavaScript)

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Example

- **Setting a cookie (visiting google.nl)**
- **Using that cookie**



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HTTP referer (sic!)

- **When visiting a website**
 - Website learns URL of page reached from
 - In so called HTTP Referer
- **Consequence:**
 - Visiting website learns how I reached it
 - Result of a search query (including the query!)
 - Useful for logging
- **Not only when clicking a link**
 - Also with remote content embedded in a webpage

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Tracking with 3rd party cookies

- **I visit a website**
- **What really happens:**

The diagram shows a browser visiting the website nu.nl. A 'Web bug' (a small image) is loaded from doubleclick by Google. This bug tracks the user's activity across different websites.

```

GET /adjs/f4442.nu.nl/homej;sz=728x95;t11e=4;kw=;tt=0945;gr=10;rg=0;nk=0;
ord=88742309317007499 HTTP/1.1
Host: ad.nu.nl.doubleclick.net
Referer: http://www.nu.nl/
Cookie: det=_NO_DATA; id=22dd811a95010037; |e=1366012234|et=730|cs
=0022135d451b70625481e478de
    
```

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Consequence

- **3rd party collects all pages visited linked to unique cookie id**
 - **Social plugins**
-

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Browser-based defences



- **Extensive browser support for cookies**
 - Empty cookie jar
 - Block cookies
 - Disallow third party cookies
- **Plugins for cookies, scripts, and web bugs**
 - Ghostery
 - NoScript



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Non-browser based



- **IP address**
 - Source (i.e. uour IP address) included in all Internet packets
 - Can be inspected by website
- **Not very precise**
 - Roaming users change IP address
 - Home users may have dynamic IP address
- **Note: MAC address only used inside within LAN**

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II. Mobile devices



- **Online tracking**
- **Physical tracking**

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Device identifiers



- **Google Android**
 - Android ID: unique **persistent** device identifier
 - *To be phased out in 2014*
 - Advertising ID: unique device identifier
 - *User can reset and limit its use*
 - AdID (?)
 - *For Chrome (not restricted to Android)*
- **Apple iOS**
 - UDID: unique **persistent** device identifier
 - *No longer accessible since May 2013*
 - IDFA: Identifier for advertisers: unique device identifier
 - *Changed when device is reset*
 - *User can reset and limit its use*
 - IDFV: Identifier for vendors: different per app/vendor

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- **Brightest Flashlight app**
 - Device ID
 - Location
- Shared with third parties



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Device sensors



- **Location**
 - GPS, assisted with WiFi
 - iBeacon
- **Movement**
 - Accelerometer
 - Gyroscope
 - Compass
- **Sound**
 - Microphone
- **Vision**
 - Camera



Dynamic, context sensitive

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Tracking in the physical world



- **Based on device networks**
 - WiFi
 - BlueTooth
 - even GSM
- **Broadcast unique number, even in standby**
- **Hard to prevent**
 - Switch off Bluetooth and Wifi? GSM? (E.g. "Airplane mode")

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III. Advanced



- **Cross-device tracking**
- **Distinguish multiple users**

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Cross device tracking



Determine that a cellphone, work computer, home computer and tablet belong to the same person

- **User initiated (request to continue on mobile)**
 - Send special link from web to mobile of user
- **Account based**
 - Signing in to Google/Facebook etc on each device
 - Limited with current more restricted device identifiers
- **Behaviour based**
 - Statistical analysis of browsing/apppatterns



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Distinguishing multiple users



- **Behaviour analysis**
 - Precise enough to distinguish multiple users on single device

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Discussion



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[Monty Python's
Argument Clinic sketch]

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