DNS Cache-Based User Tracking

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Overview

INTRODUCTION  SOLUTION  CRITICISM
User Tracking

Cookies
- Stateful
- Stored on device
- Typically long-term

Fingerprinting
- Stateless
- Property of device
- Varying length
Tracking Countermeasures

- DNT Header
- History Cleanups
- Private Browsing
- Ad Blockers
- VPNs

- "Golden Image"
- Multiple Browsers
- Multiple Networks
User Tracking Ecosystem

Increased Public Awareness

- Software Developers work to reduce invasive tracking
- Tracking Developers look to find loopholes
Stub Resolver

- A local DNS resolver typically a component of the OS
- Forwards queries to resolution platform
- Caches results to improve performance
Process Overview

Stub Resolver

Queries Hostnames → Cache and Return IPs

Return Set of IP Addresses → Forward Queries

Requests Webpage → Returns Partial DNS ID

Web Server

Authoritative Name Server

Replies with Web Server IPs

Requests IP addresses
Technical Details

1. Queries $n$ hostnames, $x_i.tracker.domain$, where $i = 0 \rightarrow n$
2. Each hostname is associated with $m$ servers each with their own IP address
3. Name server returns $\{IP_0, IP_1, ..., IP_m\}$ to resolution platform per hostname
4. IP addresses are randomised either intentionally or by load balancing
5. Randomised lists are returned to user machine where it is cached in order
6. Script makes request to first IP for each hostname
7. A values is received from each host, e.g. $\{x_0 = 1, x_1 = 0, ..., x_n = 2\}$, combining to form a unique DNS ID of length $n$

There are $m^n$ possible DNS IDs
Summary

Advantages

• Can track across different websites and browsers
• Covers Private Browsing
• Differentiate unique devices

Limitations

• Cache eviction
• Can’t differentiate between users
• Relies heavily on DNS implementations
  • Prone to software updates
  • Doesn’t work with the same consistency for all system combinations
• NoScript
• Did not test on many OS versions
• No Specific Implementation
• Small test study for cache eviction

• No potential solutions mentioned for limitations
Questions?
References


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