On Certificate Transparency Verification and Unlinkability of Websites Visited by Tor users

June 12, 2023

Rasmus Dahlberg

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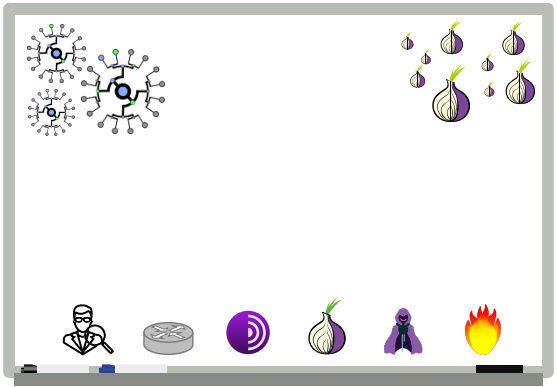
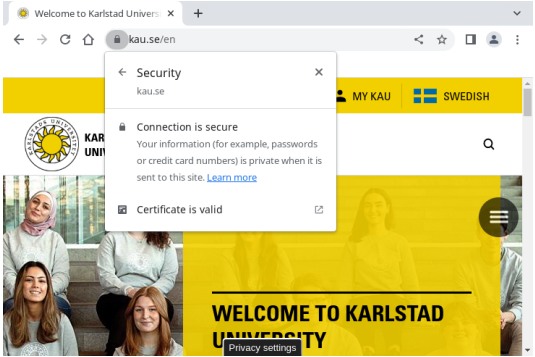
Outline

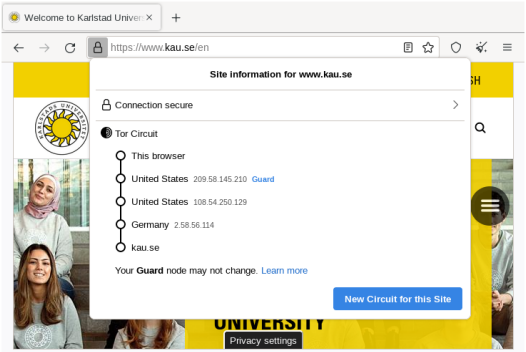


1. Introduction
2. Thesis overview
3. Contributions
4. Take away

How is all of this related to you?

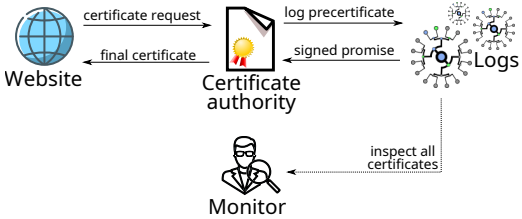


Web browsing

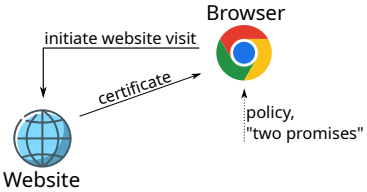


Possibly with Tor Browser

Some preliminaries, Certificate Transparency what?



Certificate issuance



Browser behavior

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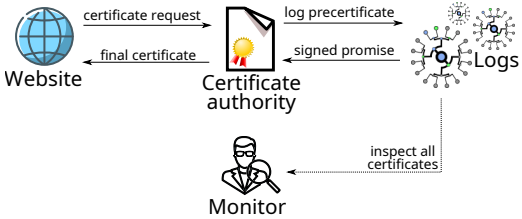

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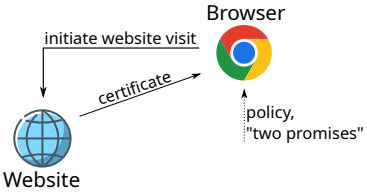

Browser behavior

Why should we take log promises at face value?

Research questions

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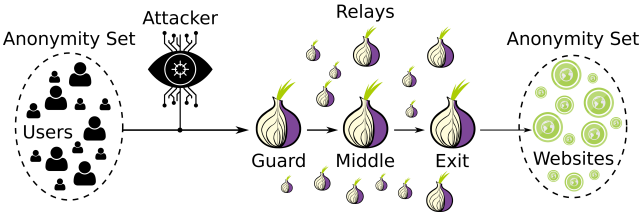
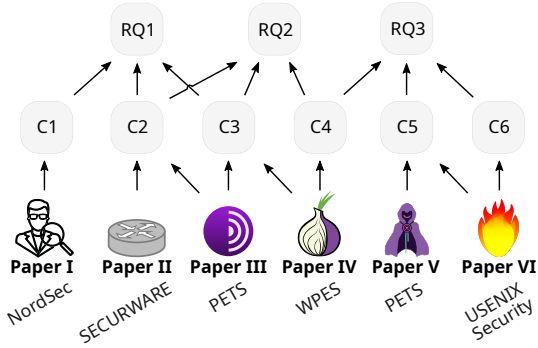


RQ1: "less trust reqs in CT" **RQ2:** "CT+Tor" **RQ3:** "exploit protocols for deanonymization"

Contributions



Contributions

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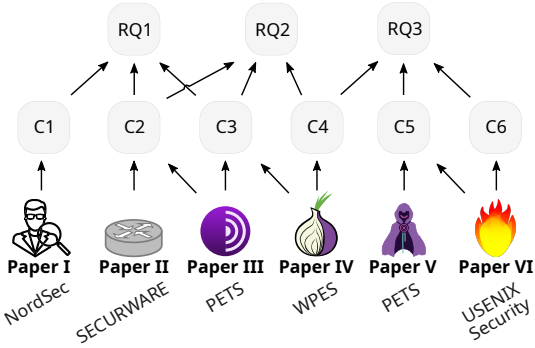

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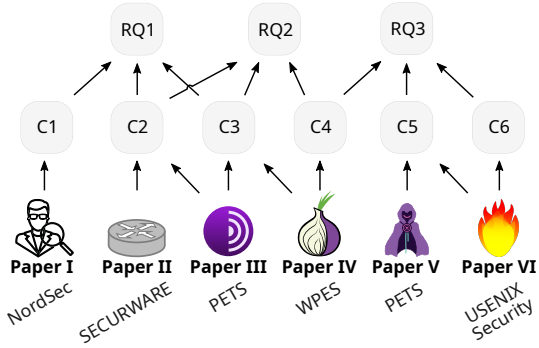

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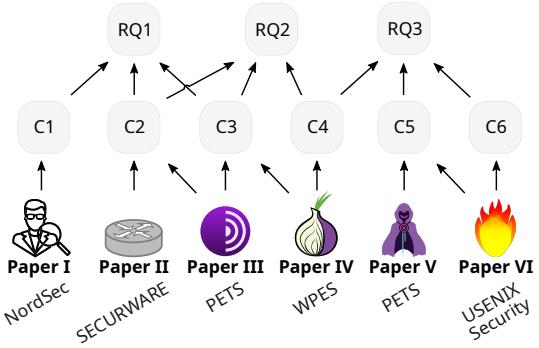

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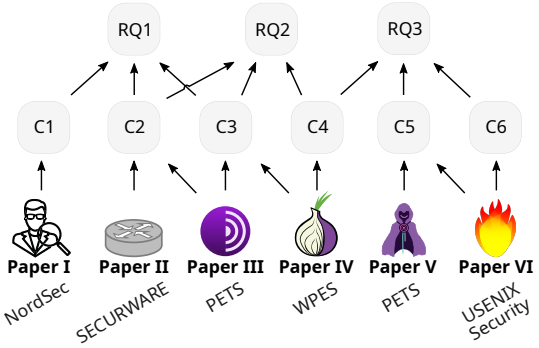

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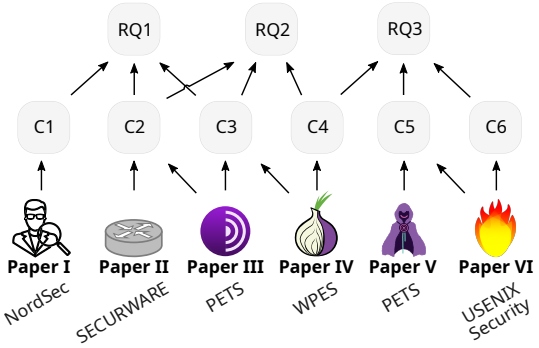

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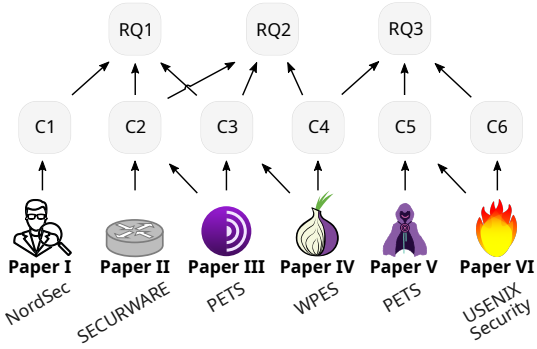
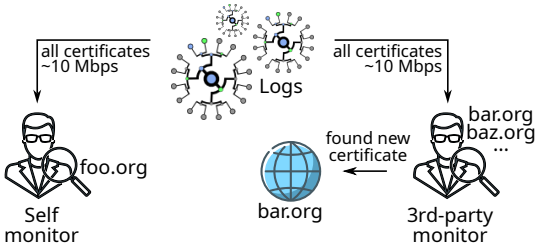


C1: Reduced trust in third-party monitoring



Problem

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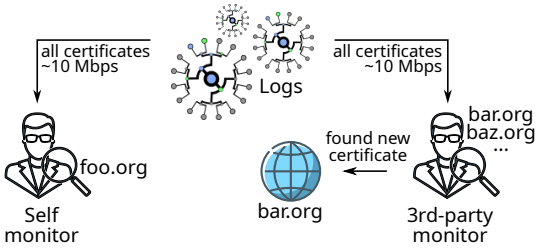

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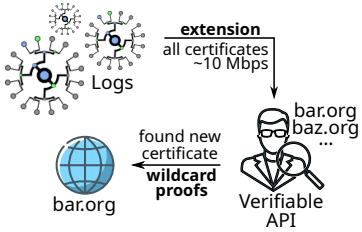

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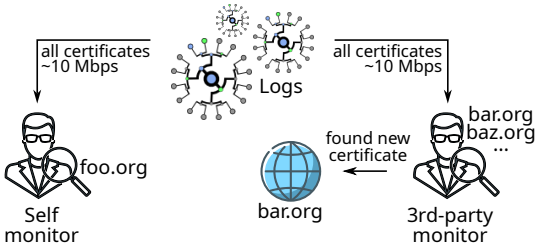

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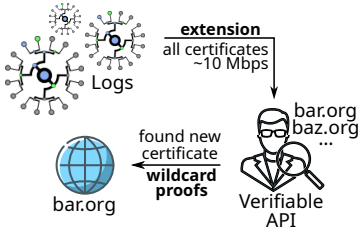
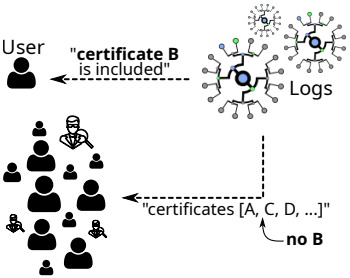


Solution

Secure in multi-instance setting, small performance overhead

C2: Increased probability of split-view detection



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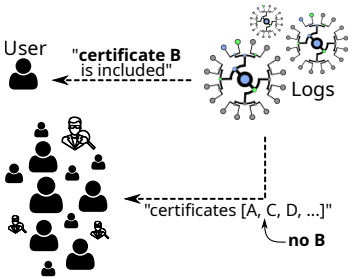

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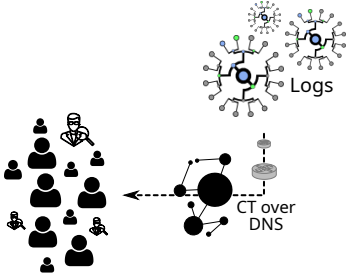

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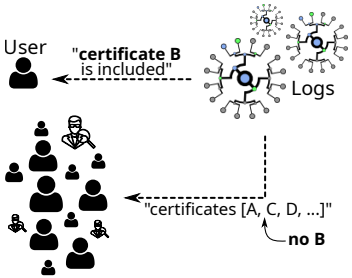

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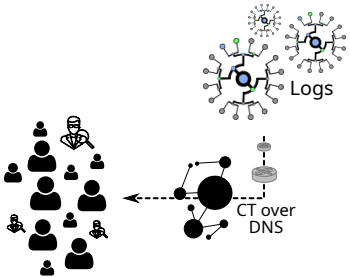

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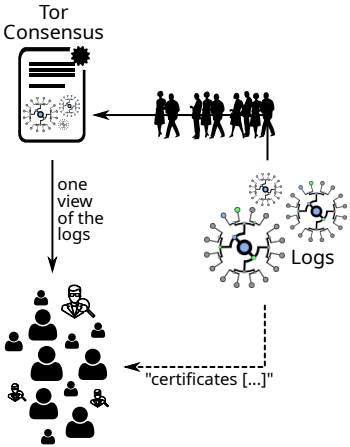
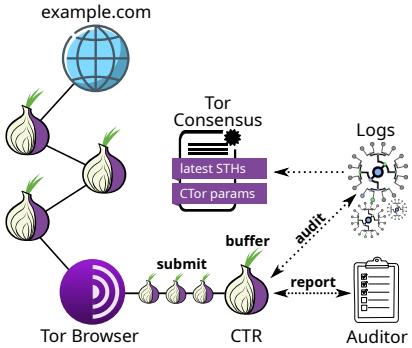


Solution (2/2)

C3: Improved detectability of website hijacks targeting Tor Browser



Solution (continued)

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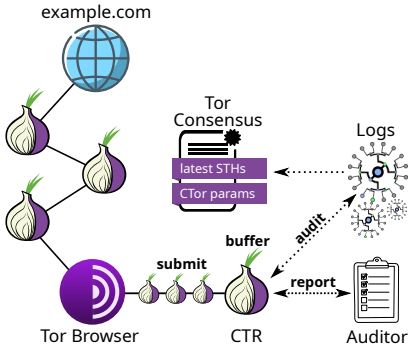

Attacker capabilities

- Vanilla Tor Browser threat model
- Plus zero-day on Tor Browser
- Plus operates enough logs

Solution (continued)

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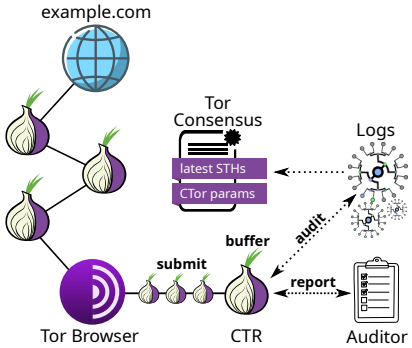

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- "Break" must go unnoticed

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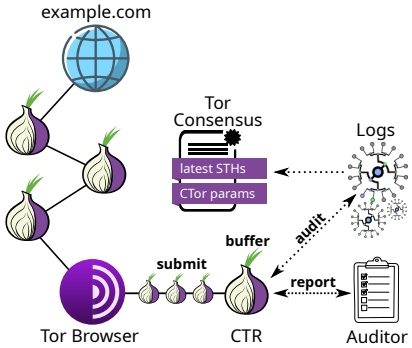

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Gradual roll out, also use-cases relating to onion services

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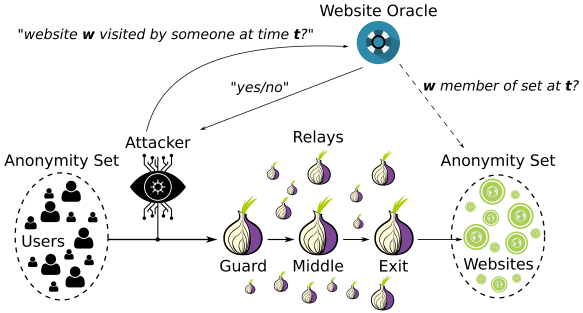

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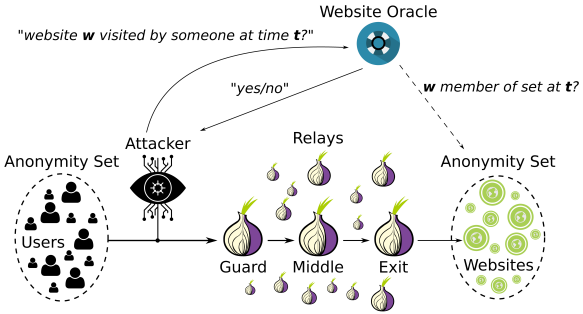

- Smaller destination anonymity set

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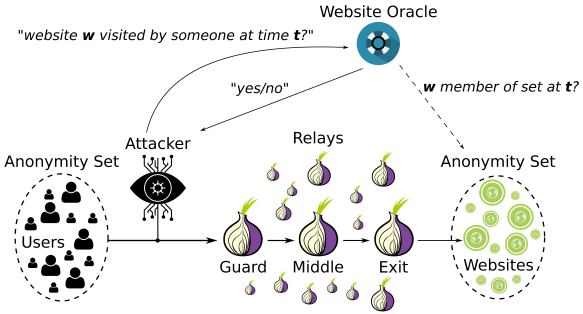

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- Eliminates most false positives for Alexa top-10k and beyond

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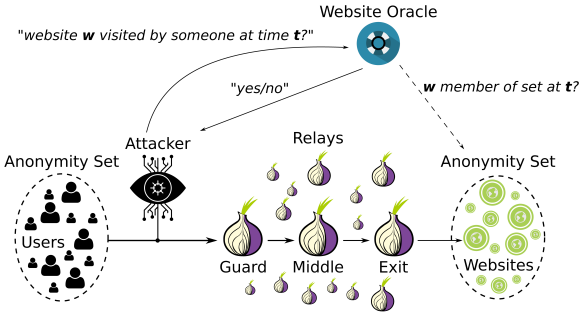

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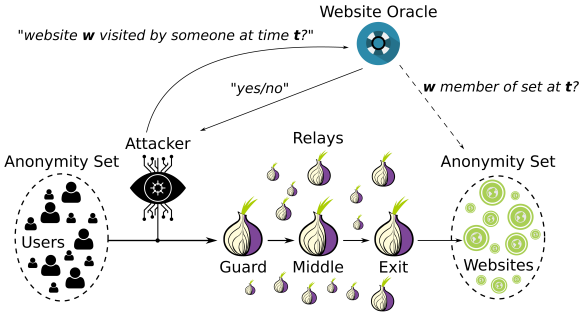

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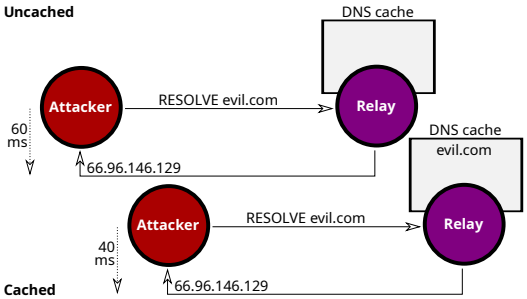
Certificate Transaprency logs, Certificate Authorities, ...

C5: Remotely-exploitable probing-attacks on Tor's DNS cache



Timing attack

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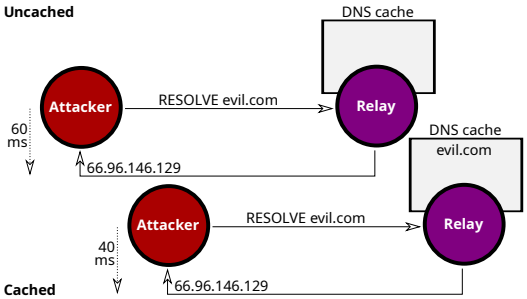

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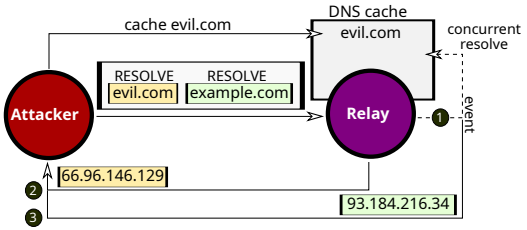

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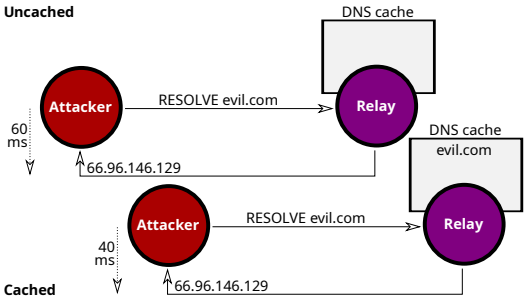

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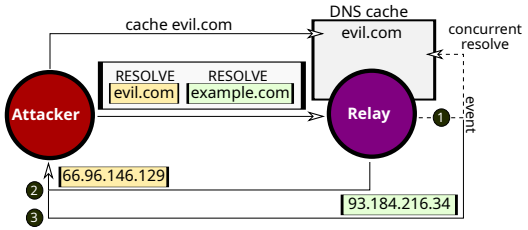
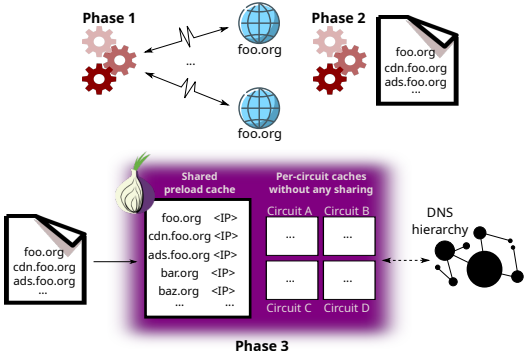


Timeless timing attack

12M repetitions in the live Tor network, fully reliable attack prototype

C6: A redesign of Tor's DNS cache to defend against all (timeless) timing attacks



Preloaded DNS cache

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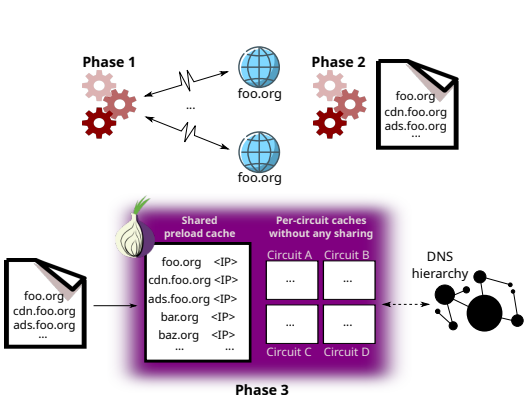

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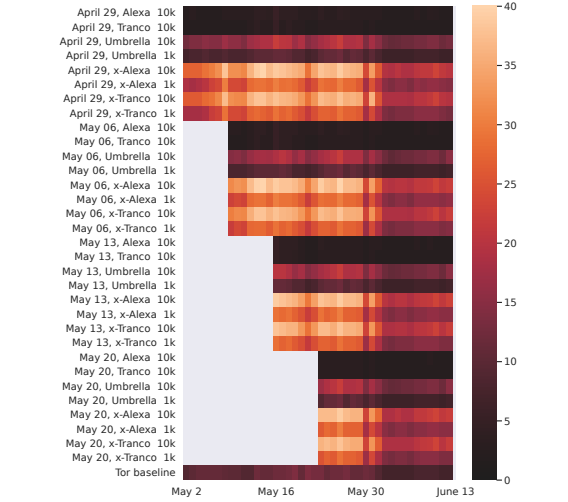
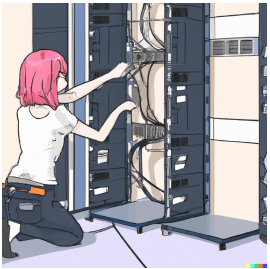
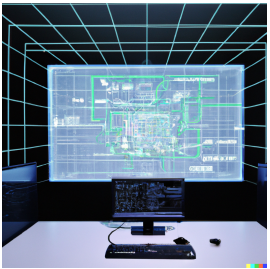


Summary of research methods

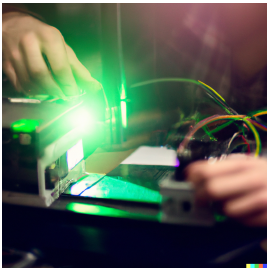
Threat modelling, proof sketching



Real-world measurements



Network simulation



Prototyping and evaluation

Take away

- Trust requirements can be reduced wrt. monitors and logs
- Certificate Transparency can work in Tor Browser's setting
- The website fingerprinting threat model could be stronger
- "On..."

Thank you

Paul Syverson
Linus Nordberg
Matthew Finkel
Tom Ritter
Tobias Pulls
Jonathan Vestin
Andreas Kassler
Toke Høiland-Jørgensen

Swedish Foundation for Strategic Research

Knowledge Foundation