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

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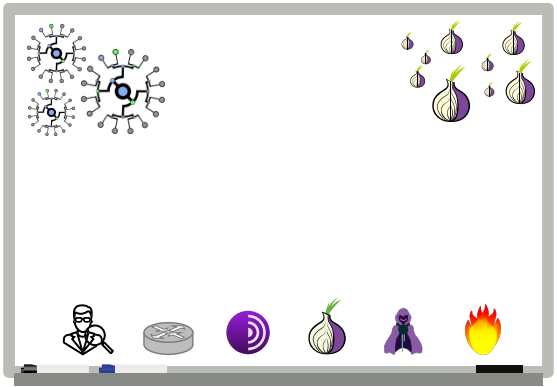
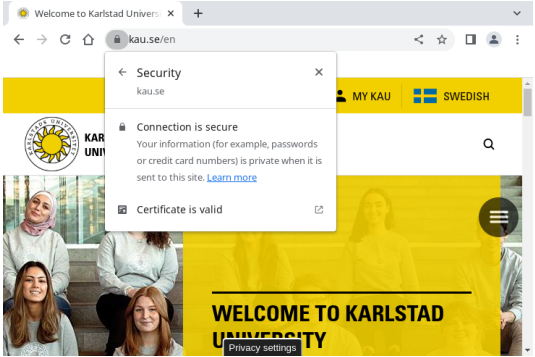
Outline

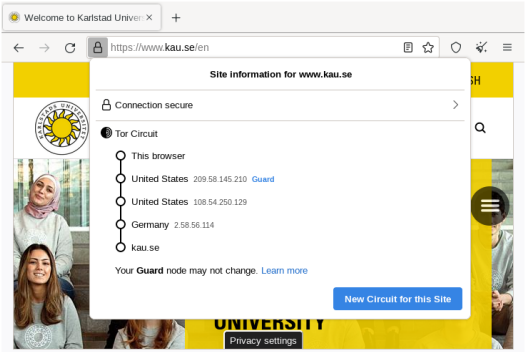


1. Introduction
2. Thesis overview
3. Contributions
4. Take away

How is all of this related to you?

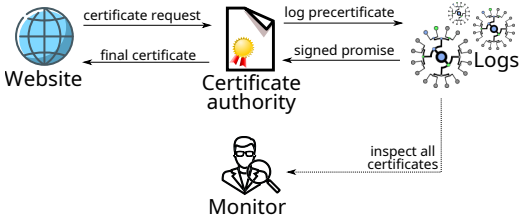


Web browsing

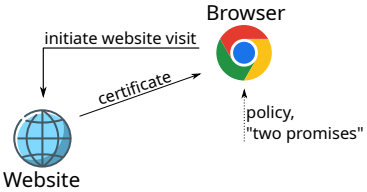


Possibly with Tor Browser

Some preliminaries, Certificate Transparency what?



Certificate issuance

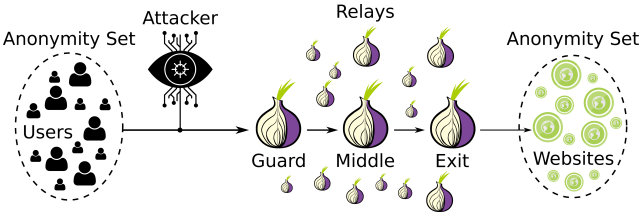


Browser behavior

Why should we take log promises at face value?

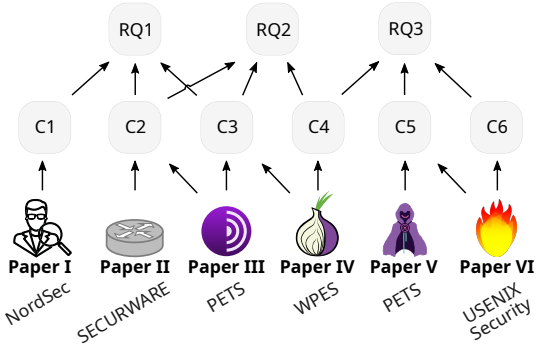
Research questions

1. Can trust requirements in Certificate Transparency be reduced in practise?
2. How can authentication of websites be improved in the context of Tor Browser?
3. How do the protocols used during website visits affect unlinkability between Tor users and their destination websites?

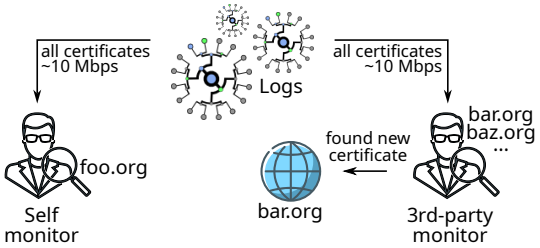


Contributions

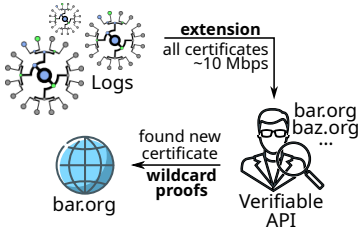
1. Reduced trust in third-party monitoring
2. Increased probability of split-view detection
3. Improved detectability of website hijacks targeting Tor Browser
4. An extension of the attacker model for website fingerprinting
5. Remotely-exploitable probing-attacks on Tor's DNS cache
6. A redesign of Tor's DNS cache to defend against all (timeless) timing attacks



C1: Reduced trust in third-party monitoring



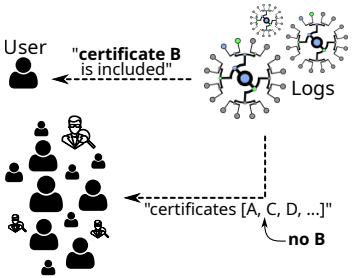
Problem



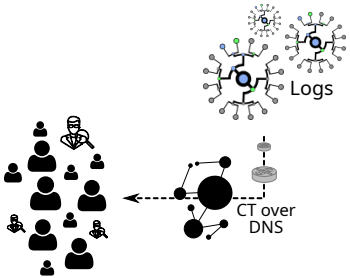
Solution

Secure in multi-instance setting, small performance overhead

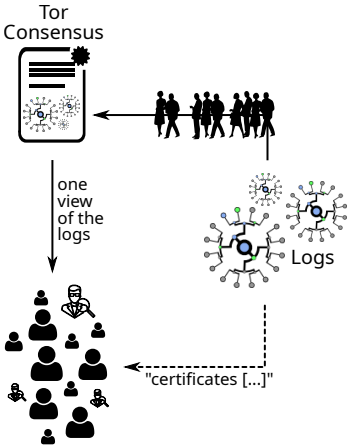
C2: Increased probability of split-view detection



Problem

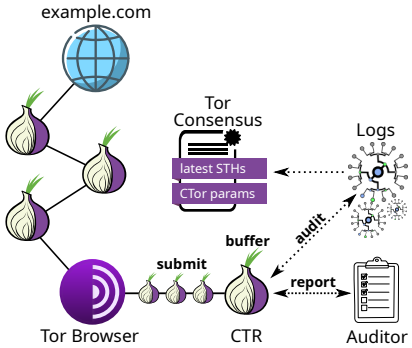


Solution (1/2)



Solution (2/2)

C3: Improved detectability of website hijacks targeting Tor Browser



Attacker capabilities

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

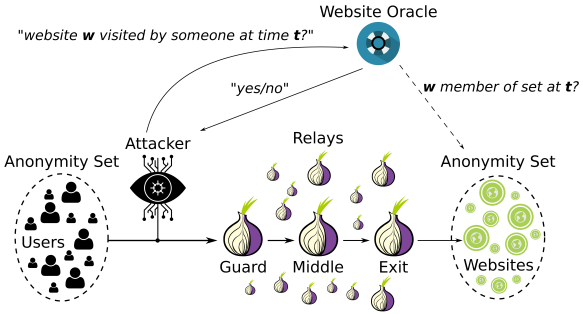
Security

- Break any of the four phases
- "Break" must go unnoticed

Solution (continued)

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

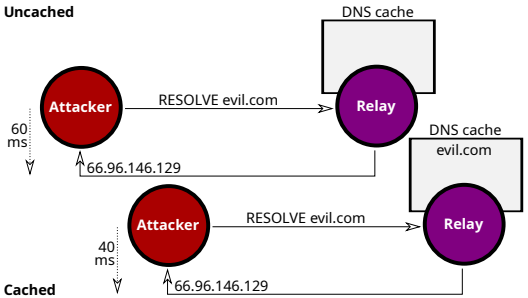
C4: An extension of the attacker model for website fingerprinting



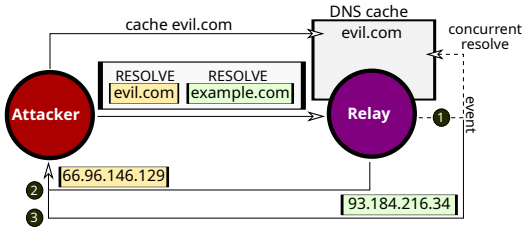
- Smaller destination anonymity set
- Eliminates most false positives for Alexa top-10k and beyond
- Gaining access to a website oracle?

Certificate Transaprency logs, Certificate Authorities, ...

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



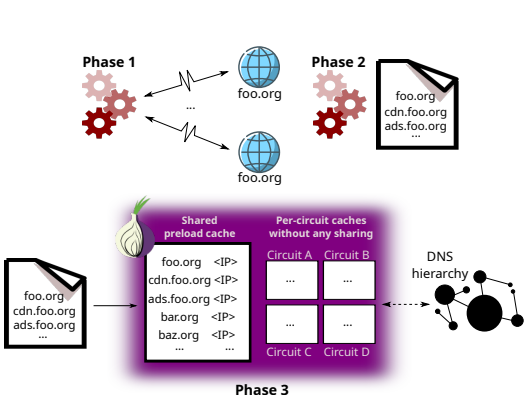
Timing attack



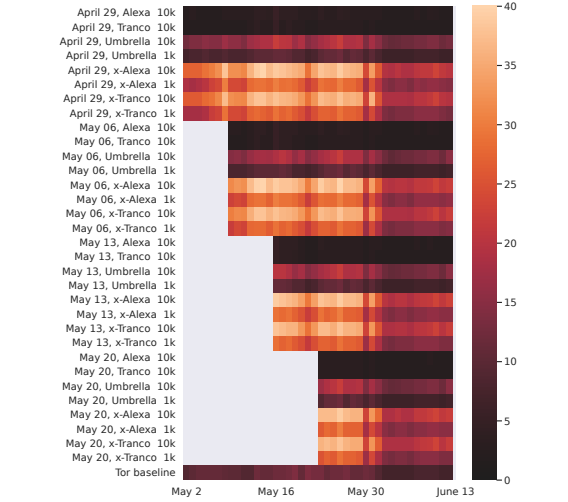
Timeless timing attack

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

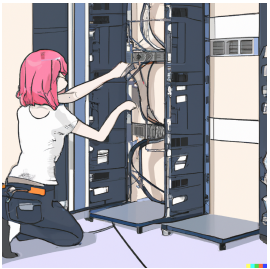


Preloaded DNS cache

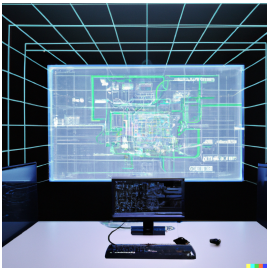


Summary of research methods

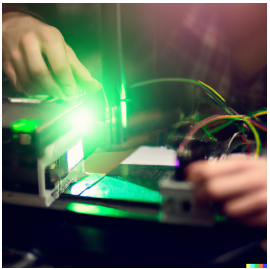
Threat modelling, proof sketching



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

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