Transparent Logging—An introduction and ongoing work

October 15, 2024

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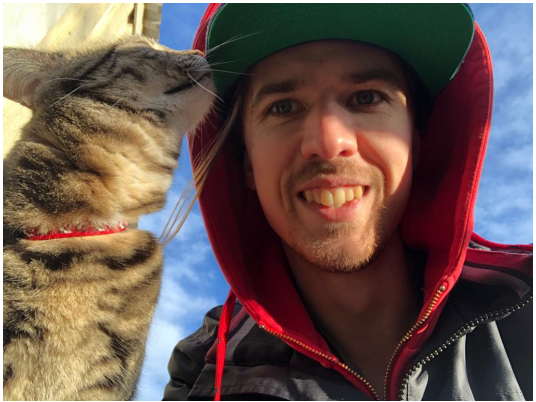
Outline

1. Transparent Logging
   - Why?
   - How?
   - What?
2. “System Transparency Logging”



Let's travel in space and time

- June, 2011
- Netherlands, Beverwijk
- DigiNotar

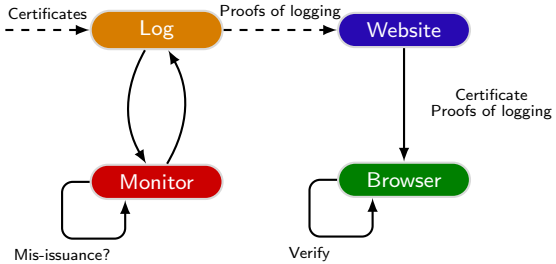
What happened?

- DigiNotar issued web certificates
- Did not live up to expectations
- Then lied about it for weeks

https://www.bbc.com/news/technology-14989334

What to make of this

- DigiNotar was neither first nor last[1]
- Detection of certificate mis-issuance?
- Discoverability with transparent logs[2]



[1] https://sslmate.com/certspotter/failures
[2] https://certificate.transparency.dev/

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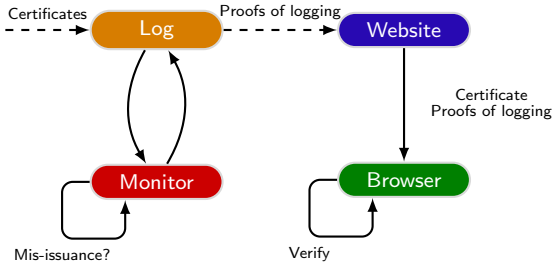

Chrome and Safari enforce Certificate Transparency

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Transparency logging is good for more than just certificates

Source code
Binaries
Config files
TPM quotes
Media content
Tax declarations
Documents of ownership
BGP announcements
Tor's consensus
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The log we are working on is helpful for all these use-cases!

Example use-case#1

Meet Daniel

- The author of `curl`
- Digitally signs new releases
- Long-term signing key-pair

Example use-case#2

Meet the R-B project

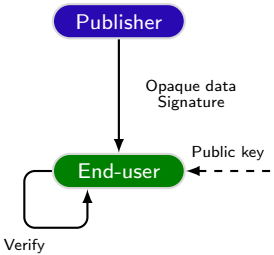
- Same input gives the same output
- Consensus of "valid" checksum?

Problem summary

1. Which signatures were produced by what private keys?
2. Consensus of checksums that should be considered valid?

Our starting point

- Data publisher
- End-user
- Assumptions
  - Public key can be located
  - Signed data can be located
  - End-user can install extra tooling



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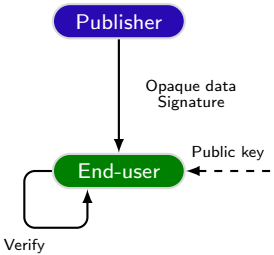

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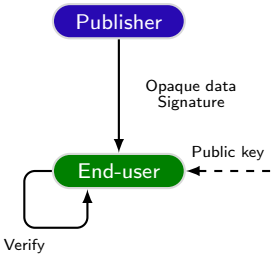
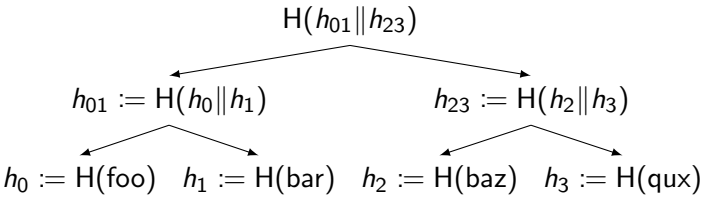


The attacker can compromise the data publisher
The goal is to detect unwanted key-usage

An intuition of transparency log properties



- Tree head
- Consistency proof
- Inclusion proof

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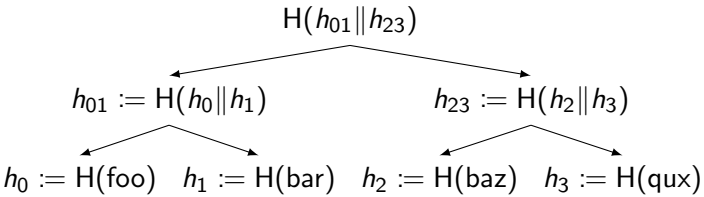

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The attacker can control the log

Preparing a logging request

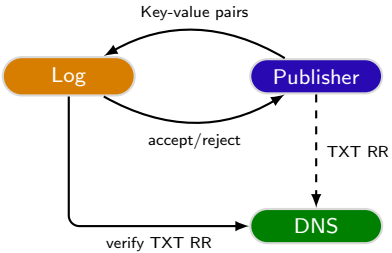
- Select a shard hint and checksum
- Sign using your private key

```
/*
 * The logged Merkle tree leaf data
 */
struct tree_leaf {
    u64 shard_hint;
    u8 checksum[32];
    u8 signature[64];
    u8 key_hash[32];
}
```

Submitting a logging request

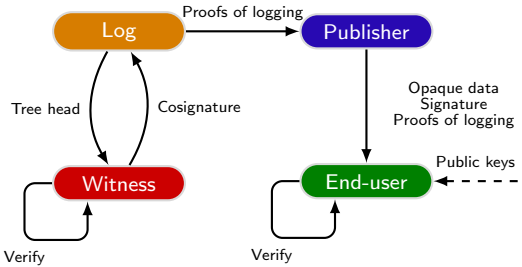
Key-value pairs:

- Shard hint
- Checksum
- Signature
- Public key
- Domain hint



Distributing proofs of public logging

- End-user will not talk to the log
- Proofs of logging
  - Inclusion proof
  - Tree head
- Witness cosigning



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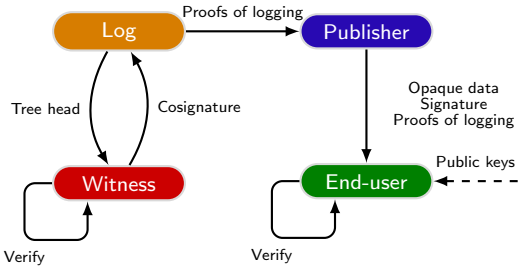

The attacker can control a threshold of witnesses

Example use-case#1

Remember Daniel?

- Sign a checksum of each `curl` release
- Start logging every signed checksum
- Monitor the log for your own leaves

Example use-case#2

Remember the R-B project?

- Sign the expected checksum of each build
- A valid checksum is a logged checksum
- Rebuilders validate logged checksums

Summary and feature overview

- Signed checksums
- Sharding
- Preserved data flows
- Anti-spam
- Global consistency
- Few simple parsers
- No cryptographic agility

Current status

- Version v0 README and documentation[3]
- A public instance of the log is up and running
- At least one party is witnessing the log
- Come say hello and contribute if you want!
  - `irc/oftc #siglog`
  - Matrix bridge[4]
  - Open meetings every Tuesday, 1300

[1] https://github.com/system-transparency/stfe/

[2] https://app.element.io/#/room/#siglog:matrix.org