Mission Accomplished? HTTPS Security after DigiNotar

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TLS/HTTPS Security Extensions

- Certificate Transparency
- HSTS (HTTP Strict Transport Security)
- HPKP (HTTP Public Key Pinning)
- SCSV (TLS Fallback Signaling Cipher Suite Value)
- CAA (Certificate Authority Authorization)
- DANE-TLSA (DNS Based Authentication of Named Entities)

Methodology

- Active & passive scans
- Active measurements from 2 continents
  - Largest domain-based TLS scan so far
  - More than 192 million domains
- Passive measurements on 3 continents
  - More than 2.4 billion observed TLS connections

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Certificate Transparency

CA

Issues Certificates

CT Log

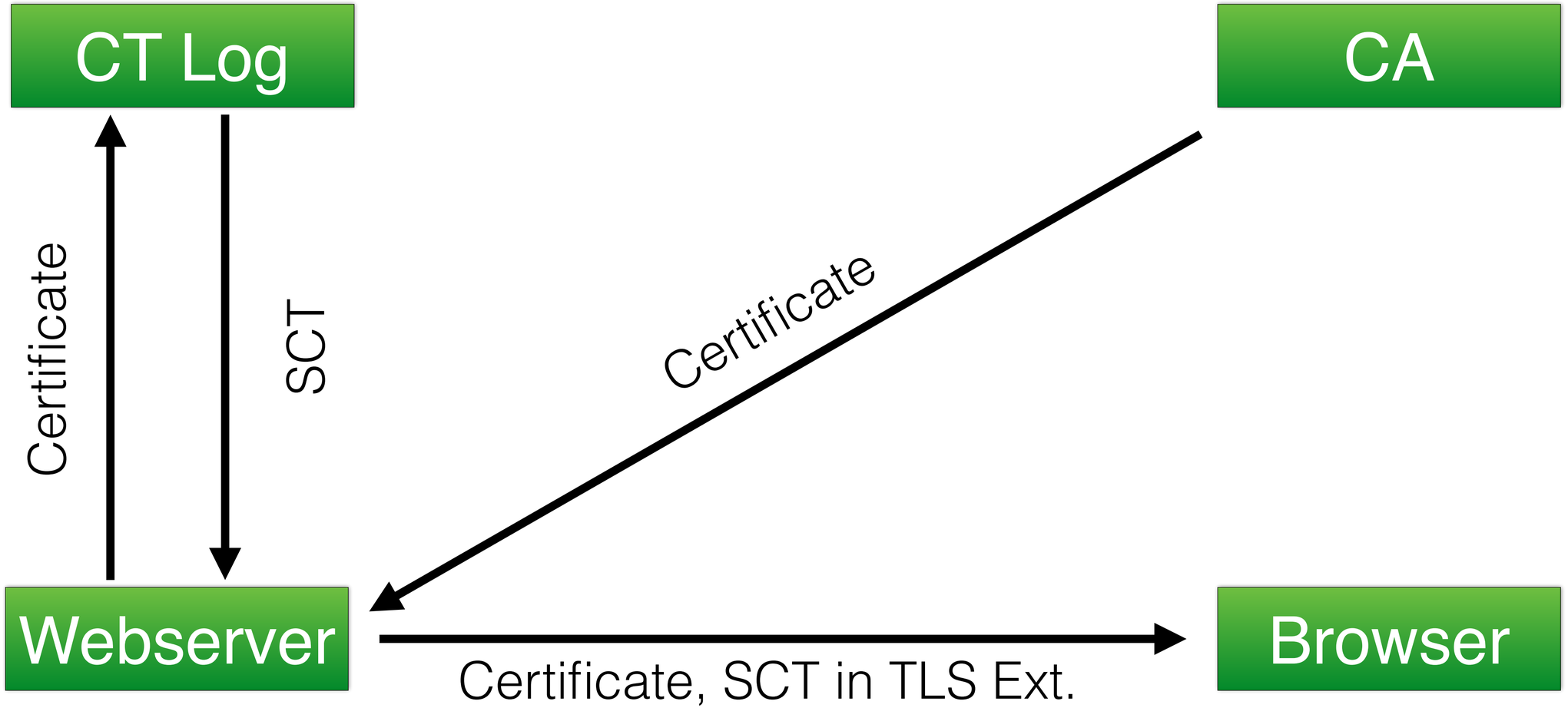
Provides publicly auditable, append-only Log of certificates

Also provides proof of inclusion

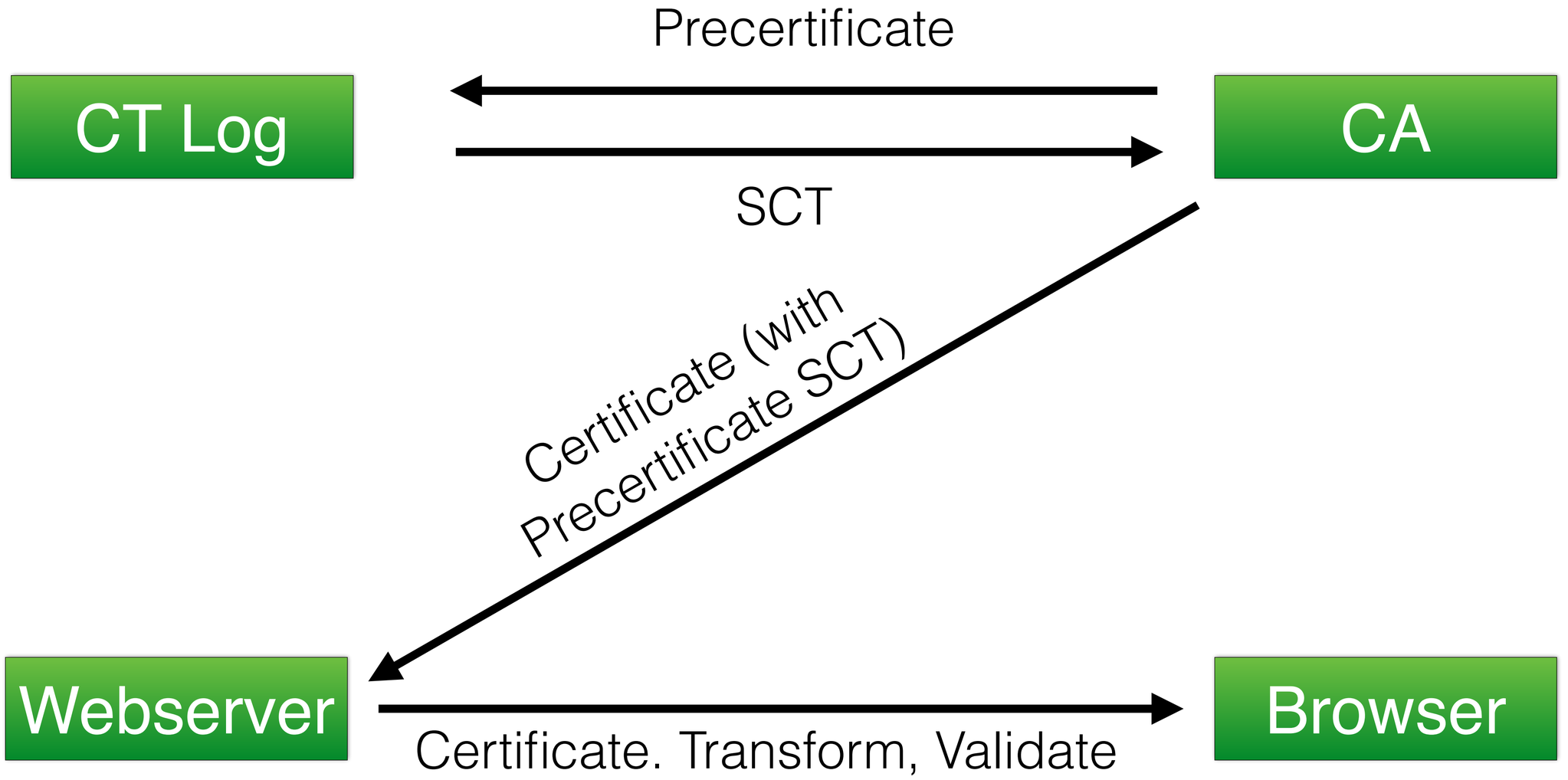
Browser

Verifies proof of inclusion

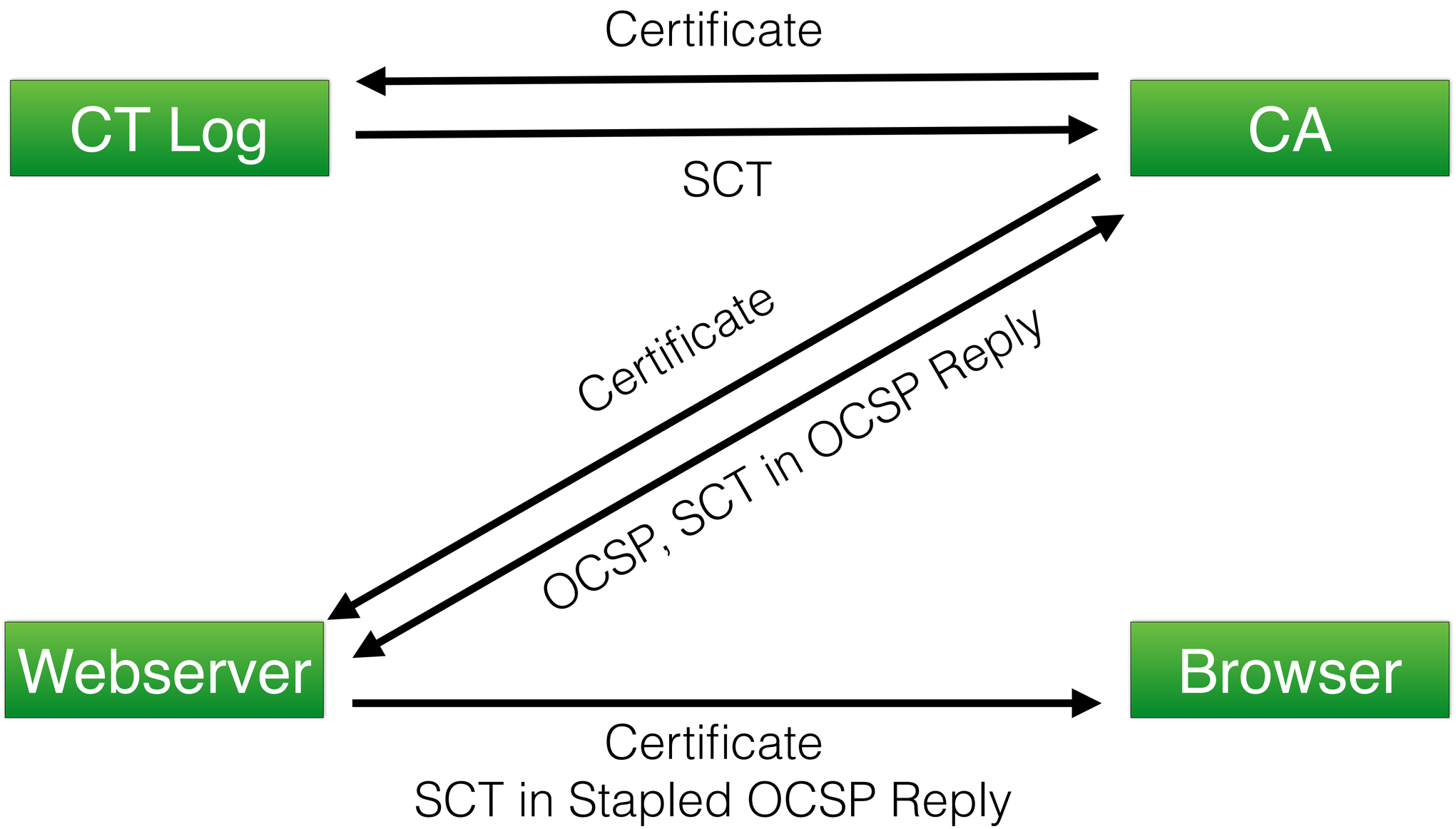
Certificate Transparency - TLS Ext.



Certificate Transparency - x509



Certificate Transparency - OCSP

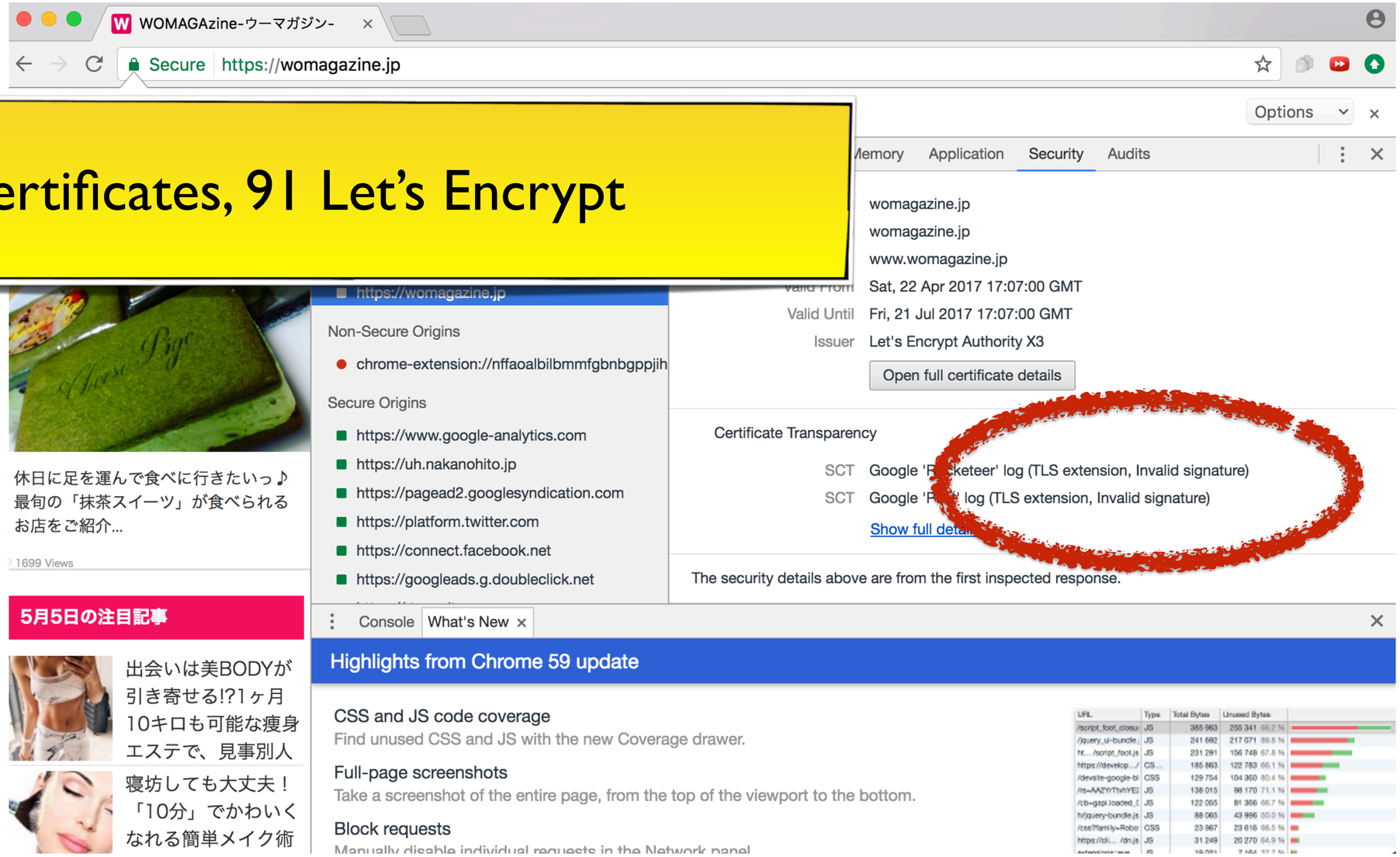


SCT Statistics - Active

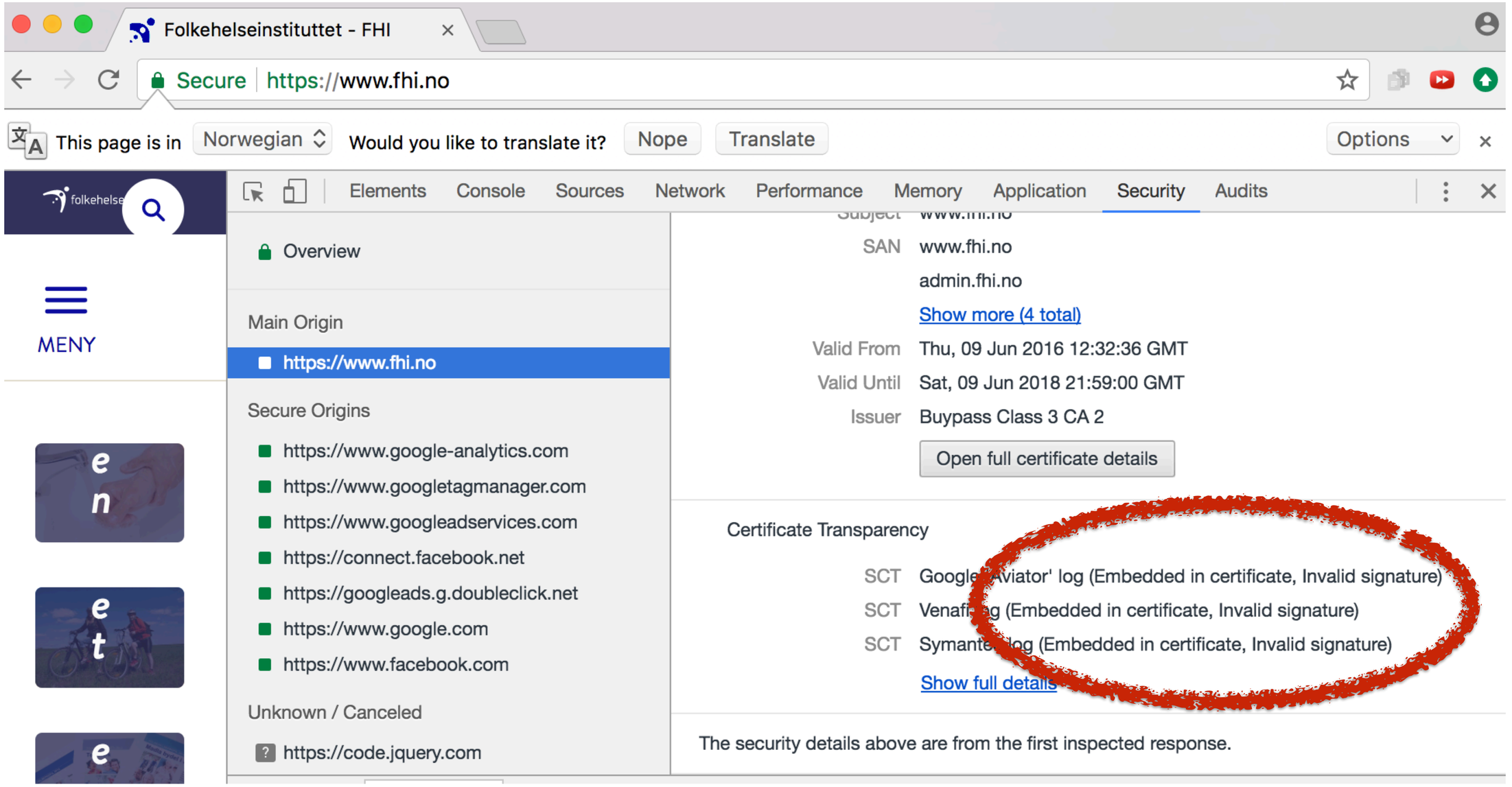
	Sydney v4	Munich v4	Munich v6
Domains we could connect to	55.7M	58.0M	5.1M
Domains with SCT	6.8M	6.8M	357K
… via X509	6.7M	6.8M	344K
… via TLS Ext.	27.6K	27.2K	12.9K
… via OCSP	180	188	3

SCT via TLS Ext. is Error-Prone

105 Certificates, 91 Let's Encrypt



Invalid embedded SCT?



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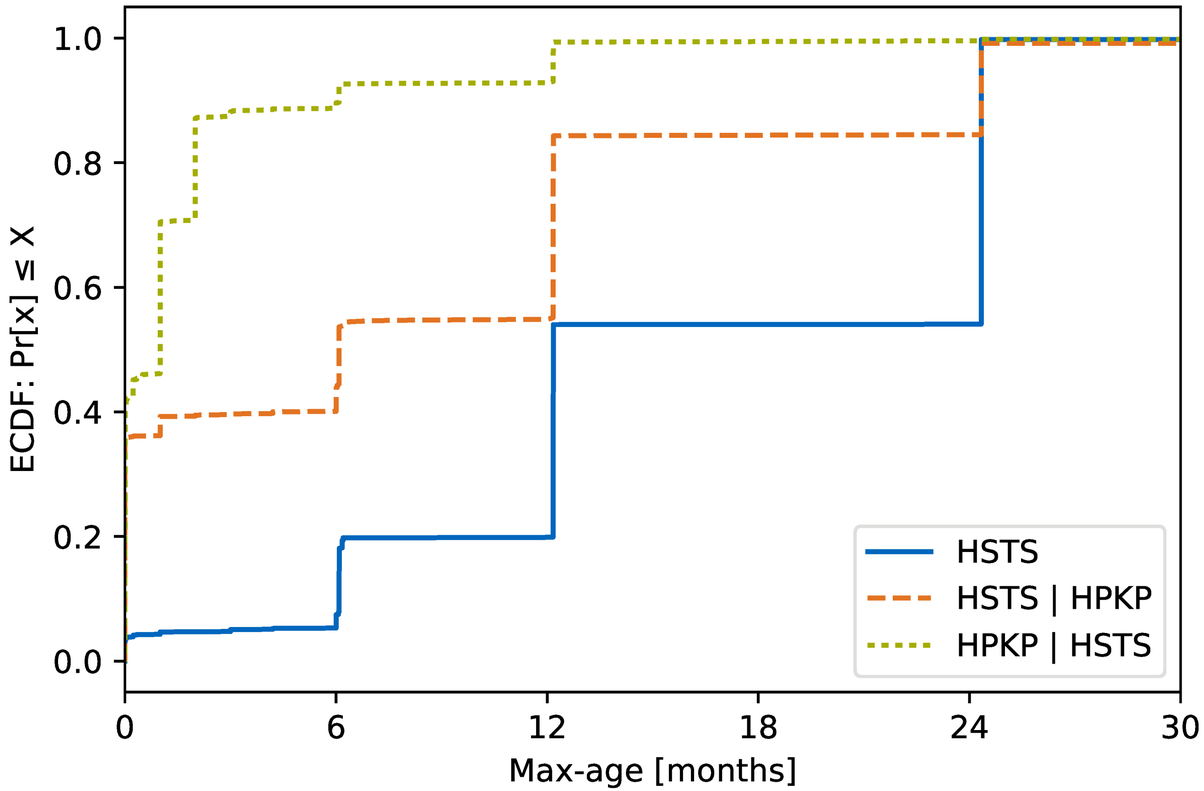
HSTS, HPKP: Much longer max-age values for HSTS

- HSTS: ~3.5% of domains
  - 0.2% send incorrect headers (misspellings, wrong attributes, …)
- HPKP: ~0.02% of domains (6,181)
  - 41 invalid



TLS/HTTPS Security Extensions

- Certificate Transparency
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SCSV

Automatically deployed when servers/libraries update

> 96% deployment

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Basically no deployment of CAA and TLSA as of April 2017

	SYD	MUC	Intersection	Top1M
CAA	3,243 (100%)	3,509 (100%)	3,057 (100%)	340 (100%)
signed	674 (21%)	899 (26%)	621 (20%)	53 (16%)
TLSA	1,697 (100%)	1,364 (100%)	1,246 (100%)	100 (100%)
signed	330 (78%)	1,042 (76%)	973 (78%)	89 (89%)

Deployment

Mechanism	Standard-ized	Deployment Overall	Deployment Top 10K↓	Effort	Availability Risk
SCSV	2015	49.2M	6789	**none**	low
CT-x509	2013	7.0M	1788	**none**[2]	**none**
HSTS	2012	0.9M	349	low	low
CT-TLS	2013	27,759	171	high	**none**
HPKP	2015	6616	156	high	high
HPKP PL.	2012[1]	479	150	high	high
HSTS PL.	2012[1]	23,539	144	medium	medium
CAA	2013	3057	20	medium	low
TLSA	2012	973	3	high	medium
CT-OCSP	2013	191	0	low	**none**

1: Preloading list first added to Chrome in 2012

2: Requires deployment effort on CA side and a new site certificate.

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Intent To Deprecate And Remove: Public Key Pinning

31 posts by 14 authors

Chris Palmer Oct 27

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Summary

Deprecate support for public key pinning (PKP) in Chrome, and then remove it entirely.

This will first remove support for HTTP-based PKP ("dynamic pins"), in which the user-agent learns of pin-sets for hosts by HTTP headers. We would like to do this in Chrome 67, which is estimated to be released to Stable on 29 May 2018.

Finally, remove support for built-in PKP ("static pins") at a point in the future when Chrome requires Certificate Transparency for all publicly-trusted certificates (not just newly-issued publicly-trusted certificates). (We don't yet know when this will be.)

Summary

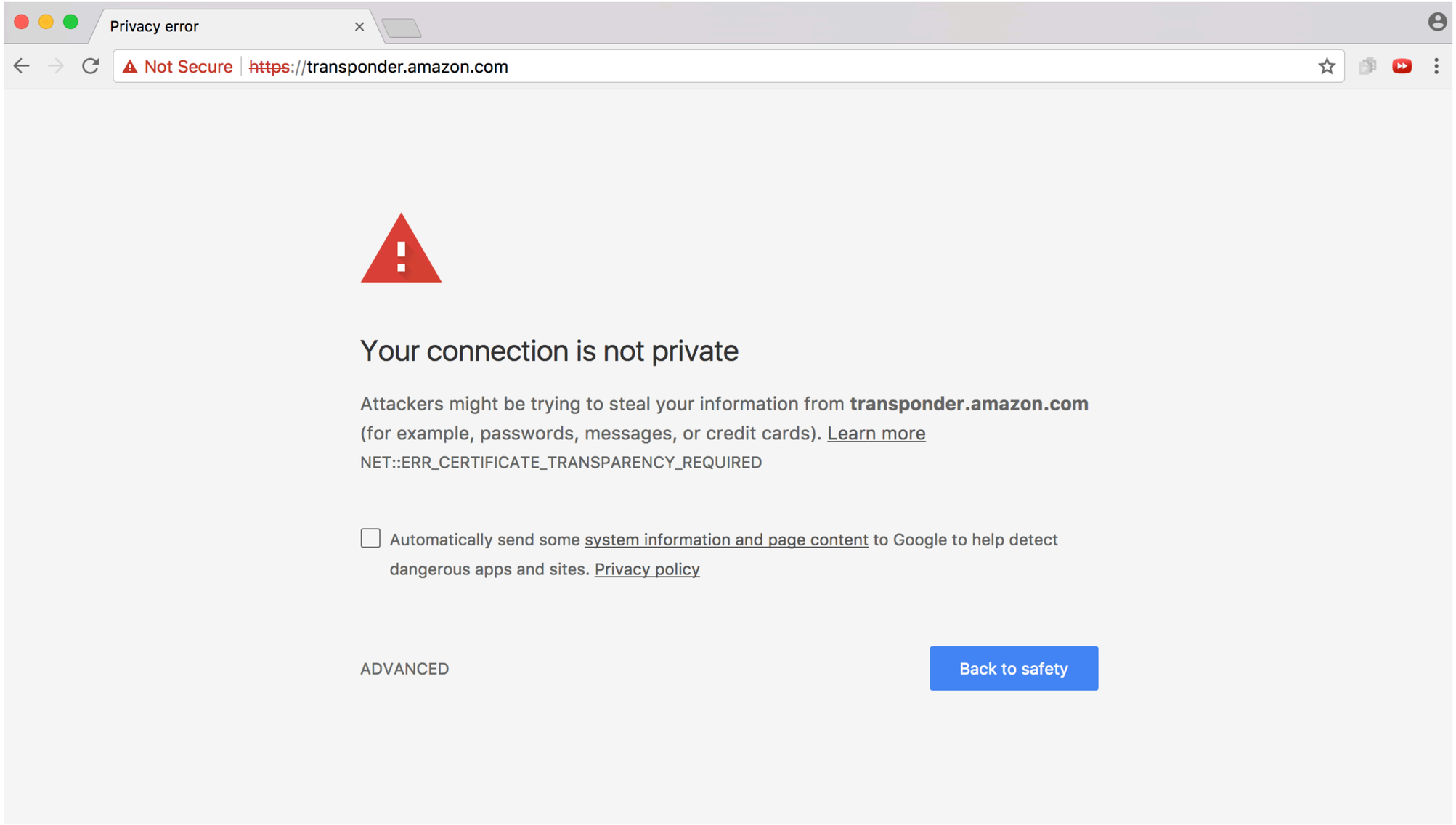
- Deployment status correlates with:
    - Configuration effort
    - Risk
    - Default deployment / settings work best
- Measurements from several sites have very similar results
    - One measurement location probably good enough in most cases

Community Contributions

- PCAPs of active scans
- Active scan results, CT database dumps
- Analysis Scripts (primarily Jupyter notebooks)
- Datasets: https://mediatum.ub.tum.de/1377982
- Software:
  - goscanner (HTTPS scanner): https://github.com/tumi8/goscanner
  - extended Bro TLS support (in master): https://bro.org

Backup

Log Operators



Log Operators

Active	Passive
Symantec log (81.26%)	Symantec log (62.78%)
Google ’Pilot’ log (79.9%)	Google ’Rocketeer’ log (58.6%)
Google ’Rocketeer’ log (31.72%)	Google ’Pilot’ log (58.48%)
DigiCert Log Server (26.96%)	Google ’Icarus’ log (14.37%)
Google ’Aviator’ log (25.67%)	Google ’Aviator’ log (9.39%)
Google ’Skydiver’ log (8.32%)	Vena log (7.47%)
Symantec VEGA log (3.98%)	WoSign ctlog (4.64%)
StartCom CT log (1.49%)	DigiCert Log Server (4.07%)
WoSign ctlog (0.67%)	Google ’Skydiver’ log (1.7%)

SCT Statistics - Passive

	California	Munich	Sydney
Time	4/4-5/2	5/12-5/16	5/12-5/16
Conns	2.6B	287M	196M
Conns with SCT	779M	73M	58M
… in Cert	520M	58M	44M
… in TLS	248M	14M	14M
… in OCSP	156K	38K	31K
# v4 IPs	737K	344K	226K
# SCT v4 IPs	222K	102K	66K