black hat USA 2023
AUGUST 9-10, 2023
BRIEFINGS

# Cookie Crumbles:

## Unveiling Web Session Integrity Vulnerabilities

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Joint work with **Lorenzo Veronese** and **Matteo Maffei**

# Who Are We

- **PhD** @ Ca' Foscari, Venice, IT 🇮🇹
- **Senior Scientist** @ TU Wien, Vienna, AT 🇦🇹
- **Web** & **Mobile** (**in**)**Security**
- **CTF player / organizer** since 2009
- Founder of **mhackeroni** 🍝
  (5x **DEF CON CTF** finalist)
  Playing with **WE_OWN_YOU** 🇦🇹
- IT security education projects with
  **ENISA** 🇪🇺, **CSA**, formerly **Cyberchallenge.IT**
- https://minimalblue.com/

**Marco** Squarcina

# Who Are We

**Pedro** Adão

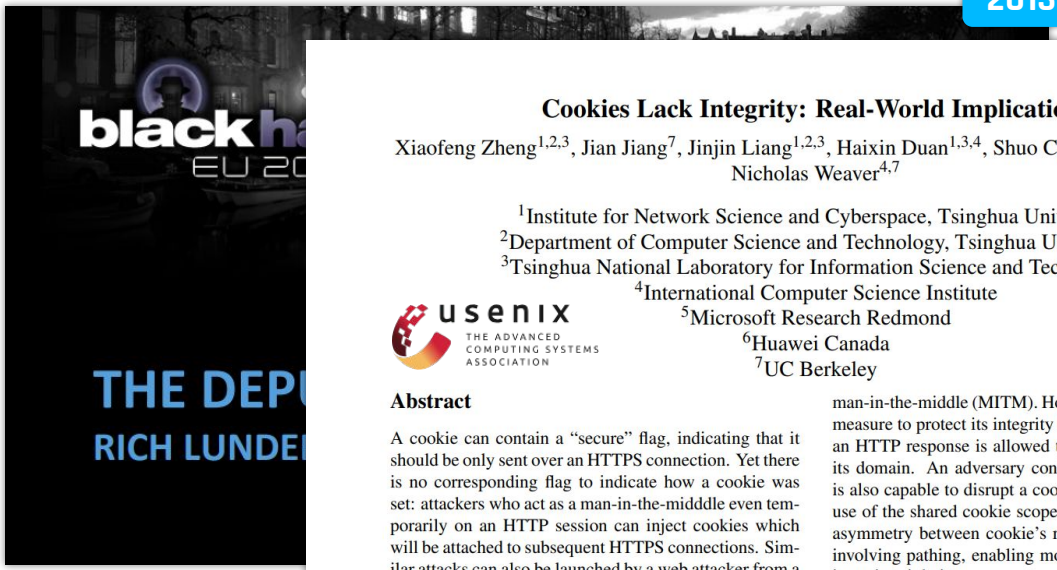
- **PhD** @ Técnico-Lisboa, PT 🇵🇹
- **Associate Prof.** @ Técnico-Lisboa, PT 🇵🇹
- **Programming Lang** & **Web** (**in**)**Security**
- **CTF player** since 2013
- Founder of **STT** and **CyberSecurity ChallengePT**
- **Coach Team PT** 🇵🇹 (ECSC 2019-...)
- **Coach Team Europe (ENISA)** 🇪🇺 (ICC 2022, 2023)

# Have Weak Integrity

2013


black hat
EU 2013
THE DEPUTIES ARE STILL CONFUSED
RICH LUNDEEN

2013




2015

## Cookies Lack Integrity: Real-World Implications

Xiaofeng Zheng[1,2,3], Jian Jiang[7], Jinjin Liang[1,2,3], Haixin Duan[1,3,4], Shuo Chen[5], Tao Wan[6], and Nicholas Weaver[4,7]

[1]Institute for Network Science and Cyberspace, Tsinghua University
[2]Department of Computer Science and Technology, Tsinghua University
[3]Tsinghua National Laboratory for Information Science and Technology
[4]International Computer Science Institute
[5]Microsoft Research Redmond
[6]Huawei Canada
[7]UC Berkeley

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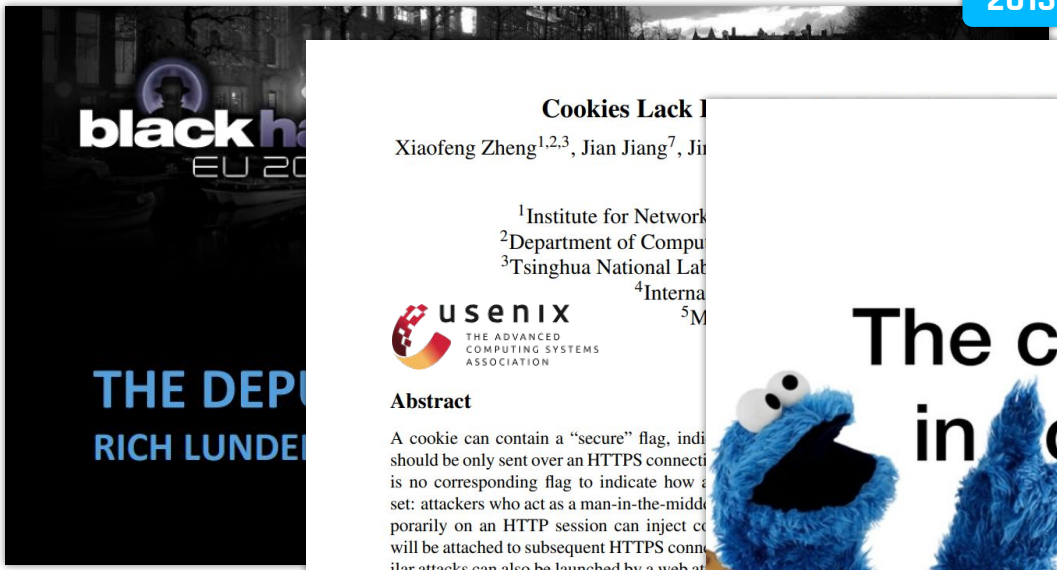
THE ADVANCED COMPUTING SYSTEMS ASSOCIATION

### Abstract

A cookie can contain a "secure" flag, indicating that it should be only sent over an HTTPS connection. Yet there is no corresponding flag to indicate how a cookie was set: attackers who act as a man-in-the-midddle even temporarily on an HTTP session can inject cookies which will be attached to subsequent HTTPS connections. Similar attacks can also be launched by a web attacker from a related domain. Although an acknowledged threat, it has not yet been studied thoroughly. This paper aims to fill this gap with an in-depth empirical assessment of cookie injection attacks. We find that cookie-related vulnerabilities are present in important sites (such as Google and Bank of America), and can be made worse by the implementation weaknesses we discovered in major web browsers (such as Chrome, Firefox, and Safari). Our successful attacks have included privacy violation, online victimization, and even financial loss and account man-in-the-middle (MITM). However, there is no similar measure to protect its integrity from the same adversary: an HTTP response is allowed to set a secure cookie for its domain. An adversary controlling a related domain is also capable to disrupt a cookie's integrity by making use of the shared cookie scope. Even worse, there is an asymmetry between cookie's read and write operations involving pathing, enabling more subtle form of cookie integrity violation.

The lack of cookie integrity is a known problem, noted in the current specification [2]. However, the real-world implications are under-appreciated. Although the problem has been discussed by several previous researchers [4, 5, 30, 32, 24, 23], none provided in-depth and real-world empirical assessment. Attacks enabled by merely injecting malicious cookies could be elusive, and the consequence could be serious. For example, a cautious user might only visit news websites at open wireless

2013




2015

**Cookies Lack I**

Xiaofeng Zheng[1,2,3], Jian Jiang[7], Ji

[1]Institute for Network
[2]Department of Compu
[3]Tsinghua National Lab
[4]Interna
[5]M

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**Abstract**

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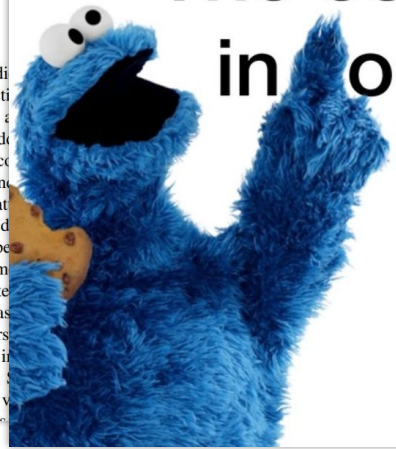
successful attacks have included privacy v
line victimization, and even financial loss

2019

# The cookie monster in our browsers



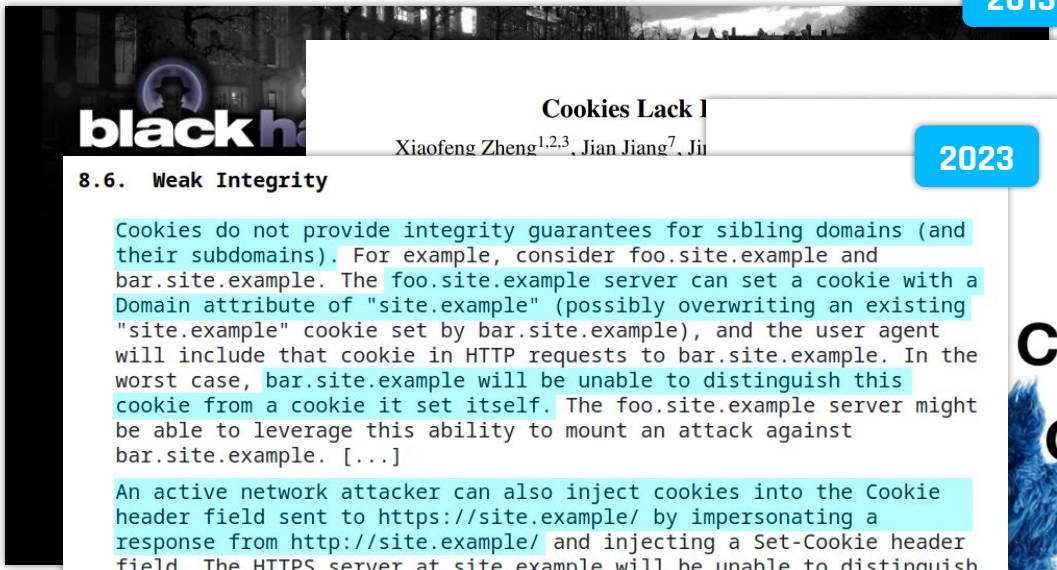
@filedescriptor
HITCON 2019

2013

2015

2019

2023




Cookies Lack I

Xiaofeng Zheng[1,2,3], Jian Jiang[7], Ji

### 8.6. Weak Integrity

Cookies do not provide integrity guarantees for sibling domains (and their subdomains). For example, consider foo.site.example and bar.site.example. The foo.site.example server can set a cookie with a Domain attribute of "site.example" (possibly overwriting an existing "site.example" cookie set by bar.site.example), and the user agent will include that cookie in HTTP requests to bar.site.example. In the worst case, bar.site.example will be unable to distinguish this cookie from a cookie it set itself. The foo.site.example server might be able to leverage this ability to mount an attack against bar.site.example. [...]

An active network attacker can also inject cookies into the Cookie header field sent to https://site.example/ by impersonating a response from http://site.example/ and injecting a Set-Cookie header field. The HTTPS server at site.example will be unable to distinguish these cookies from cookies that it set itself in an HTTPS response. An active network attacker might be able to leverage this ability to mount an attack against site.example even if site.example uses HTTPS exclusively. [...]

Finally, an attacker might be able to force the user agent to delete cookies by storing a large number of cookies. Once the user agent reaches its storage limit, the user agent will be forced to evict some cookies. Servers SHOULD NOT rely upon user agents retaining cookies.

rfc6265bis-12

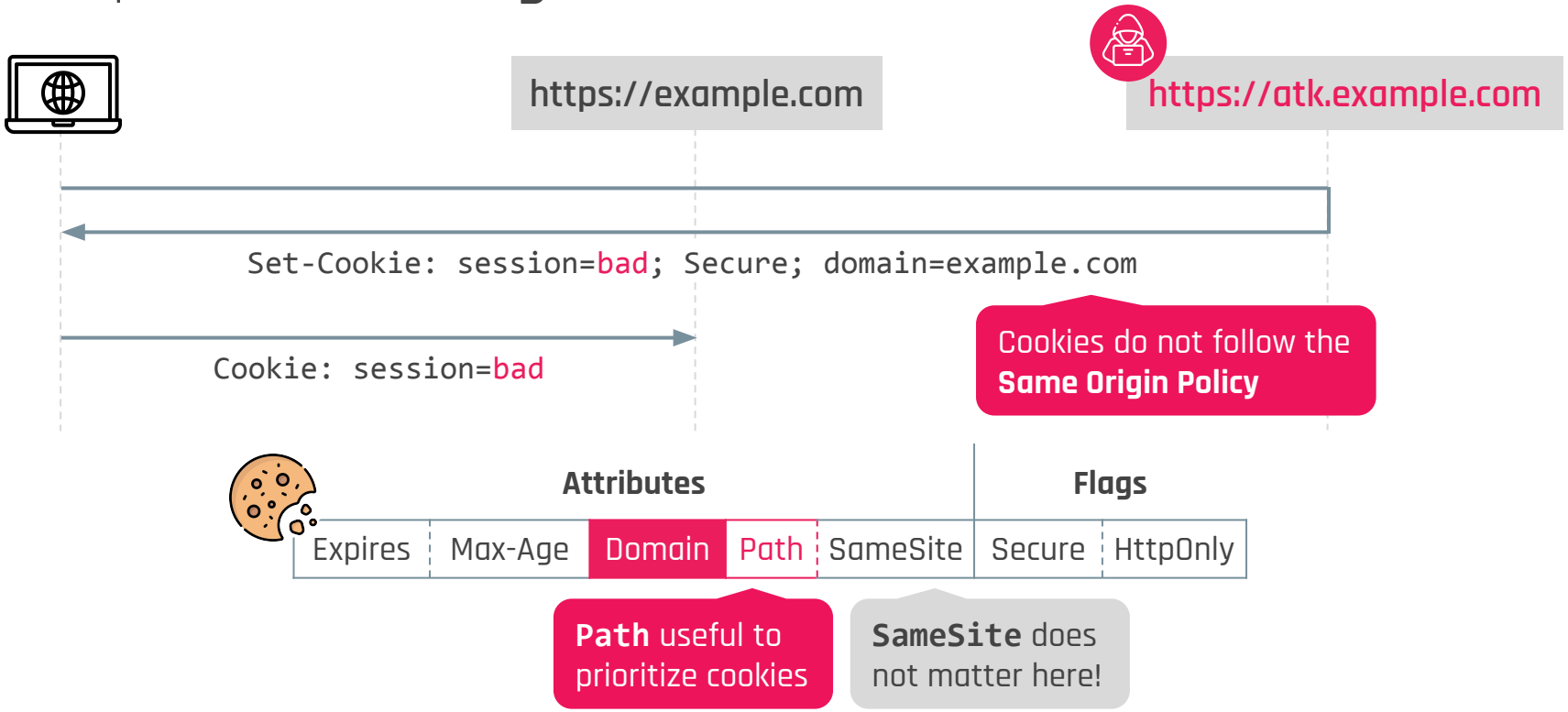
cookie monster

our browsers

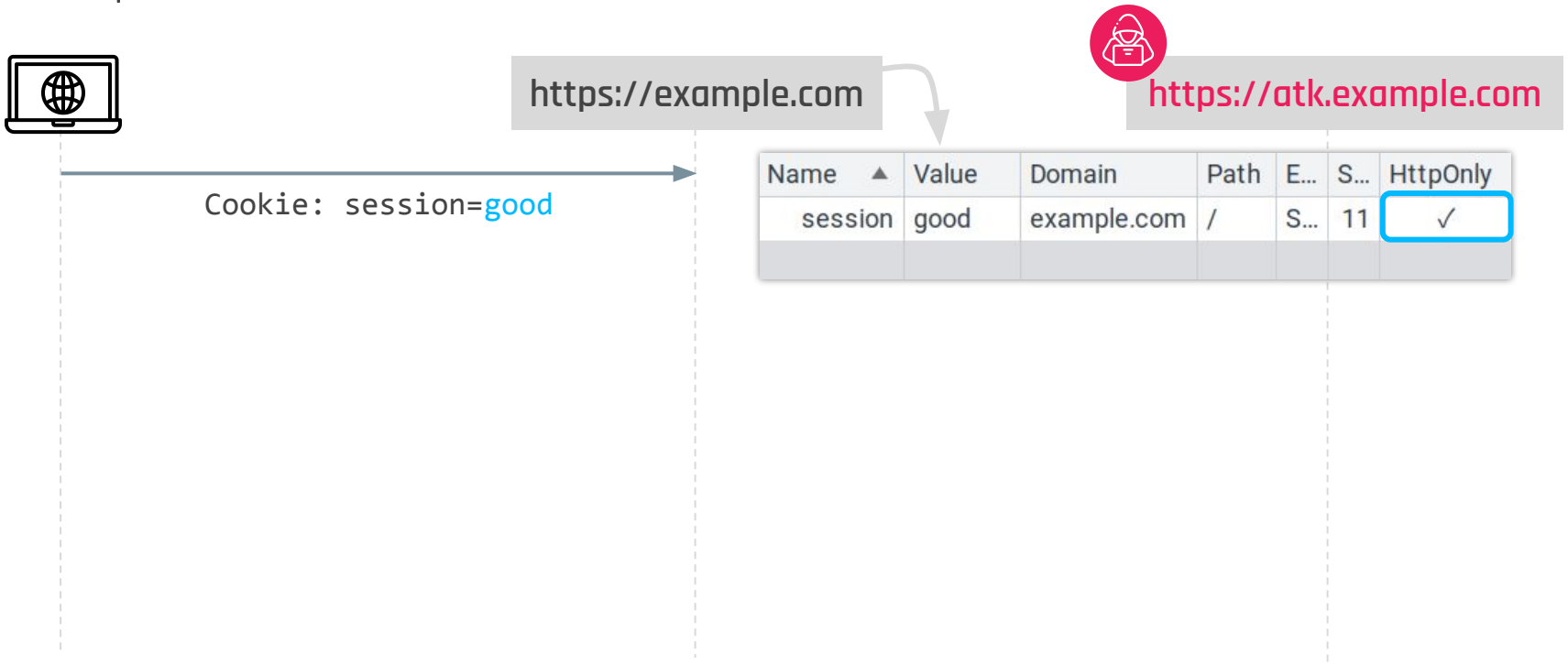
@filedescriptor

HITCON 2019

# Recap: **Cookie Tossing**



# Recap: **Cookie Eviction**



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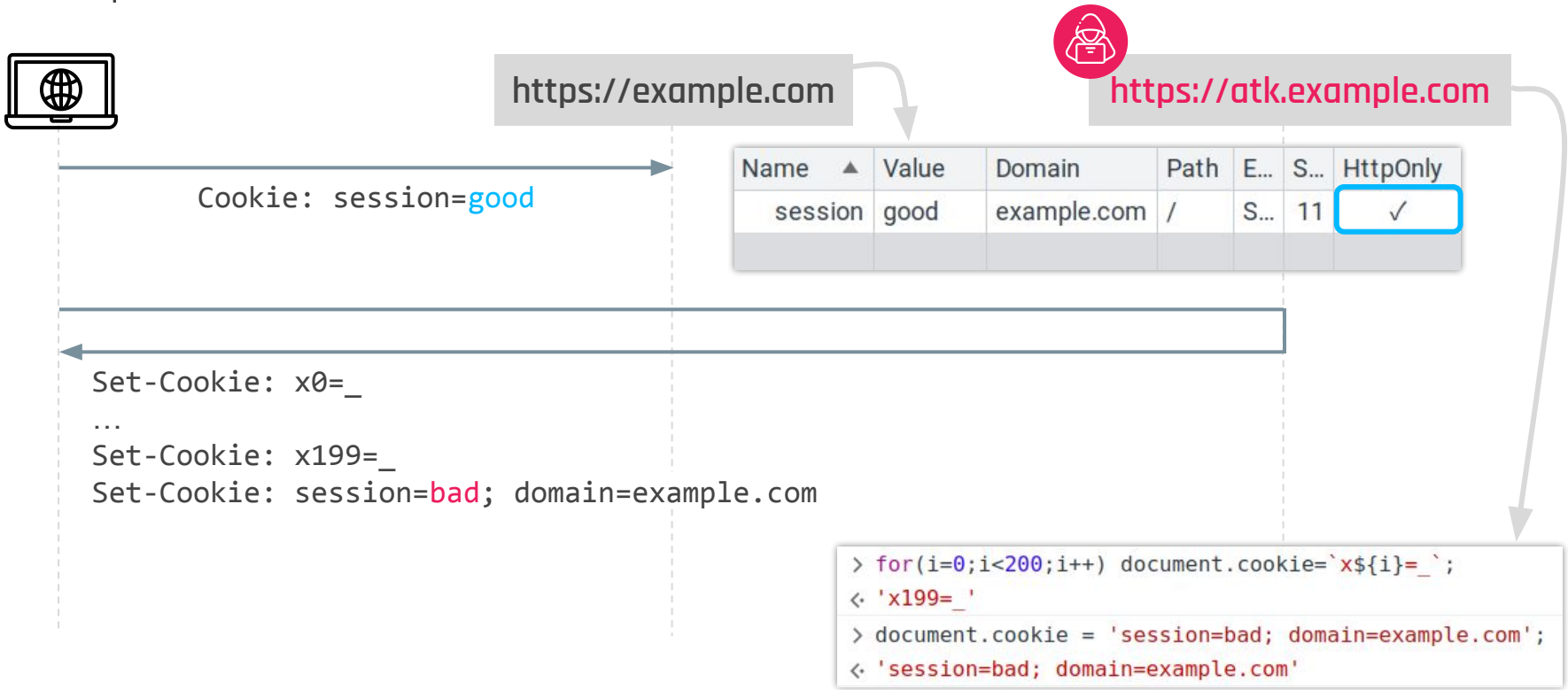
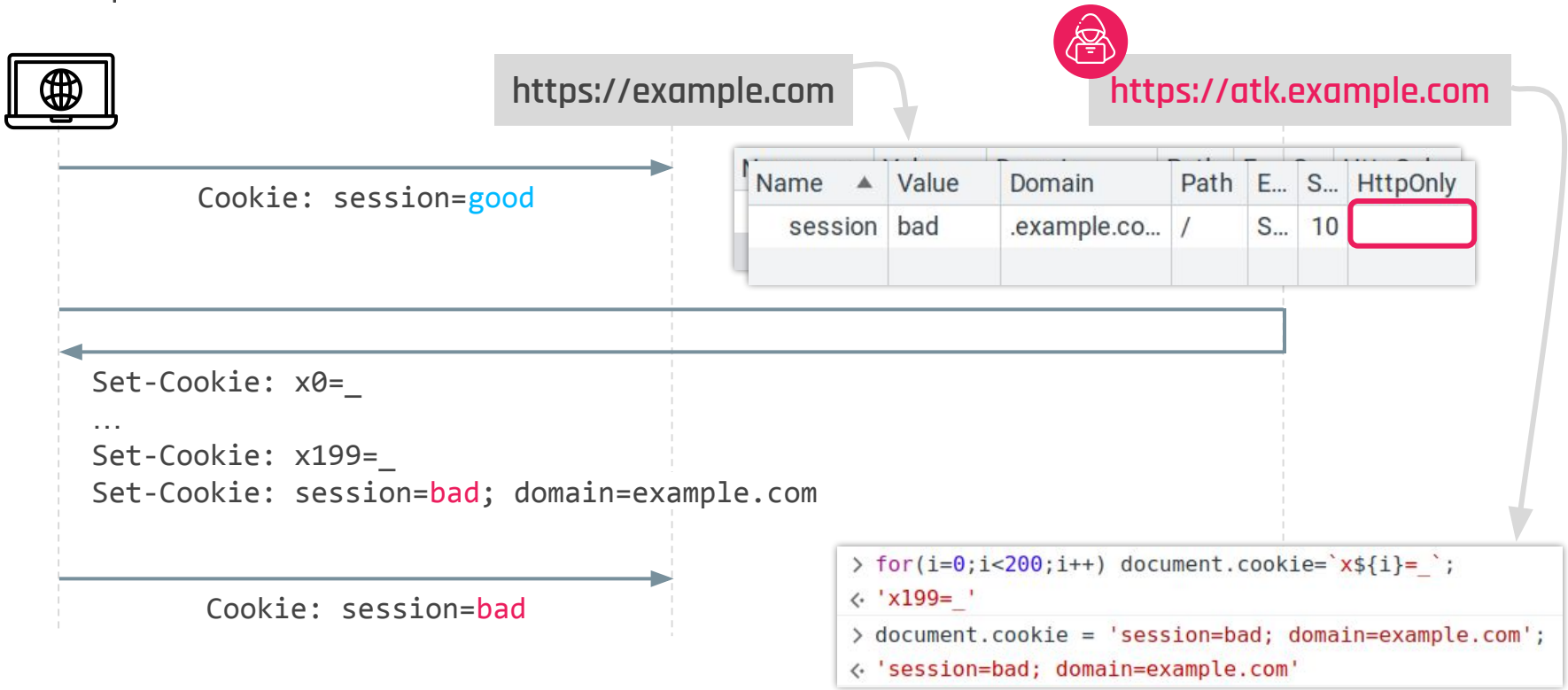
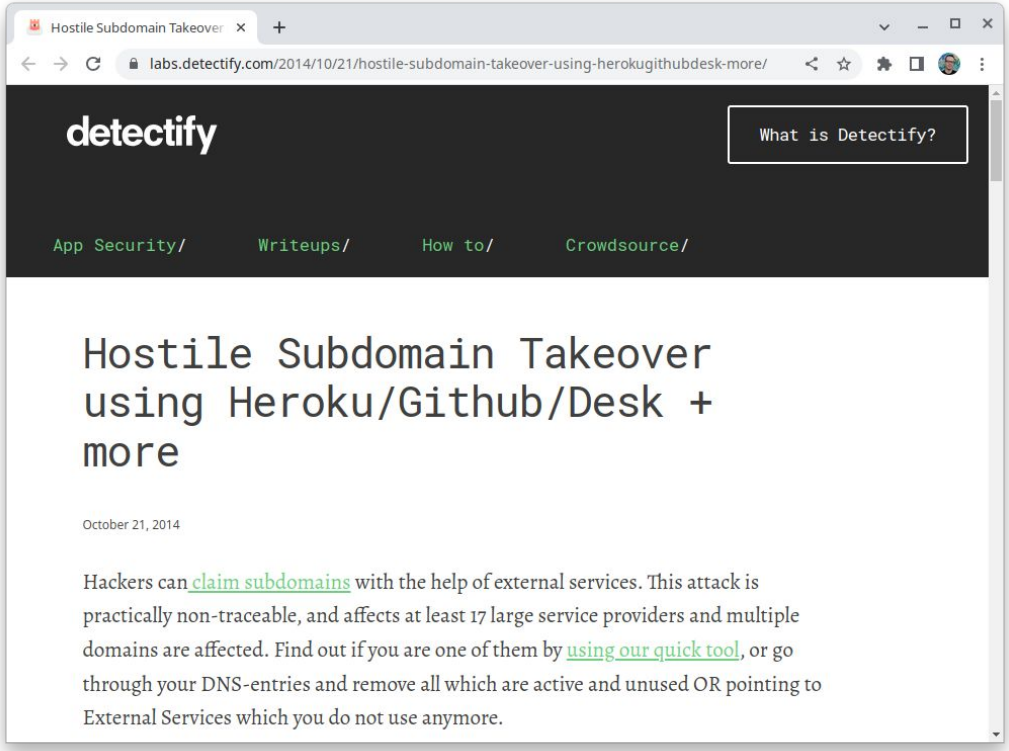


# Recap: **Cookie Eviction**



# Threat Models (Same-site & Network Attacker)




**Dangling DNS Records**

**Discontinued Services**

# Threat Models (Same-site & Network Attacker)

Can I Take Your Subdomain? Exploring Same-Site Attacks in the Modern Web

Marco Squarcina[1] Mauro Tempesta[1] Lorenzo Veronese[1] Stefano Calzavara[2] Matteo Maffei[1]
[1] TU Wien [2] Università Ca' Foscari Venezia & OWASP

usenix THE ADVANCED COMPUTING SYSTEMS ASSOCIATION

2021

**Abstract**

Related-domain attackers control a sibling domain of their target web application, e.g., as the result of a subdomain takeover. Despite their additional power over traditional web attackers, related-domain attackers received only limited attention from the research community. In this paper we define and quantify for the first time the threats that related-domain attackers pose to web application security. In particular, we first clarify the capabilities that related-domain attackers can acquire through different attack vectors, showing that different instances of the related-domain attacker concept are worth attention. We then study how these capabilities can be abused to compromise web application security by focusing on different angles, including cookies, CSP, CORS, postMessage, and domain relaxation. By building on this framework, we report on a large-scale security measurement on the top 50k domains from the Tranco list that led to the discovery of vulnerabilities in 887 sites, where we quantified the threats posed by related-domain attackers to popular web applications.

attacker is traditionally defined as a we
twist, i.e., its malicious website is hos
of the target web application. For ins
about the security of `www.example.`
that a related-domain attacker contro
The privileged position of a related-domain attacker endows it, for instance, with the ability to compromise cookie confidentiality and integrity, because cookies can be shared between domains with a common ancestor, reflecting the assumption underlying the original Web design that related domains are under the control of the same entity. Since client authentication on the Web is mostly implemented on top of cookies, this represents a major security threat.

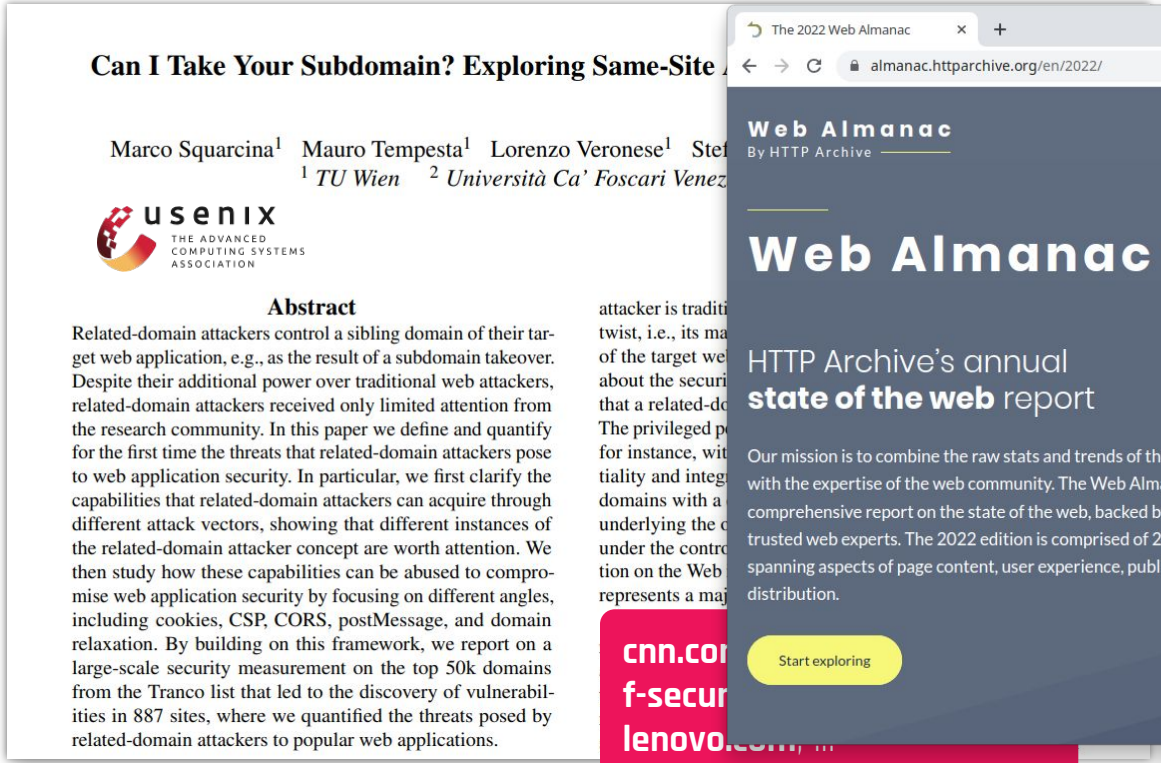
**1520** vulnerable subdomains

**cnn.com**, **nih.gov**, **cisco.com**, **f-secure.com**, **harvard.edu**, **lenovo.com**, ...

## Dangling DNS Records

- **Discontinued Services** — Corporate Networks
- **Expired Domains** — Roaming Services
- **Deprovisioned Cloud Instances** — Dynamic DNS Providers

# Threat Models (Same-site & Network Attacker)



Can I Take Your Subdomain? Exploring Same-Site

Marco Squarcina[1] Mauro Tempesta[1] Lorenzo Veronese[1] Stef
[1] TU Wien [2] Università Ca' Foscari Venez

usenix
THE ADVANCED COMPUTING SYSTEMS ASSOCIATION

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Related-domain attackers control a sibling domain of their target web application, e.g., as the result of a subdomain takeover. Despite their additional power over traditional web attackers, related-domain attackers received only limited attention from the research community. In this paper we define and quantify for the first time the threats that related-domain attackers pose to web application security. In particular, we first clarify the capabilities that related-domain attackers can acquire through different attack vectors, showing that different instances of the related-domain attacker concept are worth attention. We then study how these capabilities can be abused to compromise web application security by focusing on different angles, including cookies, CSP, CORS, postMessage, and domain relaxation. By building on this framework, we report on a large-scale security measurement on the top 50k domains from the Tranco list that led to the discovery of vulnerabilities in 887 sites, where we quantified the threats posed by related-domain attackers to popular web applications.

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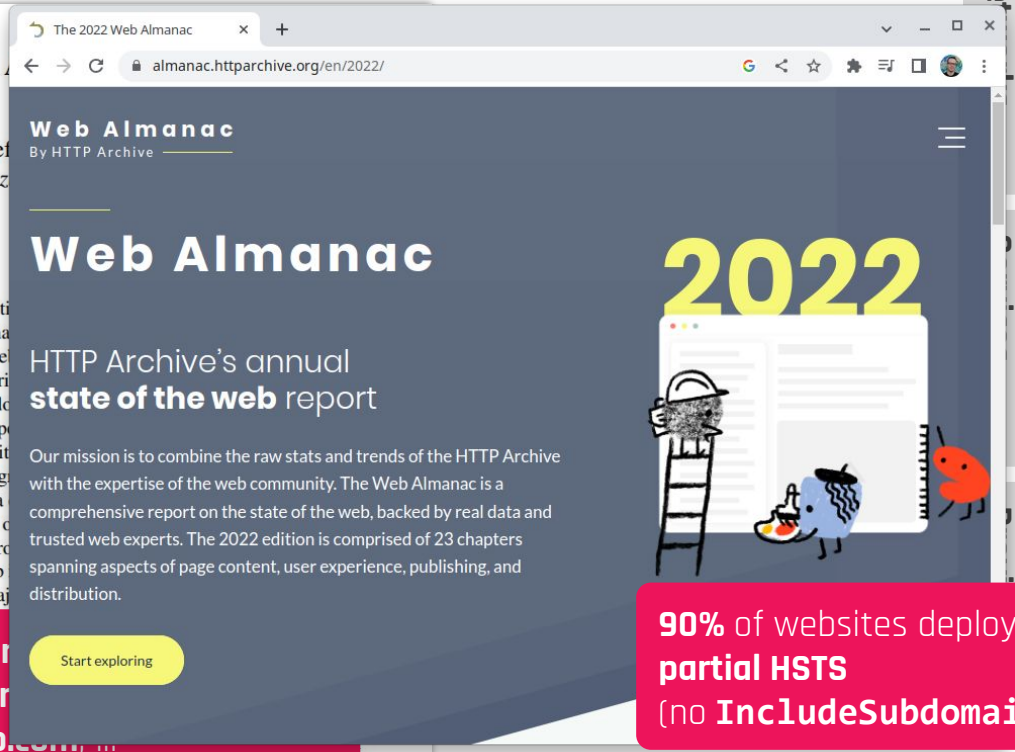
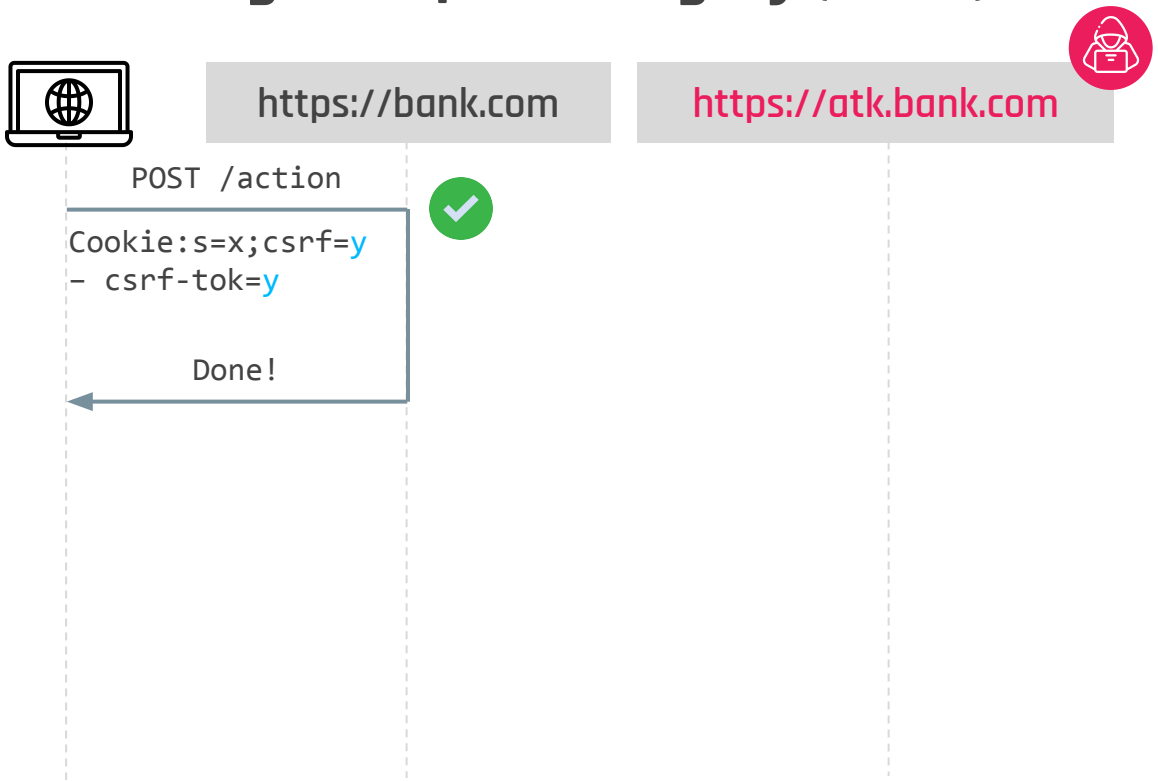



cnn.co
f-secur
lenovo.com, m

**90%** of websites deploy **partial HSTS** (no **`IncludeSubdomain`**)

Corporate Ne
Roaming
Dyna

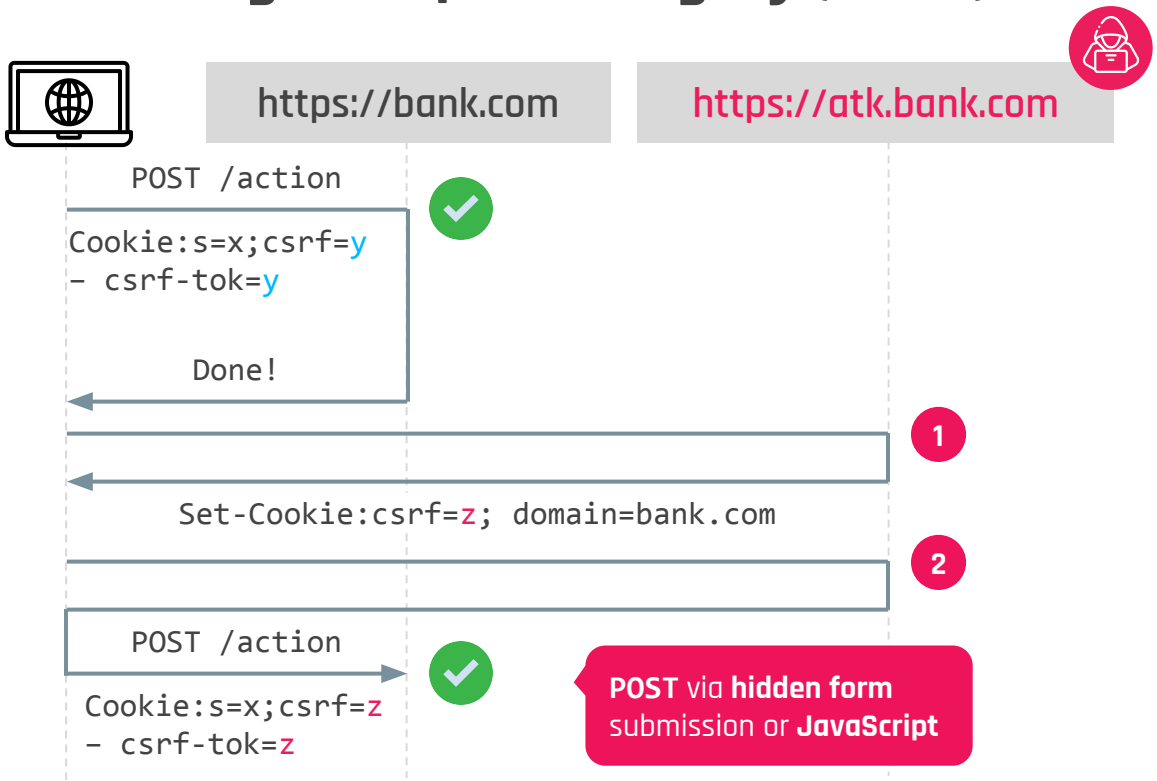
# Cross-Origin Request Forgery (CORF)




## Double-Submit Pattern (DSP)

```
if cookie(csrf)==POST(csrf-tok):
      return True
return False
```

# Cross-Origin Request Forgery (CORF)




## Double-Submit Pattern (DSP)

```
if cookie(csrf)==POST(csrf-tok):
      return True
return False
```

**Wrong assumption**: attacker can only manipulate the token, but not the cookie!

Trivially **vulnerable** against same-site attackers, just **toss** and **submit**!

# Synchronizer Token Pattern (STP)

Improves the vulnerable **Double-Submit Pattern** (**DSP**)

- Session  `:= <id, CSRF_secret>`

  **CSRF secret** stored in the **session** (can be client or server-side)

- `CSRF_token = generate_token(CSRF_secret, params...)`

- **Verification** (server-side)

  `CSRF_token == generate_token(CSRF_secret, params...)`

- Overwrite the session cookie? Deauth the user, **NO CORF**, attacker sad :/

# Synchronizer Token Pattern (Flask-login + Flask-WTF)

https://bank.com

1

GET /login

csrf_token=t0

Set-Cookie: session={csrf:s0, id:None}

Client-side sessions, cryptographically signed

```
s = <random value>

t = <exp_time,
     HMAC(SECRET, exp_time, s)>
```

Verification:

```
exp_time, h = t
if h == HMAC(SECRET, exp_time, s):
  return True
return False
```

# Synchronizer Token Pattern (Flask-login + Flask-WTF)

https://bank.com

1. GET /login

   csrf_token=t0

   Set-Cookie: session={csrf:s0, id:None}

2. POST /login

   Cookie: session={csrf:s0, id:None}
   – user/password & csrf_token=t0

   Hi Bob, csrf_token=t1

   Set-Cookie: session={csrf:s0, id:bob}

Client-side sessions, cryptographically signed

```
s = <random value>

t = <exp_time,
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Verification:

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   Cookie: session={csrf:s0, id:None}
   – user/password & csrf_token=t0

   Hi Bob, csrf_token=t1

   Set-Cookie: session={csrf:s0, id:bob}

3. POST /action

   Cookie: session={csrf:s0, id:bob}
   – csrf_token=t1

Client-side sessions, cryptographically signed

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s = <random value>

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   - user/password & csrf_token=t0

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   Set-Cookie: session={csrf:s0, id:bob}

3. POST /action

   Cookie: session={csrf:s0, id:bob}
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return False
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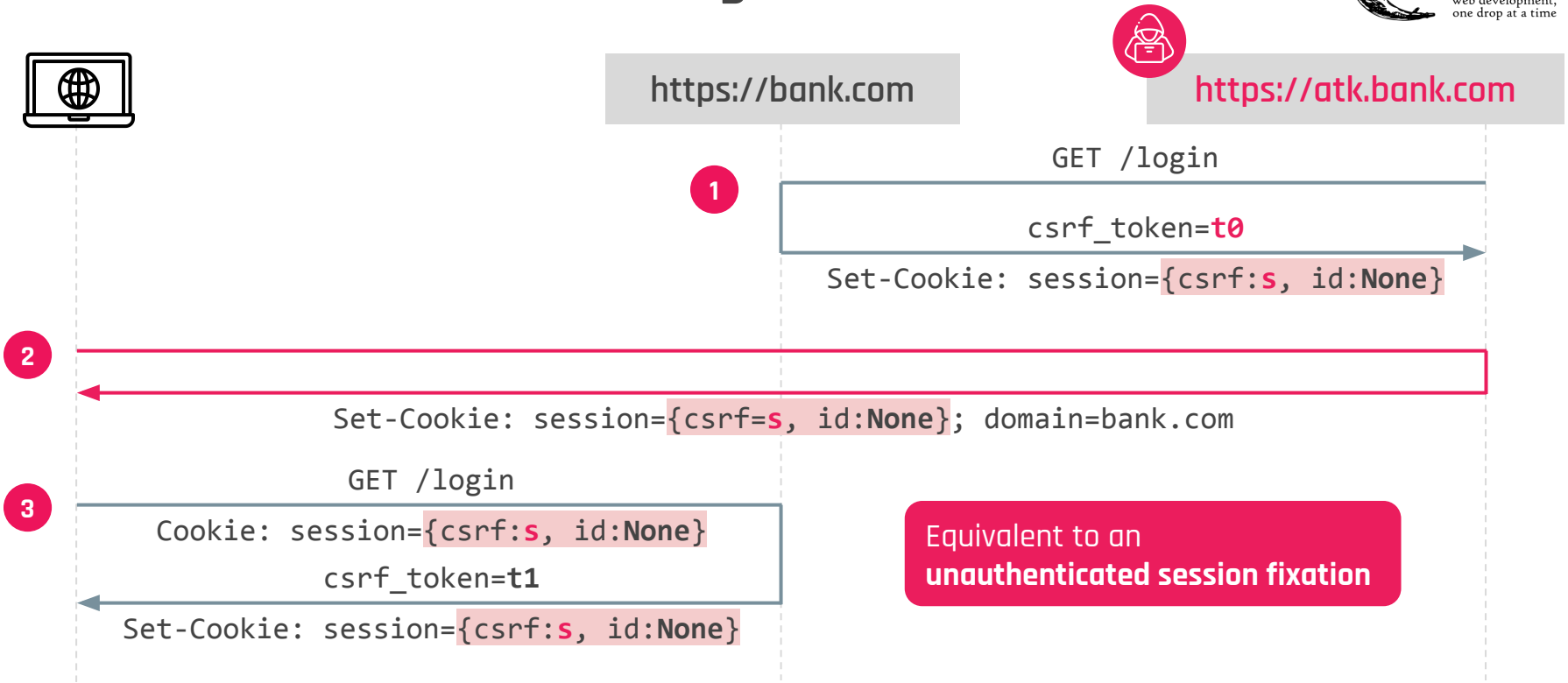
# CORF Token Fixation (Flask-login + Flask-WTF)



# CORF Token Fixation (Flask-login + Flask-WTF)

https://bank.com

https://atk.bank.com

4

POST /login

Cookie: session={csrf:s, id:None}
– user/password & csrf_token=t1

Welcome Bob!

Set-Cookie: session={csrf:s, id:bob}

Bob authenticates

# CORF Token Fixation (Flask-login + Flask-WTF)

https://bank.com

https://atk.bank.com

4

POST /login

Cookie: session={csrf:s, id:None}
– user/password & csrf_token=t1

Welcome Bob!

Set-Cookie: session={csrf:s, id:bob}

Bob authenticates

5

POST /action

Cookie: session={csrf:s, id:bob}
– csrf_token=t0

The **CSRF secret s** is not refreshed during login!
The **CSRF token t0** known by the attacker is valid for Bob's session!

# CORF Token Fixation

- Bypasses faulty implementations of the **Synchronizer Token Pattern**
- Caused by the **CSRF secret** in the session **not being renewed** upon login
- The attacker does not need to know the CSRF secret, but only an **unauthenticated session id** and a **valid CSRF token** for that session
- Works against **server-side** and **client-side** session handling implementations
- User already logged-in? No problem, **force a deauth** and toss the attacker's pre-session, either via eviction or request to `/logout` endpoint

# CORF Token Fixation (CodeIgniter4)

https://bank.com

1 GET /login

csrf_token=t0

Set-Cookie: session=sess0

```
__ci_last_regenerate|i:1690849755;
csrf_test_name|s:32:"47be9758fe558
98f1958bd201764a0be";
```

CSRF secret **s0**

# CORF Token Fixation (CodeIgniter4)

CodeIgniter

https://bank.com

1 GET /login

csrf_token=t0

Set-Cookie: session=sess0

2 POST /login

Cookie: session=sess0
– user/password & csrf_token=t0

Welcome Bob!

Set-Cookie: session=sess1

```
__ci_last_regenerate|i:1690849755;
csrf_test_name|s:32:"1f5b0c83a29e9
f9725d219e53a6d2be1";user|a:1:{s:2
:"id";s:1:"1";}
```

CSRF secret **s1**

# CORF Token Fixation (CodeIgniter4)

https://bank.com

1 GET /login

csrf_token=t0

Set-Cookie: session=sess0

2 POST /login

Cookie: session=sess0
– user/password & csrf_token=t0

Welcome Bob!

Set-Cookie: session=sess1

```
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```

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```

CSRF secret **s1**

# CORF Token Fixation (CodeIgniter4)

https://bank.com

https://atk.bank.com

1 Pre-Login Session Fixation with `session=sess0`

2 Bob authenticates with `sess0`, obtains `sess1`

**`sess0`** updated with the **CSRF secret** of **sess1**

# CORF Token Fixation (CodeIgniter4)

CodeIgniter

https://bank.com

https://atk.bank.com

Pre-Login Session Fixation with `session=sess0`

1

Bob authenticates with `sess0`, obtains `sess1`

2

**`sess0` updated with the CSRF secret of `sess1`**

3

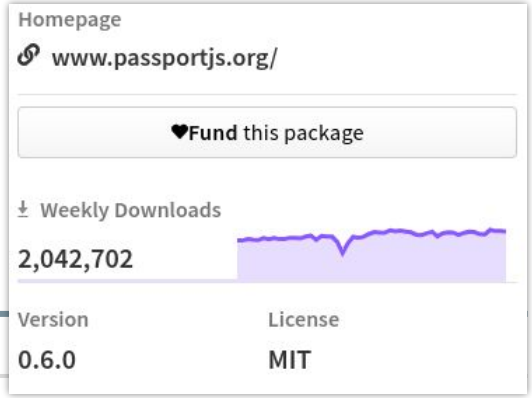
```
GET /login
Cookie: session=sess0
csrf_token=t2
Set-Cookie: session=sess0
```

4

```
POST /action
Cookie: session=sess1
- csrf_token=t2
```

# Web Frameworks Analysis

| Framework (9/13 vulnerable) | Broken STP | Default DSP | Session Fixation | | | |
|---|---|---|---|---|---|---|
| **Express** (passport + csurf) | ● | | ● | CVE-2022-25896 | | |
| **Koa** (koa-passport + csrf) | ● | | | | | |
| **Fastify** (fastify/passport + csrf-protection) | ● | ● | ● | CVE-2023-29020 | CVE-2023-27495 | CVE-2023-29019 |
| **Sails*** (csurf) | ● | | ● | | | |
| **Flask** (flask-login+flask-wtf) | ● | | | | | |
| **Tornado** | | ● | | | | |
| **Symfony** (security-bundle) | ● | | | CVE-2022-24895 | | |
| **CodeIgniter4** (shield) | ● | ● | | CVE-2022-35943 | | |
| **Yii2** | | ● | | | | |




*affects the bootstrap template app

# Are  Getting Better?

# Methodology

2 **Browser testing suite** for tossing & eviction: check **discrepancies**


Manual **review** of the cookie standard

1

Simple **differential fuzzing** to test server implementations

3

# Strict Secure &  Prefixes (__Host-)

HTTP Working Group — M. West
Internet-Draft — Google, Inc
Updates: 6265 (if approved) — September 5, 2016
Intended status: Standards Track
Expires: March 9, 2017

**Deprecate modification of 'secure' cookies from non-secure origins**
**draft-ietf-httpbis-cookie-alone-01**

block setting cookie without the **Secure** flag if the cookie jar contains Secure cookie with the same name

HTTP Working Group — M. West
Internet-Draft — Google, Inc
Updates: 6265 (if approved) — February 23, 2016
Intended status: Standards Track
Expires: August 26, 2016

**Cookie Prefixes**
**draft-ietf-httpbis-cookie-prefixes-00**

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**draft-ietf-httpbis-cookie-prefixes-00**

```
> document.cookie = '__Host-sess=bar; Path=/; Secure; Domain=example.com'
<· '__Host-sess=bar; Path=/; Secure; Domain=example.com'
> document.cookie
<· ''
```

**High-integrity** cookies, cannot be set from a sibling domain!

# Trivia

| Set-Cookie: |
| --- |
| foo= |
| =foo |
| =foo= |
| ==foo |
| foo |

## Valid? Or Invalid?

If valid, think of the corresponding `Cookie:` header…

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## Valid? Or Invalid?

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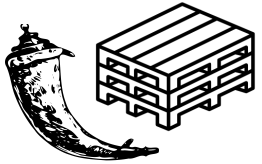
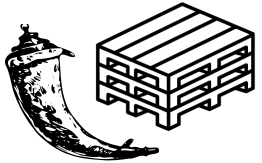
# Trivia



Werkzeug <2.2.3

| Set-Cookie: | Cookie: | Key | Value | Server <key, value> |
|---|---|---|---|---|
| foo= | foo= | foo | | <foo, > |
| =foo | | | | |
| =foo= | | | | |
| ==foo | | | | |
| foo | | | | |

# Trivia

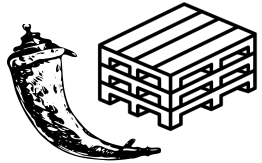


Werkzeug <2.2.3

| Set-Cookie: | Cookie: | Key | Value | Server <key, value> |
|---|---|---|---|---|
| foo= | foo= | foo | | <foo, > |
| =foo | foo | | foo | |
| =foo= | foo= | | foo= | |
| ==foo | =foo | | =foo | |
| foo | foo | | foo | |

# Trivia

CVE-2023-23934

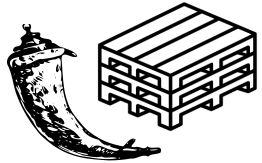


Werkzeug <2.2.3

| Set-Cookie: | Cookie: | Key | Value | Server <key, value> |
|---|---|---|---|---|
| foo= | foo= | foo | | <foo, > |
| =foo | foo | | foo | <foo, > |
| =foo= | foo= | | foo= | <foo, > |
| ==foo | =foo | | =foo | <foo, > |
| foo | foo | | foo | <foo, > |

# Trivia

CVE-2023-23934



Werkzeug <2.2.3

**[RFC6265bis] Accept nameless cookies. (#1018)**

Browse files

```
This patch alters the cookie parsing algorithm to treat
`Set-Cookie: token` as creating a cookie with an empty name and a value
of "token". It also rejects cookies with neither names nor values (e.g.
`Set-Cookie:` and `Set-Cookie: =`.

Closes #159.
```

**main** (#1018)

**draft-ietf-httpbis-unprompted-auth-02** ··· b68e4ff

committed on Jan 10, 2020

1 parent c43cdae commit 0178223

| Set | | | Server <key, value> |
|---|---|---|---|
| foo | | | <foo, > |
| =fo | | | <foo, > |
| =fo | | | <foo, > |
| ==f | | | <foo, > |
| foo | foo | | <foo, > |

# Bypassing __Host-

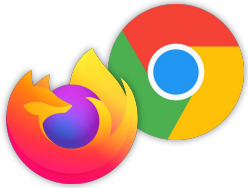
http://atk.bank.com

https://bank.com

```
Set-Cookie: __Host-sess=good;
            Secure; Path=/
```

# Bypassing __Host-

http://atk.bank.com



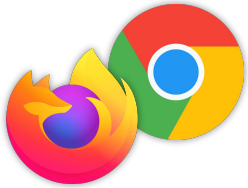
https://bank.com

Set-Cookie: __Host-sess=good;
Secure; Path=/

Set-Cookie: =__Host-sess=bad; Path=/app;
domain=bank.com

# Bypassing __Host-

http://atk.bank.com



https://bank.com

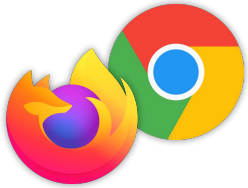
```
Set-Cookie: __Host-sess=good;
            Secure; Path=/
```

```
  Set-Cookie: =__Host-sess=bad; Path=/app;
              domain=bank.com
```

```
Cookie: __Host-sess=bad;
        __Host-sess=good;
```

# Bypassing __Host-

http://atk.bank.com



https://bank.com

CVE-2022-2860*

CVE-2022-40958*


**Fixed in browsers and rfc6265bis** by blocking nameless cookies with value starting for __Host- or __Secure-

* Reported almost simultaneously with **Axel Chong**, our issues were merged to jointly discuss mitigations and additional security implications. See also https://github.com/httpwg/http-extensions/issues/2229

# Bypassing __Host-  (after the **fix**)

## Amazon API Gateway

CVE-2022-2860*

CVE-2022-40958*

- **Serialization collisions** could still be used to bypass __Host- against chains of pa  s
- Fixed in **AWS Lambda proxy integration for HTTP APIs** after our report

**Fixed in browsers and rfc6265bis** by blocking nameless cookies with value starting for __Host- or __Secure-

* Reported almost simultaneously with **Axel Chong**, our issues were merged to jointly discuss mitigations and additional security implications. See also https://github.com/httpwg/http-extensions/issues/2229

# Bypassing Strict Secure

http://atk.bank.com

https://bank.com

Set-Cookie: session=good; Secure

Set-Cookie: =session=bad

Set-Cookie: =session=bad; Path=/app;
domain=bank.com

Cookie: session=bad; session=good;

| Name | Value | Domain | Path | E... | S... | H... | Secure |
|---|---|---|---|---|---|---|---|
| session | good | bank.com | / | S... | 11 | | ✓ |
| | session=bad | .bank.com | /app | S... | 11 | | |

# Bypassing `__Host-`  (with the help of the **server**)

- Popular programming languages / Web frameworks **diverge from the spec**
- Client / server inconsistencies. Security implications?


**PHP** <8.1.11

**CVE-2022-31629**

```
Cookie: __Host-sess=bad
Cookie: _ Host-sess=bad
Cookie: ..Host-sess=bad
```

Parsed as the **same cookie**

**`register_globals`** heritage:
`' '` `.` `[` are replaced by `_` in the `$_COOKIE` superglobal array

# Desynchronization Issues

1. `https://bank.com` set a secure 
   `Set-Cookie: sess=good; Secure`
2. `http://bank.com` sets a non-secure  via JS
   `document.cookie = 'sess=bad'`

| | |
|---|---|
| **EXPECTATION** | `sess=bad` is **not set** (Strict Secure  ) |
| **REALITY** | |

# Desynchronization Issues

1. `https://bank.com` set a secure 
   `Set-Cookie: sess=good; Secure`
2. `http://bank.com` sets a non-secure  vja JS
   `document.cookie = 'sess=bad'`

**CVE-2023-29547**

**Fixed in Firefox 112**

Caused by restrictions imposed by the FF implementation of **Site Isolation** (**Project Fission**)

| | |
|---|---|
| **EXPECTATION** | `sess=bad` is **not set** (Strict Secure  ) |
| **REALITY** | Cookie not set, but `document.cookie` at `http://bank.com` returns `sess=bad` |

# Desynchronization Issues

1. `https://atk.bank.com`

**Fixed in Firefox 115**

```
>> for(let i=0; i<400; i++) document.cookie = `a${i}=_; domain=bank.com`
⚠ ▸ Some cookies are misusing the recommended “SameSite“ attribute  400
← "a399=_; domain=bank.com"
>> document.cookie.split('; ').length
← 400
>> window.open("https://bank.com")
```

2. **Delete**  via `Set-Cookie` (exp. date), `Clear-Site-Data` header, or manually

3. The first 240  are still in `Document.cookie` in the original and opened window (survives reloads and schemeful navigations)

# Desynchronization Issues

1. `https://atk.bank.com`

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← "a399=_; domain=bank.com"
>> document.cookie.split('; ').length
← 400
>> window.open("https://bank.com")
```

Could introduce vulnerabilities in frontends trusting **`document.cookie`** to set **custom HTTP headers** like **ASP.NET** and **Angular**

2. **Delete**  via `Set-Cookie` (exp. date), `Clear-Site-Data` header, or manually

3. The first 240  are still in `Document.cookie` in the original and opened window (survives reloads and schemeful navigations)

# … and that's the way the cookie crumbles!

# Takeaways

- Battle-tested Web frameworks and libraries had **concerning session integrity vulnerabilities**. Causes & consequences?

- **Legacy design** is still cursing standards and modern applications: can we **move on without breaking the Web**?

- Developers are falling behind in **keeping track of changes to Web standards**.

Composition issues or lack of understanding of the threat models? Apps in the wild?

Backward compatibility issues? How to make deployment easier without trading on security?

Lack of cohesiveness between browser vendors, developers, and authors of Web standards?

# Paper & Artifacts

https://github.com/SecPriv/cookiecrumbles

+ Details on the Web framework vulnerabilities (including PoCs)
+ Outcome of the responsible disclosure
+ Cookie measurement (nameless and `__Host-`), dataset & code
+ Formal modeling of (patched) Web frameworks
+ Browser test suite & server-side testing code

Icons by **flaticon**

# Thank You! Questions?


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https://github.com/SecPriv/cookiecrumbles