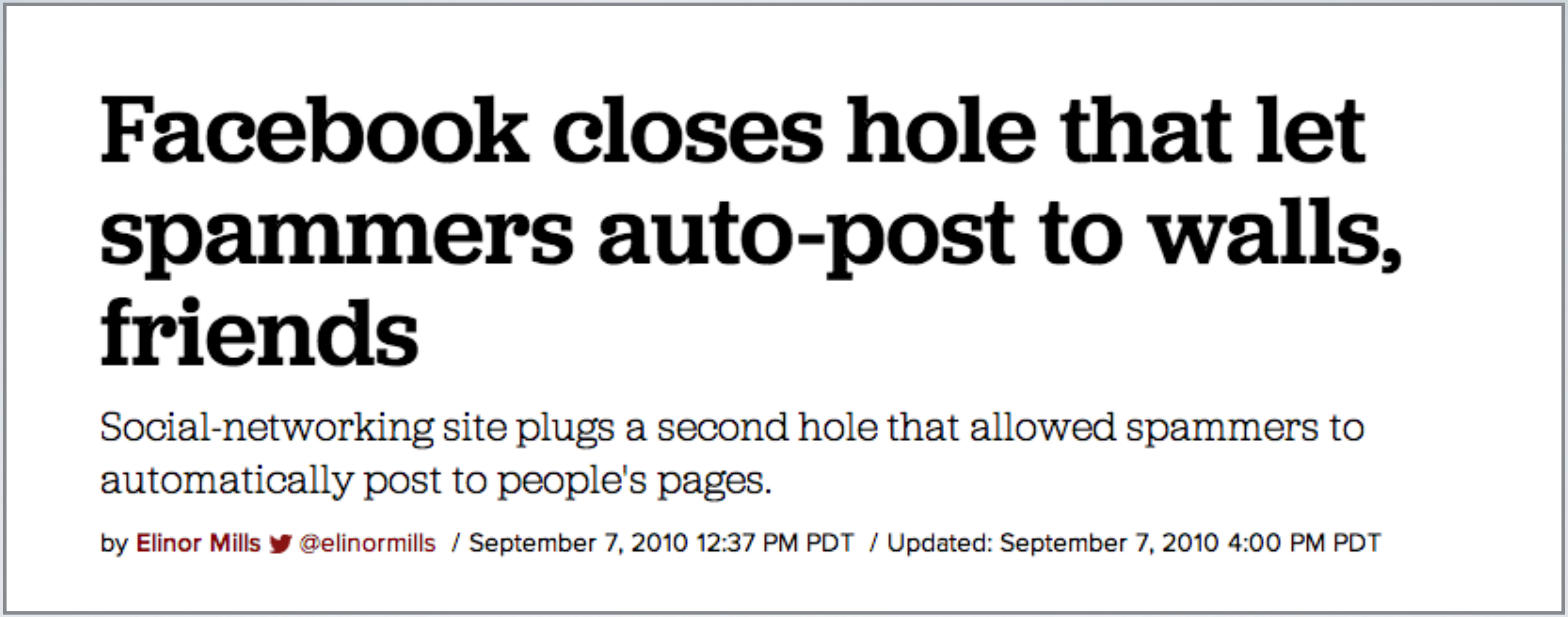
Web Security

Thierry Sans

Securing the web architecture means securing ...

- The network
- The operating system
- The administration
- The web architecture
- The database
- The web application

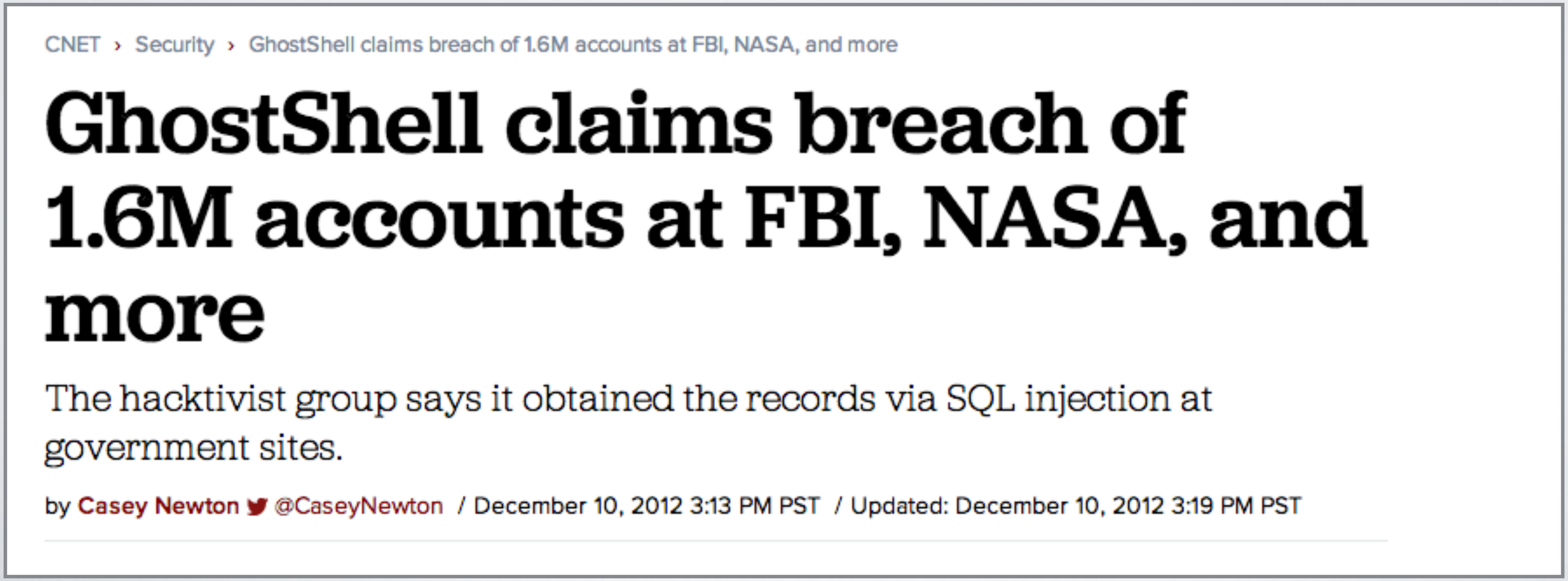
Our focus here!



Facebook closes hole that let spammers auto-post to walls, friends

Social-networking site plugs a second hole that allowed spammers to automatically post to people's pages.

by Elinor Mills @elinormills / September 7, 2010 12:37 PM PDT / Updated: September 7, 2010 4:00 PM PDT

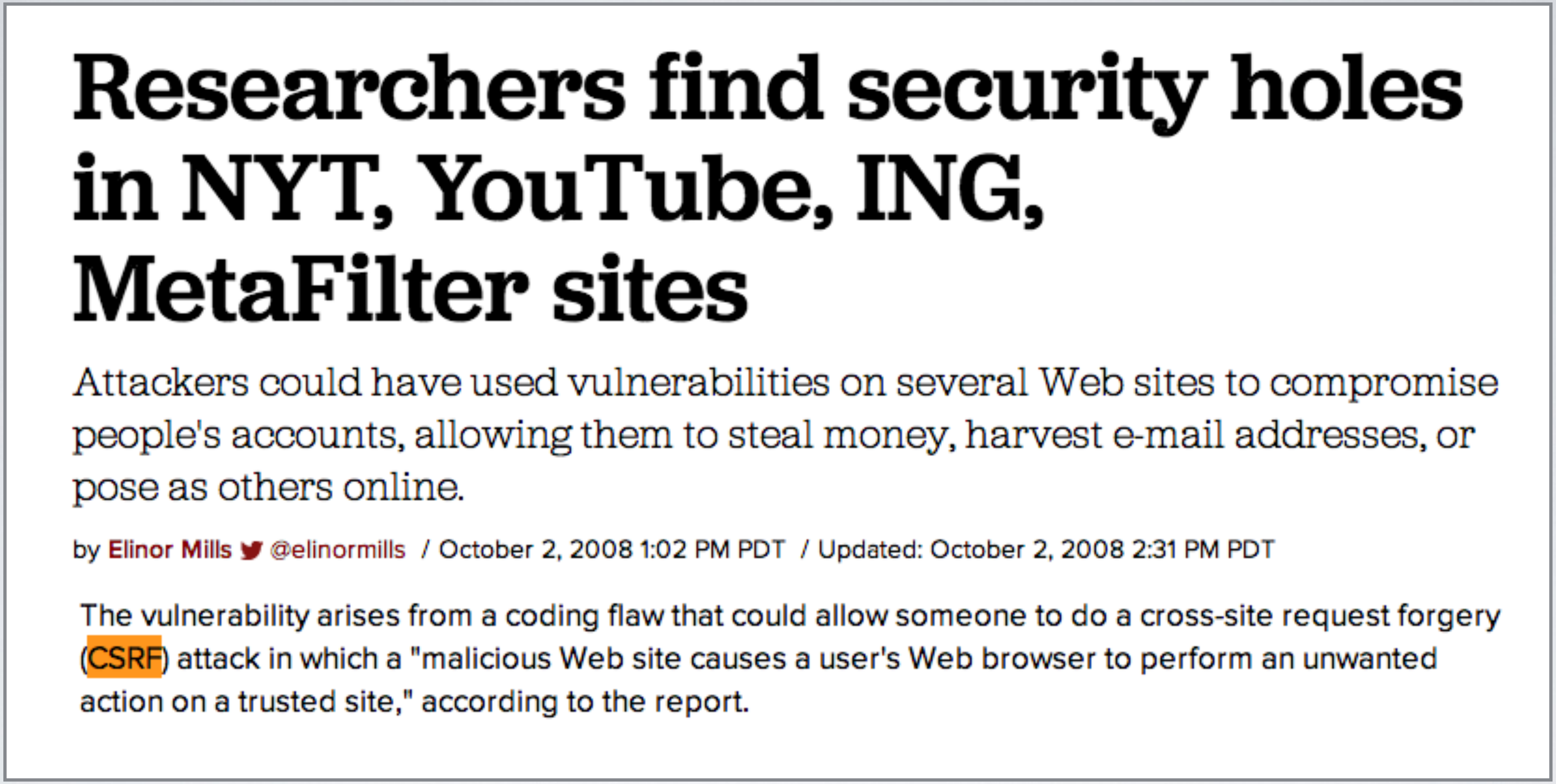


CNET › Security › GhostShell claims breach of 1.6M accounts at FBI, NASA, and more

GhostShell claims breach of 1.6M accounts at FBI, NASA, and more

The hacktivist group says it obtained the records via SQL injection at government sites.

by Casey Newton @CaseyNewton / December 10, 2012 3:13 PM PST / Updated: December 10, 2012 3:19 PM PST

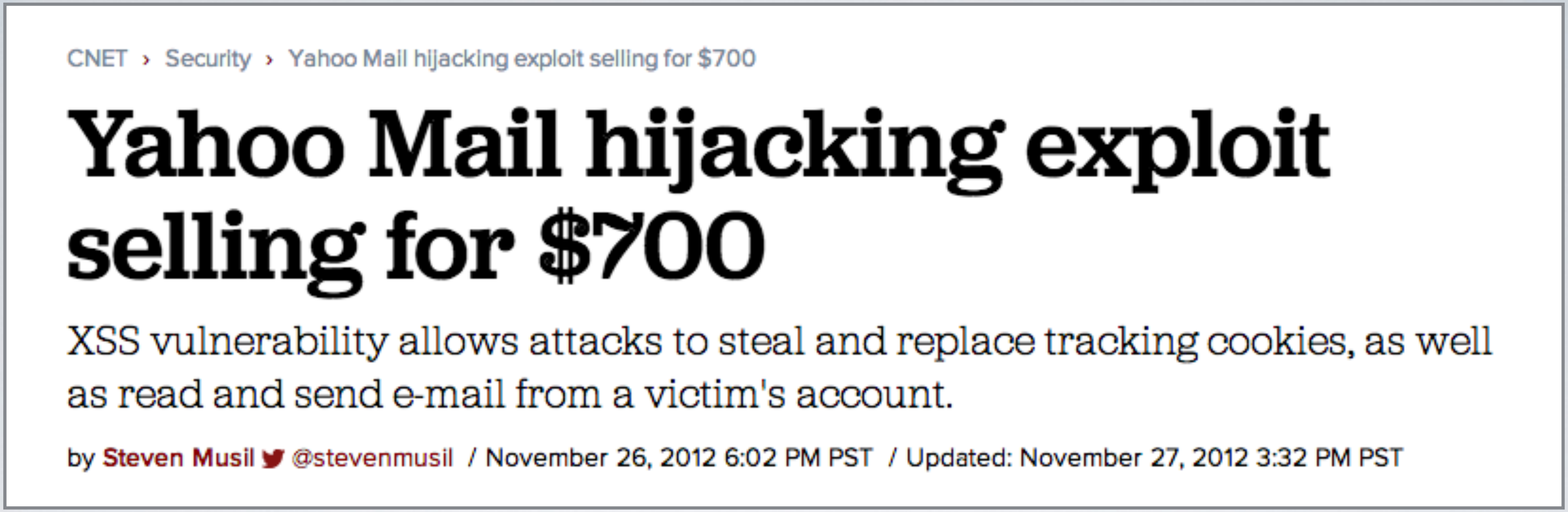


Researchers find security holes in NYT, YouTube, ING, MetaFilter sites

Attackers could have used vulnerabilities on several Web sites to compromise people's accounts, allowing them to steal money, harvest e-mail addresses, or pose as others online.

by Elinor Mills @elinormills / October 2, 2008 1:02 PM PDT / Updated: October 2, 2008 2:31 PM PDT

The vulnerability arises from a coding flaw that could allow someone to do a cross-site request forgery (CSRF) attack in which a "malicious Web site causes a user's Web browser to perform an unwanted action on a trusted site," according to the report.

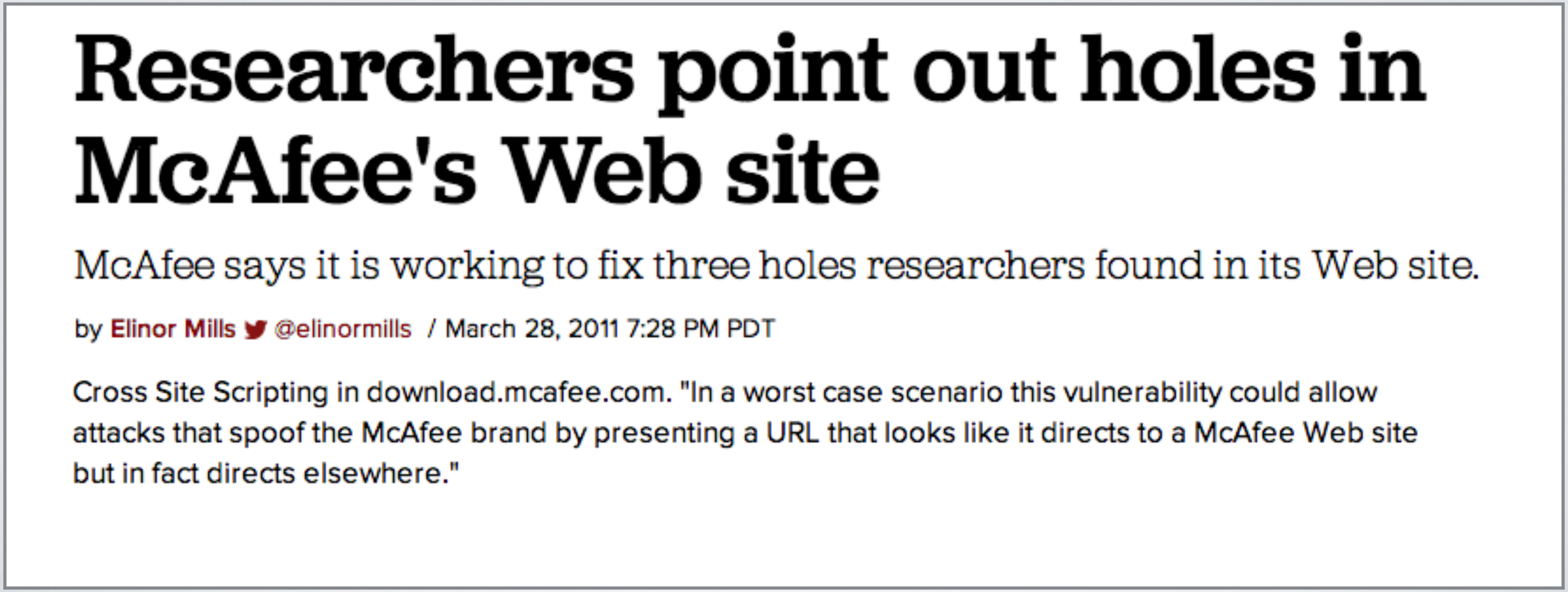


CNET › Security › Yahoo Mail hijacking exploit selling for $700

Yahoo Mail hijacking exploit selling for $700

XSS vulnerability allows attacks to steal and replace tracking cookies, as well as read and send e-mail from a victim's account.

by Steven Musil @stevenmusil / November 26, 2012 6:02 PM PST / Updated: November 27, 2012 3:32 PM PST

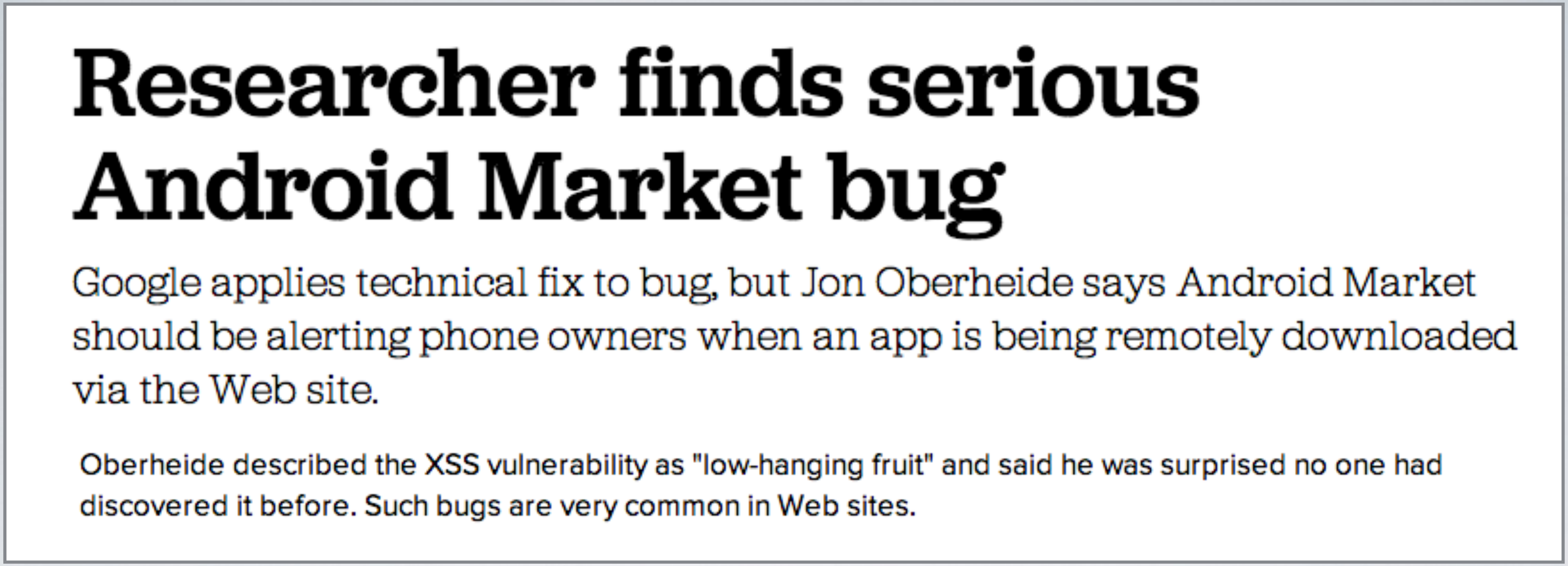


Researchers point out holes in McAfee's Web site

McAfee says it is working to fix three holes researchers found in its Web site.

by Elinor Mills @elinormills / March 28, 2011 7:28 PM PDT

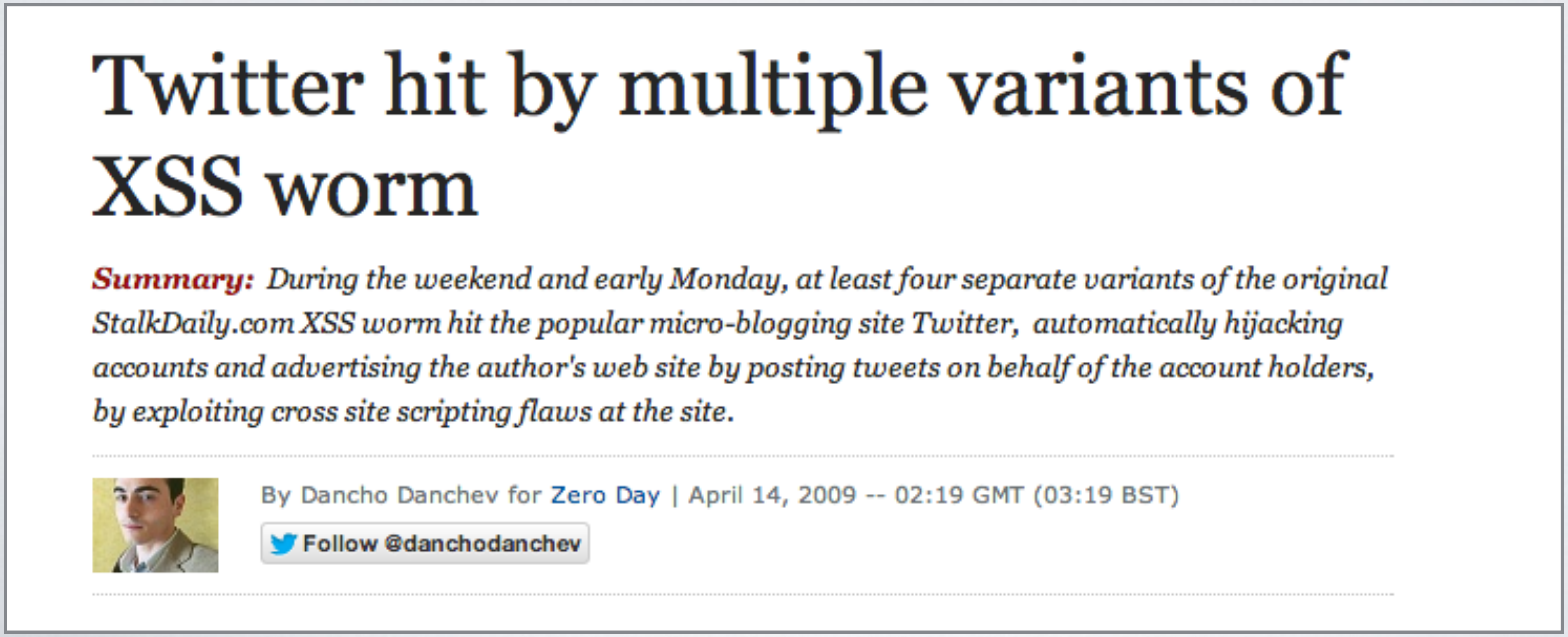
Cross Site Scripting in download.mcafee.com. "In a worst case scenario this vulnerability could allow attacks that spoof the McAfee brand by presenting a URL that looks like it directs to a McAfee Web site but in fact directs elsewhere."



Researcher finds serious Android Market bug

Google applies technical fix to bug, but Jon Oberheide says Android Market should be alerting phone owners when an app is being remotely downloaded via the Web site.

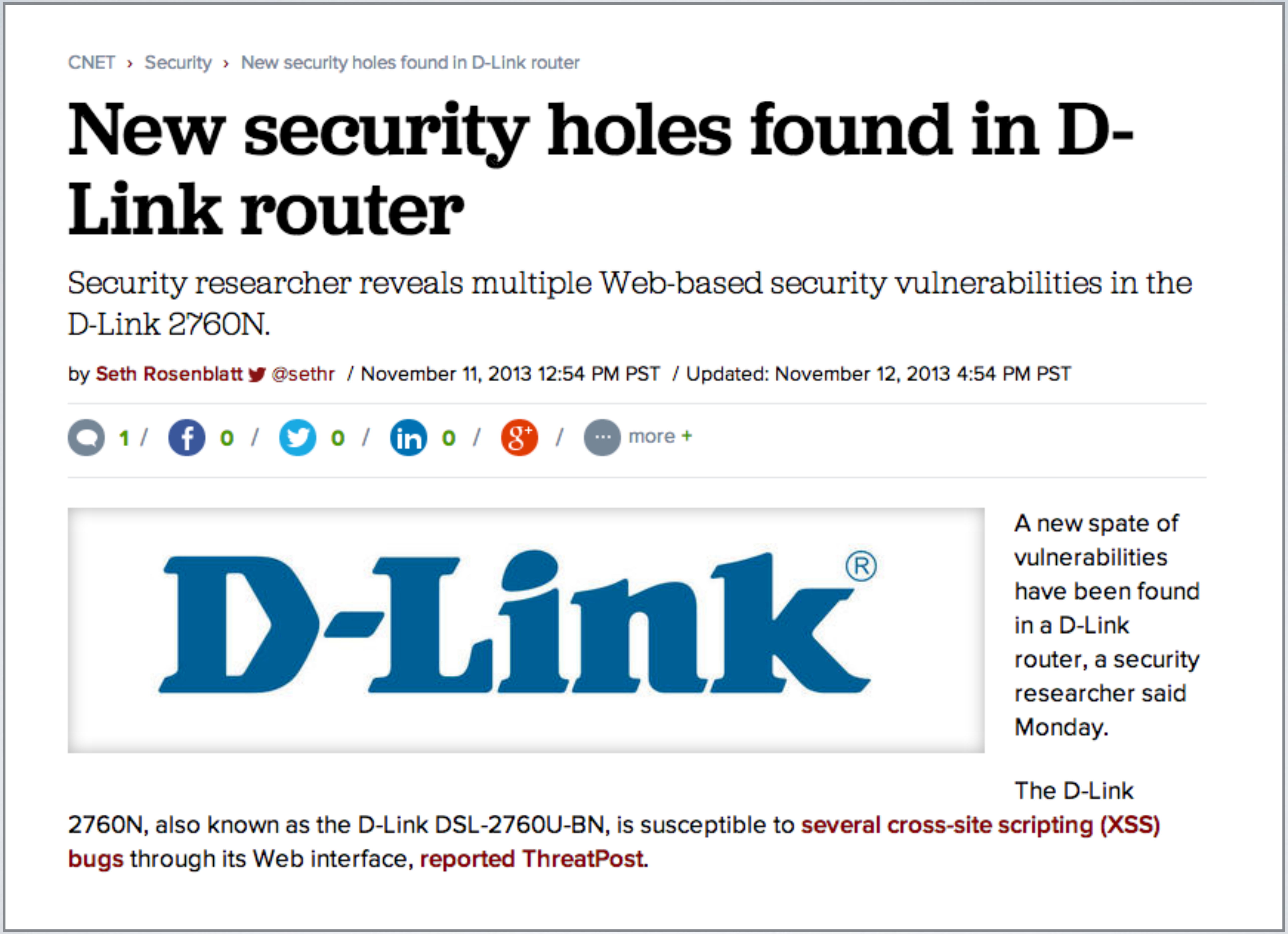
Oberheide described the XSS vulnerability as "low-hanging fruit" and said he was surprised no one had discovered it before. Such bugs are very common in Web sites.



Twitter hit by multiple variants of XSS worm

Summary: *During the weekend and early Monday, at least four separate variants of the original StalkDaily.com XSS worm hit the popular micro-blogging site Twitter, automatically hijacking accounts and advertising the author's web site by posting tweets on behalf of the account holders, by exploiting cross site scripting flaws at the site.*

By Dancho Danchev for Zero Day | April 14, 2009 -- 02:19 GMT (03:19 BST)



CNET › Security › New security holes found in D-Link router

New security holes found in D-Link router

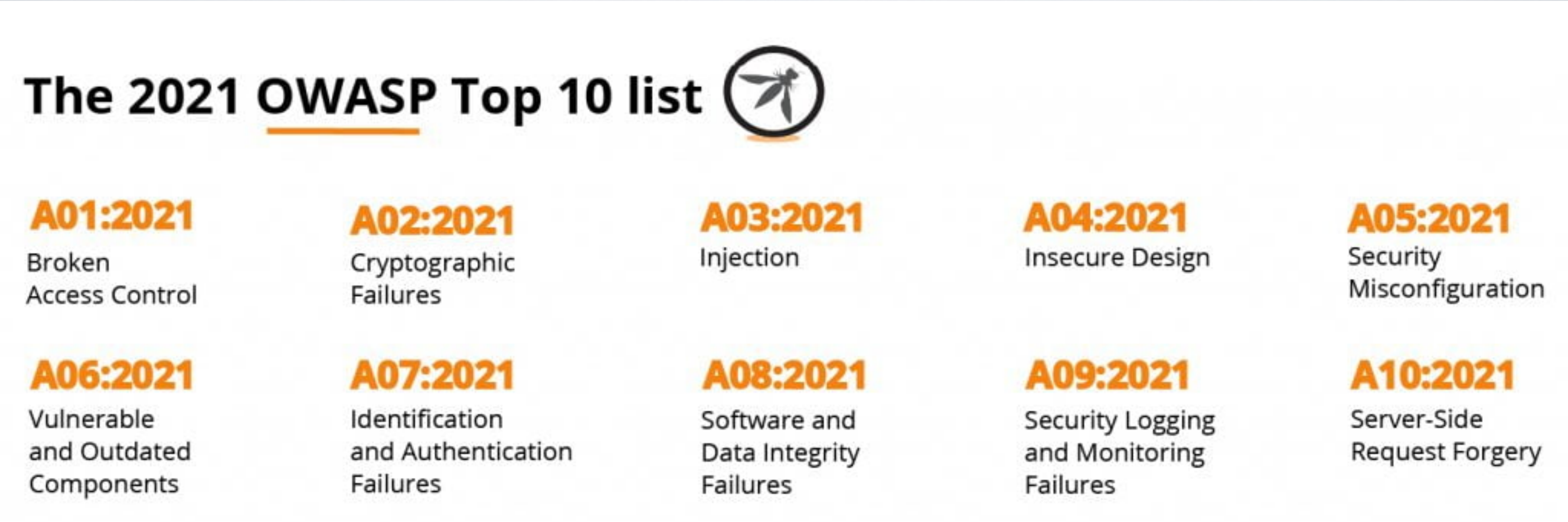
Security researcher reveals multiple Web-based security vulnerabilities in the D-Link 2760N.

by Seth Rosenblatt @sethr / November 11, 2013 12:54 PM PST / Updated: November 12, 2013 4:54 PM PST

A new spate of vulnerabilities have been found in a D-Link router, a security researcher said Monday.

The D-Link 2760N, also known as the D-Link DSL-2760U-BN, is susceptible to several cross-site scripting (XSS) bugs through its Web interface, reported ThreatPost.

https://owasp.org/Top10/



The 2021 OWASP Top 10 list

A01:2021
Broken Access Control

A02:2021
Cryptographic Failures

A03:2021
Injection

A04:2021
Insecure Design

A05:2021
Security Misconfiguration

A06:2021
Vulnerable and Outdated Components

A07:2021
Identification and Authentication Failures

A08:2021
Software and Data Integrity Failures

A09:2021
Security Logging and Monitoring Failures

A10:2021
Server-Side Request Forgery

- ➡ Risks are ranked according to the frequency of discovered security defects, the severity of the uncovered vulnerabilities, and the magnitude of their potential impacts

A02 Cryptographic Failure

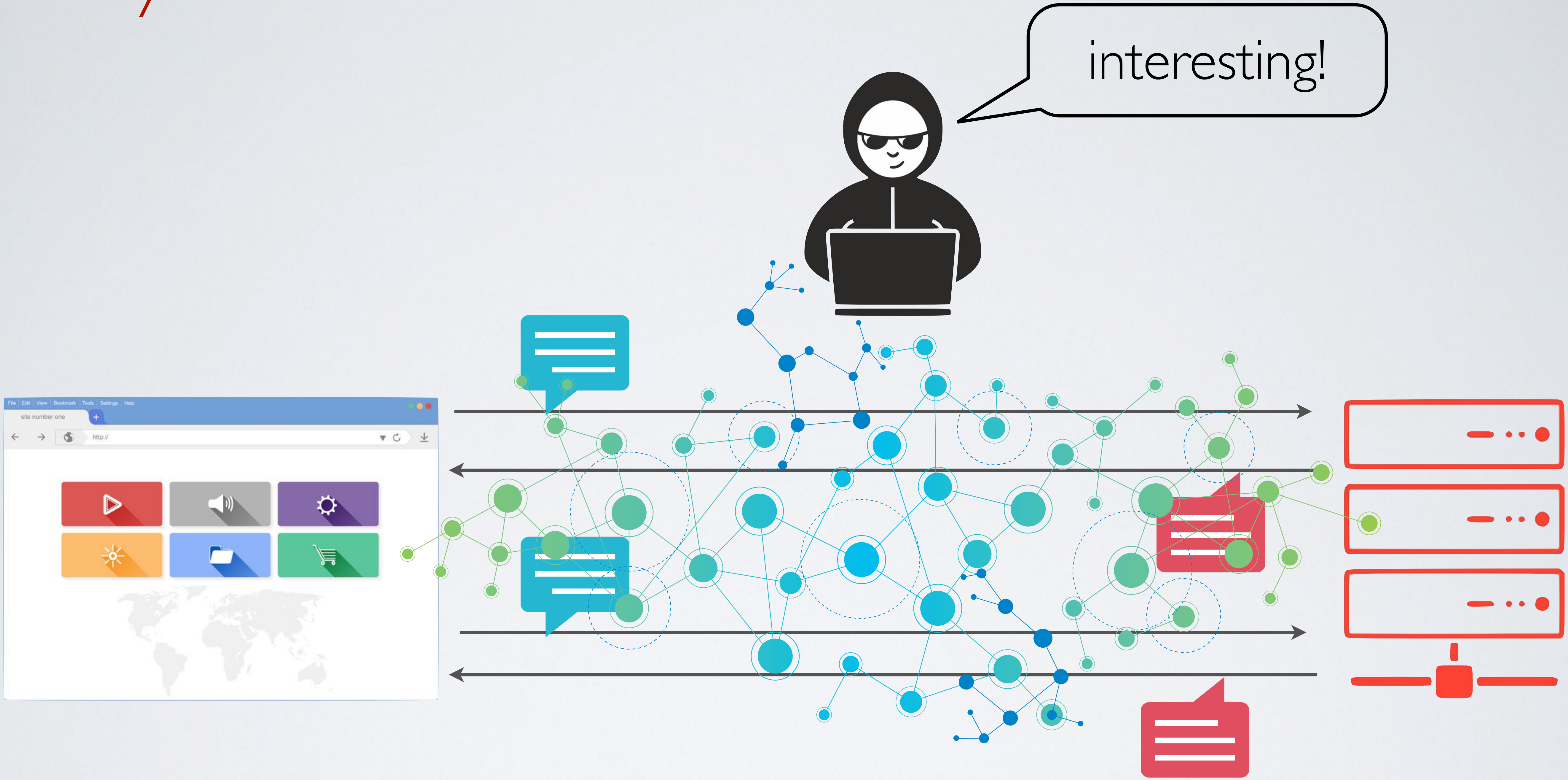
Insufficient Transport Layer Protection

How to steal user's credentials

- ➡ Brute force the user's password or session ID ✗ ✗

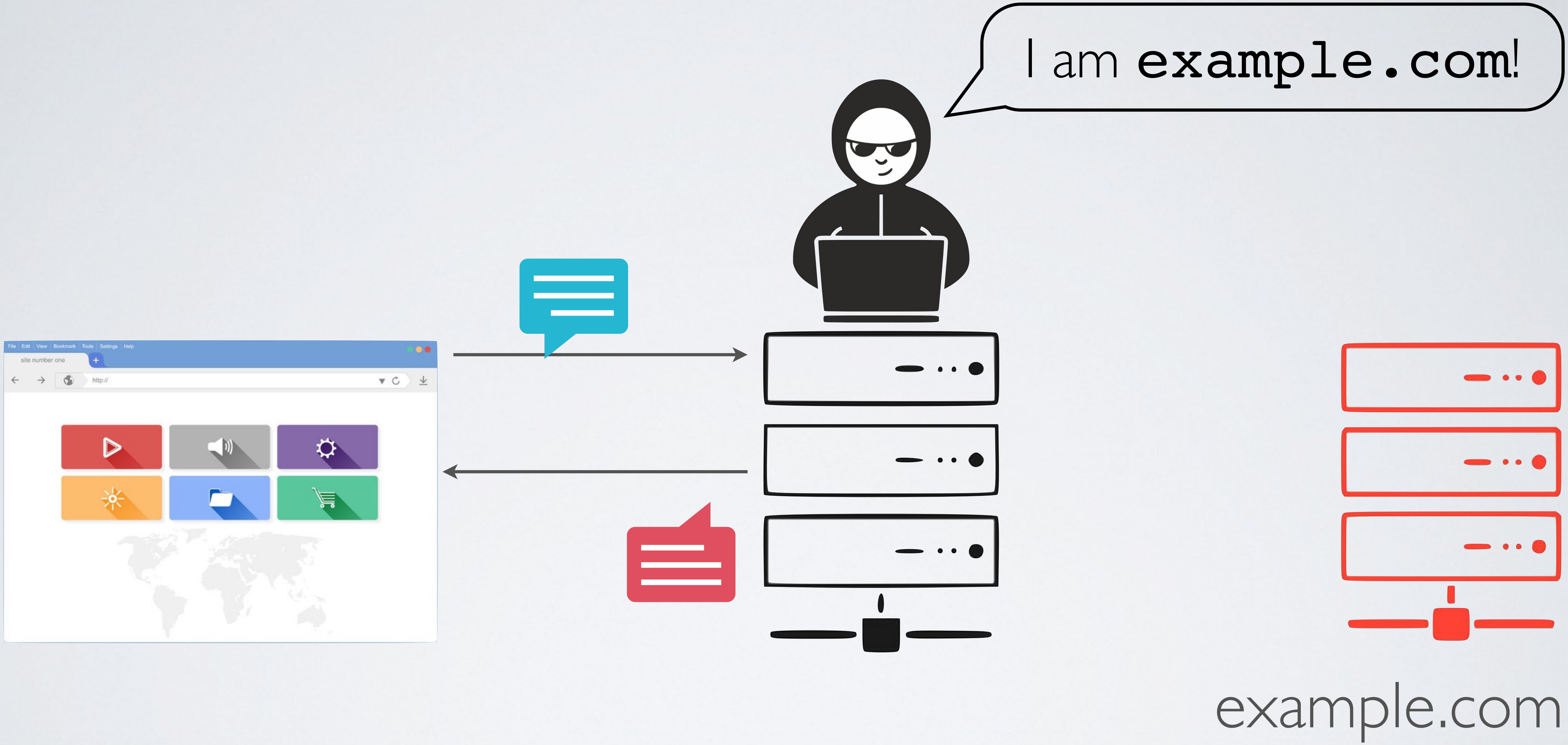
- ➡ Steal the user's password or session ID ✓

Do you trust the network?



- Threat 1 : an attacker **can eavesdrop** messages sent back and forth

Do you *really* trust the network?



- Threat 2 : an attacker **can tamper with** messages sent back and forth

Confidentiality and Integrity

- Threat 1 : an attacker **can eavesdrop** messages sent back and forth

  Confidentiality: how do exchange information secretly?

- Threat 2 : an attacker **can tamper** messages sent back and forth

  Integrity: How do we exchange information reliably?

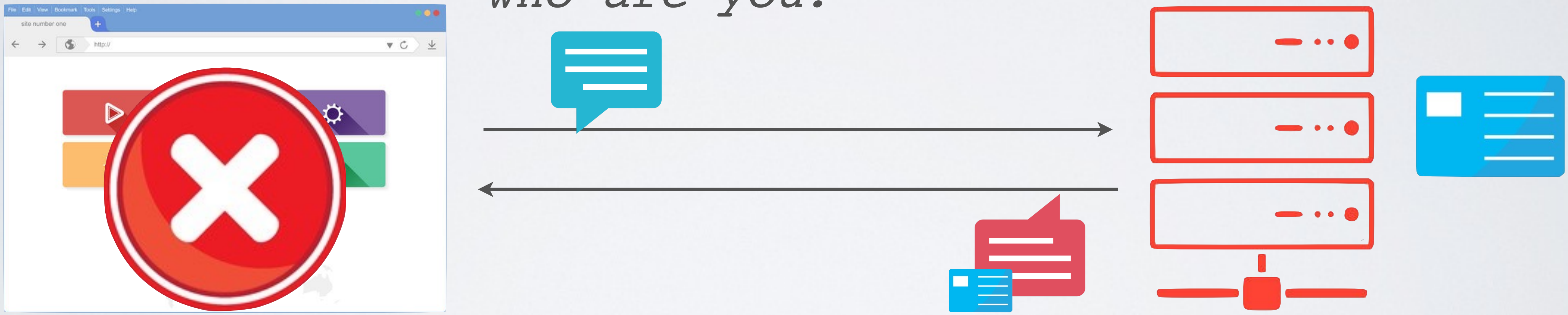
Generic solution - HTTPS

✓ HTTPS = HTTP + TLS

➡ Transport Layer Security (TLS previously known as SSL) provides

- **confidentiality:** end-to-end secure channel
- **integrity:** authentication handshake

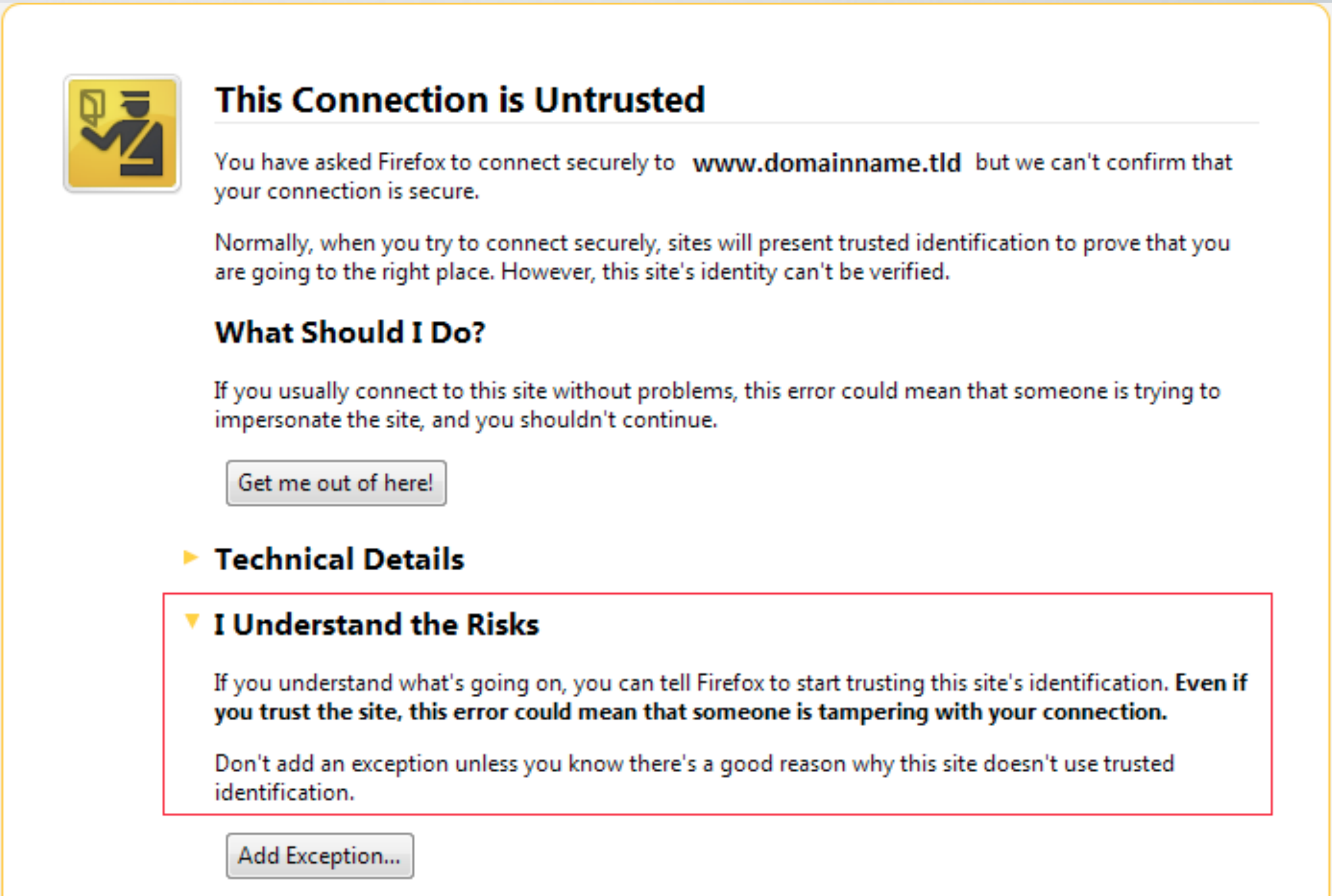
Generating and using (self-signed) certificates



who are you?

I am example.com

Self-signed certificates are not trusted by your browser



This Connection is Untrusted

You have asked Firefox to connect securely to **www.domainname.tld** but we can't confirm that your connection is secure.

Normally, when you try to connect securely, sites will present trusted identification to prove that you are going to the right place. However, this site's identity can't be verified.

What Should I Do?

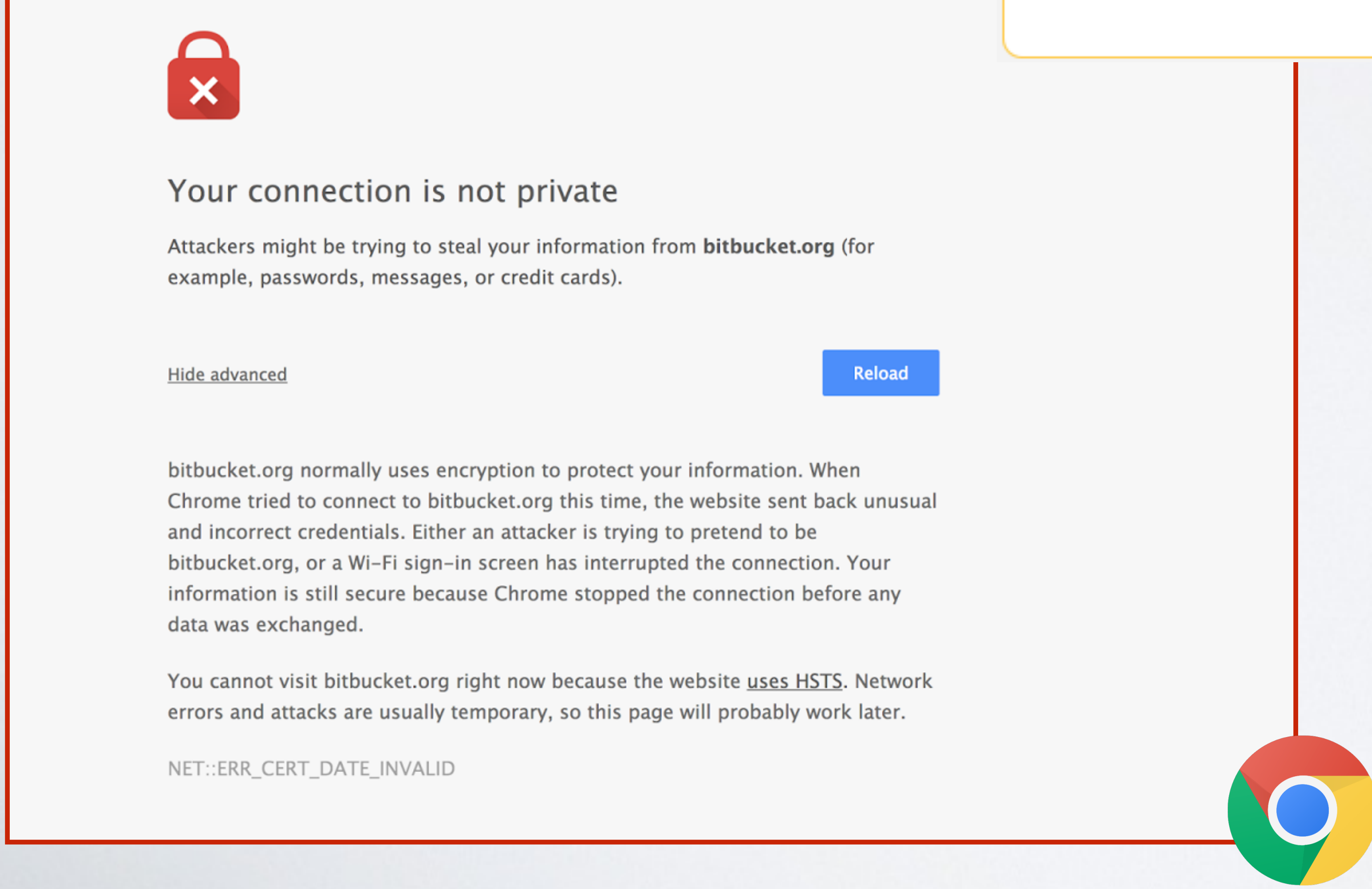
If you usually connect to this site without problems, this error could mean that someone is trying to impersonate the site, and you shouldn't continue.

▶ **Technical Details**

▼ **I Understand the Risks**

If you understand what's going on, you can tell Firefox to start trusting this site's identification. **Even if you trust the site, this error could mean that someone is tampering with your connection.**

Don't add an exception unless you know there's a good reason why this site doesn't use trusted identification.



Your connection is not private

Attackers might be trying to steal your information from **bitbucket.org** (for example, passwords, messages, or credit cards).

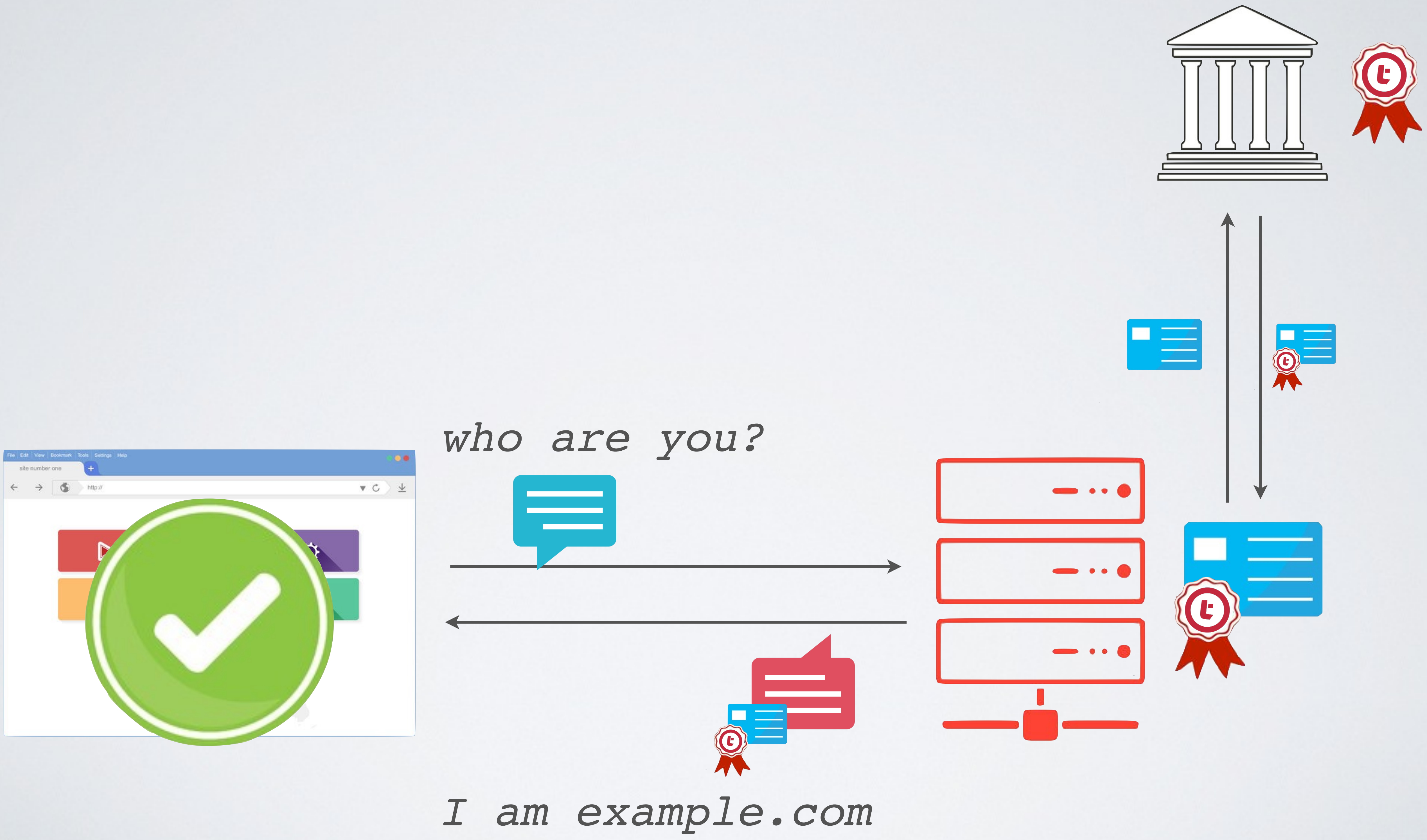
bitbucket.org normally uses encryption to protect your information. When Chrome tried to connect to bitbucket.org this time, the website sent back unusual and incorrect credentials. Either an attacker is trying to pretend to be bitbucket.org, or a Wi-Fi sign-in screen has interrupted the connection. Your information is still secure because Chrome stopped the connection before any data was exchanged.

You cannot visit bitbucket.org right now because the website uses HSTS. Network errors and attacks are usually temporary, so this page will probably work later.

NET::ERR_CERT_DATE_INVALID

Signed Certificate

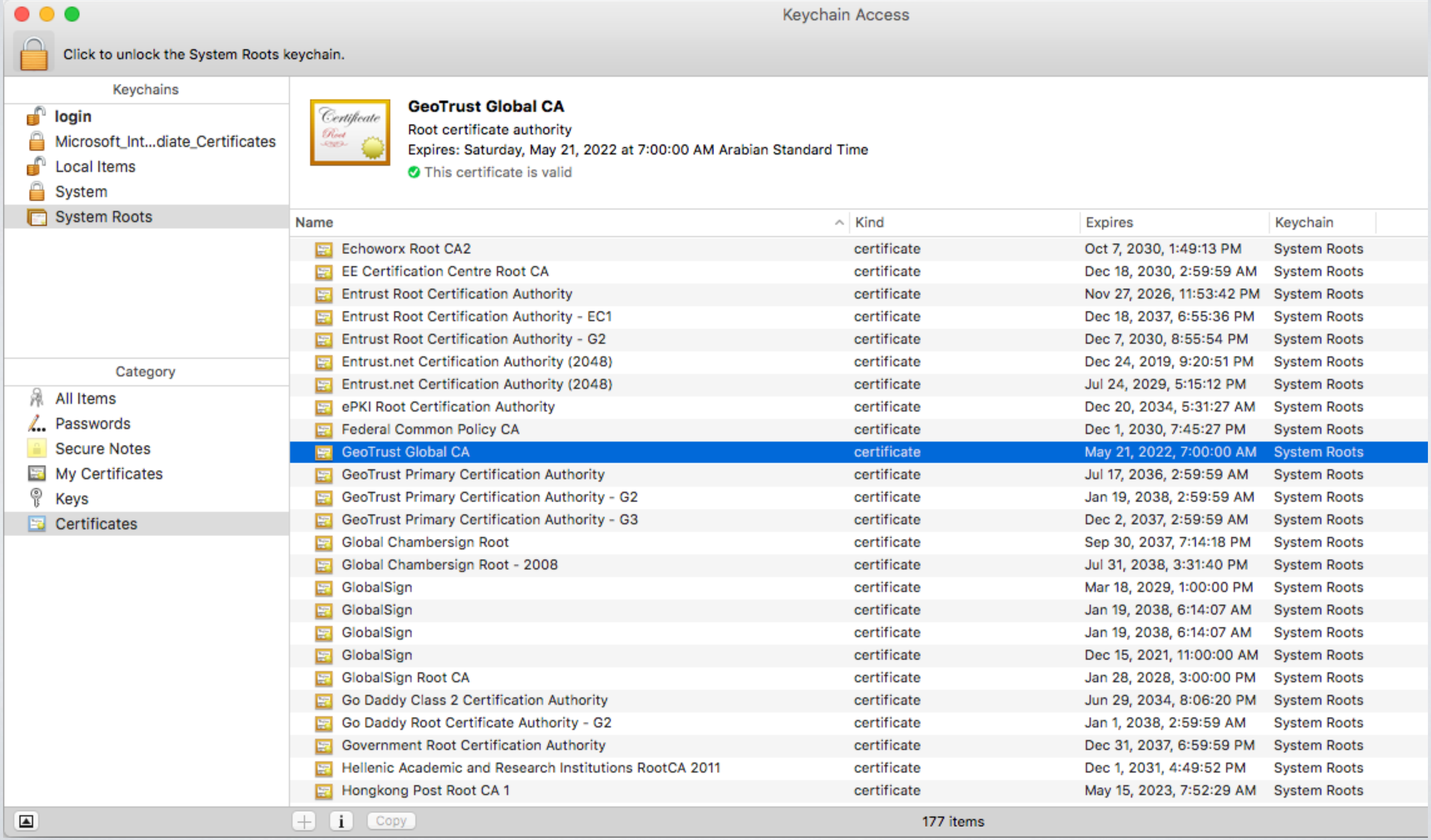
Certificate Authority (CA)



who are you?

I am example.com

Your browser trusts many CAs **by default**



Click to unlock the System Roots keychain.

GeoTrust Global CA
Root certificate authority
Expires: Saturday, May 21, 2022 at 7:00:00 AM Arabian Standard Time
✓ This certificate is valid

Name	Kind	Expires	Keychain
Echoworx Root CA2	certificate	Oct 7, 2030, 1:49:13 PM	System Roots
EE Certification Centre Root CA	certificate	Dec 18, 2030, 2:59:59 AM	System Roots
Entrust Root Certification Authority	certificate	Nov 27, 2026, 11:53:42 PM	System Roots
Entrust Root Certification Authority - EC1	certificate	Dec 18, 2037, 6:55:36 PM	System Roots
Entrust Root Certification Authority - G2	certificate	Dec 7, 2030, 8:55:54 PM	System Roots
Entrust.net Certification Authority (2048)	certificate	Dec 24, 2019, 9:20:51 PM	System Roots
Entrust.net Certification Authority (2048)	certificate	Jul 24, 2029, 5:15:12 PM	System Roots
ePKI Root Certification Authority	certificate	Dec 20, 2034, 5:31:27 AM	System Roots
Federal Common Policy CA	certificate	Dec 1, 2030, 7:45:27 PM	System Roots
GeoTrust Global CA	certificate	May 21, 2022, 7:00:00 AM	System Roots
GeoTrust Primary Certification Authority	certificate	Jul 17, 2036, 2:59:59 AM	System Roots
GeoTrust Primary Certification Authority - G2	certificate	Jan 19, 2038, 2:59:59 AM	System Roots
GeoTrust Primary Certification Authority - G3	certificate	Dec 2, 2037, 2:59:59 AM	System Roots
Global Chambersign Root	certificate	Sep 30, 2037, 7:14:18 PM	System Roots
Global Chambersign Root - 2008	certificate	Jul 31, 2038, 3:31:40 PM	System Roots
GlobalSign	certificate	Mar 18, 2029, 1:00:00 PM	System Roots
GlobalSign	certificate	Jan 19, 2038, 6:14:07 AM	System Roots
GlobalSign	certificate	Jan 19, 2038, 6:14:07 AM	System Roots
GlobalSign	certificate	Dec 15, 2021, 11:00:00 AM	System Roots
GlobalSign Root CA	certificate	Jan 28, 2028, 3:00:00 PM	System Roots
Go Daddy Class 2 Certification Authority	certificate	Jun 29, 2034, 8:06:20 PM	System Roots
Go Daddy Root Certificate Authority - G2	certificate	Jan 1, 2038, 2:59:59 AM	System Roots
Government Root Certification Authority	certificate	Dec 31, 2037, 6:59:59 PM	System Roots
Hellenic Academic and Research Institutions RootCA 2011	certificate	Dec 1, 2031, 4:49:52 PM	System Roots
Hongkong Post Root CA 1	certificate	May 15, 2023, 7:52:29 AM	System Roots

177 items

Why and when using HTTPS?

HTTPS = HTTP + TLS

➡ TLS provides

- confidentiality: end-to-end secure channel
- integrity: authentication handshake

➡ HTTPS protects any data send back and forth including:

- login and password
- session ID

✓ **HTTPS everywhere**
HTTPS must be used during the entire session

Be careful of mixed content

Mixed-content happens when:

1. an HTTPS page contains elements (ajax, js, image, video, css ...) served with HTTP

2. an HTTPS page transfers control to another HTTP page within the same domain

◉ authentication cookie will be sent over HTTP

✓ browsers provide a mix-content protection now

`Secure` cookie flag

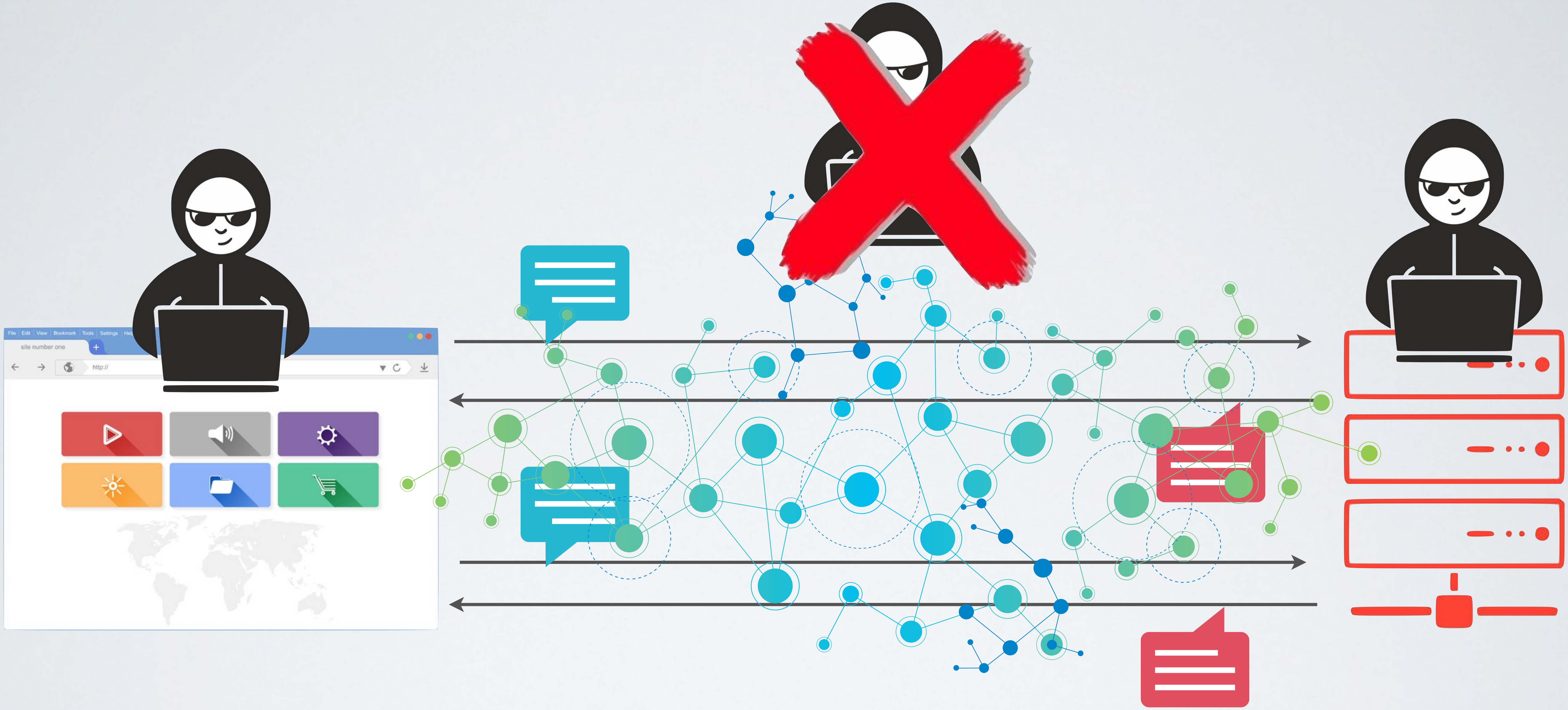
✓ The cookie will be sent over HTTPS exclusively

➡ Prevents authentication cookie from leaking in case of mixed-content

Do/Don't with HTTPS

- Always use HTTPS exclusively (in production)
- Always have a valid and signed certificate (no self-signed cert)
- Always avoid using absolute URL (mixed-content)
- Always use **`secure`** cookie flag with authentication cookie

Limitation of HTTPS

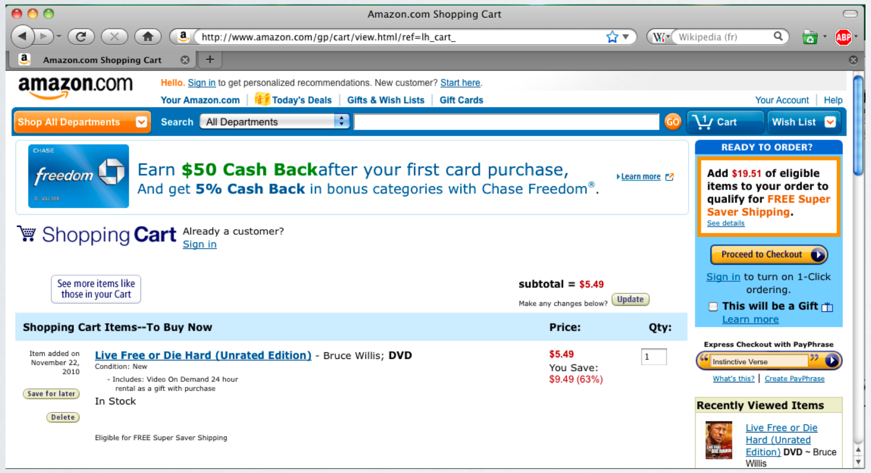


Problem

You have **absolutely no control** on the client and the network

Client Side

Server Side



Amazon.com Shopping Cart

http://www.amazon.com/gp/cart/view.html/ref=lh_cart_

Wikipedia (fr)

Amazon.com Shopping Cart

amazon.com

Hello. Sign in to get personalized recommendations. New customer? Start here.

Your Amazon.com | Today's Deals | Gifts & Wish Lists | Gift Cards

Your Account | Help

Shop All Departments | Search | All Departments | GO | Cart | Wish List

Earn **$50 Cash Back**after your first card purchase,
And get **5% Cash Back** in bonus categories with Chase Freedom®.

Learn more

Shopping **Cart** Already a customer? Sign in

See more items like those in your Cart

subtotal = $5.49

Make any changes below? Update

Shopping Cart Items--To Buy Now	Price:	Qty:
Item added on November 22, 2010 Save for later Delete Live Free or Die Hard (Unrated Edition) - Bruce Willis; **DVD** Condition: New - Includes: Video On Demand 24 hour rental as a gift with purchase In Stock Eligible for FREE Super Saver Shipping	$5.49 You Save: $9.49 (63%)	1

READY TO ORDER?

Add $19.51 of eligible items to your order to qualify for FREE Super Saver Shipping.
See details

Proceed to Checkout

Sign in to turn on 1-Click ordering.

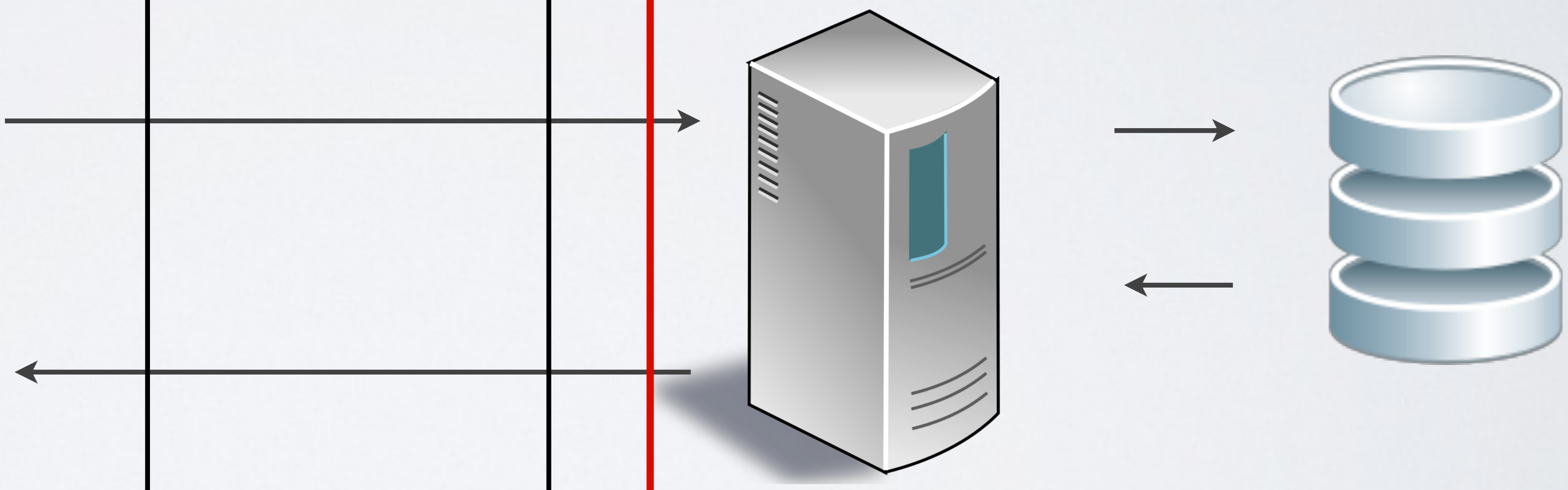
□ **This will be a Gift**
Learn more

Express Checkout with PayPhrase
Instinctive Verse
What's this? | Create PayPhrase

Recently Viewed Items

Live Free or Die Hard (Unrated Edition) DVD ~ Bruce Willis

Web Browser



Web Server

Database

Beyond HTTPS - attacking the web application

Frontend Vulnerabilities

- Cross-Site Scripting
- Cross-site Request forgery

Backend Vulnerabilities

- Incomplete Mediation
- SQL injection

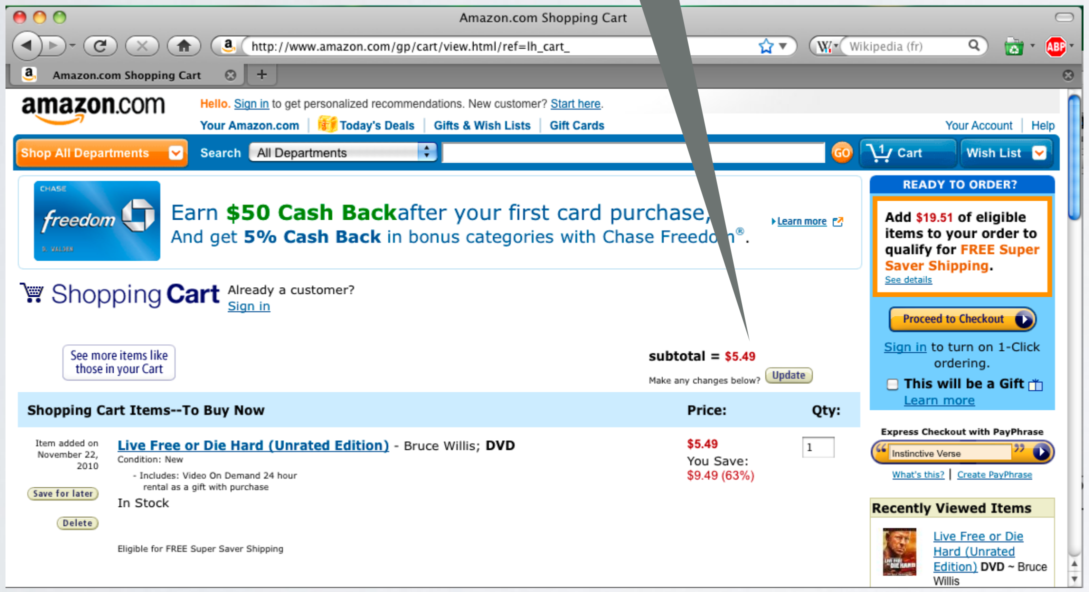
A01 Broken Access Control

Incomplete Mediation

The Shopping Cart Attack

The total is calculated by a script on the client

The order is generated based on the request



Amazon.com Shopping Cart

http://www.amazon.com/gp/cart/view.html/ref=lh_cart_

Wikipedia (fr)

Amazon.com Shopping Cart

amazon.com

Hello. Sign in to get personalized recommendations. New customer? Start here.

Your Amazon.com | Today's Deals | Gifts & Wish Lists | Gift Cards

Your Account | Help

Shop All Departments

Search All Departments

GO

Cart

Wish List

Earn **$50 Cash Back**after your first card purchase, And get **5% Cash Back** in bonus categories with Chase Freedom®.

Learn more

Shopping Cart Already a customer? Sign in

See more items like those in your Cart

subtotal = $5.49

Make any changes below? Update

Shopping Cart Items--To Buy Now	Price:	Qty:
Item added on November 22, 2010 Save for later Delete **Live Free or Die Hard (Unrated Edition)** - Bruce Willis; **DVD** Condition: New - Includes: Video On Demand 24 hour rental as a gift with purchase In Stock Eligible for FREE Super Saver Shipping	$5.49 You Save: $9.49 (63%)	1

READY TO ORDER?

Add $19.51 of eligible items to your order to qualify for FREE Super Saver Shipping.

See details

Proceed to Checkout

Sign in to turn on 1-Click ordering.

☐ **This will be a Gift**

Learn more

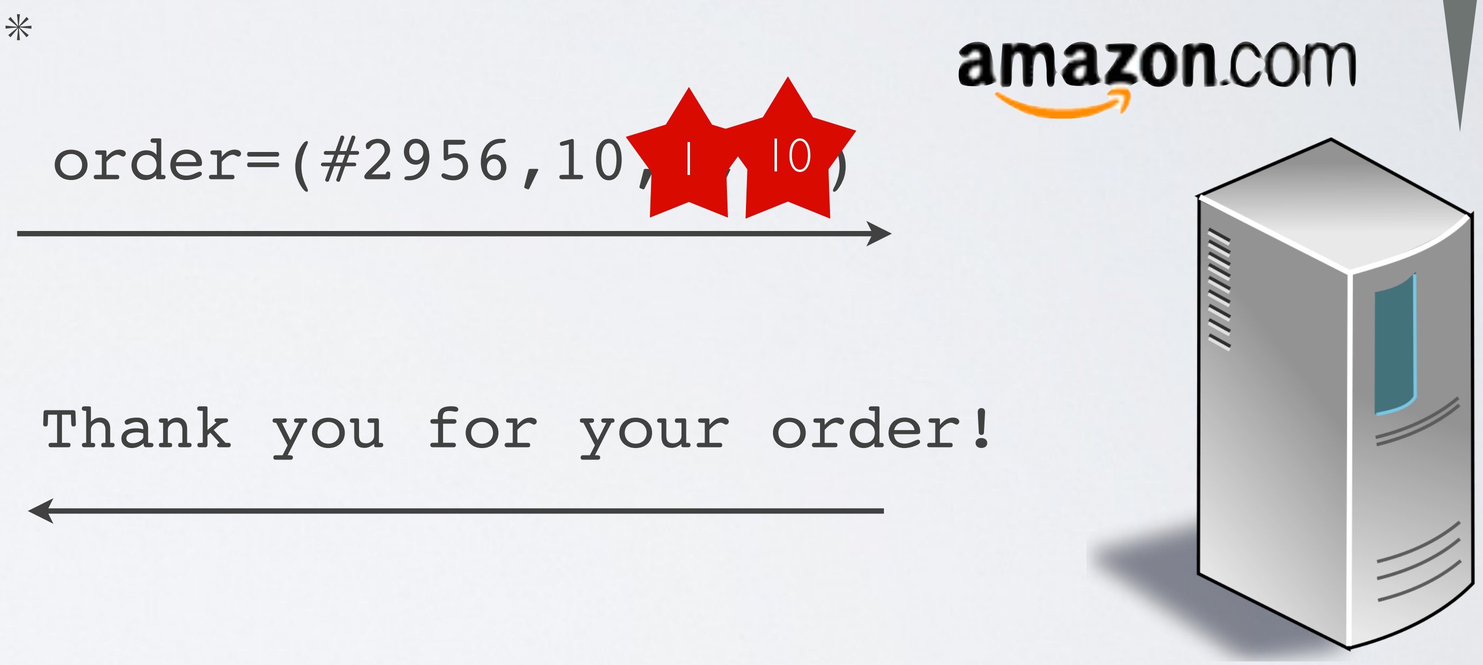
Express Checkout with PayPhrase

"Instinctive Verse"

What's this? | Create PayPhrase

Recently Viewed Items

Live Free or Die Hard (Unrated Edition) **DVD** ~ Bruce Willis



order=(#2956,10,1,10)

Thank you for your order!

Client Trusted Domain

Server Trusted Domain

* *Notice that Amazon is **not** vulnerable to this attack*

The backend is the **only trusted domain**

- ◉ Data coming from the frontend cannot be trusted
- ✓ Sensitive operations must be done on the backend

A03 Injection

SQL Injection

Problem

➡ An attacker can inject SQL/NoSQL code

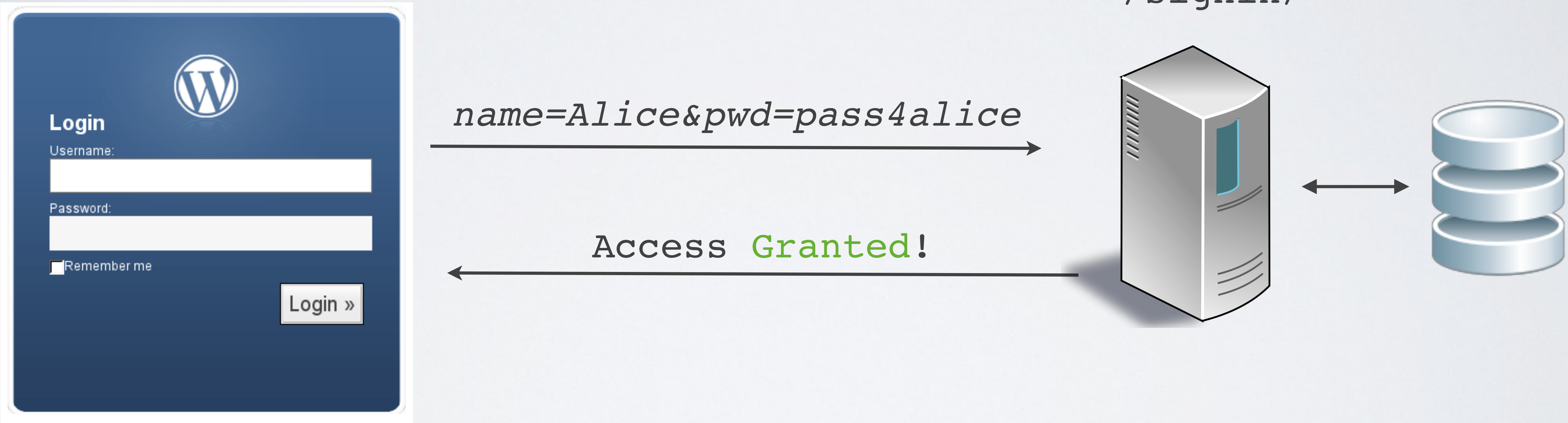
◉ Retrieve, add, modify, delete information

◉ Bypass authentication

Checking password

`signin.html`

`/signin/`



name=Alice&pwd=pass4alice

Access Granted!

SQL Injection

```
db.run("SELECT * FROM users
WHERE USERNAME = '" + username + "'
  AND PASSWORD = '" + password + "'")
```

```
username: alice
password: pas[illegible]lice
```

```
  blah' OR '1'='1
```

NoSQL Injection

```
db.find({  username: username,
           password: password   });
```

```
username: alice
password: pas✖lice
```

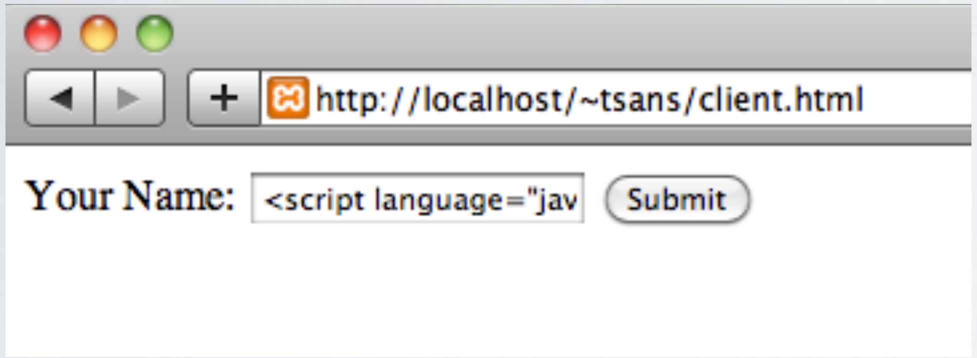
```
{gt: ""}
```

A03 Injection

Cross-Site Scripting (XSS)

Cross-Site Scripting Attack (XSS attack)

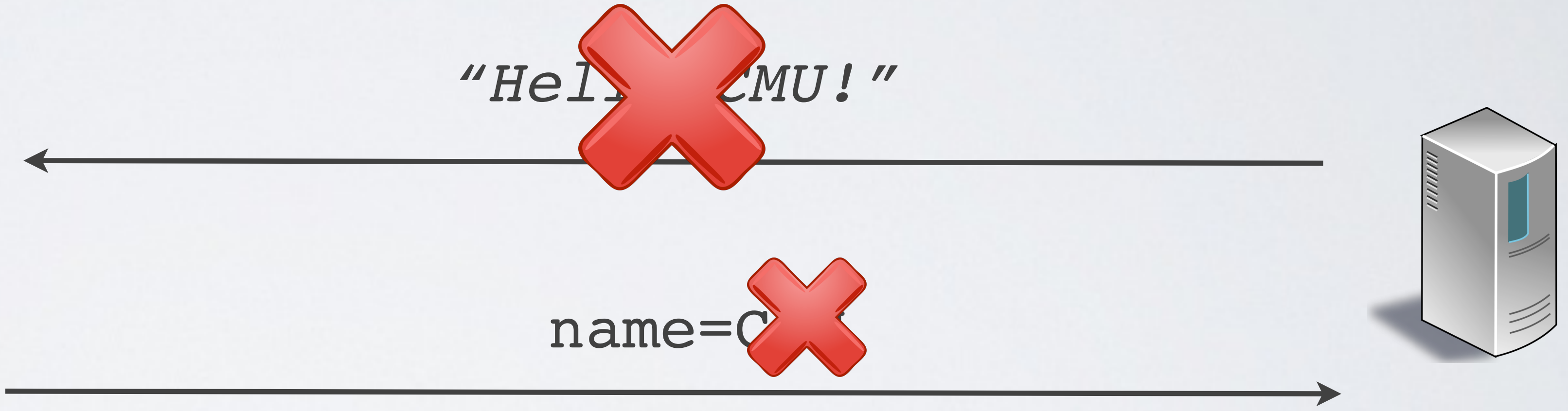
```
“Hello <script language="javascript">alert(“XSS attack”);</script>!”
```



http://localhost/~tsans/client.html

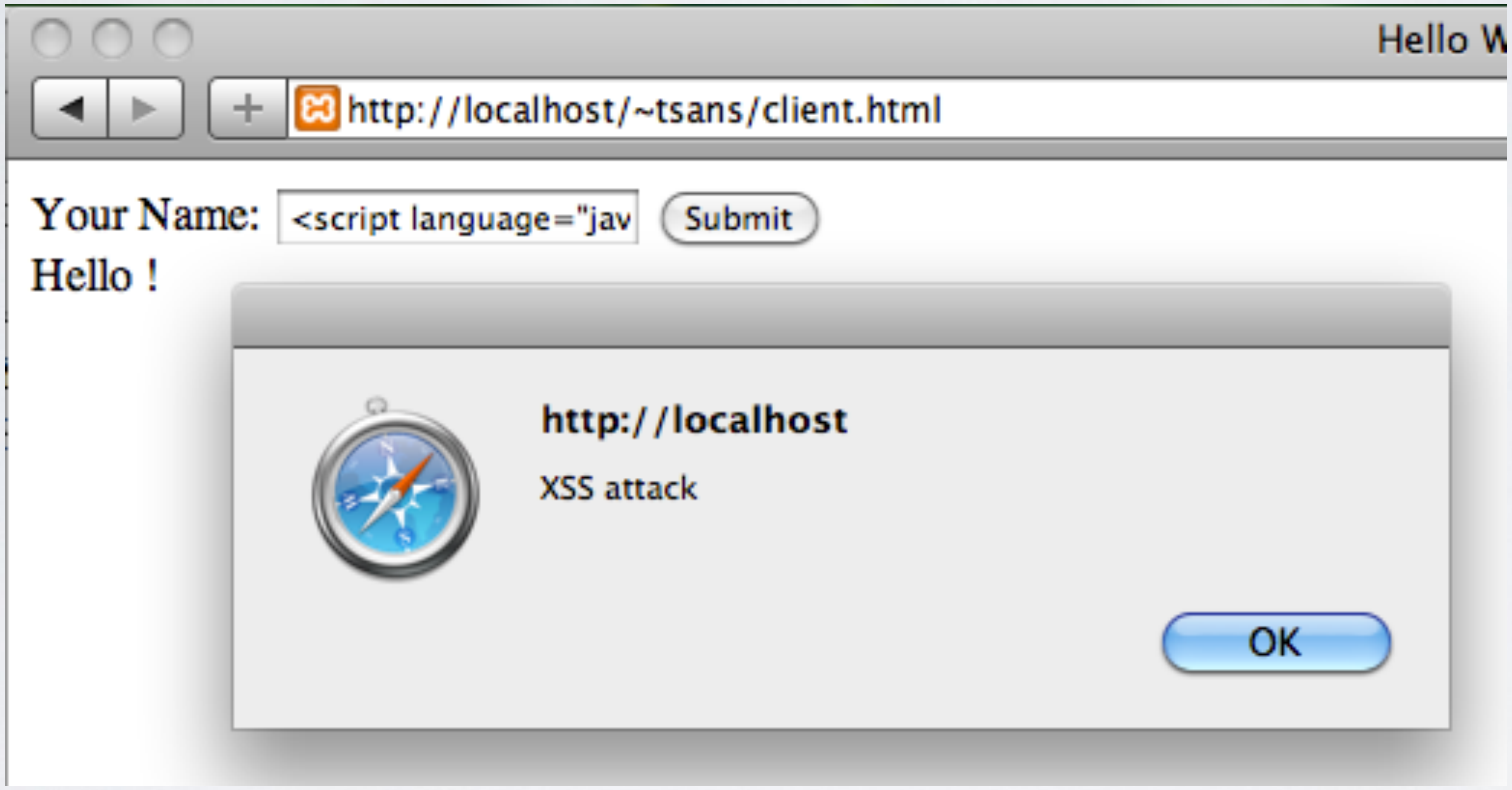
Your Name: <script language="jav

Submit



```
name=<script language="javascript">alert(“XSS attack”);</script>
```

XSS Attack = Javascript Code Injection



Your Name: <script language="jav Submit

Hello !

http://localhost

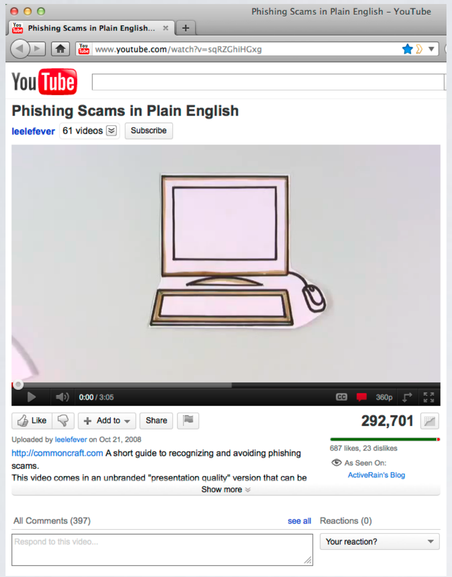
XSS attack

Problem

➡ An attacker can inject **arbitrary javascript code** in the page that will be executed by the browser

- **Inject illegitimate content** in the page (same as content spoofing)
- **Perform illegitimate HTTP requests** through Ajax (same as a CSRF attack)
- **Steal Session ID** from the cookie
- **Steal user's login/password** by modifying the page to forge a perfect scam

Forging a perfect scam



Phishing Scams in Plain English – YouTube

Phishing Scams in Plain English...

www.youtube.com/watch?v=sqRZGhiHGxg

Phishing Scams in Plain English

leelefever 61 videos Subscribe

0:00 / 3:05 360p

Like Add to Share 292,701

Uploaded by leelefever on Oct 21, 2008

http://commoncraft.com A short guide to recognizing and avoiding phishing scams.

This video comes in an unbranded "presentation quality" version that can be

Show more

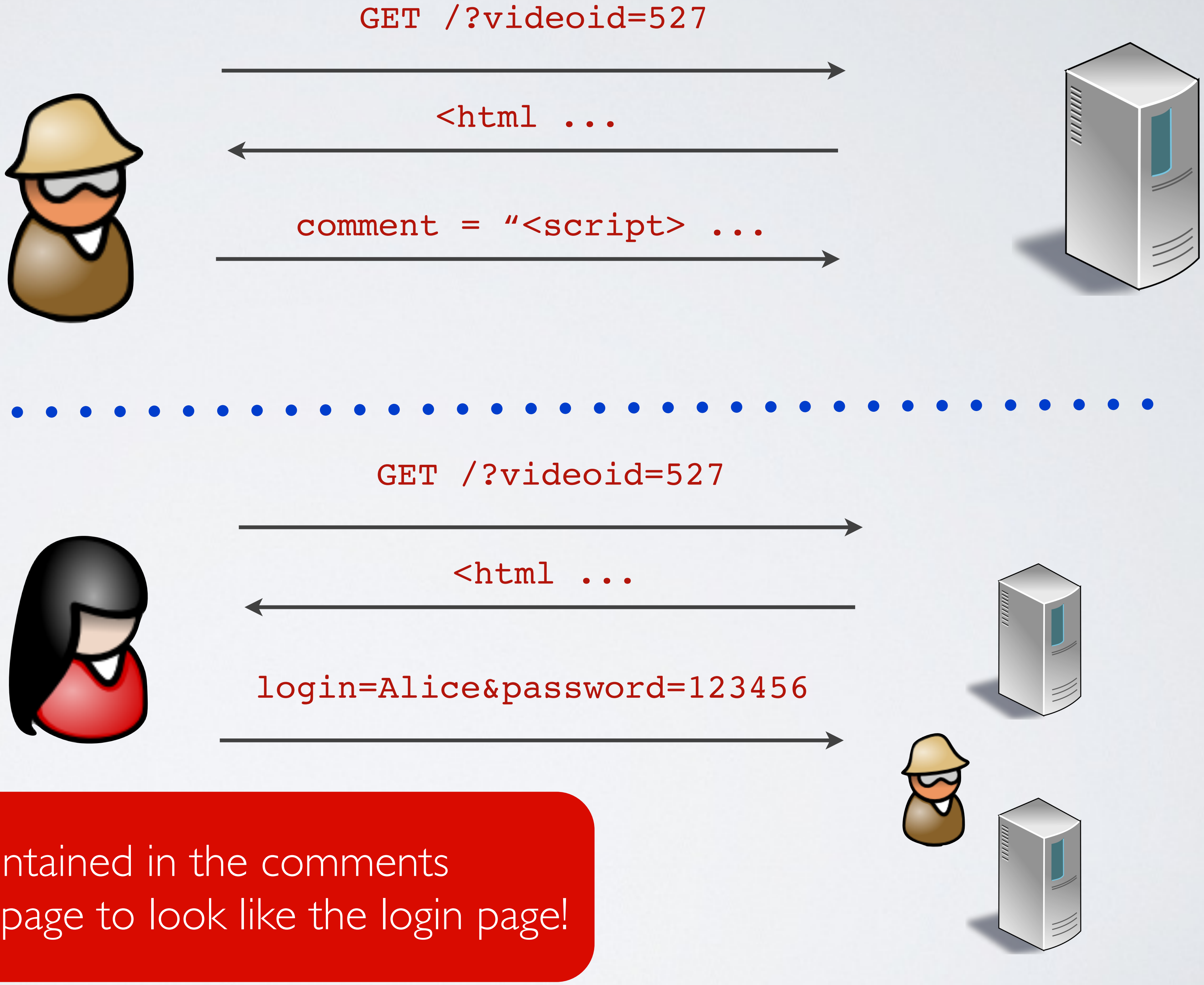
687 likes, 23 dislikes

As Seen On: ActiveRain's Blog

All Comments (397) see all Reactions (0)

Respond to this video...

Your reaction?



GET /?videoid=527

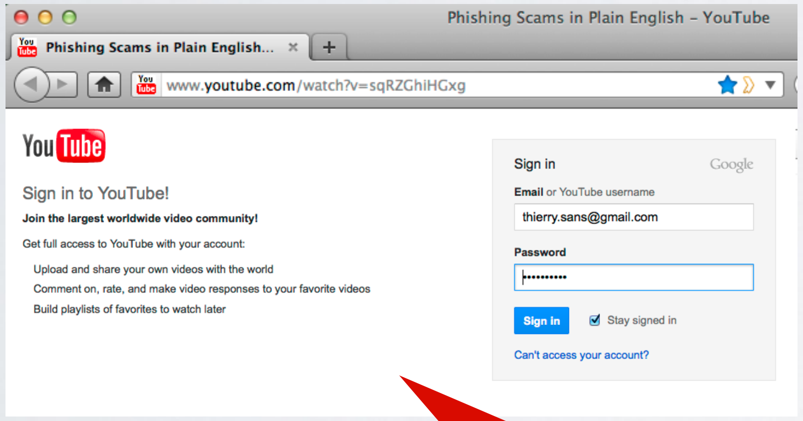
<html ...

comment = “<script> ...

GET /?videoid=527

<html ...

login=Alice&password=123456



Phishing Scams in Plain English – YouTube

Phishing Scams in Plain English...

www.youtube.com/watch?v=sqRZGhiHGxg

Sign in to YouTube!

Join the largest worldwide video community!

Get full access to YouTube with your account:

Upload and share your own videos with the world

Comment on, rate, and make video responses to your favorite videos

Build playlists of favorites to watch later

Sign in Google

Email or YouTube username: thierry.sans@gmail.com

Password: ••••••••••

Sign in ☑ Stay signed in

Can't access your account?

The script contained in the comments modifies the page to look like the login page!

** Notice that Youtube is **not** vulnerable to this attack*

It gets worst - XSS Worms

Spread on social networks

- Samy targeting MySpace (2005)
- JTV.worm targeting Justin.tv (2008)
- Twitter worm targeting Twitter (2010)

Variations on XSS attacks

- **Reflected XSS**
  Malicious data sent to the backend are immediately sent back to the frontend to be inserted into the DOM

- **Stored XSS**
  Malicious data sent to the backend are store in the database and later-on sent back to the frontend to be inserted into the DOM

- **DOM-based attack**
  Malicious data are manipulated in the frontend (javascript) and inserted into the DOM

Solution

✓ Data inserted in the DOM must be validated

`HttpOnly` cookie flag

✓ The cookie is not readable/writable from the frontend

➡ Prevents the authentication cookie from being leaked when an XSS attack (cross-site scripting) occurs

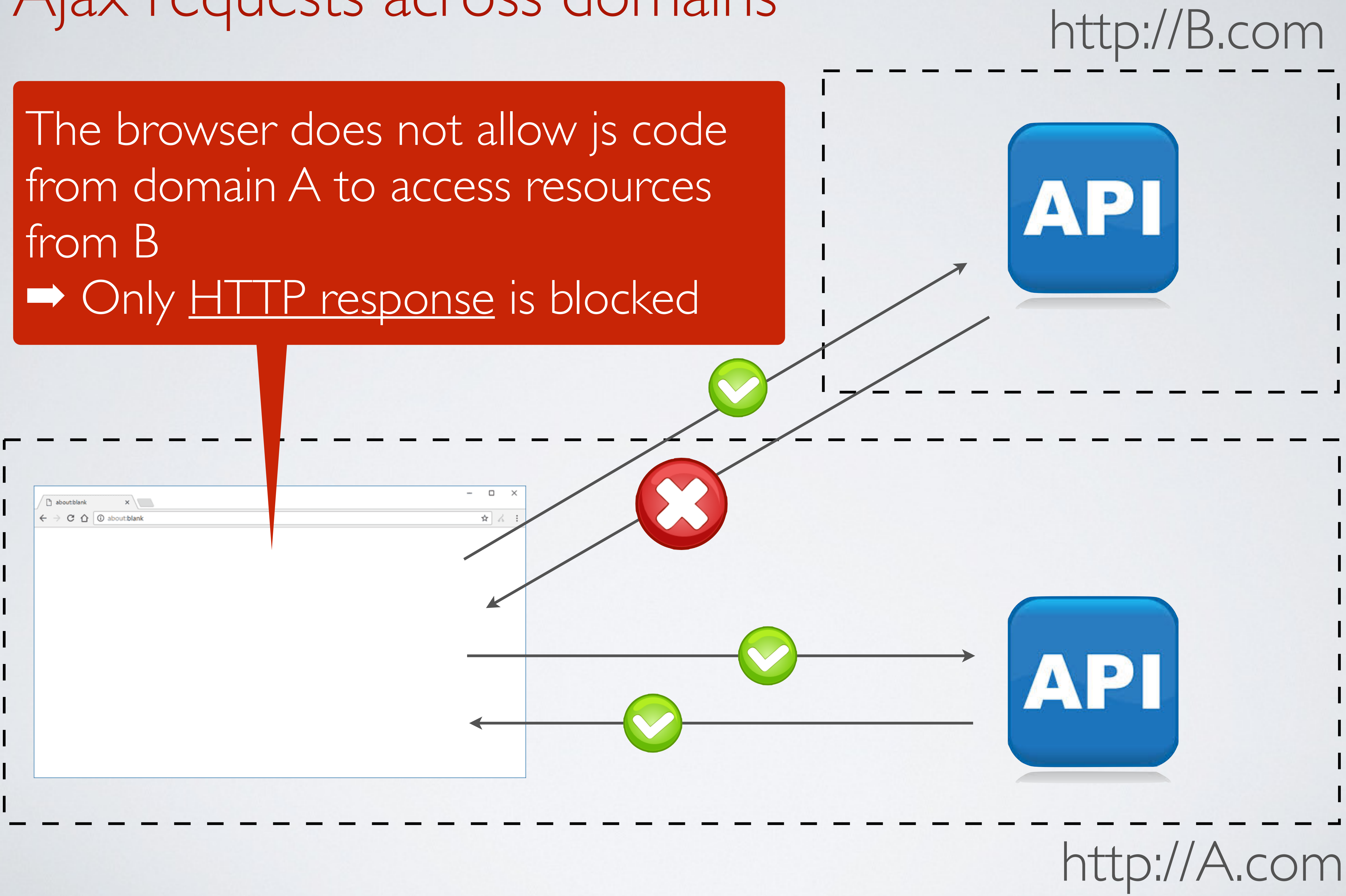
A05 Security Misconfiguration

Cross-Site Request Forgery

Ajax requests across domains

The browser does not allow js code from domain A to access resources from B

➡ Only HTTP response is blocked



Same origin policy

➡ **Resources must come from the same domain (protocol, host, port)**

Elements under control of the same-origin policy

- Ajax requests
- Form actions

Elements **not** under control of the same-origin policy

- Javascript scripts
- CSS
- Images, video, sound
- Plugins

Examples

	client	server
same protocol, port and host	`http://example.com`	`http://example.com`
	`http://user:pass@example.com`	`http://example.com`
top-level domain	`http://example.com`	`http://example.org`
host	`http://example.com`	`http://other.com`
sub-host	`http://www.example.com`	`http://example.com`
sub-host	`http://example.com`	`http://www.example.com`
port	`http://example.com:3000`	`http://example.com`
protocol	`http://example.com`	`https://example.com`

[digression] relaxing the same-origin policy

- Switch to the superdomain with javascript
  `www.example.com` can be relaxed to **`example.com`**
- iframe
- JSONP
- Cross-Origin Resource Sharing (CORS)

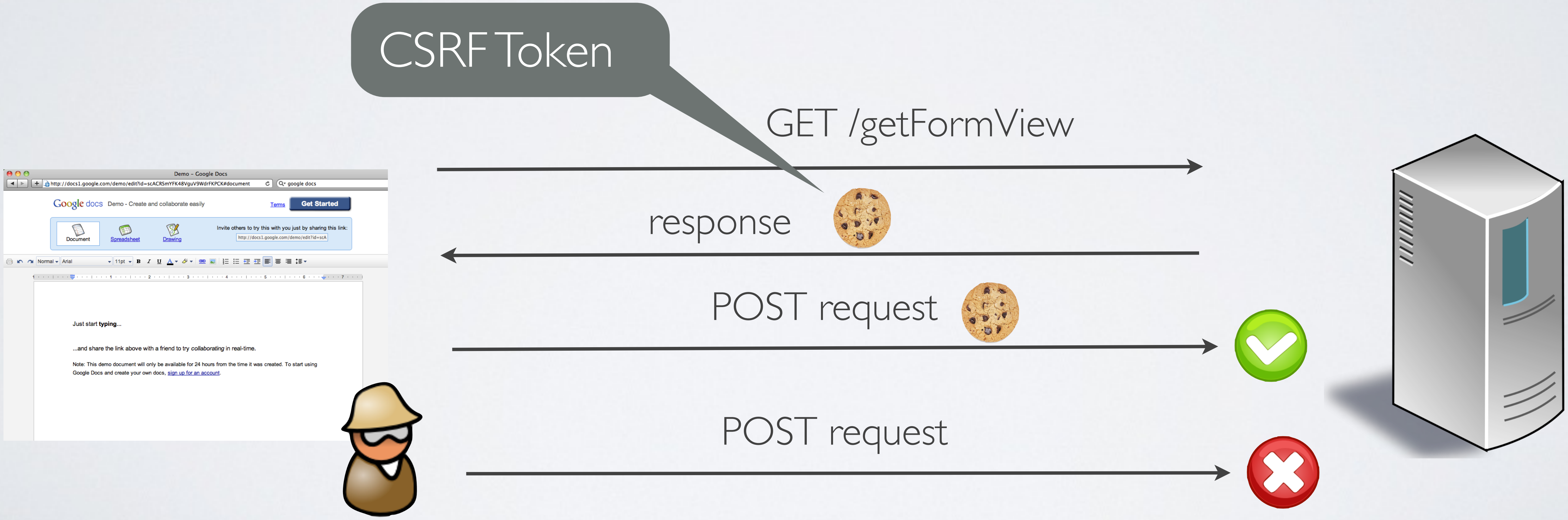
Problem

➡ An attacker can executes unwanted but yet authenticated actions on a web application by either

- setting up a malicious website with cross-origin requests
- or by injecting malicious urls into the page

Generic solution - CSRF tokens

✓ Protect legitimate requests with a CSRF token



Demo - Create and collaborate easily

Invite others to try this with you just by sharing this link:

http://docs1.google.com/demo/edit?id=scA

Just start **typing**...

...and share the link above with a friend to try *collaborating* in real-time.

Note: This demo document will only be available for 24 hours from the time it was created. To start using Google Docs and create your own docs, sign up for an account.

`SameSite` cookie flag

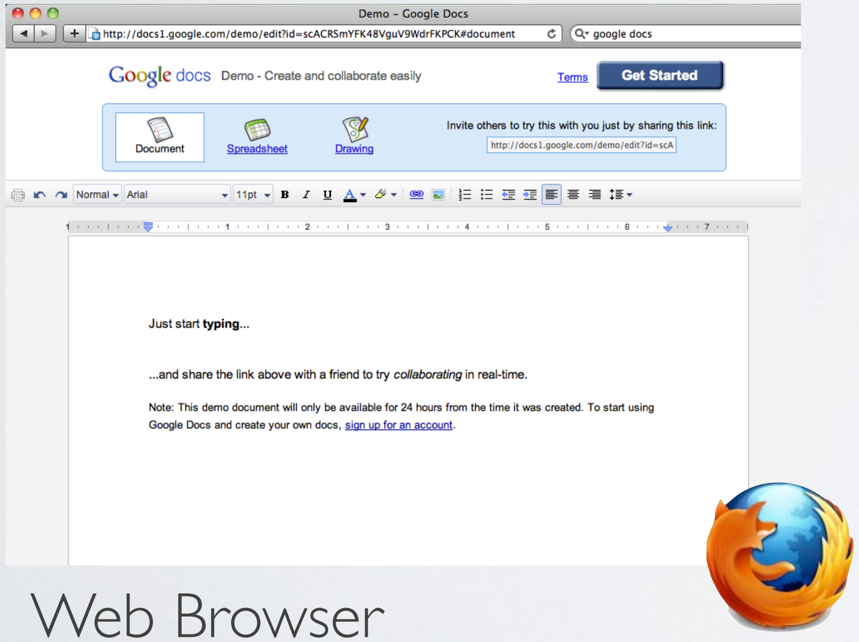
✓ The cookie will be not be sent over cross-site requests

➡ Prevents forwarding the authentication cookie over cross-origin requests (cross-site request forgery)

Conclusion

You have **absolutely no control** on the client

Client Side



Demo – Google Docs

http://docs1.google.com/demo/edit?id=scACRSmYFK48VguV9WdrFKPCK#document

google docs

Google docs Demo - Create and collaborate easily

Terms

Get Started

Document

Spreadsheet

Drawing

Invite others to try this with you just by sharing this link:

http://docs1.google.com/demo/edit?id=scA

Normal

Arial

11pt

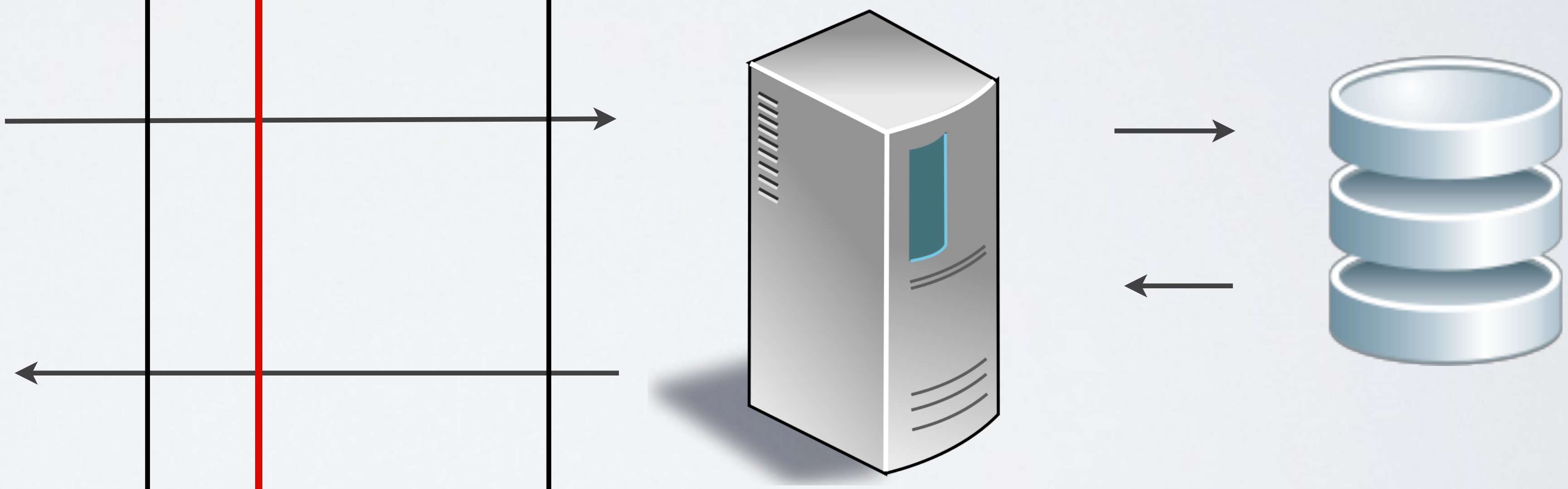
Just start **typing**...

...and share the link above with a friend to try *collaborating* in real-time.

Note: This demo document will only be available for 24 hours from the time it was created. To start using Google Docs and create your own docs, sign up for an account.

Web Browser

Server Side



Web Server

Database

References

- OWASP Top 10
  https://owasp.org/www-project-top-ten/

- Mozilla Secure Coding Guideline
  https://wiki.mozilla.org/WebAppSec/Secure_Coding_Guidelines

- Node Express - Production Best Practices: Security
  https://expressjs.com/en/advanced/best-practice-security.html