

# New Tricks For Defeating SSL In Practice



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# The Back Story

# SSL And Certificate Chaining

General | Details

**This certificate has been verified for the following uses:**

SSL Server Certificate

**Issued To**

Common Name (CN) www.paypal.com  
Organization (O) PayPal, Inc.  
Organizational Unit (OU) Information Systems  
Serial Number 63:4D:CE:1C:61:9F:FB:6B:26:1E:05:AD:5B:A9:85:86

**Issued By**


Common Name (CN) VeriSign Class 3 Extended Validation SSL SGC CA  
Organization (O) VeriSign, Inc.  
Organizational Unit (OU) VeriSign Trust Network

**Validity**

Issued On 05/01/2008  
Expires On 05/02/2009

**Fingerprints**

SHA1 Fingerprint A4:25:F6:7E:D2:C9:AC:D6:DE:F6:53:DA:79:5E:01:C5:17:B3:75:2D  
MD5 Fingerprint 22:B7:78:93:7D:BA:56:8B:84:BD:F9:A9:74:70:07:00

Close

You probably know what they do...

More specifically...

# CA Certificate

- Embedded in browser.
- All powerful.
- Certifies that a site certificate is authentic.

# Site Certificate

- Identifies a particular URL
- Is known to be authentic based on CA Certificate's signature.

# CA Certificate

- Embedded in browser.
- All powerful.
- Certifies that an intermediate CA is authentic.

# Intermediate CA

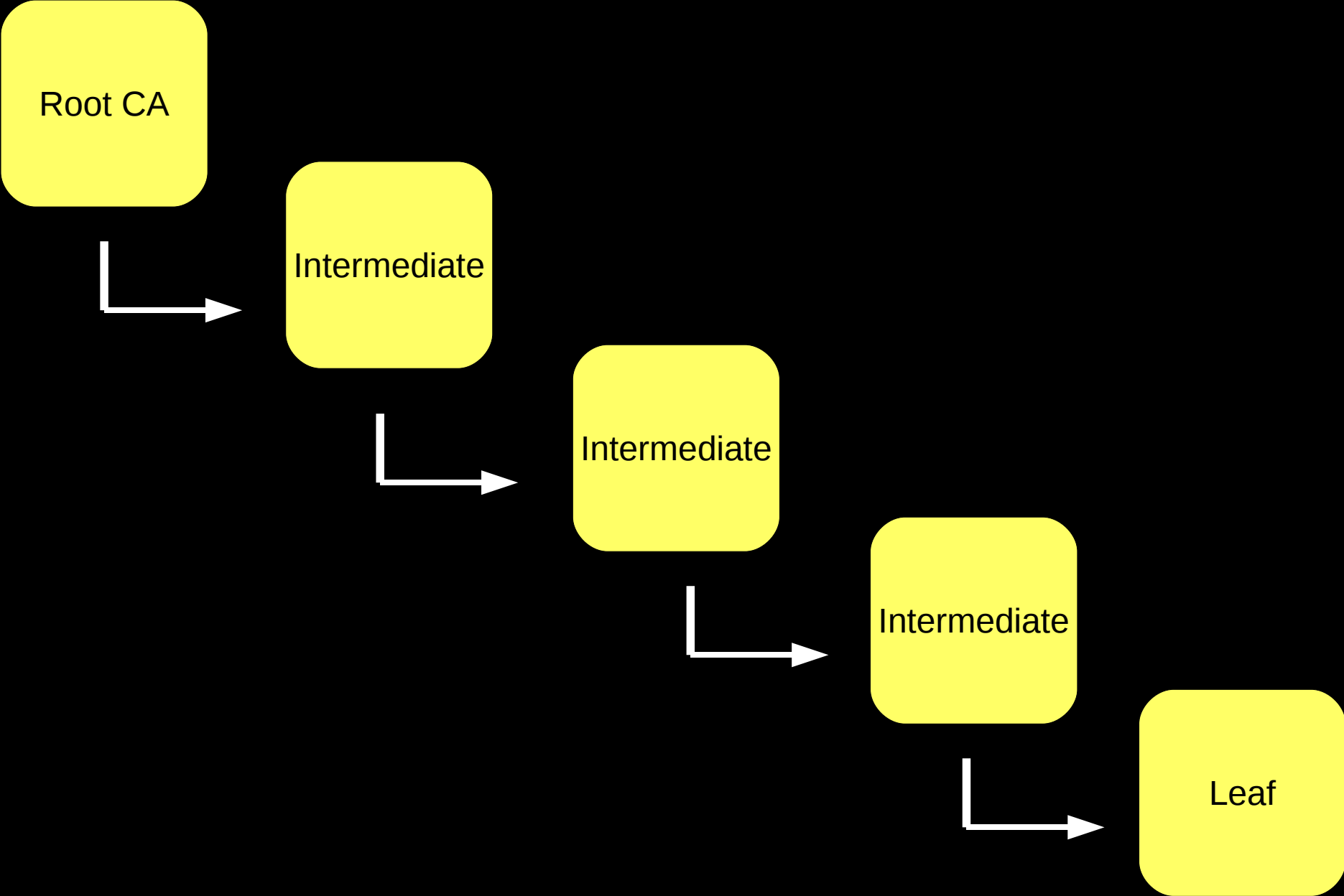
- Not embedded in browser.
- Still sort of all-powerful.
- Certifies that a site certificate is authentic.

# Site Certificate

- Identifies a particular URL
- Is known to be authentic based on CA Certificate's signature.



# Certificate Chains Can Be $> 3$



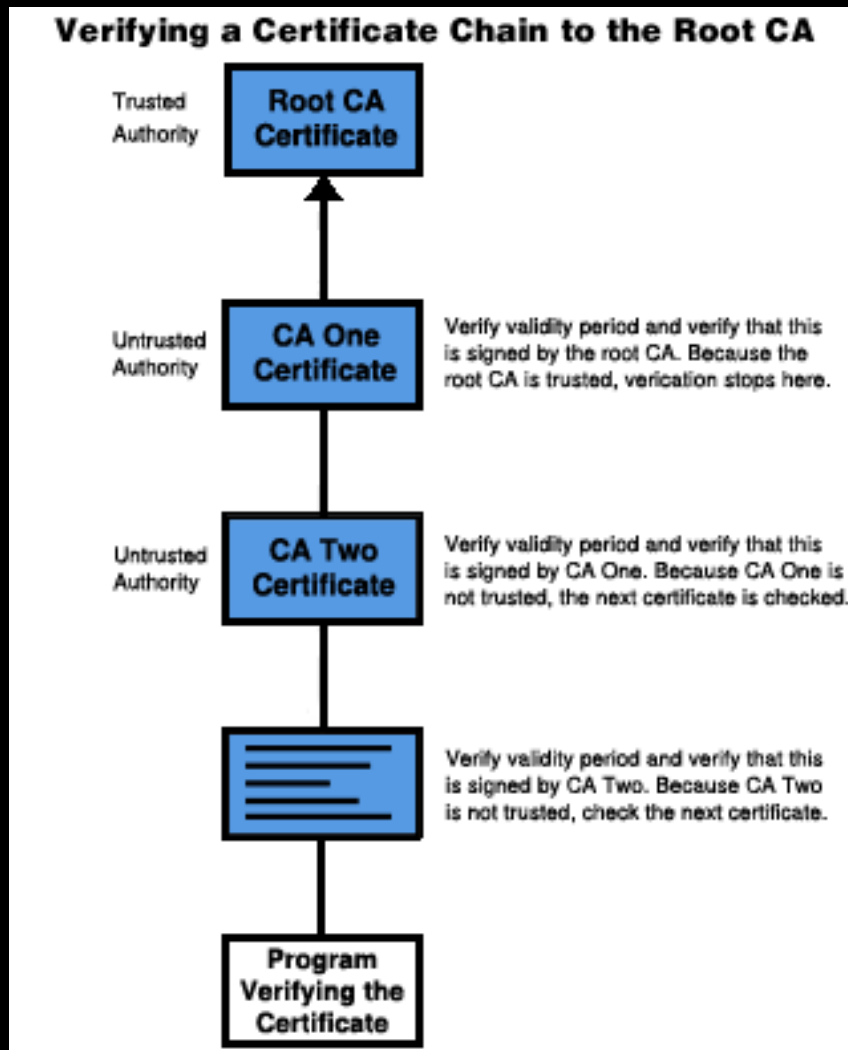
How do we validate these things?

Almost everyone tells you the  
same story.

# What they say:

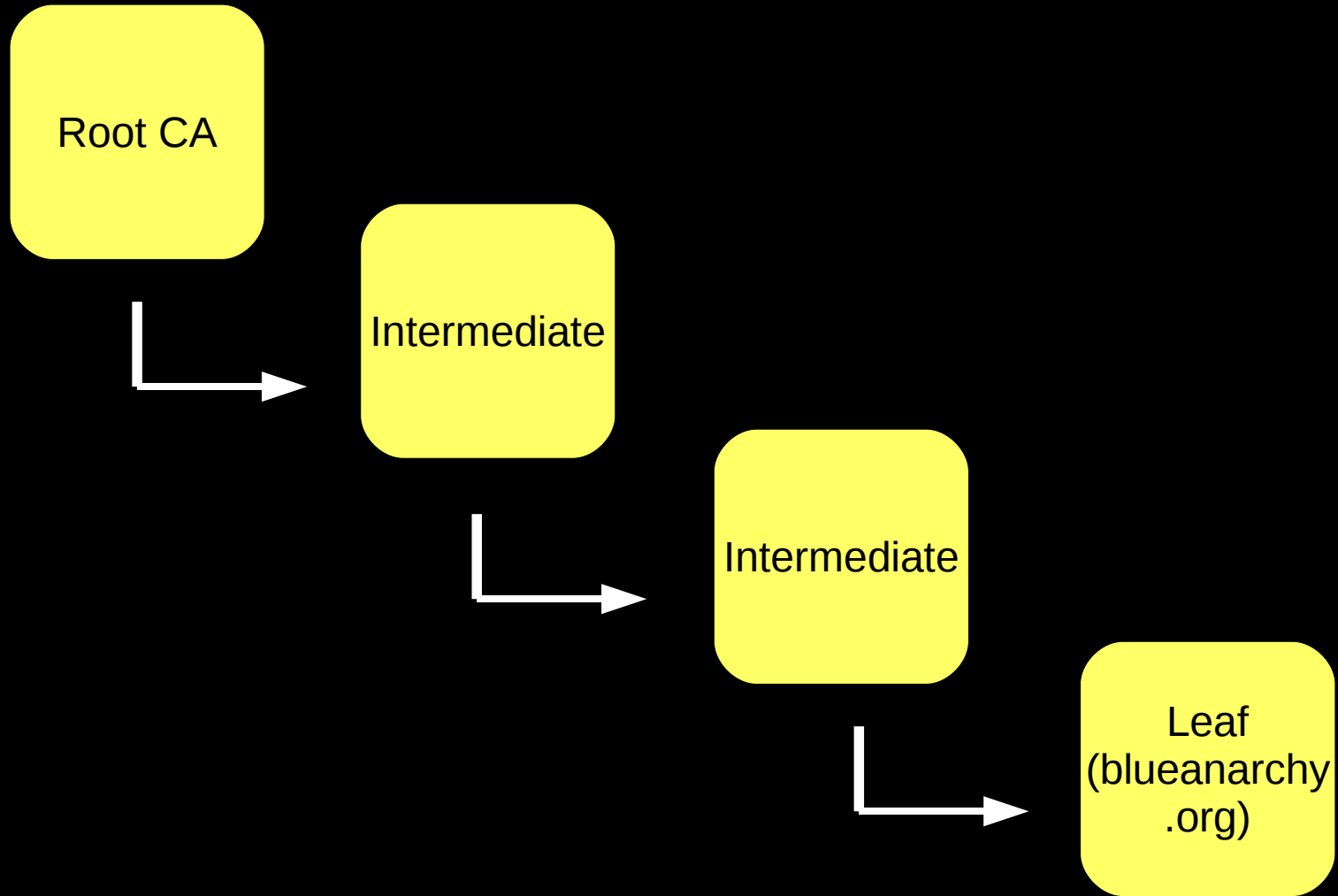
- Verify that the leaf node has the name of the site you're connecting to.
- Verify that the leaf node hasn't expired.
- Check the signature.
- If the signing certificate is in our list of root CA's, stop.
- Otherwise, move one up the chain and repeat.

# Here Be Dragons

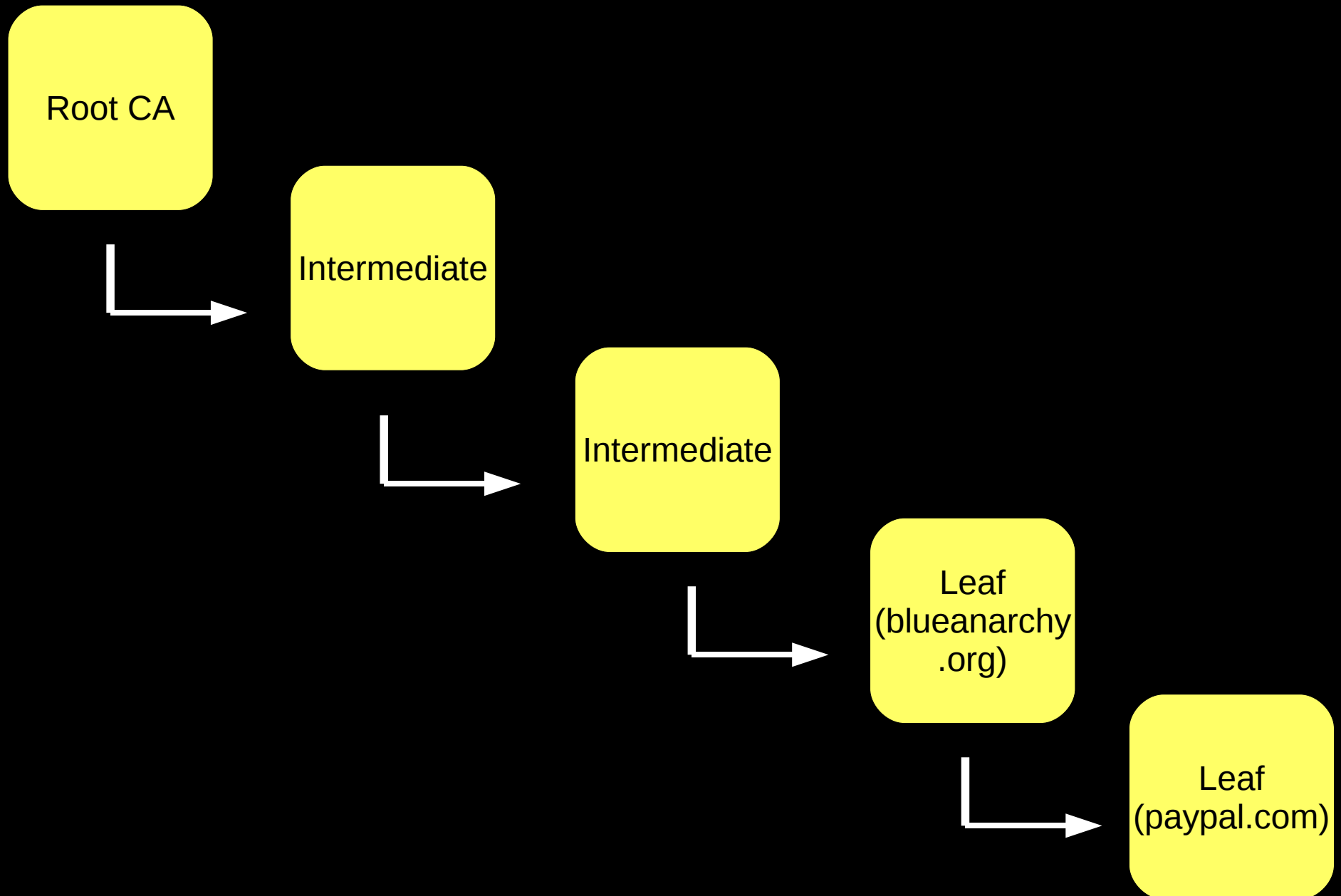


- Very tempting to use a simple recursive function.
- Everyone focuses on the signature validation.
- The result of a naïve attempt at validation is a chain that is complete, but nothing more.

# What if...



# What if...



# What they say:

- Verify that the leaf node has the name of the site you're connecting to.
- Verify that the leaf node hasn't expired.
- Check the signature.
- If the signing certificate is in our list of root CA's, stop.
- Otherwise, move one up the chain and repeat.



# Something must be wrong, but...

- All the signatures are valid.
- Nothing has expired.
- The chain is in tact.
- The root CA is embedded in the browser and trusted.

But we just created a valid certificate  
for PayPal, and we're not PayPal?

The missing piece...

...is a somewhat obscure field.

```
File Edit View Terminal Tabs Help
moxie@searching: ~/Desktop/b... X moxie@searching: ~/Desktop/b... X moxie@searching: ~/Desktop/b... X
      f8:c9:0f:24:d2:c7:c2:92:0c:13:54:93:d5:9b:c7:
      0e:fa:19:a8:d5:d3:f7:ab:5d
      Exponent: 65537 (0x10001)
X509v3 extensions:
  X509v3 Key Usage: critical
    Digital Signature, Non Repudiation, Key Encipherment, Data Encip
herment
  X509v3 Subject Key Identifier:
    DF:48:EF:25:BF:D2:23:B0:F0:C2:AC:FA:5A:85:50:74:FF:F9:34:EF
  X509v3 CRL Distribution Points:
    URI:http://crl.geotrust.com/crls/globalca1.crl

  X509v3 Authority Key Identifier:
    keyid:BE:A8:A0:74:72:50:6B:44:B7:C9:23:D8:FB:A8:FF:B3:57:6B:68:6
C

  X509v3 Extended Key Usage:
    TLS Web Server Authentication, TLS Web Client Authentication
  X509v3 Basic Constraints: critical
    CA:FALSE
Signature Algorithm: sha1WithRSAEncryption
7a:58:f9:88:14:cb:77:32:aa:83:12:de:d9:15:74:8e:34:e3:
66:ca:bc:24:2c:28:96:54:cd:be:51:56:60:87:e3:be:c6:2e:
86:7e:74:c1:68:01:b6:8c:07:c6:a2:0c:a4:36:ca:e1:a8:e9:
```



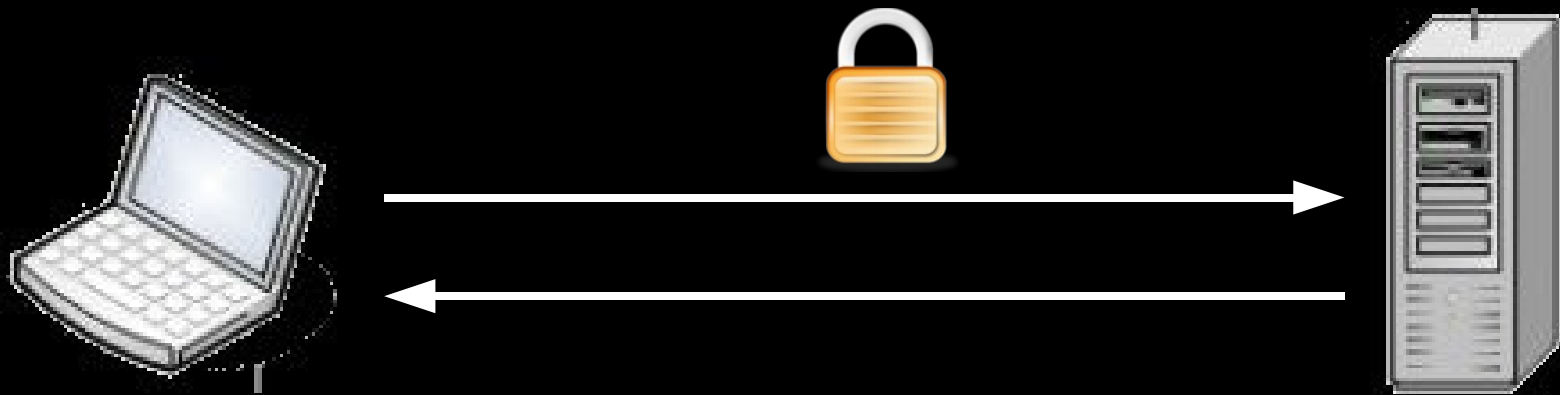
# Back In The Day

- Most CA's didn't explicitly set basicConstraints: CA=FALSE
- A lot of web browsers and other SSL implementations didn't bother to check it, whether the field was there or not.
- *Anyone* with a valid leaf node certificate could create and sign a leaf node certificate for *any other* domain.
- When presented with the complete chain, IE, Konqueror, OpenSSL, and others considered it valid.

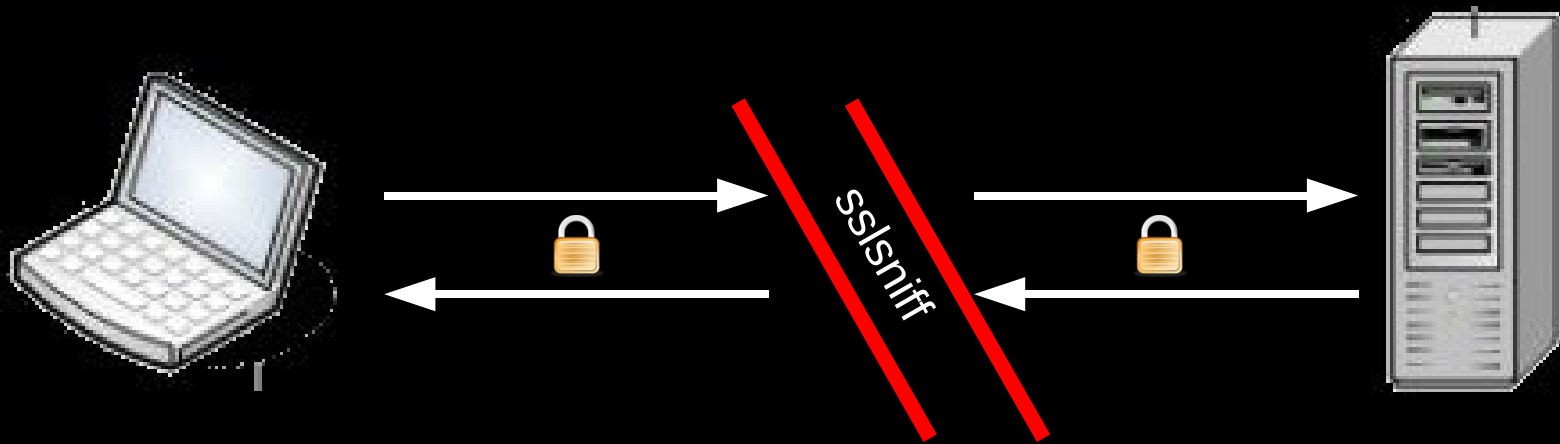
# And then in 2002...

- Microsoft did something particularly annoying, and I blew this up by publishing it.
- Microsoft claimed that it was impossible to exploit.
- So I also published a tool that exploits it.

# sslsniff

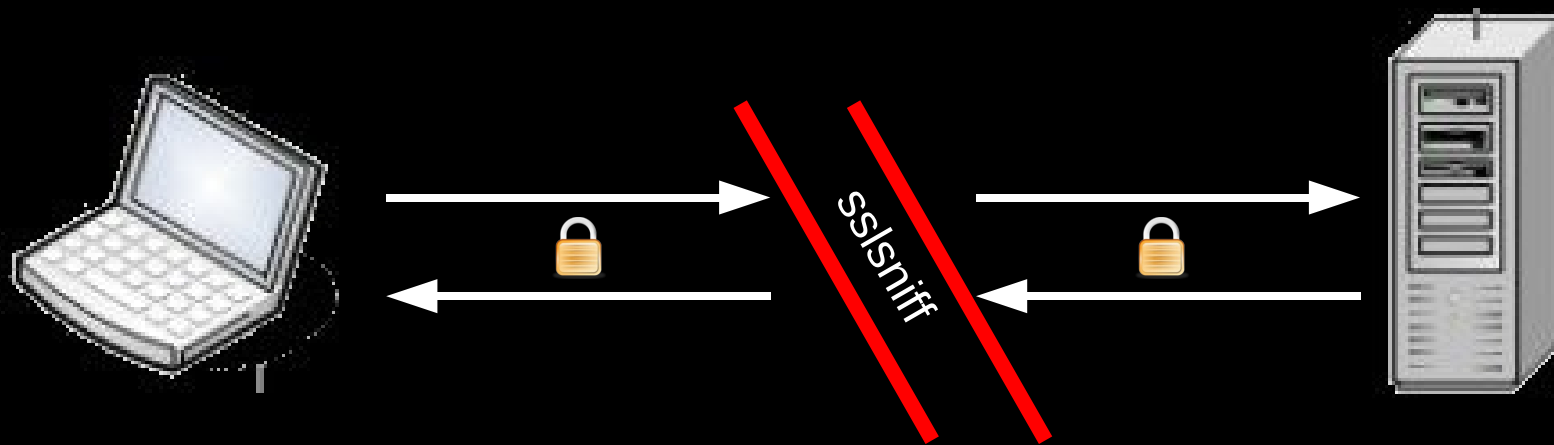


# sslsniff





# sslsniff



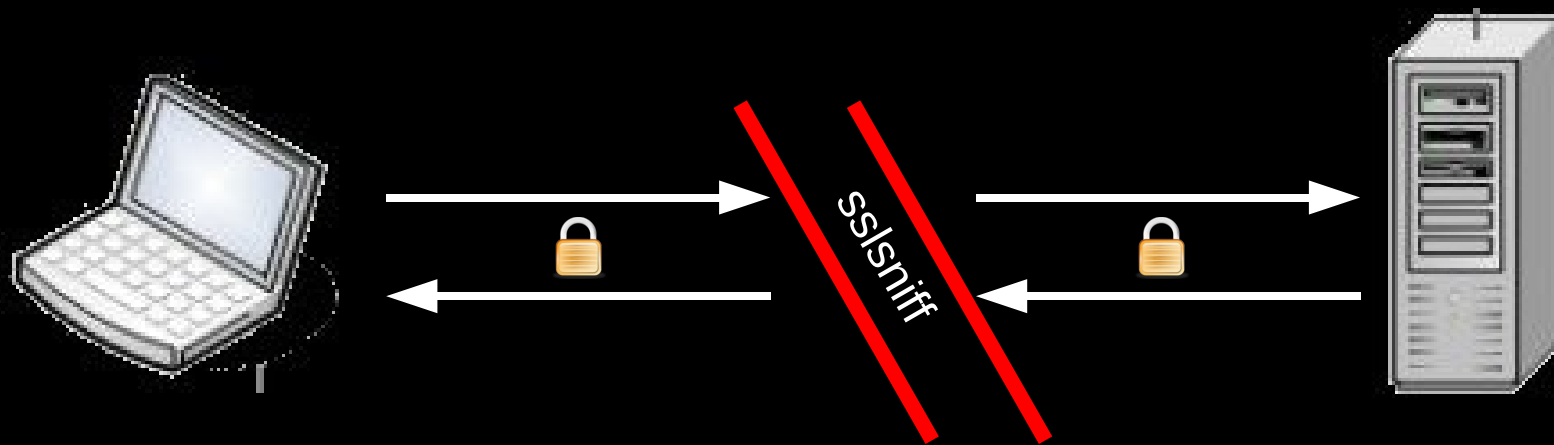
## Client Side:

- Intercepts HTTPS traffic.
- Generates a certificate for the site the client is connecting to.
- Signs that with whatever certificate you specify.
- Proxies data through.

## Server Side:

- Makes normal HTTPS connection to the server.
- Sends and receives data as if it's a normal client.

# sslsniff



- Back before people started checking BasicConstraints:
- All you had to do was pass sslsniff a valid leaf node certificate for any domain.
- It would automatically generate a certificate for the domain the client was connecting to on the fly.
- It would sign that certificate with the leaf node.
- IE, Konqueror, etc... wouldn't notice the difference.

# sslsniff post-disclosure

- You'd be surprised who still doesn't check basic constraints.
- Even when people got warning dialogs in browsers that had been fixed, most of the time they'd just click through them.
- Still useful as a general MITM tool for SSL.
  - The folks who did the MD5 hash collision stuff used sslsniff to hijack connections once they'd gotten a CA cert.
- There are other uses yet, to be disclosed another day.

Surely we can do better.

# The things you learn in TV studios.

The image shows a screenshot of the Bank of America website as it appeared in a Mozilla Firefox browser window. The browser's address bar shows the URL `http://www.bankofamerica.com/index.jsp`. The website features the Bank of America logo and navigation links for "Locations", "Contact Us", "Help", "Sign In", and "En Español". A search bar is also present. The main navigation bar includes "PERSONAL", "SMALL BUSINESS", "CORPORATE & INSTITUTIONAL", and "ABOUT BANK OF AMERICA".

The "Online Banking" section on the left includes the text "Easy. Secure. Free." and an "Enroll" button. Below this, there are input fields for "Enter Online ID:" and "Password:", along with a "Sign In" button and a link for "Forgot or need help with your ID?".

The central banner features the headline "You've served our country. Now it's our privilege to serve you." and promotes "Military Banking accounts from Bank of America." with a "Get started today" button. The banner includes an image of a soldier's photo album and dog tags.

The "Products & Services" section is divided into three columns:

- Products & Services:** Checking, Savings & CDs, Credit cards, Mortgage, Refinance, Home equity, Auto loans, IRAs, Investment Services.
- Manage Your Accounts:** Fees and processes, Order Check Card, Online Investing, **Online Banking >** Viewing your accounts, Accessing credit cards, Bill Pay, Tracking your expenses.
- Achieve Your Goals:** Keep the Change®, Buying a home, Searching for a home, Retirement Center, Planning for college, Student loans, Purchasing a car, Consolidating debt, Small Business Online.

The bottom of the browser window shows a search bar with the text "Find:" and options for "Previous", "Next", "Highlight all", and "Match case".

# The things you learn in TV studios.

Bank of America | Home | Personal - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.bankofamerica.com/index.jsp

Google

Most Visited

Locations • Contact Us • Help • Sign In • En Español

**Bank of America**

PERSONAL ▾ SMALL BUSINESS ▾ CORPORATE & INSTITUTIONAL ▾ ABOUT BANK OF AMERICA ▾

**Online Banking**

Easy. Secure. Free.

**Enroll** View demo | Learn more

Enter Online ID:

Save this Online ID

**Password:**

Where do I enter my Passcode?

**Sign In**

Forgot or need help with your ID?

Reset Passcode

**Your Privacy & Security**

Report suspicious email

Norton 360 - Free Trial

**You've served our country. Now it's our privilege to serve you.**

**Military Banking** accounts from Bank of America.

Convenient, secure banking wherever you are. Military Banking from Bank of America.

**Get started today**

**Products & Services**

- Checking
- Savings & CDs
- Credit cards
- Mortgage
- Refinance
- Home equity
- Auto loans
- IRAs
- Investment Services

**Manage Your Accounts**

- Fees and processes
- Order Check Card
- Online Investing
- Online Banking >**
- Viewing your accounts
- Accessing credit cards
- Bill Pay
- Tracking your expenses

**Achieve Your Goals**

- Keep the Change®
- Buying a home
- Searching for a home
- Retirement Center
- Planning for college
- Student loans
- Purchasing a car
- Consolidating debt
- Small Business Online

Find:  Previous Next Highlight all Match case

Done

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The image shows a screenshot of the Bank of America website as viewed in a Mozilla Firefox browser. The browser's address bar displays the URL `http://www.bankofamerica.com/index.jsp`. The website's header includes the Bank of America logo, navigation links for "Locations", "Contact Us", "Help", "Sign In", and "En Español", and a search bar. A red navigation bar below the header contains links for "PERSONAL", "SMALL BUSINESS", "CORPORATE & INSTITUTIONAL", and "ABOUT BANK OF AMERICA".

The main content area is divided into several sections. On the left, the "Online Banking" section features the text "Easy. Secure. Free." and an "Enroll" button. Below this, there are input fields for "Enter Online ID:" and "Password:", a "Save this Online ID" checkbox, and a "Sign In" button. A red arrow points to the "Sign In" button. Below the "Sign In" button are links for "Forgot or need help with your ID?" and "Reset Passcode".

To the right of the "Online Banking" section is a large advertisement for "Military Banking accounts from Bank of America." The ad features the headline "You've served our country. Now it's our privilege to serve you." and a "Get started today" button. Below the ad, there are three columns of "Products & Services":

- Products & Services:** Checking, Savings & CDs, Credit cards, Mortgage, Refinance, Home equity, Auto loans, IRAs, Investment Services.
- Manage Your Accounts:** Fees and processes, Order Check Card, Online Investing, Online Banking > (with sub-links: Viewing your accounts, Accessing credit cards, Bill Pay, Tracking your expenses).
- Achieve Your Goals:** Keep the Change®, Buying a home, Searching for a home, Retirement Center, Planning for college, Student loans, Purchasing a car, Consolidating debt, Small Business Online.

At the bottom of the browser window, there is a search bar with the text "Find:" and navigation buttons for "Previous", "Next", "Highlight all", and "Match case". The status bar at the very bottom shows "Done".

# The things you learn in TV studios.



Online Banking 

Easy. Secure. Free.

**Enroll** [View demo](#) | [Learn more](#)

Enter Online ID:

Save this Online ID

**Password:**

[Where do I enter my Passcode?](#)

**Sign In**

[Forgot or need help with your ID?](#)  
[Reset Passcode](#)

This button posts to an HTTPS link, but there's no way to know that.

- It's a button, so if you mouse-over it, the link isn't displayed in the browser bar at the bottom.
- The best you could do would be to view the page source, but that's problematic in browsers like Firefox that issue a second request to the server for the source.



# Still prevalent today...

Wachovia - Personal Finance and Business Financial Services - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.wachovia.com/

Most Visited Getting Started Latest Headlines

Customer Service | Contact Us | Locations



## The time is now.

Mortgage rates are at an all-time low.  
Refinance today and save.

[Learn How >](#)

**LOGIN**

User ID:

Remember my User ID

Password:  
  
(case sensitive)

Service:  
Choose a service...

Forgot [User ID](#) or [Password](#)?

Retirement Plan Participants: [Login](#)  
Education Loan Customers: [Login](#)

**PERSONAL FINANCE**

**Online Services**  
Online Banking with BillPay  
Mobile Banking  
Online Brokerage  
More...

**Banking**  
Checking  
Savings & CDs  
Credit Cards  
Check Cards  
More...

**Retirement Planning**  
Tools & information for  
Lifetime Retirement Planning

**Lending**  
Mortgage  
Home Equity **New!**  
Education Loans  
Vehicle Loans

**Investing**  
Accounts & Services  
IRAs  
More...

**Rates**  
Mortgage Rates  
Home Equity Rates  
Credit Card Rates

**Insurance**  
Life, Auto, Home,  
Health

**Payment Challenges?**  
Explore your loan options

**Refer a Friend**  
It adds up to \$25 for both  
of you.  
[See How >>](#)

**Ready to get organized?**  
It's easier than you think.  
[Go Paperless >>](#)

**STRENGTH AND STABILITY**  
Wachovia is now  
part of Wells Fargo.  
[Learn More >>](#)

**WACHOVIA SECURITIES**  
An industry leader in investment and  
advisory services for individuals,  
corporations and institutions.

**SMALL BUSINESS**  
The tools, services, and research to  
manage your company.  
[Small Business Login](#)

**ONLINE BANKING.**  
Securely manage your business  
finances online.  
[Wachovia Business Online.](#)

**LOCATIONS**  
ZIP:    
[More Search Options](#)

Search:    
[Search Tips](#)

Done

# Still prevalent today...

The image shows a screenshot of a Mozilla Firefox browser window. The title bar reads "Sign In - Mozilla Firefox". The address bar contains the URL "http://login.live.com/login.srf?wa=wsignin1.0&r...". The page content features the Windows Live logo and a sign-in form. The form includes fields for "Windows Live ID" (with an example email address) and "Password", along with checkboxes for "Remember me on this computer" and "Remember my password", and a "Sign in" button. A "Sign up" button is also visible for users who do not have a Windows Live ID.

Sign In - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://login.live.com/login.srf?wa=wsignin1.0&r... Google

Most Visited Getting Started Latest Headlines

## Windows Live

One Windows Live ID gets you into **Hotmail, Messenger, Xbox LIVE** — and other places you see

### Hotmail

- Powerful Microsoft technology helps fight spam and improve security.
- Get more done thanks to greater ease and speed.
- Lots of storage (5 GB) - more cool stuff on the way.

[Learn more](#)

Don't have a Windows Live ID?

[Sign up](#)

### Sign in

Windows Live ID:   
(example555@hotmail.com)

Password:   
[Forgot your password?](#)

Remember me on this computer (?)

Remember my password (?)

[Sign in](#)

Use enhanced security

Done

There are some generalizable attacks here.

# Browsers Then And Now...

# Then: A Positive Feedback System

- A number of indicators deployed to designate that a page *is* secure.
- A proliferation of little lock icons.
- URL bars that turn gold.

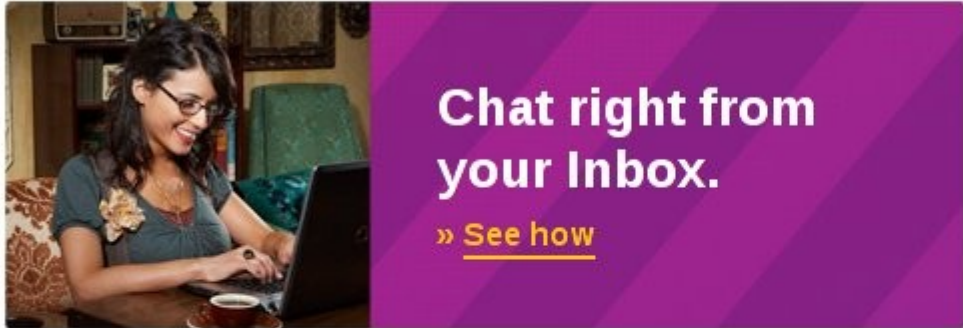
# Then: An example from Firefox 2

Yahoo! Mail: The best web-based email! - Mozilla Firefox

File Edit View History Bookmarks Tools Help




https://login.yahoo.com/config/mail?.intl=us& Google

**YAHOO! MAIL** Yahoo! - Blog - Help




**Chat right from your Inbox.**  
» [See how](#)

**Your Inbox understands you've got news to share.**

-  See which of your contacts are online at a glance.
-  Easily switch from email to chat and back again.
-  Start right away, no download or setup needed.

[See how](#) to instantly reach friends and family from the New Yahoo! Mail.

**Sign in to Yahoo!**

 **Are you protected?**  
Create your sign-in seal.  
(Why?)

Yahoo! ID:  
  
(e.g. free2rhyme@yahoo.com)

Password:

**Keep me signed in**  
for 2 weeks unless I sign out. [Info](#)  
[Uncheck if on a shared computer]

[Forget your ID or password?](#) | [Help](#)

**Don't have a Yahoo! ID?**  
Signing up is easy.  
[Sign Up](#)

Done | login.yahoo.com | Tor Disabled | FoxyProxy: Disabled

# Then: An example from Firefox 2

Yahoo! Mail: The best web-based email! - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://login.yahoo.com/config/mail?.intl=us&

Google

**YAHOO! MAIL** Yahoo! - Blog - Help

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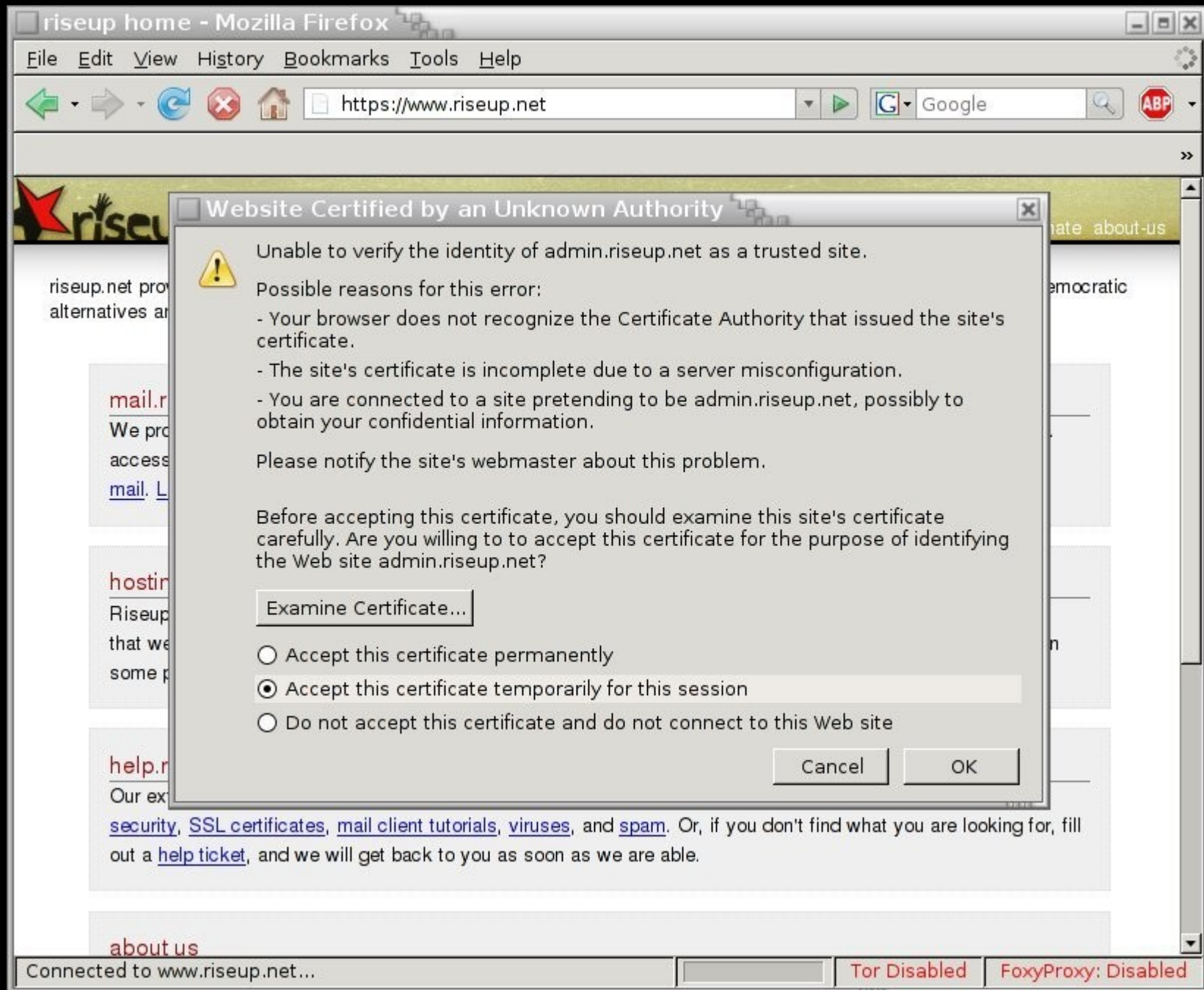
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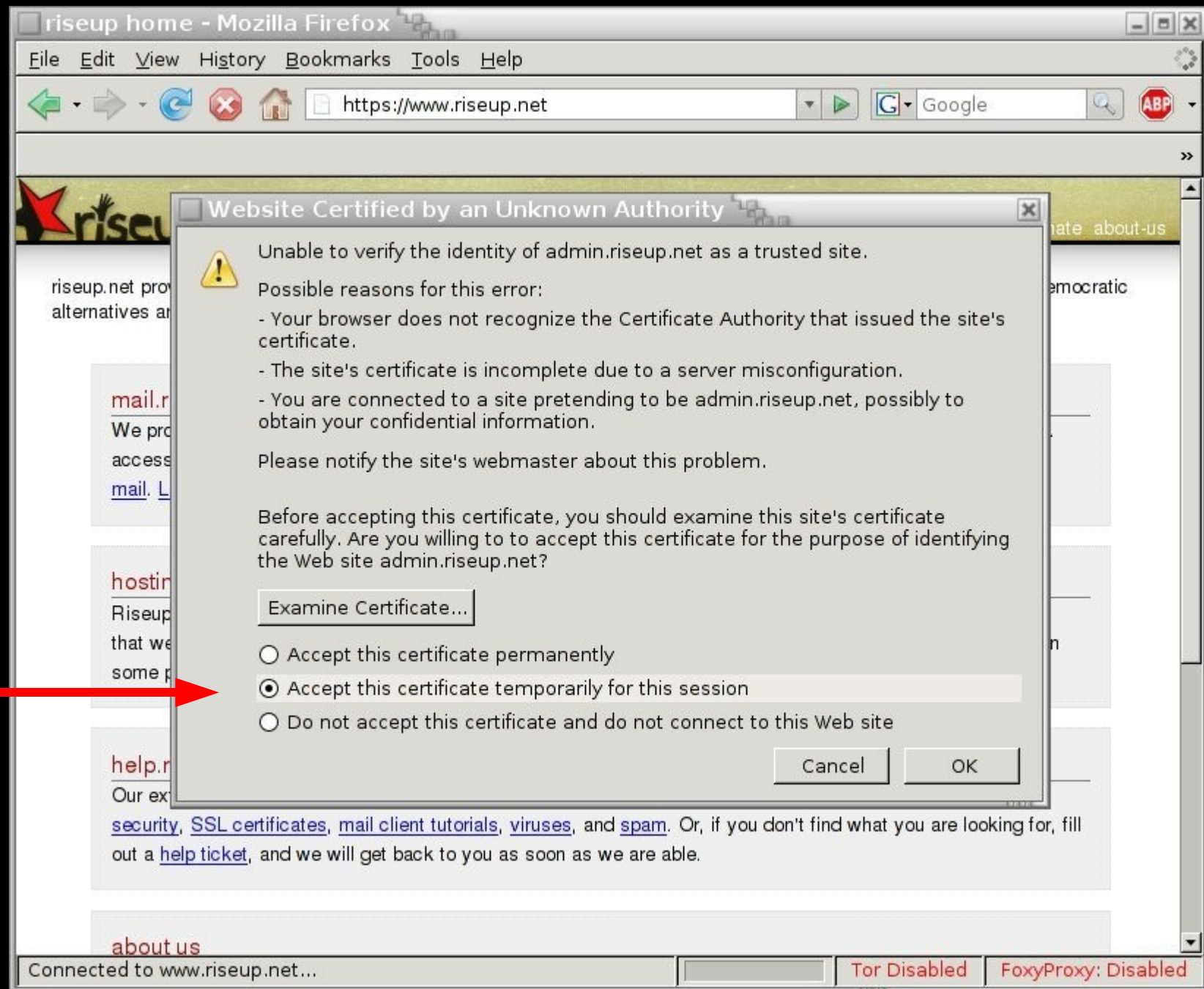
Done | login.yahoo.com | Tor Disabled | FoxyProxy: Disabled

# Then: An example from Firefox 2





# Then: An example from Firefox 2



# Now: A Negative Feedback System

- Less emphasis on sites being secure.
  - The proliferation of little locks has been toned down.
  - Firefox's gold bar is gone.
- More emphasis on alerting users to problems.
  - A maze of hoops that users have to jump through in order to access sites with certificates that aren't signed by a CA.

# Now: An example from Firefox 3


Yahoo! Mail: The best web-based email! - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://login.yahoo.com/config/login\_verify2?&.src=ym

Most Visited Getting Started Latest Headlines




**YAHOO! MAIL** Yahoo! - Help



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[Uncheck if on a shared computer]

[Sign In](#)

Done | login.yahoo.com

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Yahoo! Mail: The best web-based email! - Mozilla Firefox


File Edit View History Bookmarks Tools Help

https://login.yahoo.com/config/login\_verify2?&.src=ym

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## YAHOO! MAIL




Yahoo! - Help



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Done login.yahoo.com

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https://login.yahoo.com/config/login\_verify2?&.src=ym

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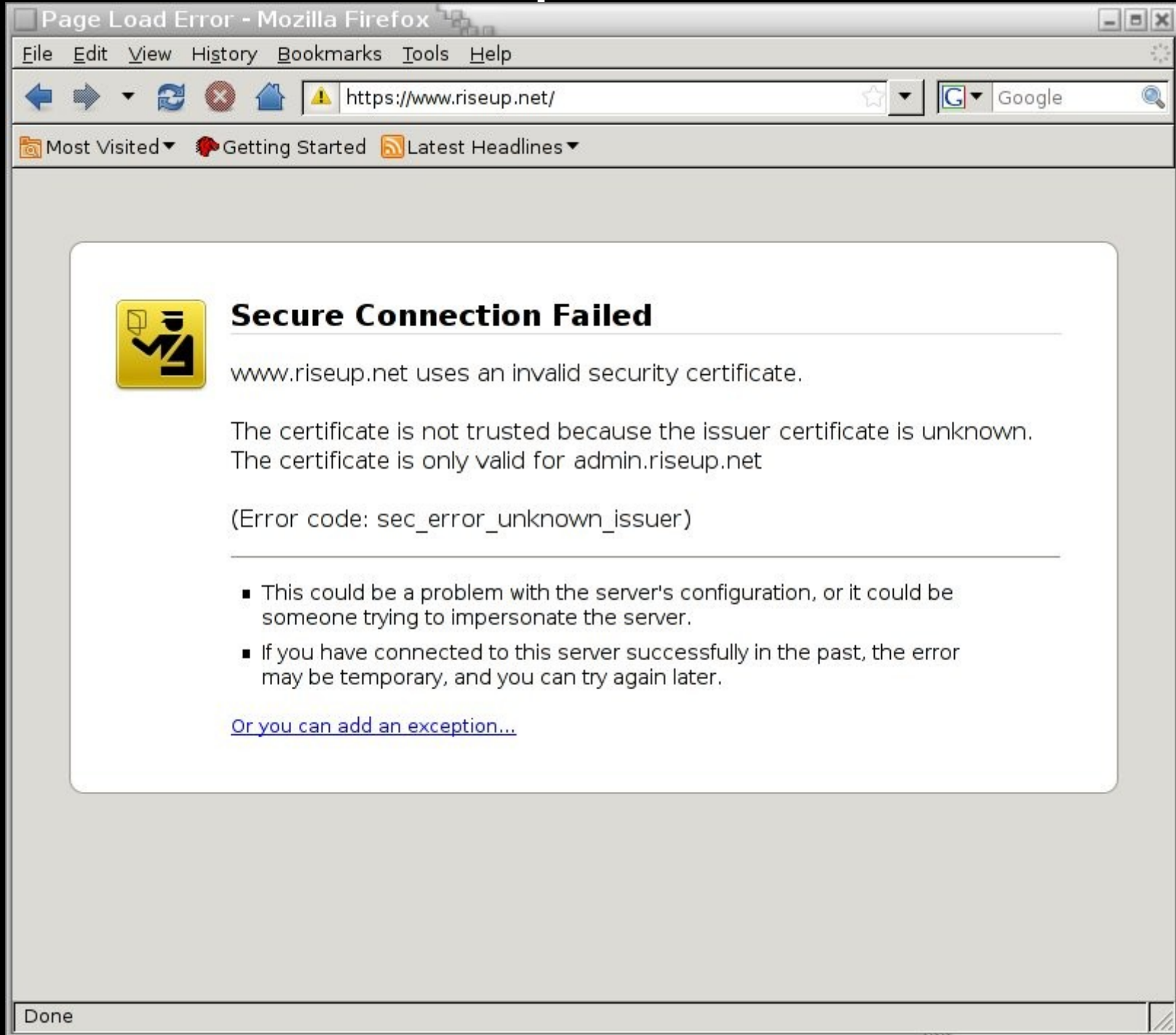
Password:

**Keep me signed in**  
for 2 weeks unless I sign out. [Info](#)  
[Uncheck if on a shared computer]

[Sign In](#)

Done login.yahoo.com

# Now: An example from Firefox 3



The screenshot shows a Mozilla Firefox browser window with the title "Page Load Error - Mozilla Firefox". The address bar displays "https://www.riseup.net/" with a warning icon. The browser interface includes a menu bar (File, Edit, View, History, Bookmarks, Tools, Help), a toolbar with navigation buttons, and a search bar with "Google" as the search engine. Below the toolbar are navigation shortcuts: "Most Visited", "Getting Started", and "Latest Headlines".

The main content area displays a "Secure Connection Failed" error message. It features a yellow warning icon with a padlock and a red 'X' over it. The text of the error message is as follows:

**Secure Connection Failed**

www.riseup.net uses an invalid security certificate.

The certificate is not trusted because the issuer certificate is unknown.  
The certificate is only valid for admin.riseup.net

(Error code: sec\_error\_unknown\_issuer)

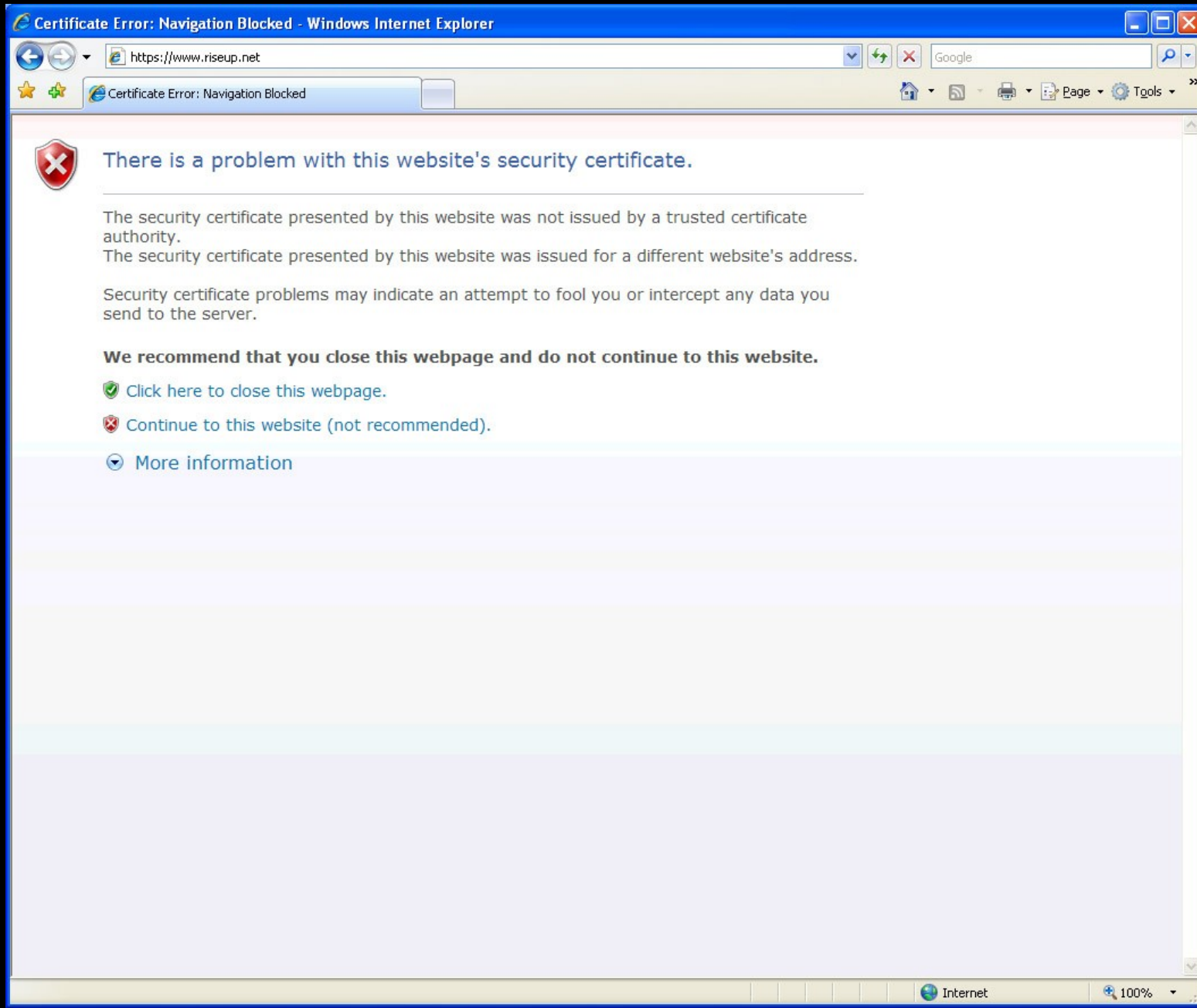
Below the error message, there are two bullet points:

- This could be a problem with the server's configuration, or it could be someone trying to impersonate the server.
- If you have connected to this server successfully in the past, the error may be temporary, and you can try again later.

At the bottom of the error message, there is a blue link: [Or you can add an exception...](#)

The status bar at the bottom left of the browser window shows the word "Done".

# Now: An example from IE





# Conclusions

- If we trigger the negative feedback, we're screwed.
- If we fail to trigger the positive feedback, it's not so bad.

How is SSL used?

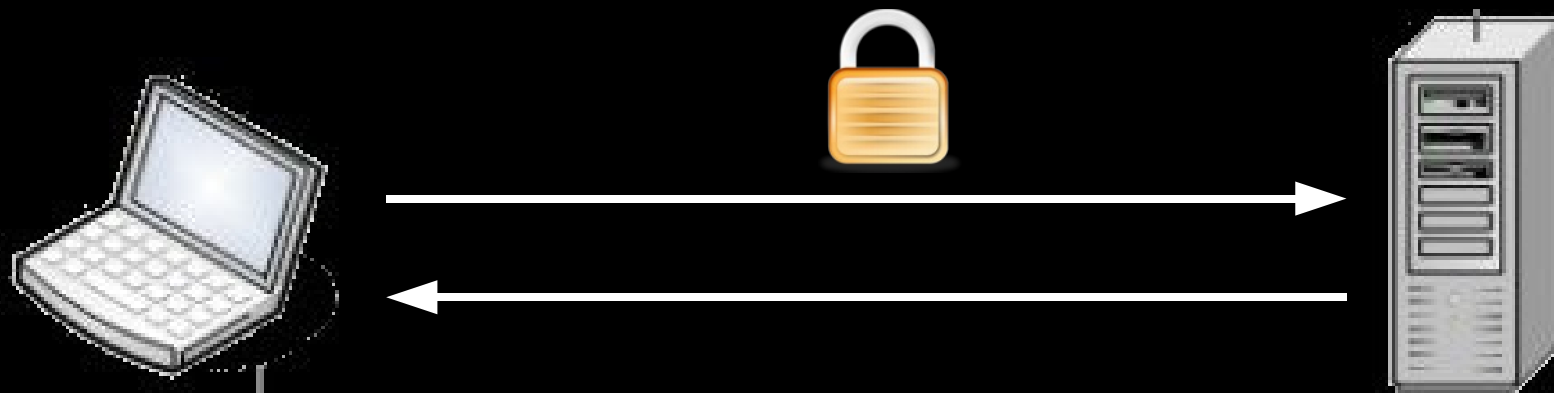
Nobody types https://  
(or http:// for that matter)

# People generally encounter SSL in only two ways:

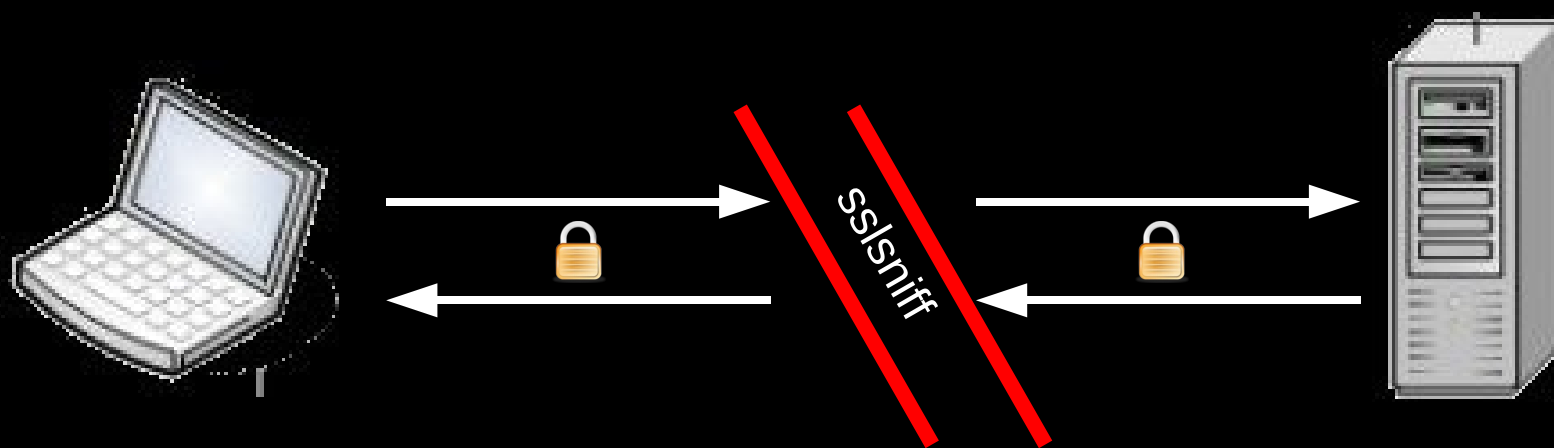
- Clicking on links.
- Through 302's.

Which means that people only encounter SSL through HTTP...

# First cut: A different kind of MITM



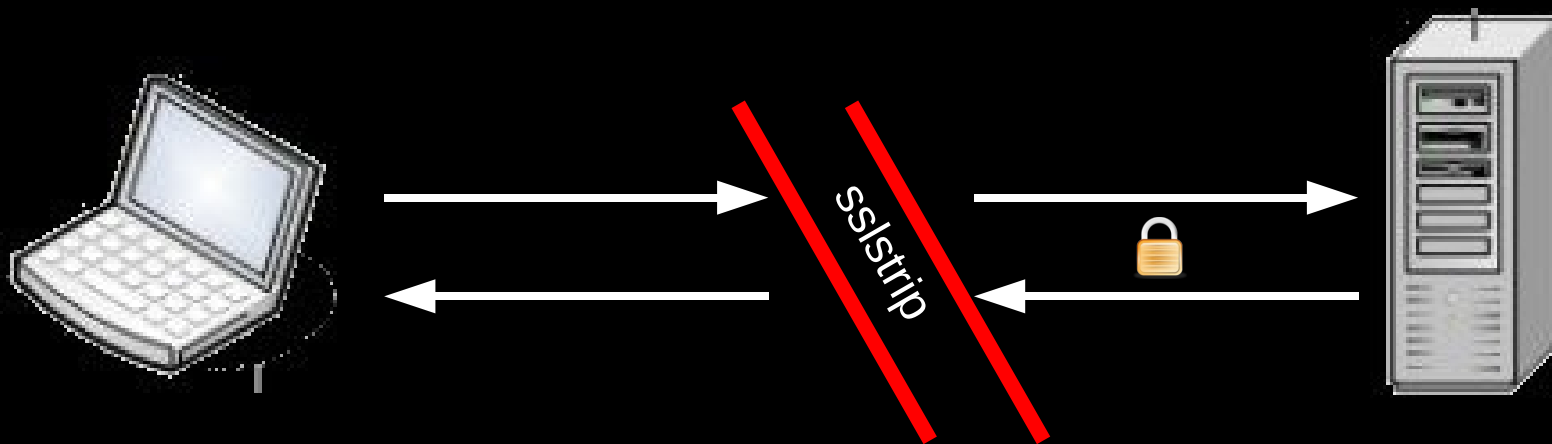
Normally we attack the SSL connection...



# First cut: A different kind of MITM



What if we attacked the HTTP connection instead...



## Remember:

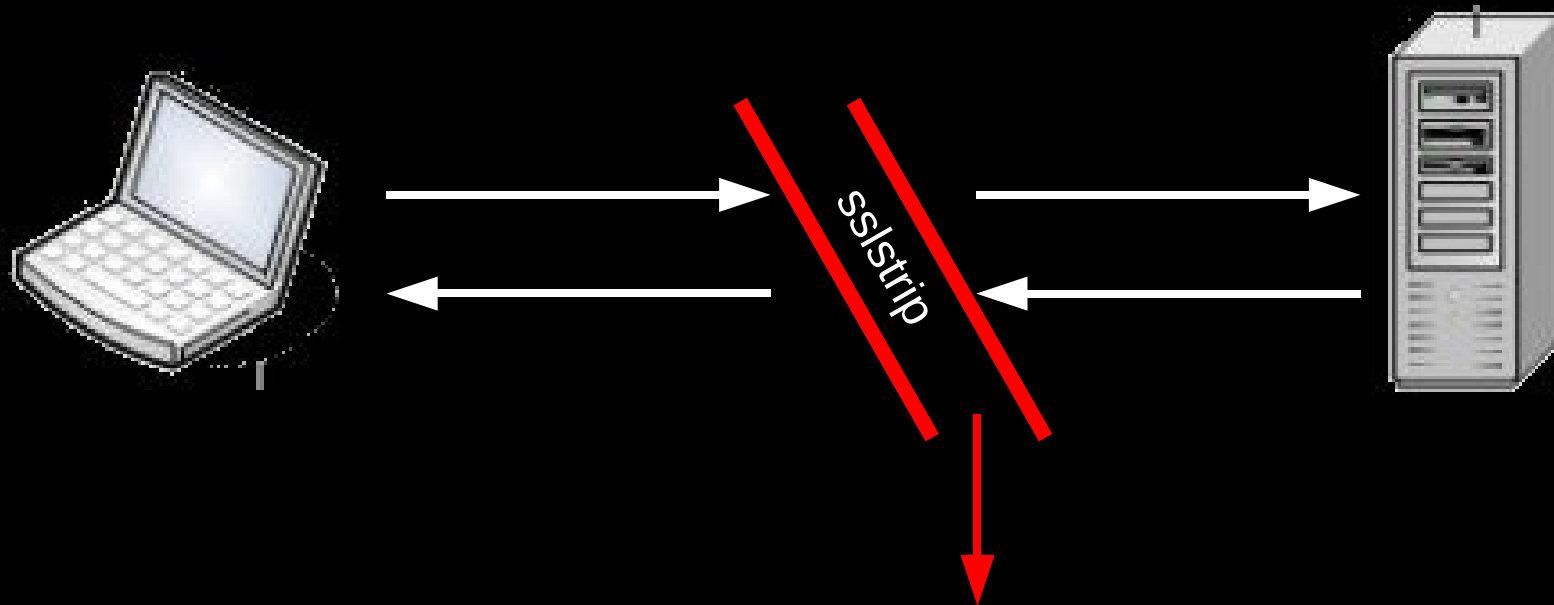
SSL is normally encountered in one of two ways.

- By clicking on links.
- Through 302 redirects.

We can attack both of those points through a HTTP MITM.

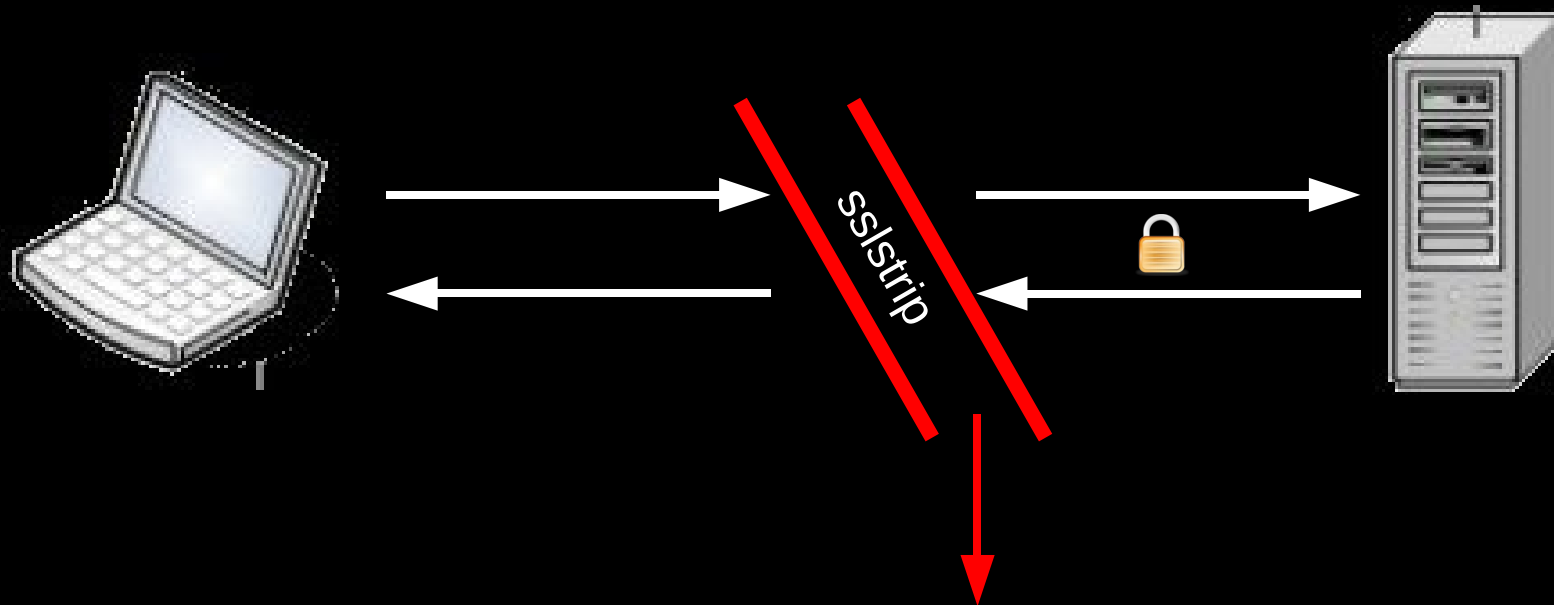


# A First Cut Recipe: sslstrip



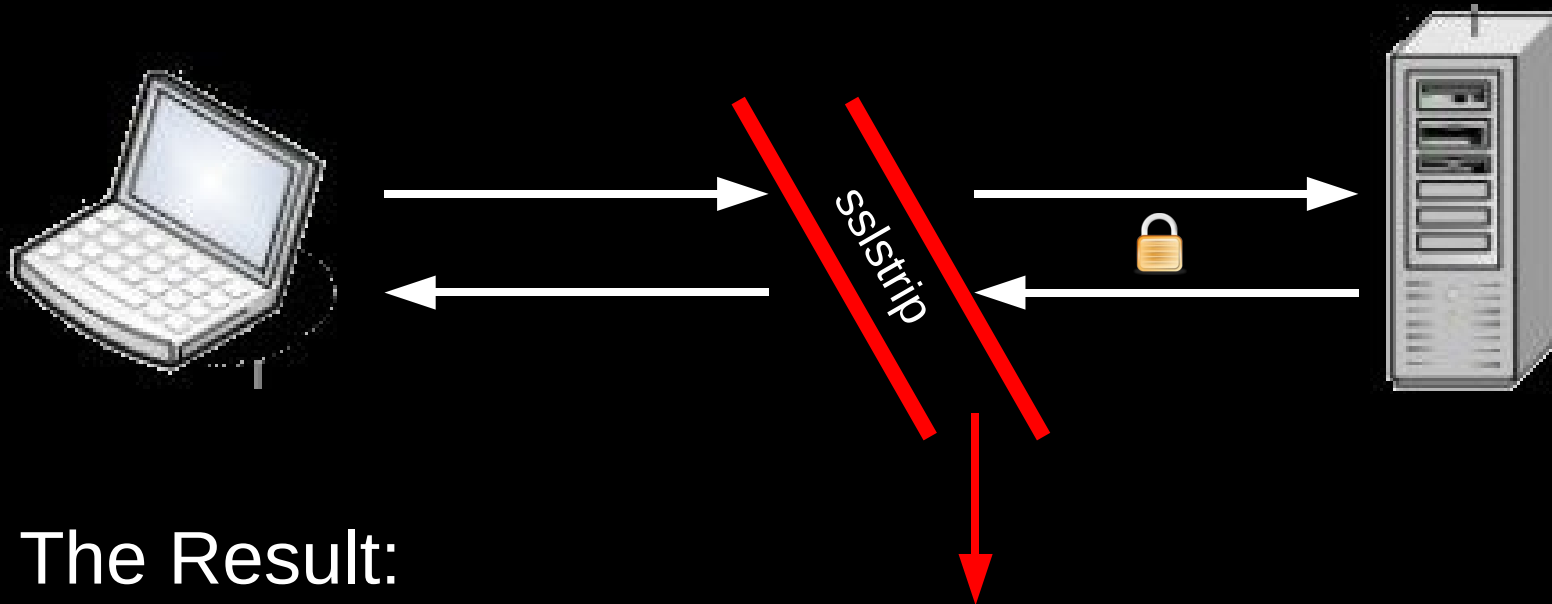
- Watch HTTP traffic go by.
- Switch `<a href="https://...">` to `<a href="http://...">` and keep a map of what's changed.
- Switch `Location: https://...` to `Location: http://...` and keep a map of what's changed.

# A First Cut Recipe: sslstrip



- Watch HTTP traffic go by.
- When we see an HTTP request for a URL that we've stripped, proxy that out as HTTPS to the server.
- Watch the HTTPS traffic go by, log everything if we want, and keep a map of the relative links, CSS links, and JavaScript links that go by.

# A First Cut Recipe: sslstrip



## The Result:

- The server never knows the difference. Everything looks secure on their end.
- The client doesn't display any of the disastrous warnings that we want to avoid.
- We see all the traffic.

How does it look?


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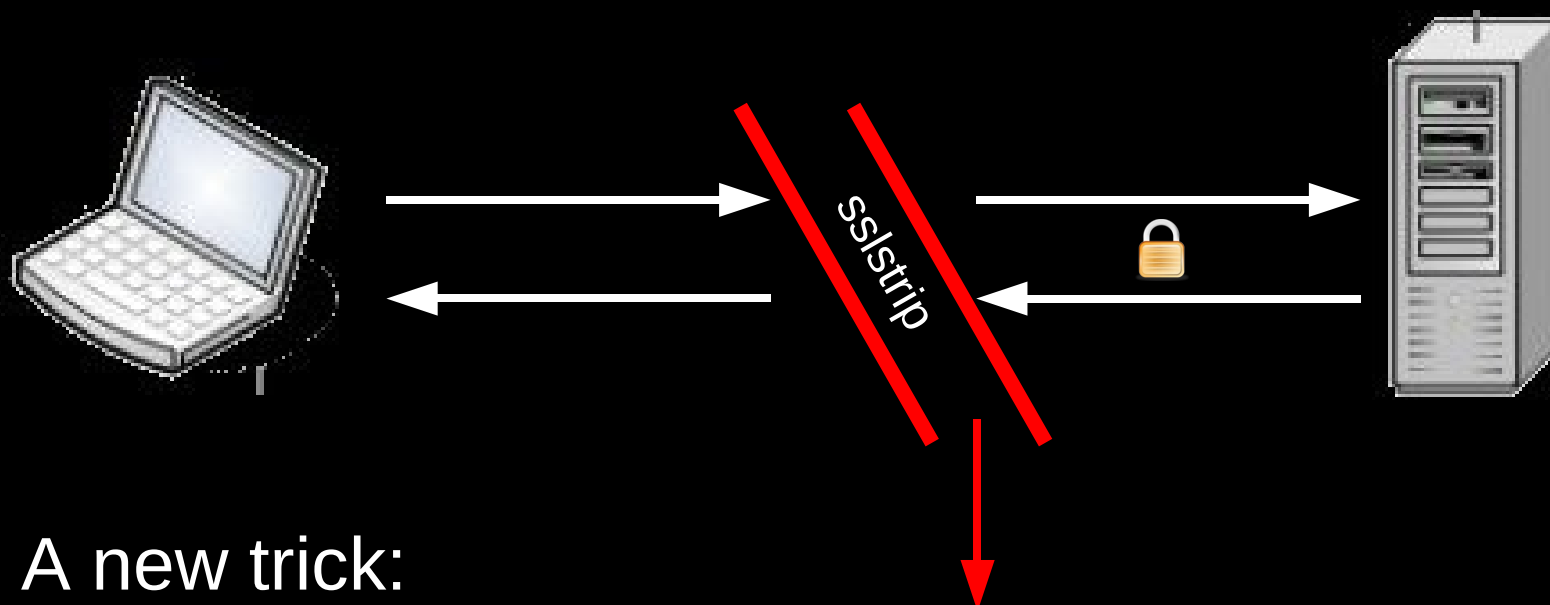
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# What else can we do?

- We've managed to avoid the negative feedback, but some positive feedback would be good too.
- People seem to like the little lock icon thing, so it'd be nice if we could get that in there too.

# A 1.5 Cut: sslstrip



## A new trick:

- Let's do everything the same, but now watch out for favicon requests as well.
- If we see a favicon request for a URL that we've stripped, we'll send back a favicon of our choosing instead.

What should our favicon be?  
You guessed it:




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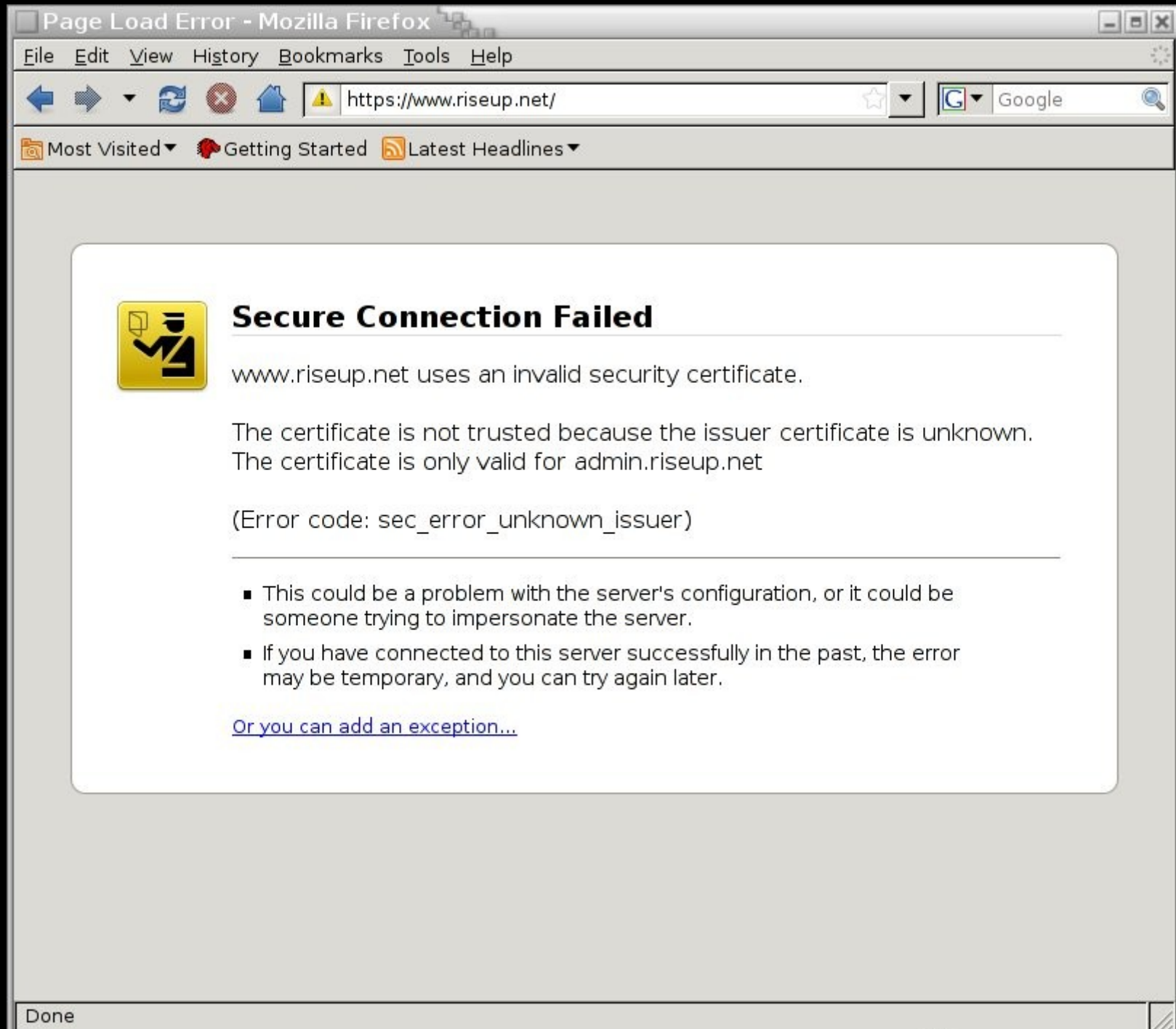
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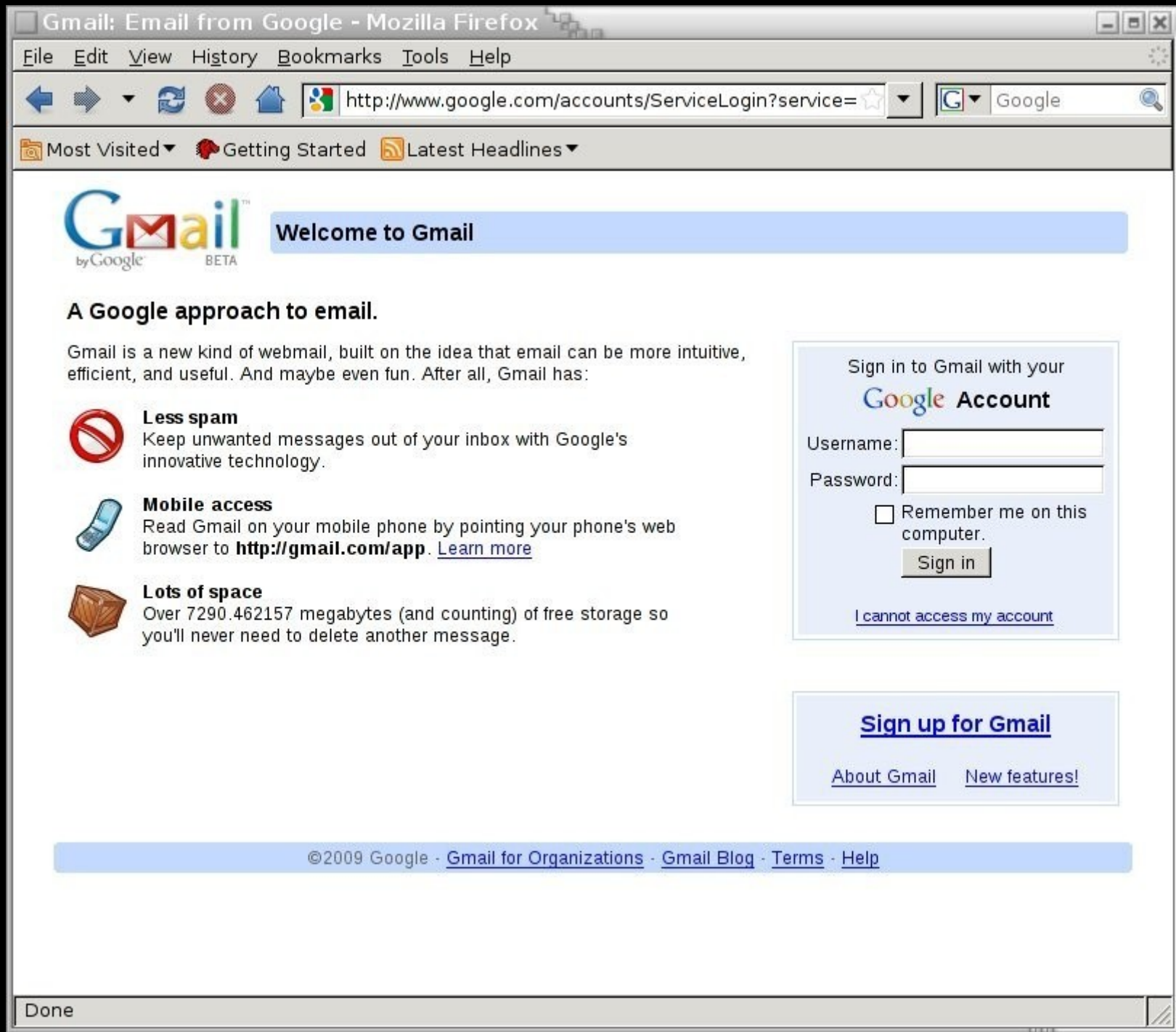
Done

We're doing pretty good.

# We've avoided the negative feedback of death.



# We can do a subtle MITM via HTTP.



The image shows a screenshot of a Mozilla Firefox browser window displaying the Gmail login page. The browser's address bar shows the URL `http://www.google.com/accounts/ServiceLogin?service=`. The page features the Gmail logo with 'by Google' and 'BETA' text, and a 'Welcome to Gmail' banner. Below the banner, there is a section titled 'A Google approach to email.' followed by a paragraph describing Gmail's features. Three key features are listed with icons: 'Less spam' (a red circle with a slash), 'Mobile access' (a blue mobile phone icon), and 'Lots of space' (a brown wooden crate icon). To the right of these features is a sign-in form titled 'Sign in to Gmail with your Google Account'. The form includes fields for 'Username:' and 'Password:', a checkbox for 'Remember me on this computer.', and a 'Sign in' button. Below the sign-in button is a link that says 'I cannot access my account'. At the bottom of the page, there is a 'Sign up for Gmail' button and two links: 'About Gmail' and 'New features!'. The footer of the page contains the copyright notice '©2009 Google' and links for 'Gmail for Organizations', 'Gmail Blog', 'Terms', and 'Help'. The browser's status bar at the bottom shows the word 'Done'.

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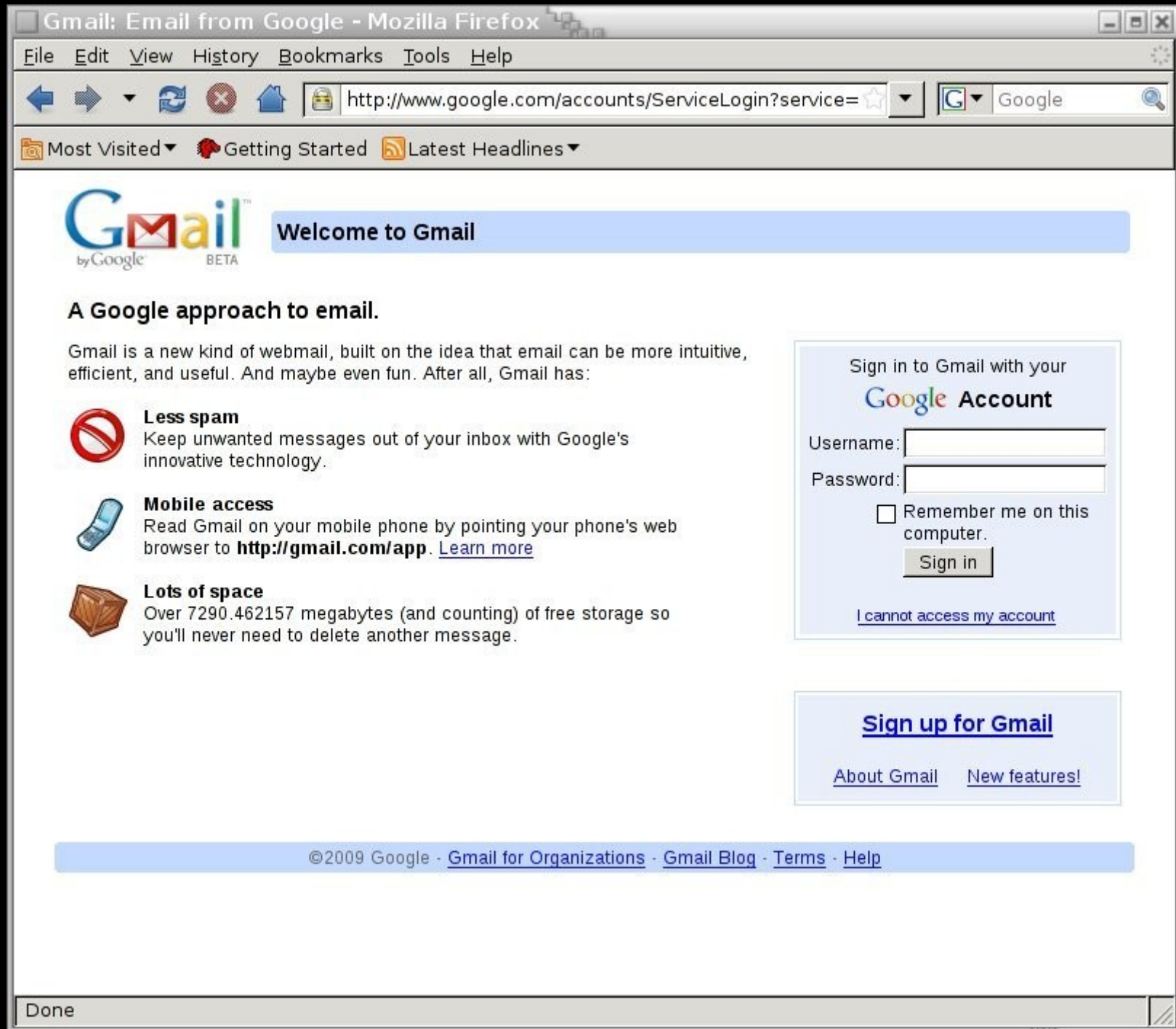
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Done



And if we want we can throw in a little lock icon.



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# A Few Gotchas

- Content encodings that are difficult to parse (compress, gzip, etc...)
- Secure cookies won't get sent over HTTP that's been stripped of SSL.
- Cached pages that don't give us a chance to swap out their links.



# A Few Gotchas

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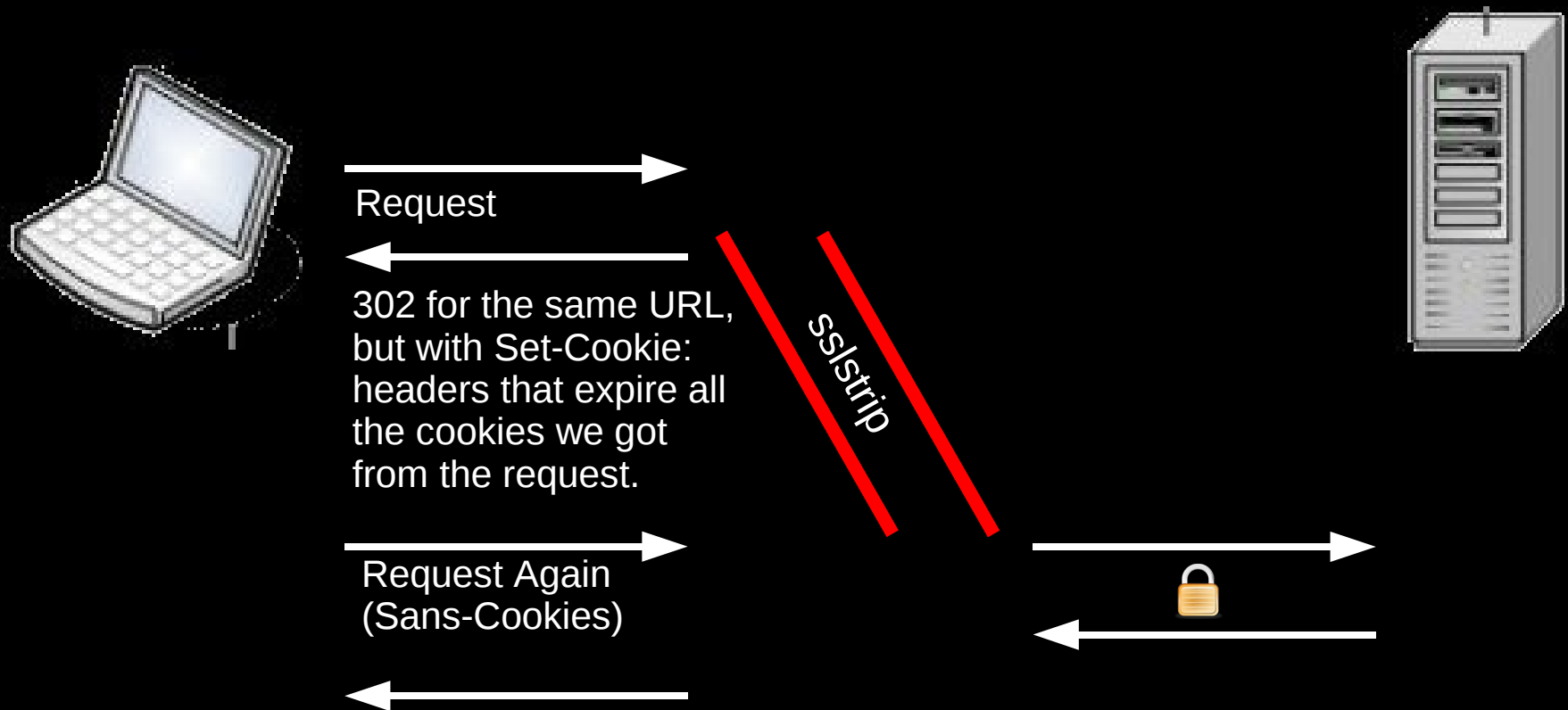
## A Simple Solution

- Strip all that stuff too.
  - Kill the secure bit on Set-Cookie statements, strip the content encodings we don't like from client requests, and strip if-modified-since headers too.

# Another problem: sessions

- The most interesting stuff to log are POSTs that would have been sent via SSL.
- Particularly, usernames/passwords.
- Sessions often cause us to miss the login step, which is unfortunate.
- Sure, we can get the session cookie, but that's small change.

# So let's strip sessions too.



# And a little less sketchy...

Sessions expire, and it's not always clear when or why, but they don't usually expire right in the middle of an active session. So what we do now:

- When we start a MITM against a network, strip all the traffic immediately, but don't touch the cookies for 5 min (or some specified length of time).
- As the cookies go by, make note of the active sessions.
- After the time is up, start killing sessions, but only new sessions that we haven't seen before. These should be the “long running” sessions that won't be seen as suspicious should they disappear

# Some Results Of This Trick?

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- Gmail 50
- ticketmaster.com 42
- rapidshare.com 14
- Hotmail 13
- paypal.com 9
- linkedin.com 9
- facebook.com 3

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- 7 paypal logins.
- Over 300 other miscellaneous secure logins.

# Number of people that balked.

- 0

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- l@W@rd3nD3Villi#rs
- silvergoat94



Where can we go from here?

# Combining this technique with homograph attacks.

## Standard homograph attack:

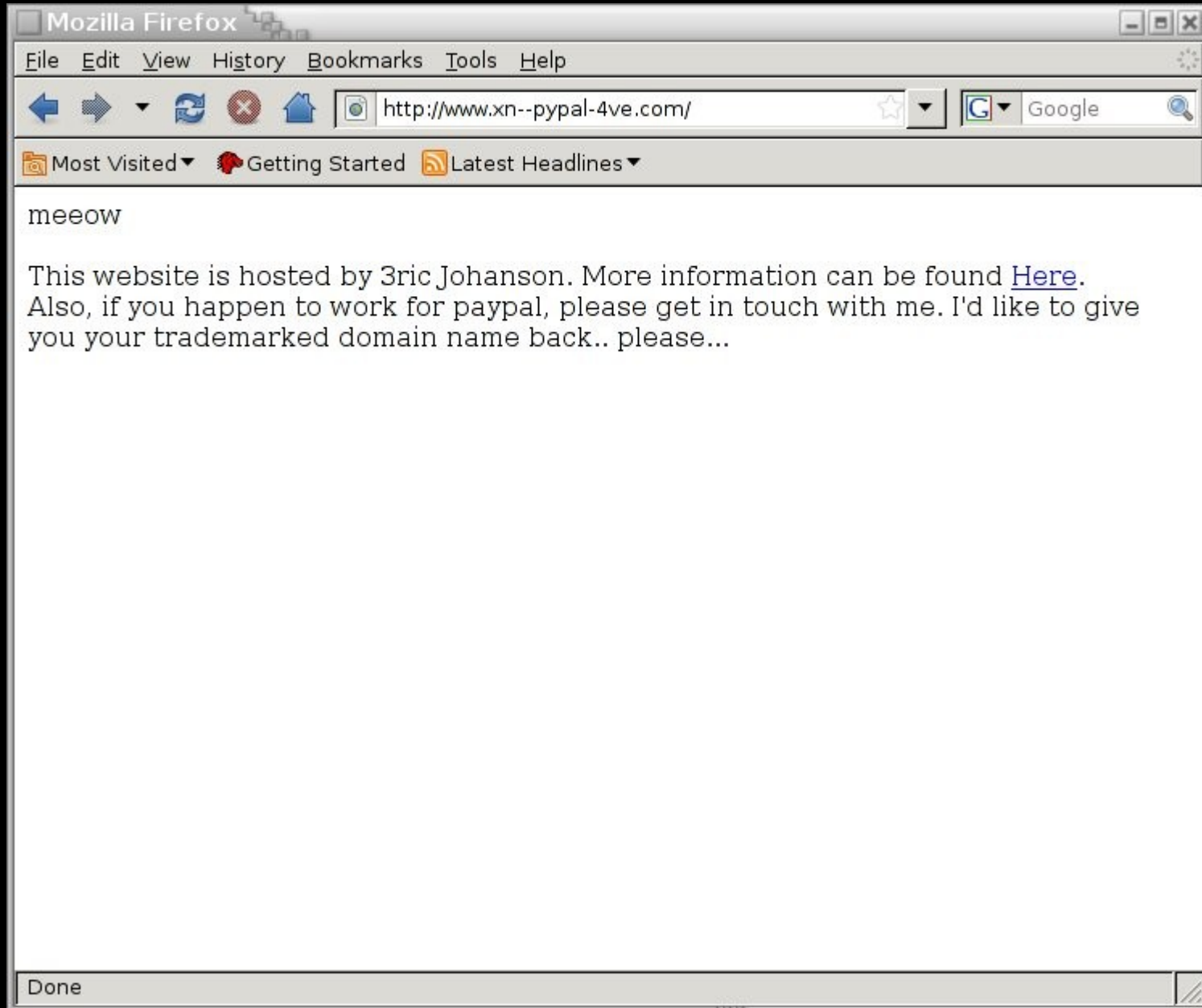
- Sometimes the glyphs of different characters look alike. PayPal.com looks like paypal.com but is really paypai.com
- Made more interesting by IDN. It became possible to register a domain with characters that appear identical to the glyphs of characters in the Latin character set.
- In 2005, Eric Johanson registered p#1072;ypal.com, which uses the Cyrillic 'a' look-alike character and displays as paypal.com

# Combining this technique with homograph attacks.

What I don't like about the standard attack:

- The attack vector has to be targeted. By registering p#1072;ypal.com, all we can attack is paypal.com
- Phishing is really just too much work. It'd be nicer if we could just MITM a network and get whatever people are doing.
- The IDN stuff has been fixed. For TLDs like .com, Firefox renders the IDN characters as punycode both in the URL bar and the status bar.

# p&#1072;ypal.com today



# So how can we reinvent this to attack SSL?

- We can't use .com or any TLD that Firefox will render into punycode.
- We want something that we can generalize, not just a simple substitution for some particular character in a domain.
- So, what's in most URLs? . / & ?

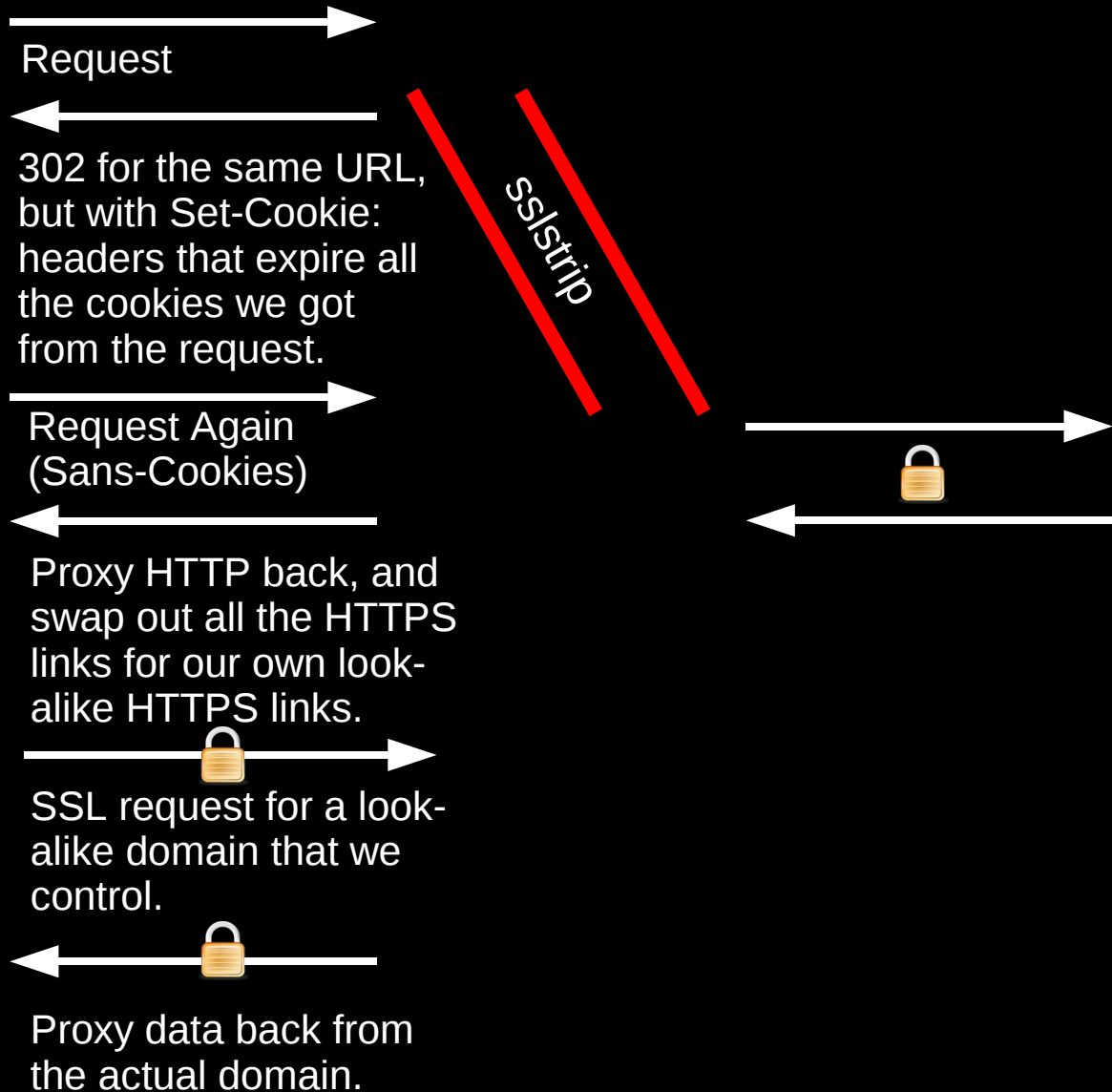
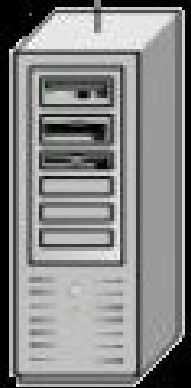
# one trick

- Register a domain like ijjk.cn
- Get a domain-validated SSL wildcard cert for \*.ijjk.cn
- Use IDN-valid characters that look very similar to '/' and '?' to create false URLs.
- MITM HTTP and swap out the HTTPS links as usual.
- But this time, instead of just stripping the HTTPS links, we swap them out for our own look-alikes.

# one trick

- <https://www.gmail.com/accounts/ServiceLogin> becomes <https://www.gmail.com/accounts/ServiceLogin?!f>
- The latter does not display as punycode in the status bar or the URL bar.
- When resolved, it becomes `www.google.xn--comaccountsservicelogin-5j9pia.f.ijjk.cn`
- When we MITM these connections, we do SSL on both ends, but are able to present our own valid `*.ijjk.cn` cert to the client.

# Here We Go





# An Example

Personal Banking - PNC Bank - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://www.pnc.com/webapp/unsec/Homepage

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Select Service

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- ▶ Planning for Retirement
- ▶ Saving for Education
- ▶ Buying a Home

Done

www.pnc.com

# An Example

The screenshot shows a Mozilla Firefox browser window displaying the PNC Bank website. The browser's address bar shows the URL <https://www.pnc.com/webapp/unsec/homepage>. The website features the PNC logo with the tagline "LEADING THE WAY" and a navigation menu with links for HOME, SECURITY ASSURANCE, LOCATE PNC, CONTACT US, and CUSTOMER SERVICE. A search bar is located in the top right corner. Below the navigation menu, there are tabs for PERSONAL, SMALL BUSINESS, CORPORATE & INSTITUTIONAL, and ABOUT PNC. The main content area is divided into several sections: "Online Banking Sign On" with a "SIGN ON" button and links for "Forgot Your User ID or Password?", "New to Online Banking?", and "Get Started Now!"; "Sign On to Other Services:" with a "Select Service" dropdown; "PNC Security Assurance" with an FDIC logo and "Important FDIC Information"; "Products and Services" with a list of services including Online Banking and Bill Pay, Checking, Savings, Loans and Lines of Credit, and Cards; and "Solutions" with a list of solutions including Making the Most of Your Money, Virtual Wallet, Planning for Retirement, Saving for Education, and Buying a Home. A large banner for "PNC Bank Select Reward Visa® Platinum Card" is also visible, featuring a family photo and a PNC Bank Visa card. The browser's status bar at the bottom shows "Done" and the URL [www.pnc.com/webapp/unsec/homepage.var.cn](http://www.pnc.com/webapp/unsec/homepage.var.cn).

# Nice thing about this...

- Happens in real-time.
- Generalized:
  - Targets whatever secure sites people are browsing to at any moment.
  - Doesn't require multiple certificates or restricting ourselves to popular sites.
- Once we get a secure POST, we can switch them back to a normal traffic stream.

# Lessons...

- Lots of times the security of HTTPS comes down to the security of HTTP, and HTTP is not secure.
- If we want to avoid the dialogs of death, start with HTTP not HTTPS.
- Once we've got control of that, we can do all kinds of stuff to re-introduce the positive indicators people might miss.

# Reactions

# The Hax0rs

- Over 10,000 downloads as of this week.
- Many posts on script kiddie type message boards asking how to run this on windows, what commands to type, etc...
- People consistently email me for advice using it in sketchy situations.
- Video tutorials on You Tube for how to use the tool.

# The Mozilla People

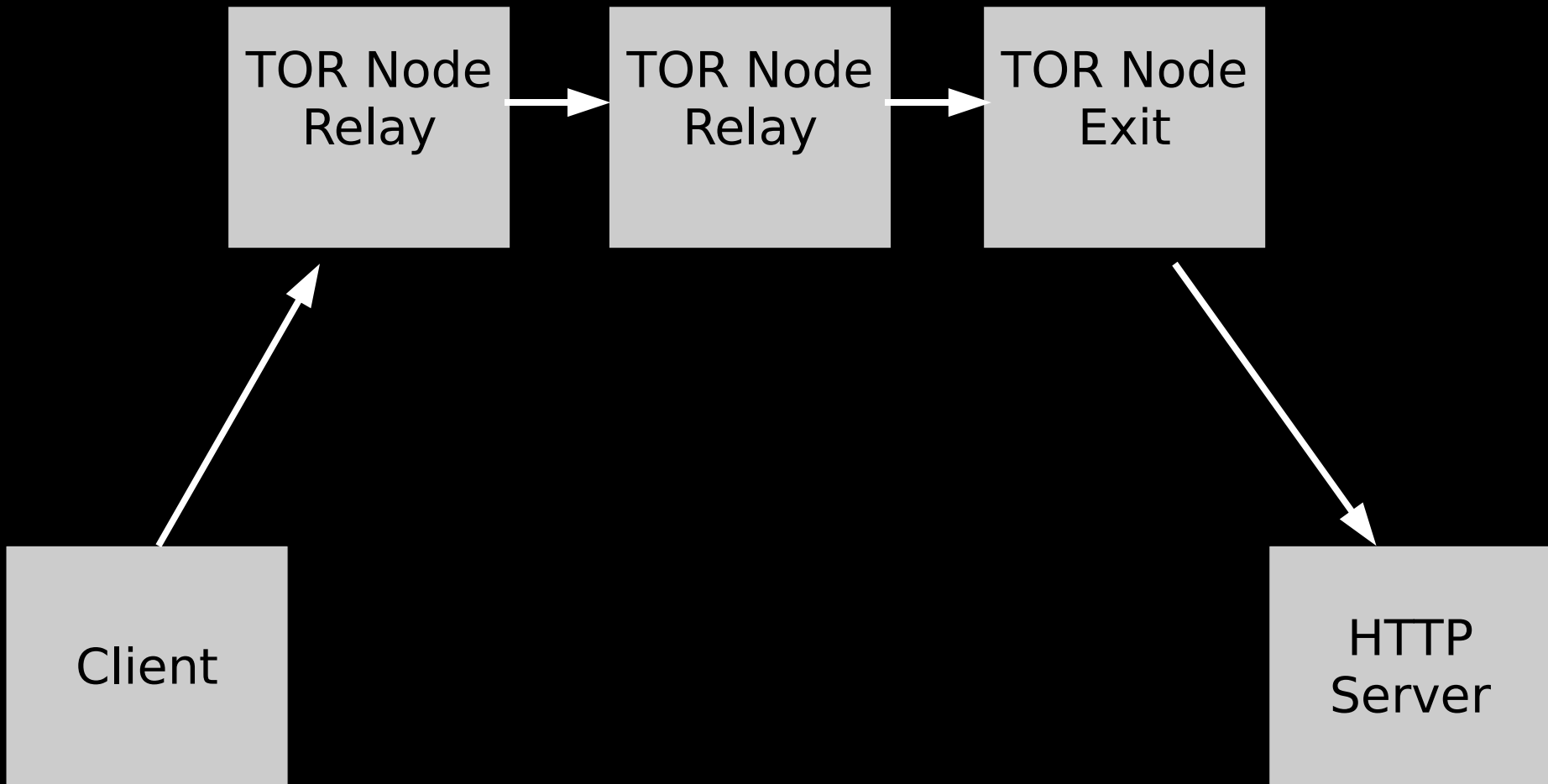
- There's no solution to this, so let's argue about a solution to this.
- It's an i18n problem. Let's go on a blacklisting blitz.
  - 2571 BOX DRAWING LIGHT DIAGONAL UPPER RIGHT TO LOWER LEFT
  - 066A ARABIC PERCENT SIGN
  - 2052 COMMERCIAL MINUS SIGN
  - 2041 CARET INSERTION POINT
  - 02D0 MODIFIER LETTER TRIANGULAR COLON

# The Tor People

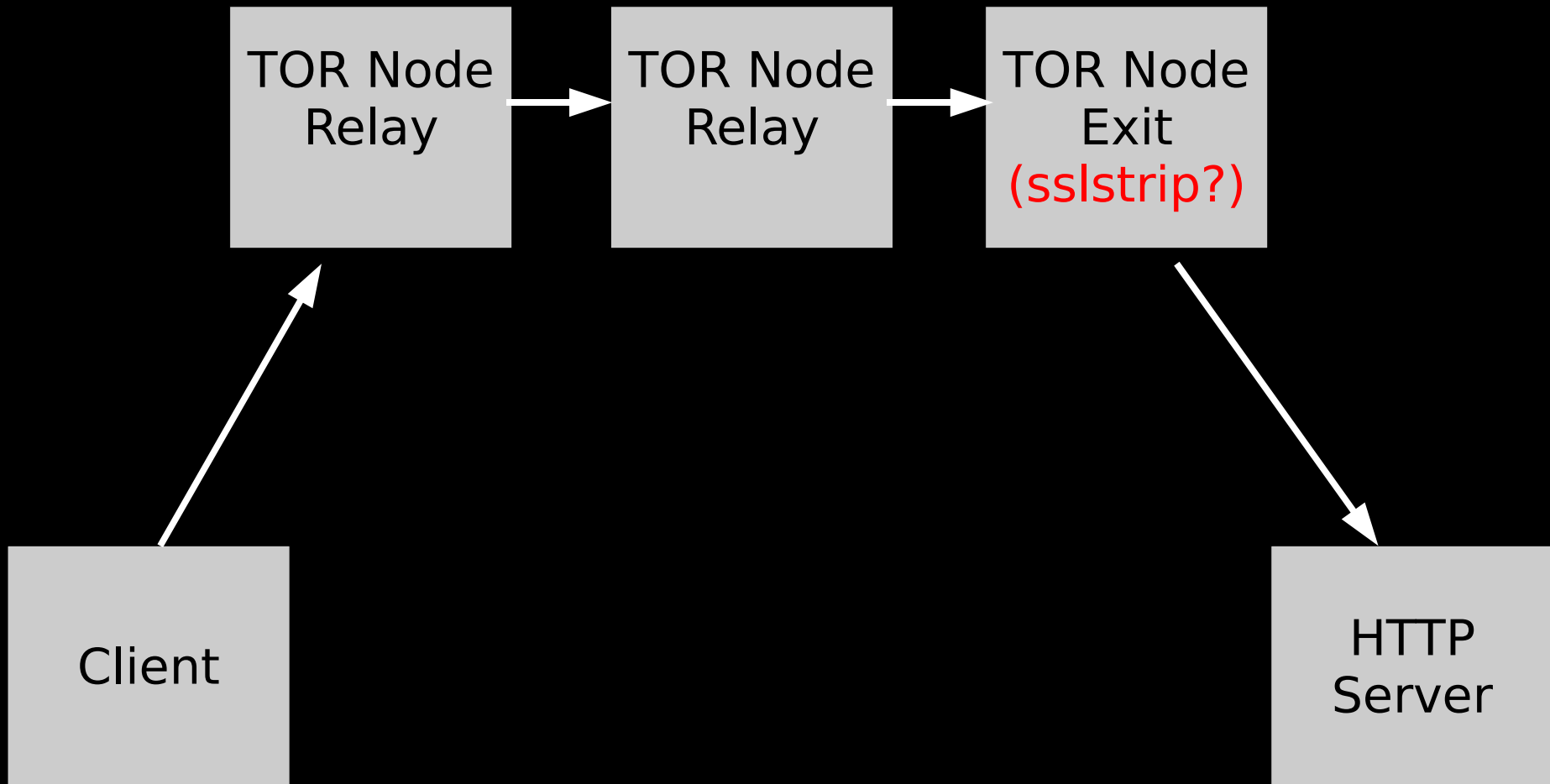
- Fuck this guy.
- Blacklist his Tor Node.
- Maybe TorButton should tell you if you're POSTing unencrypted data to the Tor network.



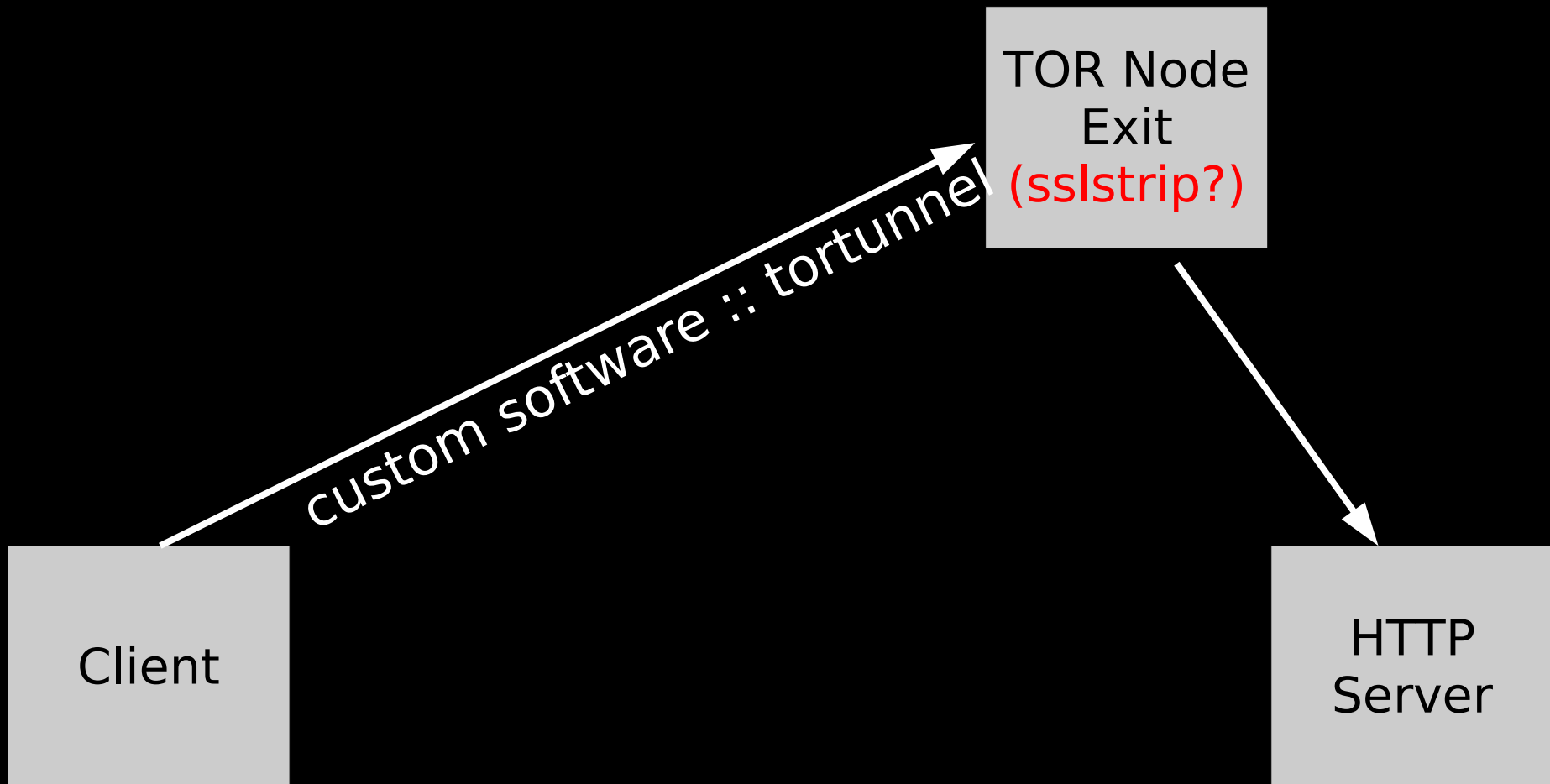
# Making Amends



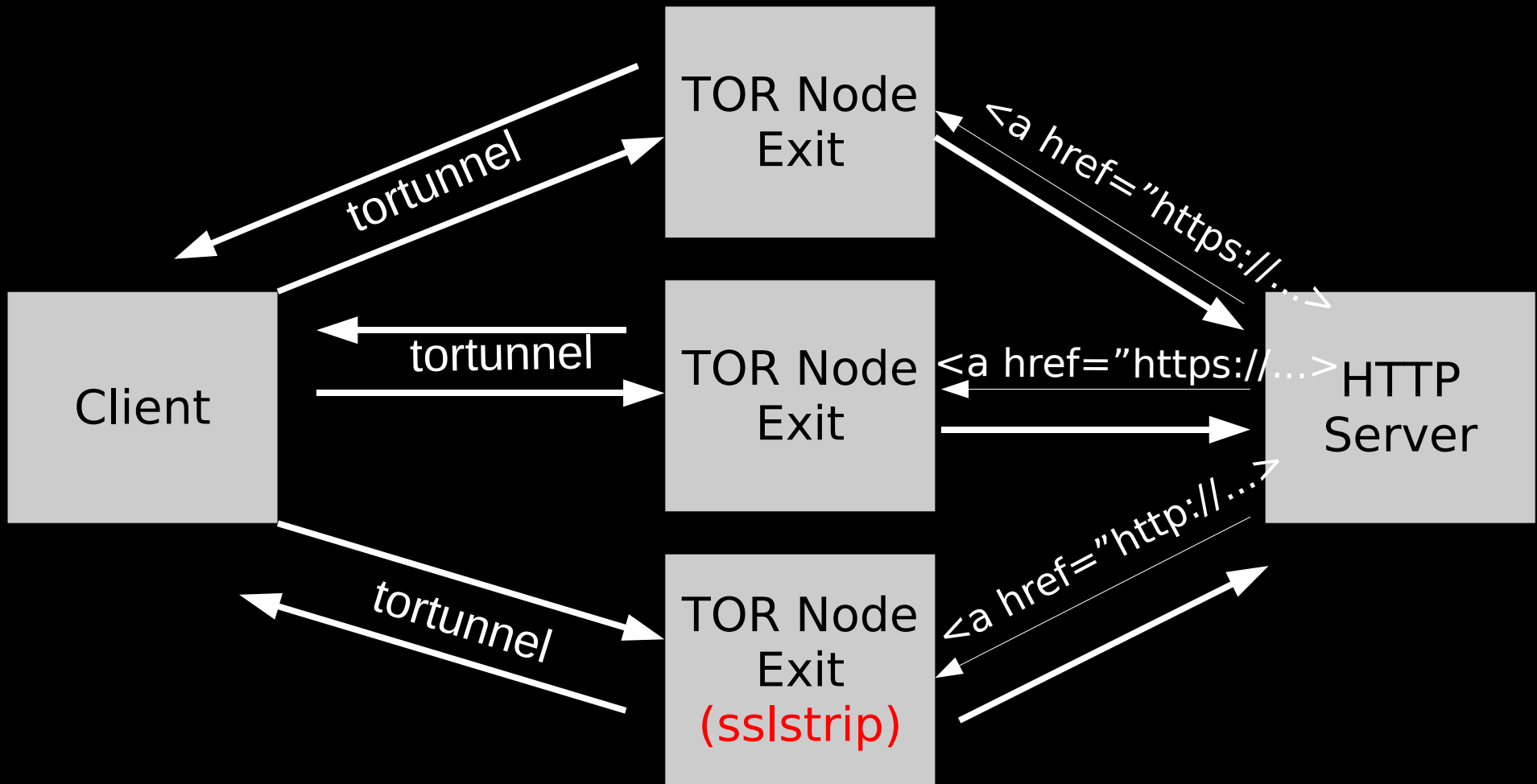
# Making Amends



# Making Amends



# Making Amends



# Making Amends

- At any given moment there are approximately 2500 exit nodes running.
- As of two weeks ago, I've been scanning through them a few times a day.
- In that time, I've only detected one node running sslstrip.
  - I tried to contact the owner, and the node disappeared.
- I'll continue trying to detect people running sslstrip, and hopefully tortunnel can become the basis for a more extensive tor scanning framework.

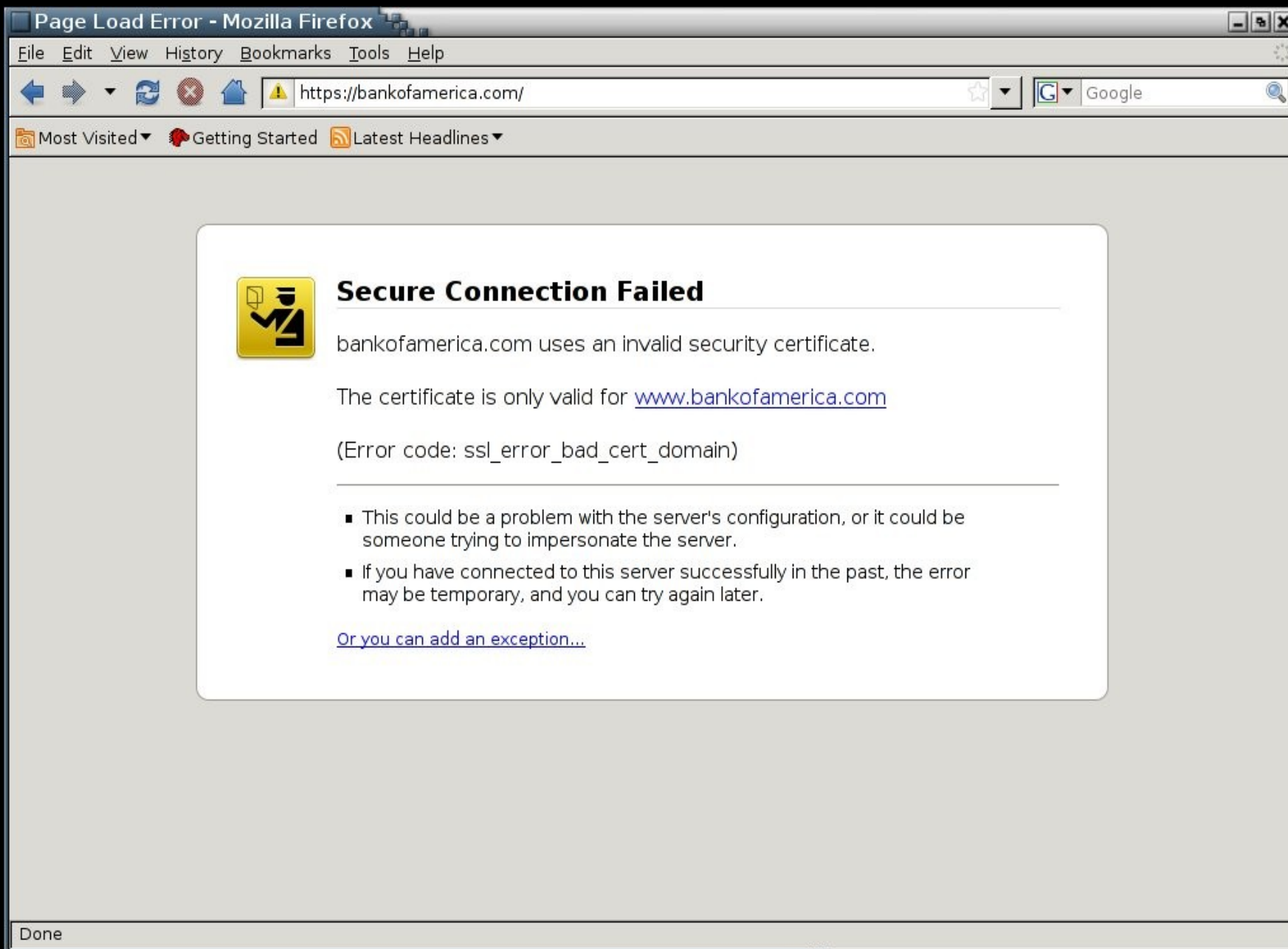
# Other tortunnel uses?

- Has a mode to run as a local SOCKS proxy.
  - Sometimes a one-hop proxy is all you want.
- Possibly a new nmap mode?
  - The code is all async, so you could hit 2000 ports simultaneously through many different exit nodes.

# Some Interesting Side Effects

- Nobody types `https://` right?
- People are used to typing “`bankofamerica.com`” in their address bar. The 302's attempt to ensure that you eventually get to `https://www.bankofamerica.com`
- Now, suddenly, there's a problem. Everyone has been warned to explicitly type `https://`
- So, people try `https://bankofamerica.com`

# Some Interesting Side Effects




Page Load Error - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://bankofamerica.com/ Google

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### Secure Connection Failed

bankofamerica.com uses an invalid security certificate.

The certificate is only valid for [www.bankofamerica.com](http://www.bankofamerica.com)

(Error code: ssl\_error\_bad\_cert\_domain)

- This could be a problem with the server's configuration, or it could be someone trying to impersonate the server.
- If you have connected to this server successfully in the past, the error may be temporary, and you can try again later.

[Or you can add an exception...](#)

Done



# Some Interesting Side Effects

- Someone is trying to hijack my connection!
- Holy shit! They warned me about this!

sslstrip

<http://www.thoughtcrime.org>