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freedom from doubt

Breaking SSL using time synchronisation attacks

Jose Selvi, Senior Security Consultant

$ whois jselvi

- Jose Selvi
- +10 years working in securitv
- Senior security Consultant
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- Twitter: @JoseSelvi
- Blog: http://www.pentester.es

Warning! Spanish accent!

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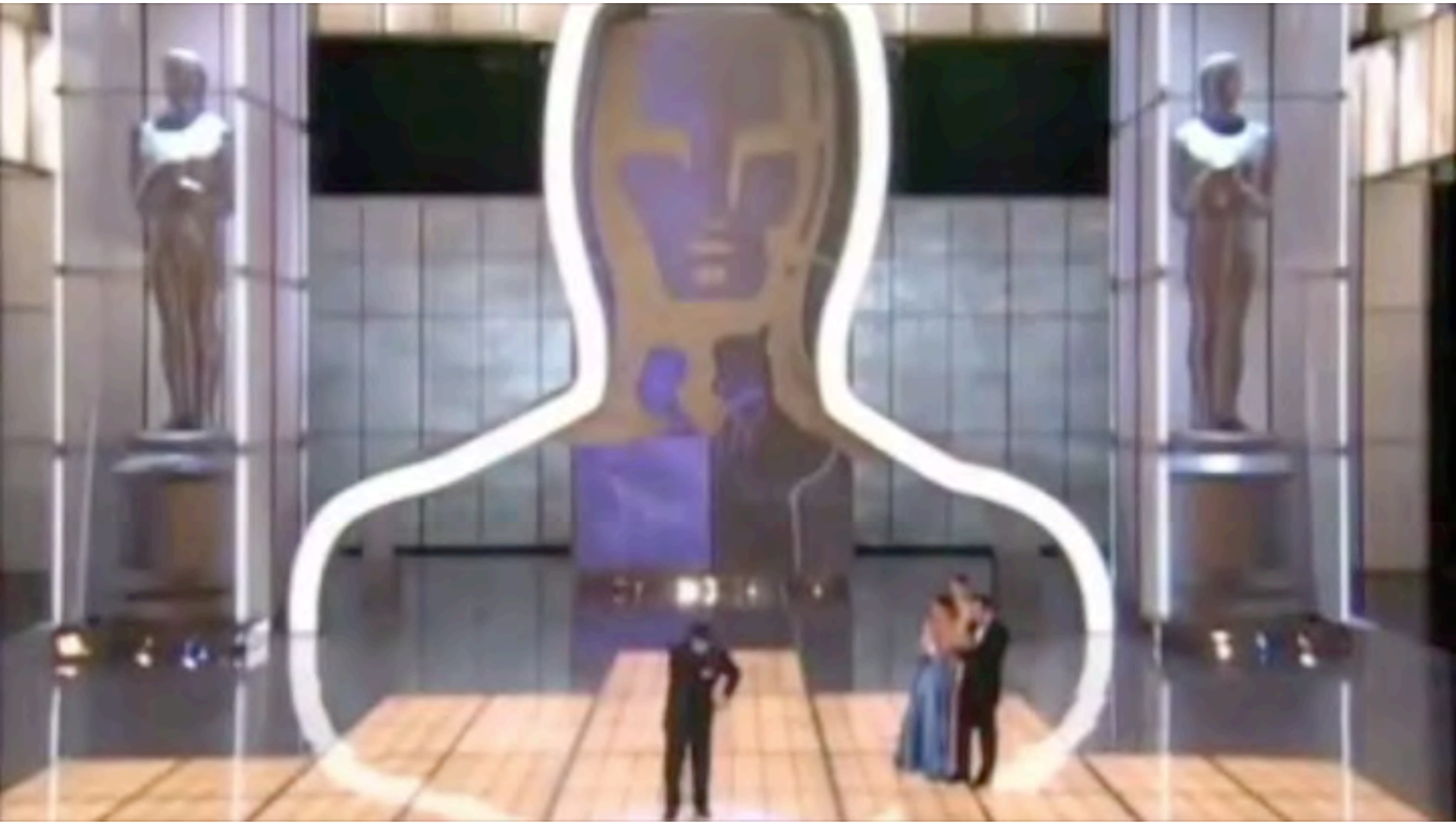

Let's Go!

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- Modern Time Synchronisation
- Get in a Delorean
- HTTP Strict Transport Security
- Windows task scheduler
- Public Key Infrastructure
- Conclusions & Recommendations

Network Time Protocol (NTP)

- Time Synchronisation Services.
- RFC-1305 (v3) / RFC-5905 (v4) / RFC-4330 (SNTPv4).

- By default in (almost) all operating systems.

- No secured by default.
- Vulnerable to Man-in-the-Middle attacks.

NTP Packet

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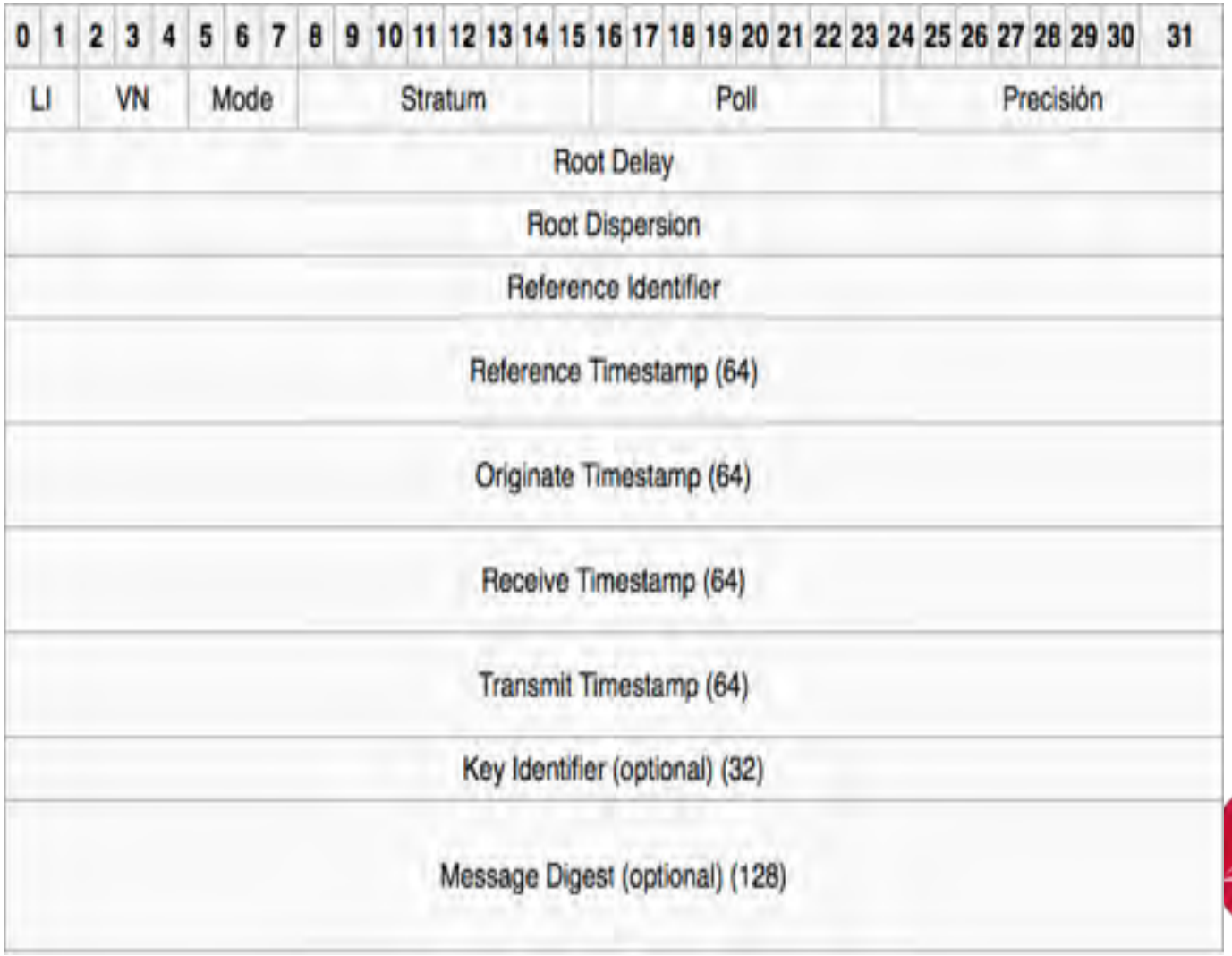
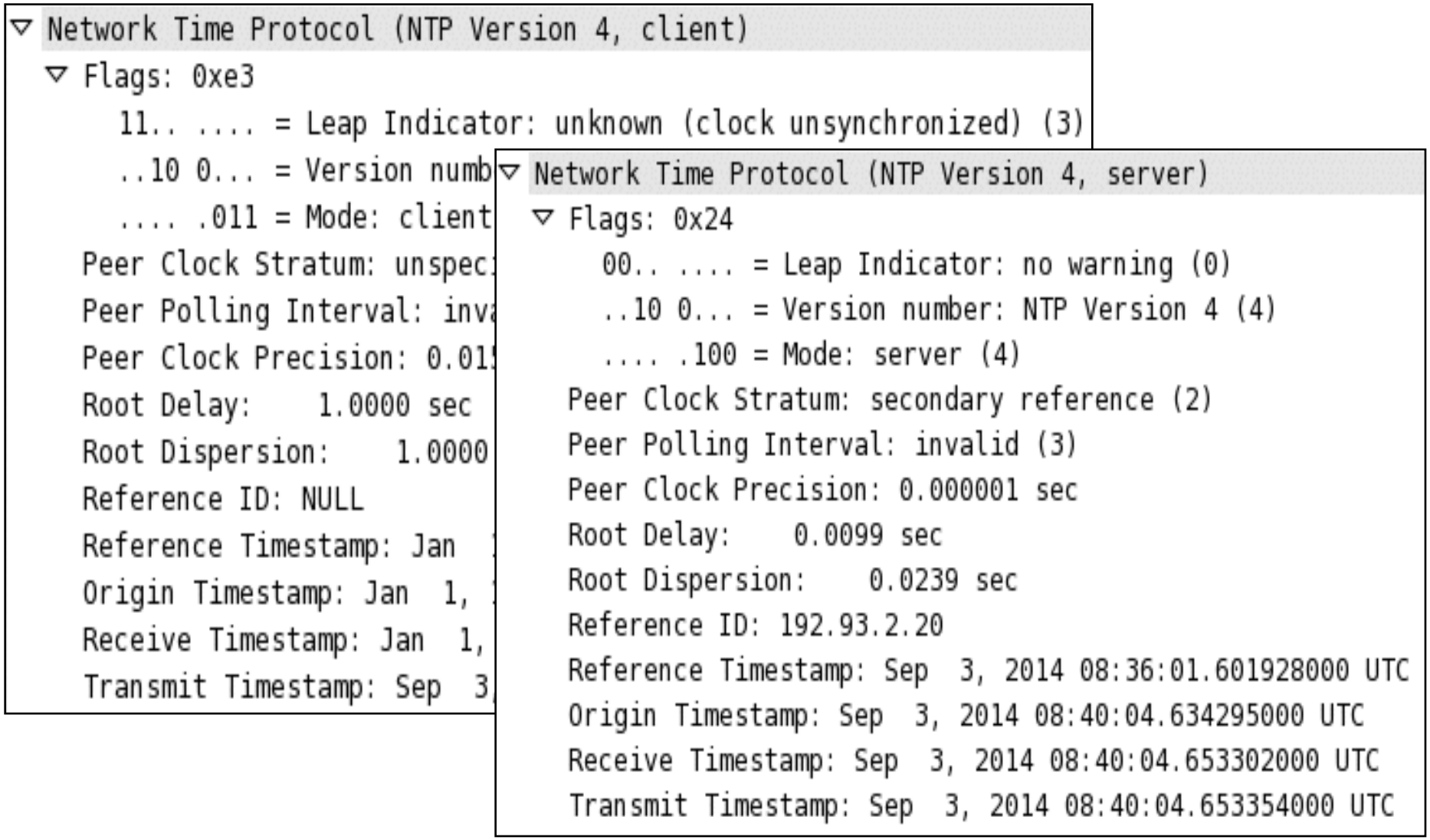


Example: Ubuntu Linux



Mac OS X - Mavericks

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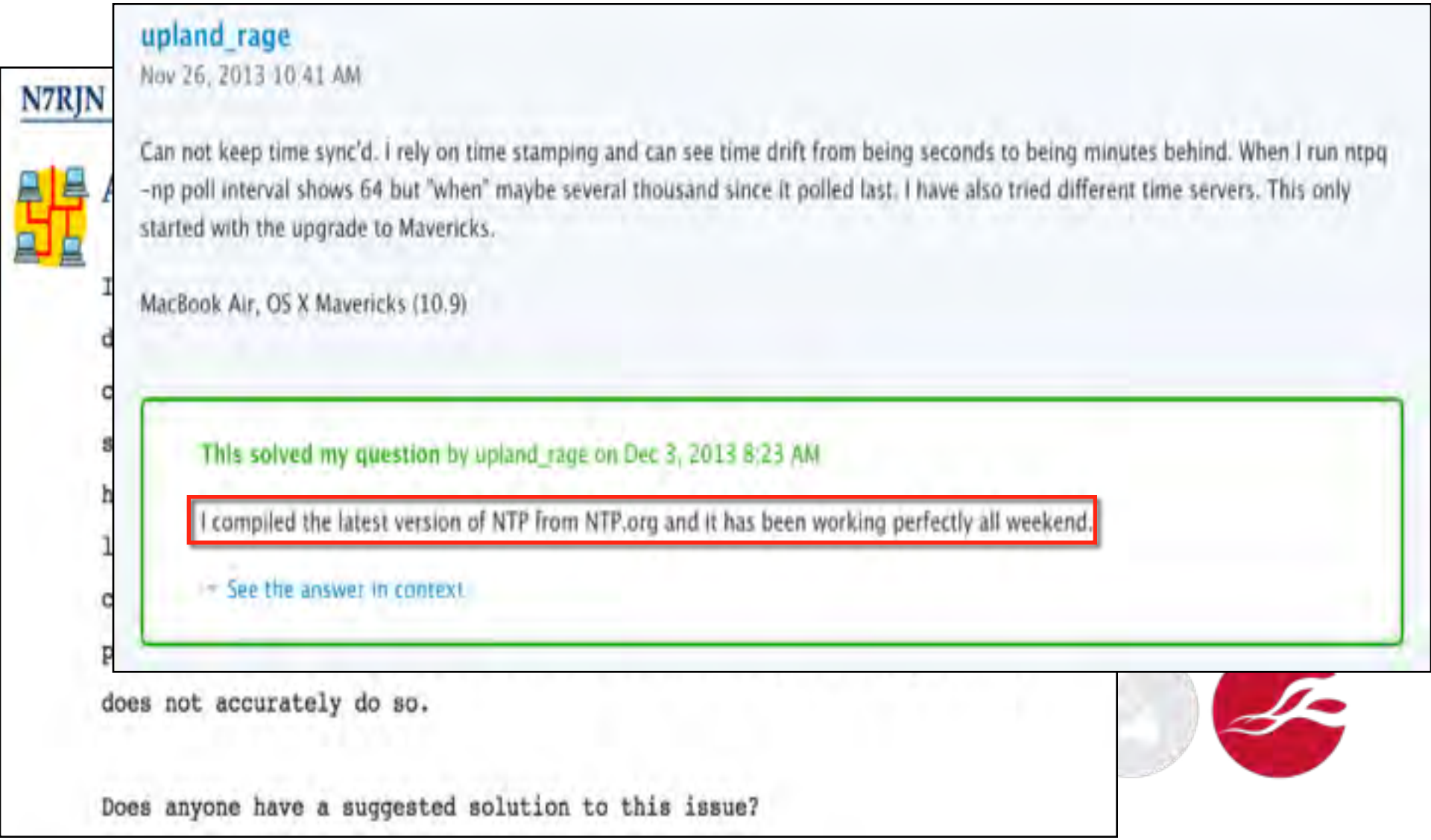
- New synchronisation service
- NTP daemon exits, but not synchronises.
- Just writes in /var/db/ntp.drift
- A new service called “pacemaker” check that file and change the clock.
- It seems it doesn’t work as it should…

http://www.atmythoughts.com/living-in-a-tech-family-blog/2014/2/28/what-time-is-it

Does NTP work?



/usr/libexec/ntpd-wrapper

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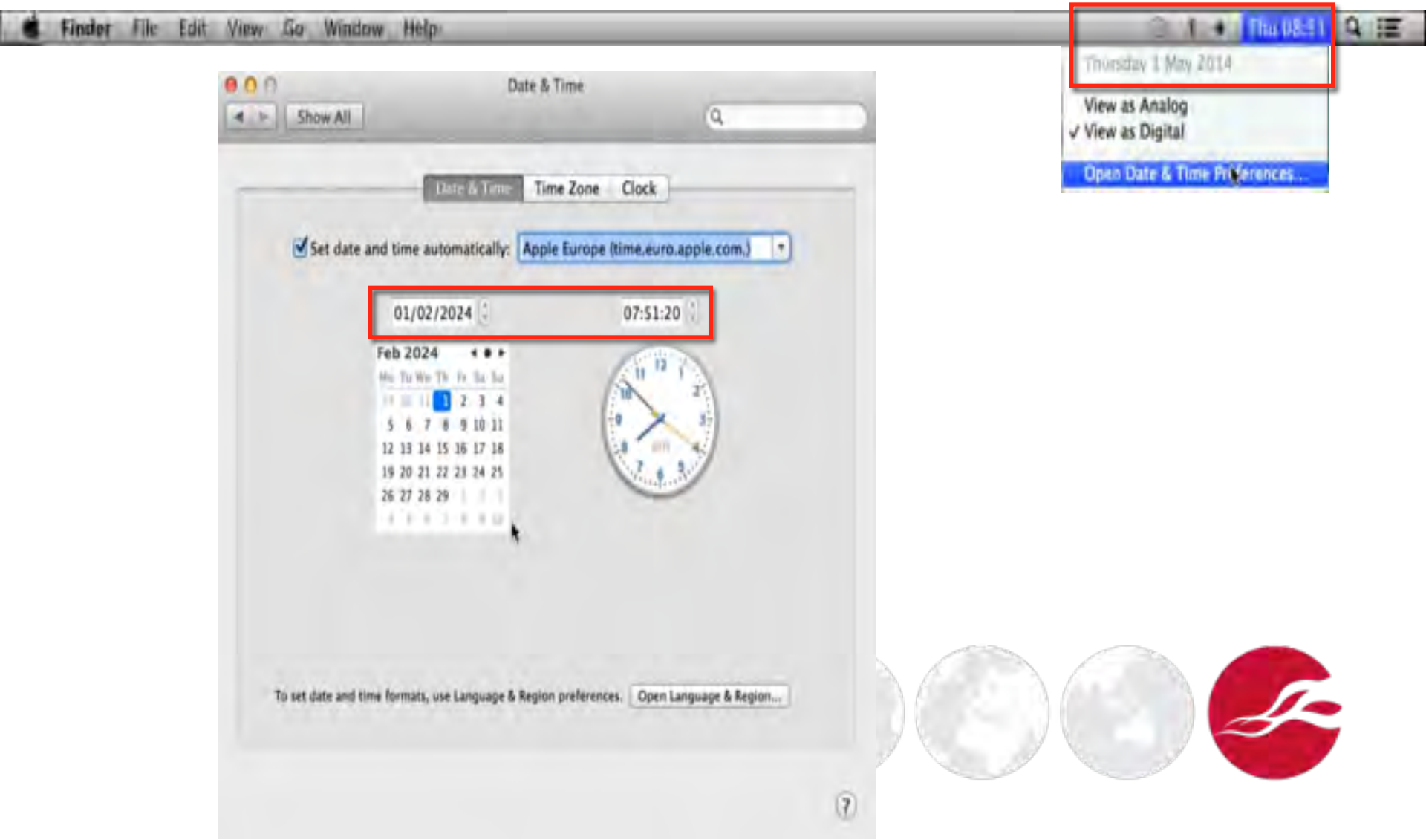
```
LOG=/var/run/sntp.log

ipconfig waitall

if [[ ! -f ${LOG} ]]; then
DEADLINE=$((SECONDS+TIMEOUT))
for (( CURTIMEOUT=TIMEOUT; SECONDS < DEADLINE; CURTIMEOUT=DEADLINE-SECONDS )); do
if scutil -w ${KEY} -t ${CURTIMEOUT}; then
if [[ -f ${DNS} ]]; then
break;
fi                  # else retry false alarms
else
logger -p daemon.err "$0: scutil key ${KEY} not present after ${TIMEOUT} seconds"
break;
fi
done
fi

for server in $(awk '/^server/ {print $2}' /etc/ntp.conf); do
if sntp -K /dev/null -s ${server} &> ${LOG}; then
break
else
logger -p daemon.err -f ${LOG}
fi
done

exec /usr/sbin/ntpd -c /private/etc/ntp-restrict.conf -d -D 10 -n -g -p /var/run/ntpd.pid -f /var/db/ntp.drift
```

Mac OS X - Mavericks



Fedora Linux

- The easiest
- NTPv3.
- More than one NTP server
- Requests each minute!

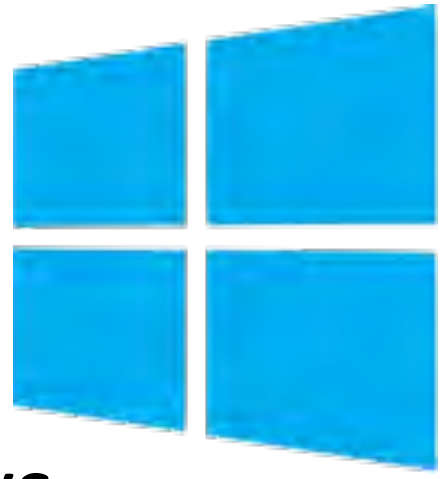

```
$ tcpdump -i eth0 -nn src port 123
12:43:50.614191 IP 192.168.1.101.123 > 89.248.106.98.123: NTPv3, Client, length 48
12:44:55.696390 IP 192.168.1.101.123 > 213.194.159.3.123: NTPv3, Client, length 48
12:45:59.034059 IP 192.168.1.101.123 > 89.248.106.98.123: NTPv3, Client, length 48
```

Ubuntu Linux

- Very simple
- NTPv4.
- Each time it connects to a network (and at boot time, of course).

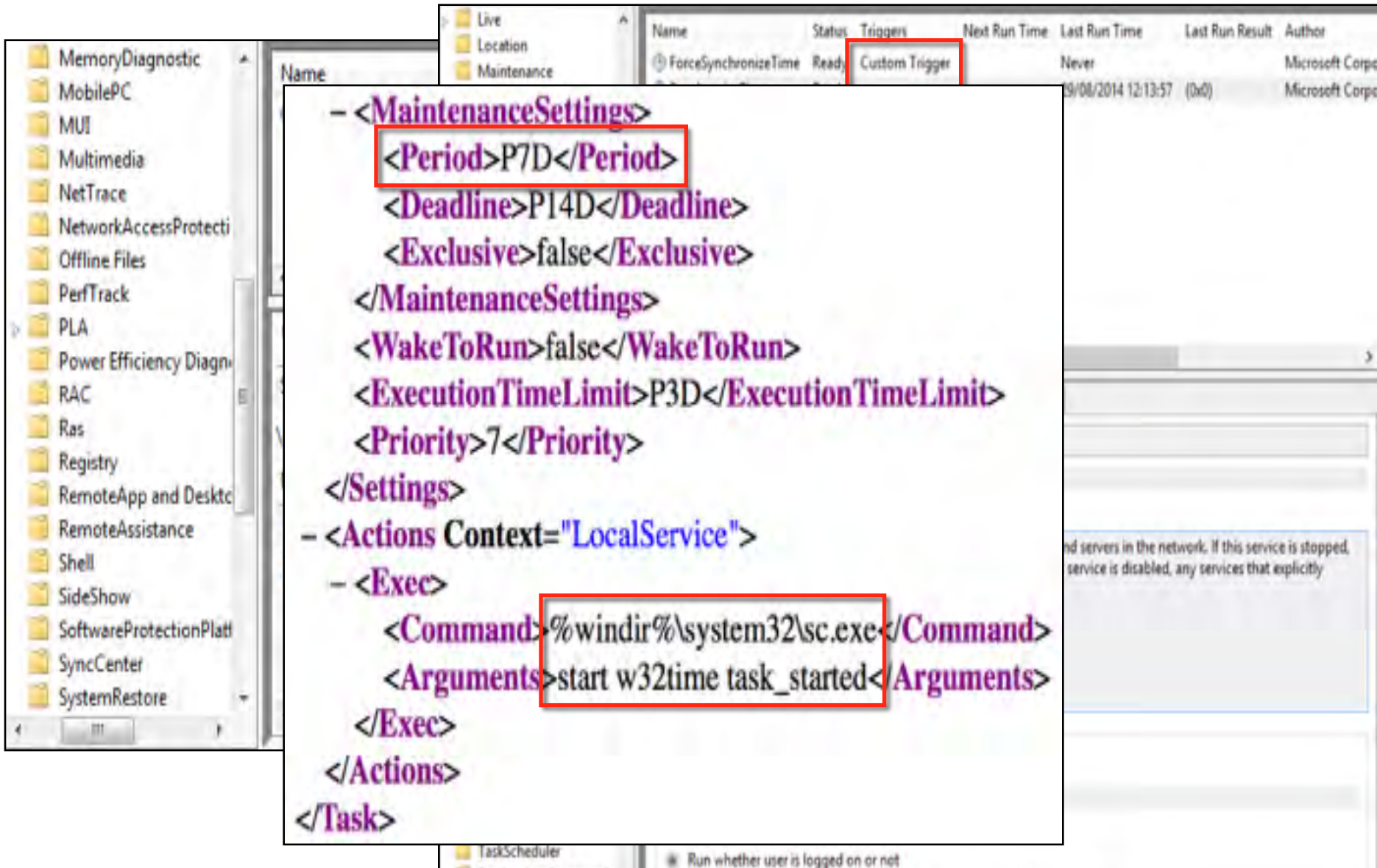
```
$ ls /etc/network/if-up.d/
000resolvconf  avahi-daemon  ntpdate  wpasupplicant
avahi-autoipd   ethtool          upstart
```

Windows

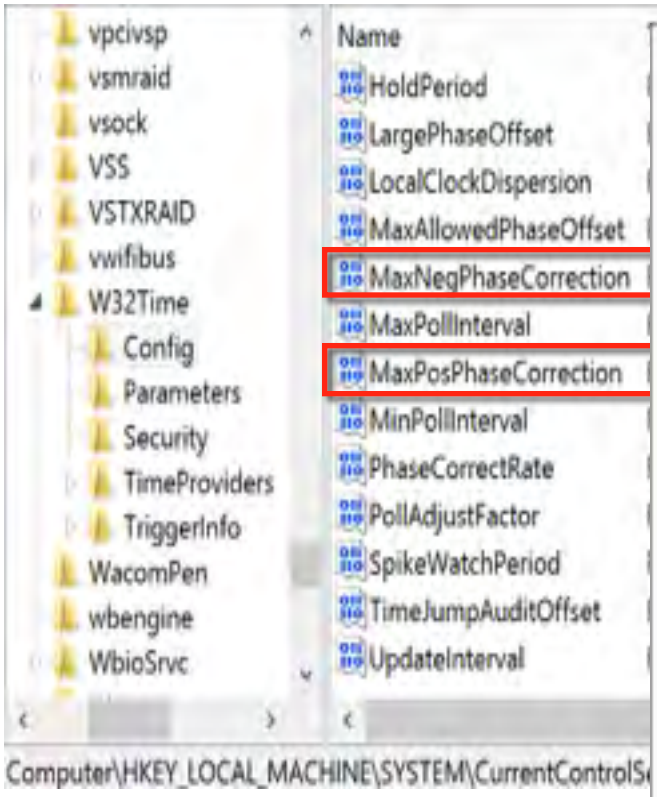


- NTPv3 but…
- The most secure.
- Synchronisation each 7 days.
- More than 15 hours drift isn’t allowed.
- Domain members work in a different way.

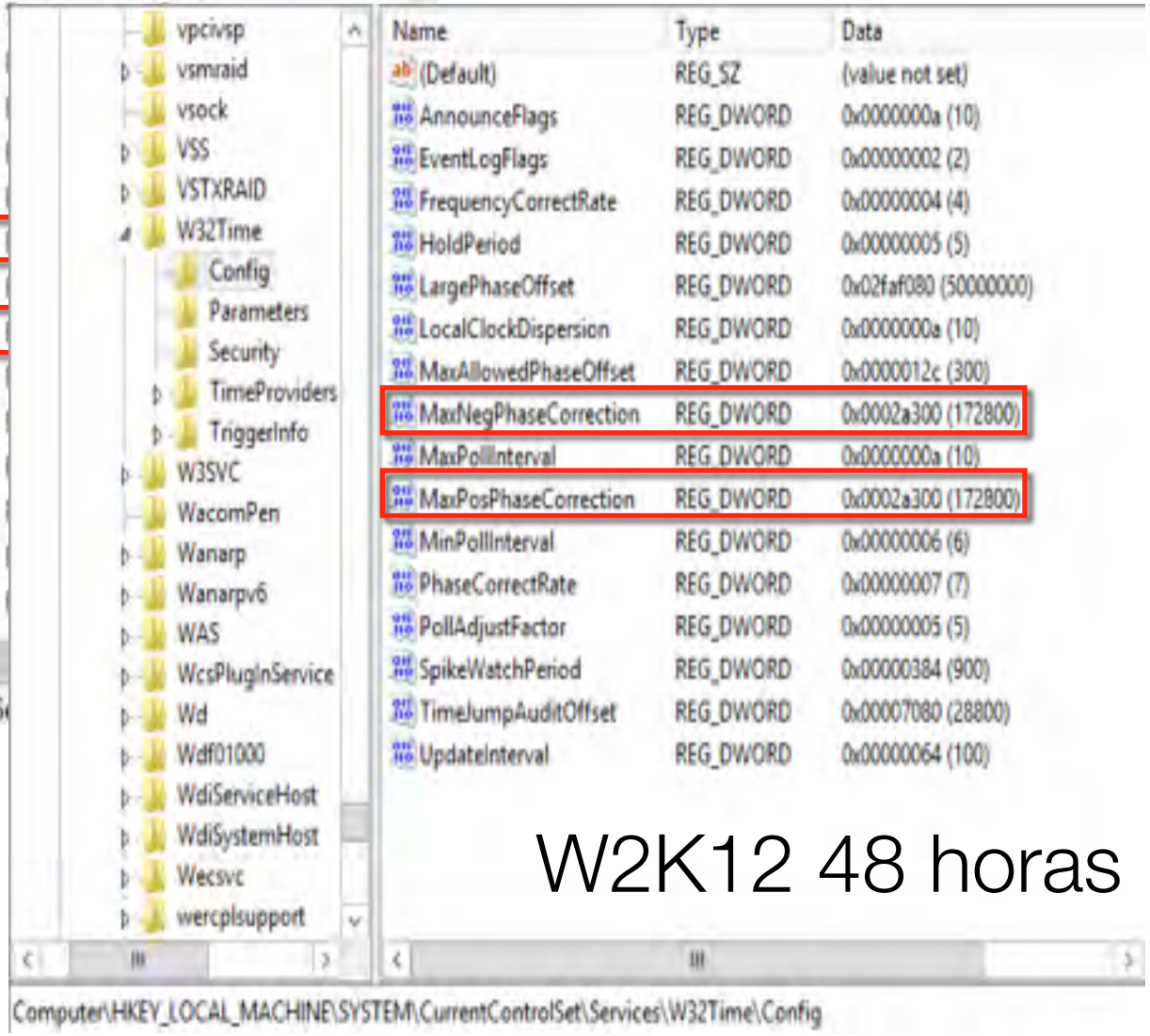
W32time service



Max[Pos|Neg]PhaseCorrection



W7 / W8
15 horas



W2K12 48 horas

What the Internet says?

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Force Windows time synchronization more often

Last week we discussed how to setup synchronization with an external time source. This week we will learn how to make the syncs

re resources.
set for once a
the PDC of a

Automatically sync windows time more often than default

4

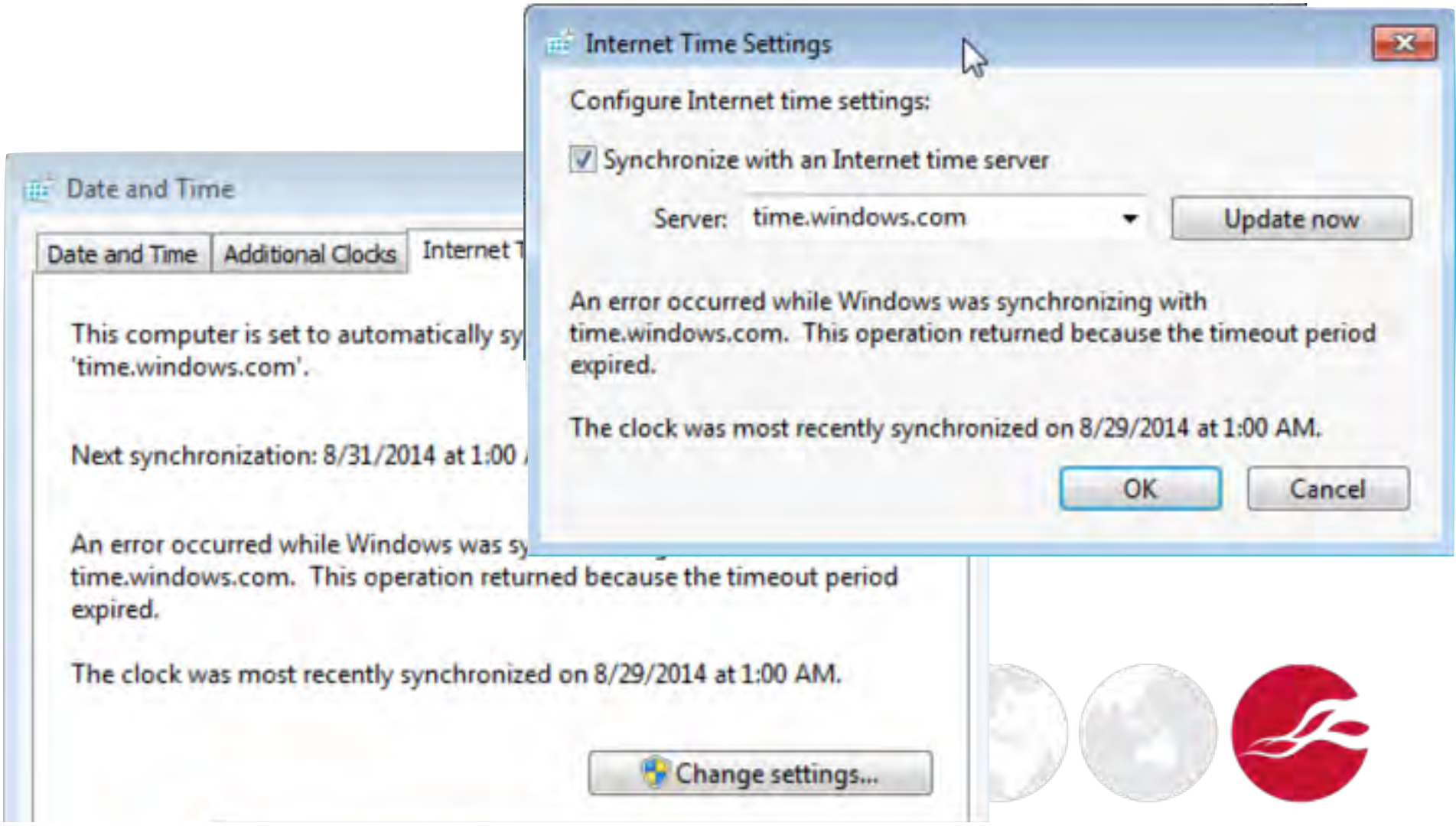
I have a few PCs that are losing time, and I'd like windows to synch them more often with the internet time. I think the windows default attempts to update only once per day, and does not update if the time server is not available (which seems to happen quite often) meaning the PCs can end up 20 or 30 seconds out.

I'd like to create a scheduled task to do this say every 5 mins, and if the default time server is not available use mul

2

windows time

Manual Synchronisation



Windows Domain Members

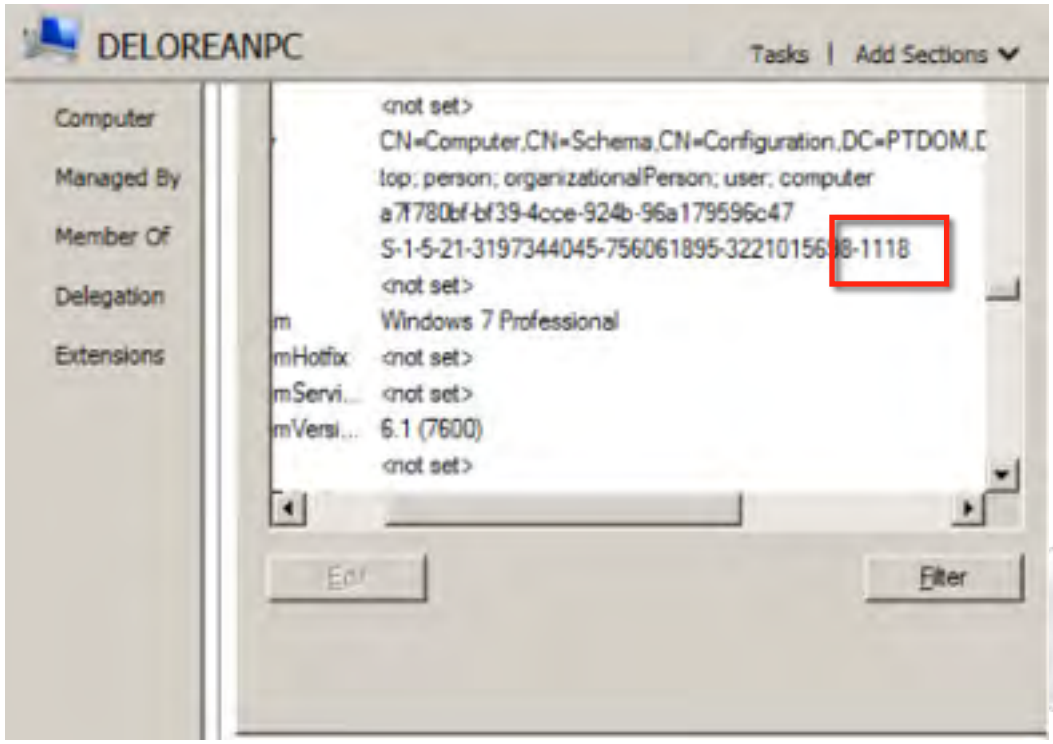
```
Network Time Protocol (NTP Version 3, server)
    Flags: 0x1c
    Peer Clock Stratum: primary reference (1)
    Peer Polling Interval: 17 (131072 sec)
    Peer Clock Precision: 0.015625 sec
    Root Delay:    0.0000 sec
    Root Dispersion:   10.8970 sec
    Reference ID: uncalibrated local clock
    Reference Timestamp: Oct  6, 2014 11:19:26.714040000 UTC
    Origin Timestamp: Oct  7, 2014 08:28:38.301633000 UTC
    Receive Timestamp: Oct  7, 2014 08:28:38.118040000 UTC
    Transmit Timestamp: Oct  7, 2014 08:28:38.118040000 UTC
    Key ID: 5e040000
    Message Authentication Code: 92981e96143be2501f1bcdb6cad6c343
```

Windows Domain Members

5E	04	00	00

RID

Key Selector



Windows Domain Members

```
/* Sign the NTP response with the unicodePwd */
MD5Init(&ctx);
MD5Update(&ctx, nt_hash->hash, sizeof(nt_hash->hash));
MD5Update(&ctx, sign_request.packet_to_sign.data,
sign_request.packet_to_sign.length);
MD5Final(signed_reply.signed_packet.data + sign_request.packet_to_sign.length
+ 4, &ctx);
```

```
        * Username : DELOREANPC$
        * Domain   : PTDOM
        * Password : 01 09 8b 63 35 9f 69 3d 15 9f d1 2a 03 74 ef 9b c3 70 ec 0
    7 3b 5c d3 54 84 1e ca 94 94 01 b3 b7 99 0f b0 7e 88 fc 1c 10 67 f3 ee 5e f2 26
    bd 1d b2 6a e1 d8 fa ff ac e7 18 32 56 35 57 6f 0b 7d a1 24 31 d7 57 88 39 84 c3
     5f aa 15 df f8 6a d3 d9 35 51 15 f5 d6 26 c2 d6 c4 18 ec 0d 22 21 be 6c f2 ac 8
    8 2a 95 49 92 11 b8 a6 5d 03 77 aa 08 c6 9d 75 b4 62 0a 9a dc 6c c1 e7 7d 28 75
    4c 2a 5b 44 00 19 8e bf b3 81 ca 23 31 01 e5 aa 14 c2 28 8c 71 9b a0 8b 9f ad 47
     be 53 7f e9 b4 e1 21 8f ff 82 11 4b cd e8 d6 d0 b7 8d b8 e2 69 08 42 e3 0a 3c 3
    9 6c 61 97 3c cb e8 e5 2b bd 1b 33 c6 55 08 1c 3e d5 49 d3 b1 20 93 9f ed 27 dd
    82 eb c4 26 15 30 3b d3 0a 76 df 75 52 61 c8 76 9f 22 a2 aa d0 39 49 27 35 46 22
     80 9e 59 f9 d7 80 9f
```

Windows Domain Members

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No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
2	12.654537000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
3	22.538317000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
4	32.064646000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
5	32.132393000	192.168.2.2	192.168.1.100	NTP	110	NTP Version 3, server
6	41.243363000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
7	51.360859000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
8	60.192576000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
9	71.125885000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
10	80.917164000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
11	89.873160000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
12	99.663807000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
13	108.534417000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
14	119.530028000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
15	128.487563000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
16	128.525009000	192.168.2.2	192.168.1.100	NTP	110	NTP Version 3, server
17	151.116206000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client
18	151.118500000	192.168.2.2	192.168.1.100	NTP	110	NTP Version 3, server
19	158.994790000	192.168.1.100	192.168.2.2	NTP	110	NTP Version 3, client

Not a silver bullet

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Let's Go!

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- Conclusions & Recommendations

Delorean

- NTP MitM Tool. Free. Open Source. Python.
  - http://github.com/PentesterES/Delorean
- Based on a kimifly's work:
  - http://github.com/limifly/ntpserver
- Implements several attacks.
- It pretends to be an NTP attack 'suite'.

Delorean

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```
$ ./delorean.py -h
Usage: delorean.py [options]


Options:
  -h, --help            show this help message and exit
  -i INTERFACE, --interface=INTERFACE
                        Listening interface
  -p PORT, --port=PORT  Listening port
  -n, --nobanner        Not show Delorean banner
  -s STEP, --force-step=STEP
                        Force the time step: 3m (minutes), 4d (days), 1M
                        (month)
  -d DATE, --force-date=DATE
                        Force the date: YYYY-MM-DD hh:mm[:ss]
  -r, --random-date     Use random date each time
```

Basic attacks

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```
# ./delorean.py -n
[22:02:57] Sent to 192.168.10.102:55962 - Going to the future! 2015-06-20 22:02
[22:02:59] Sent to 192.168.10.102:39708 - Going to the future! 2015-06-20 22:02

# ./delorean.py -s 10d -n
[22:02:57] Sent to 192.168.10.102:55962 - Going to the future! 2015-06-20 22:02
[22:02:59] Sent to 192.168.10.102:39708 - Going to the future! 2015-06-20 22:02

# ./delorean.py -d '2020-08-01' -n
[22:02:57] Sent to 192.168.10.102:55962 - Going to the future! 2015-06-20 22:02
[22:02:59] Sent to 192.168.10.102:39708 - Going to the future! 2015-06-20 22:02

# ./delorean.py -r -n
[22:02:57] Sent to 192.168.10.102:55962 - Going to the future! 2015-06-20 22:02
[22:02:59] Sent to 192.168.10.102:39708 - Going to the future! 2015-06-20 22:02
```

DEMO

Time Skimming Attack

Tin ecs

Time Skimming Attack

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```
# ./delorean.py -k 15h -t 10s -n
[21:57:26] Sent to 192.168.10.105:123 - Going to the future! 2015-06-11 12:57
[21:57:33] Sent to 192.168.10.105:123 - Going to the future! 2015-06-12 03:57
[21:57:37] Sent to 192.168.10.105:123 - Going to the future! 2015-06-12 18:56
[21:57:44] Sent to 192.168.10.105:123 - Going to the future! 2015-06-13 09:56
[21:57:50] Sent to 192.168.10.105:123 - Going to the future! 2015-06-14 00:56
[21:57:58] Sent to 192.168.10.105:123 - Going to the future! 2015-06-14 15:56
[21:58:04] Sent to 192.168.10.105:123 - Going to the future! 2015-06-15 06:56
[21:58:11] Sent to 192.168.10.105:123 - Going to the future! 2015-06-15 21:56
[21:58:17] Sent to 192.168.10.105:123 - Going to the future! 2015-06-16 12:56
```

DEMO

Replay Attack

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```
$ ./delorean.py -n -r capture.pcap
[06:19:13] Replayed to 192.168.10.105:39895 - Going to the past! 2015-06-24 21:41
[06:19:17] Replayed to 192.168.10.105:39895 - Going to the past! 2015-06-24 21:41
```

```
▲ Network Time Protocol (NTP Version 3, server)
  ▷ Flags: 0x1c
    Peer Clock Stratum: primary reference (1)
    Peer Polling Interval: 17 (131072 sec)
    Peer Clock Precision: 0.015625 sec
    Root Delay:    0.0000 sec
    Root Dispersion:   10.8970 sec
    Reference ID: uncalibrated local clock
    Reference Timestamp: Oct  6, 2014 11:19:26.714040000 UTC
    Origin Timestamp: Oct  7, 2014 08:28:38.301633000 UTC
    Receive Timestamp: Oct  7, 2014 08:28:38.118040000 UTC
    Transmit Timestamp: Oct  7, 2014 08:28:38.118040000 UTC
    Key ID: 5e040000
    Message Authentication Code: 92981e96143be2501f1bcdb6cad6c343
```

Spoofing Attack

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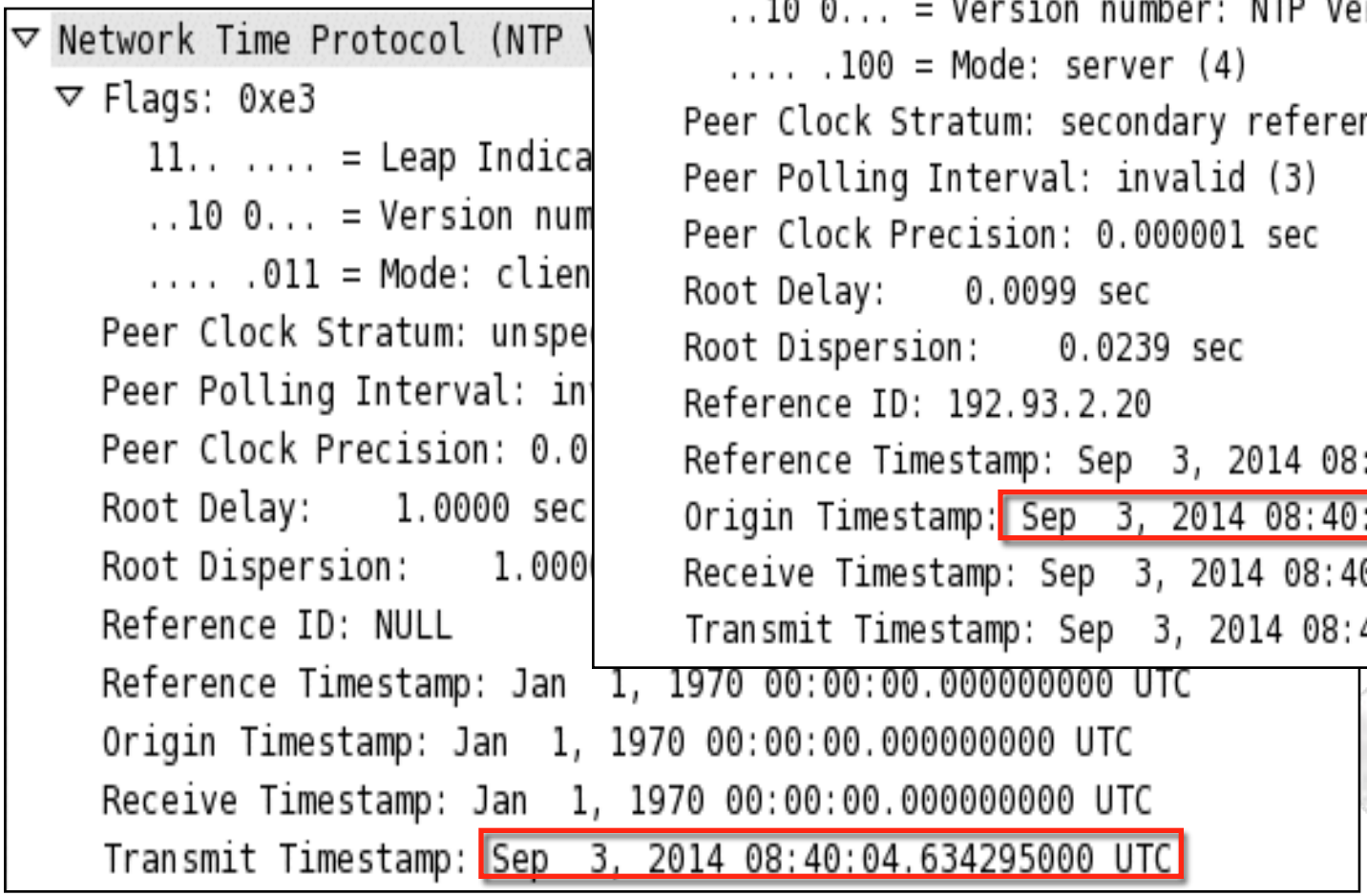
```
$ ./delorean.py -n -f 192.168.10.10 -o 8.8.8.8 -r capture.pcap
Flooding to 192.168.10.10

$ tcpdump -nn -p -i eth1 host 192.168.10.10
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth1, link-type EN10MB (Ethernet), capture size 65535 bytes
08:26:07.621412 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
08:26:07.682578 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
08:26:07.761407 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
08:26:07.766434 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
08:26:07.843923 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
08:26:07.905666 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
08:26:07.922923 IP 8.8.8.8.123 > 192.168.10.10.123: NTPv4, Server, length 48
```

Anti replaying…



Let's Go!

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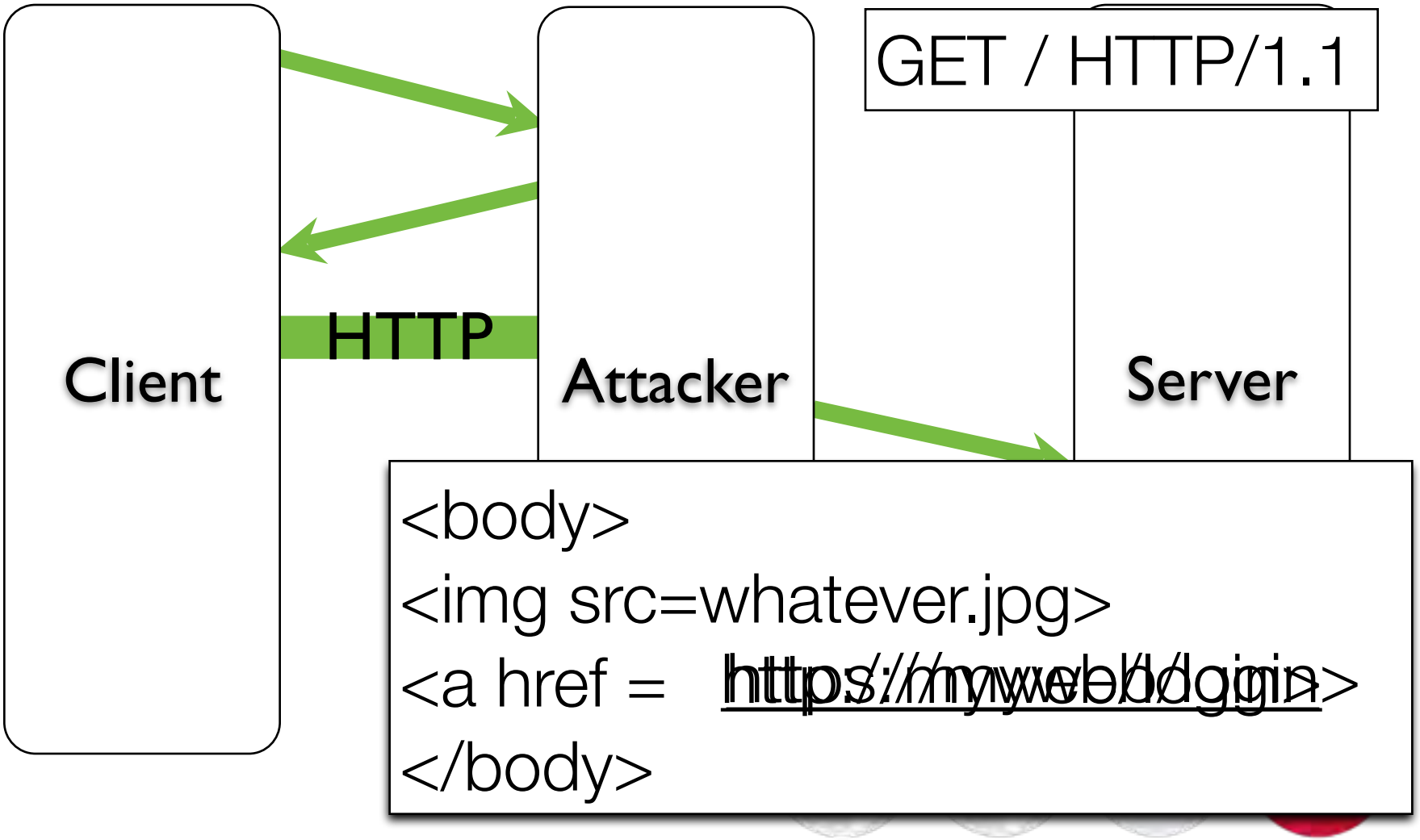
Stripping SSL links



HTTP Strict Transport Security

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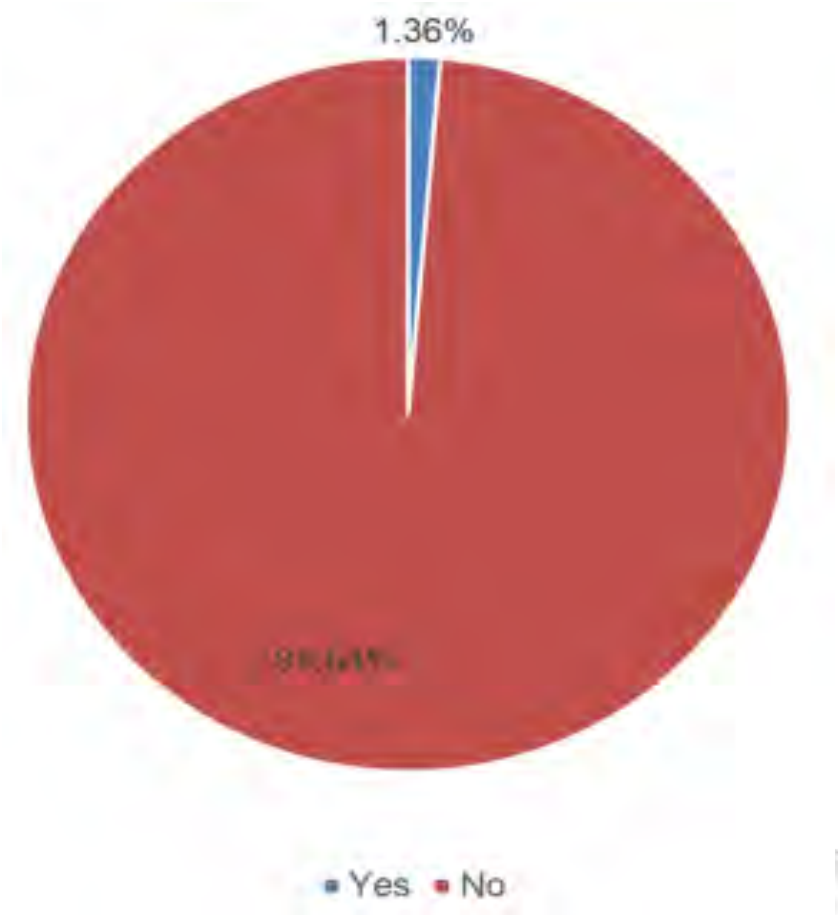
- RFC-6797: November 2012.
- Also known as HSTS or STS.
- Prevent HTTP connections.
- Prevent accepting self-signed and rogue certificates.
- Use a new “Strict-Transport-Security” header.

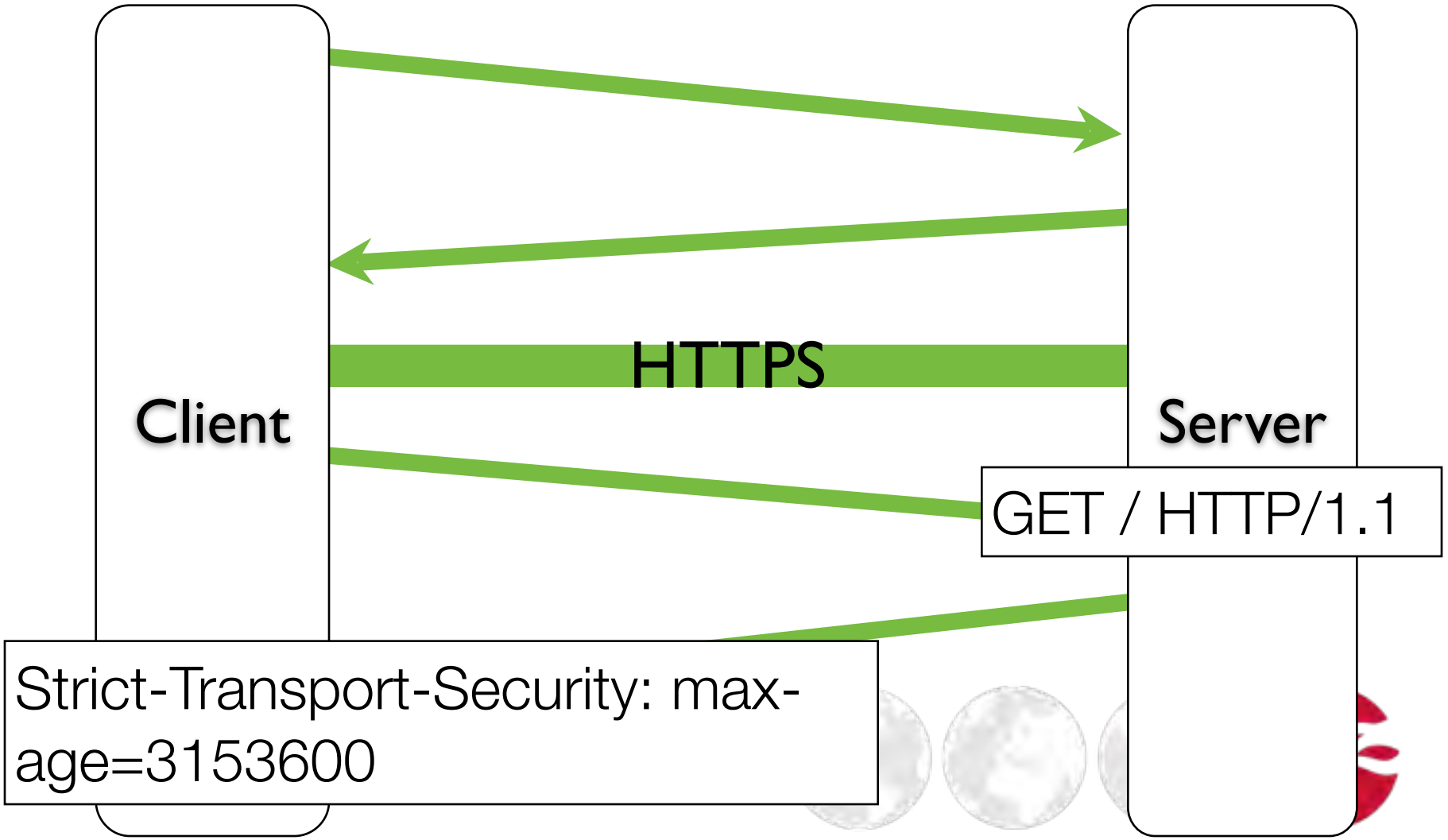
Who uses HSTS?



http://paul.vanbrouwershaven.com/2014/05/everyone-needs-http-strict-transport.html

Who uses HSTS?

How it work?


Client
HTTPS
Server
GET / HTTP/1.1
Strict-Transport-Security: max-age=3153600

Parameters

- max-age: amount of seconds that the policy is enabled.
- includeSubdomains: If present, the policy applies to all subdomains, not just the visited one.

```
$ ./hsts_catcher.py -U https://accounts.google.com
max-age=10893354; includeSubDomains
$
$ ./hsts_catcher.py -U https://paypal.com
max-age=14400
$
$ ./hsts_catcher.py -U https://github.com
max-age=31536000; includeSubdomains; preload
```

Browsers support

- http://caniuse.com/#feat=stricttransportsecurity

HSTS Timeline

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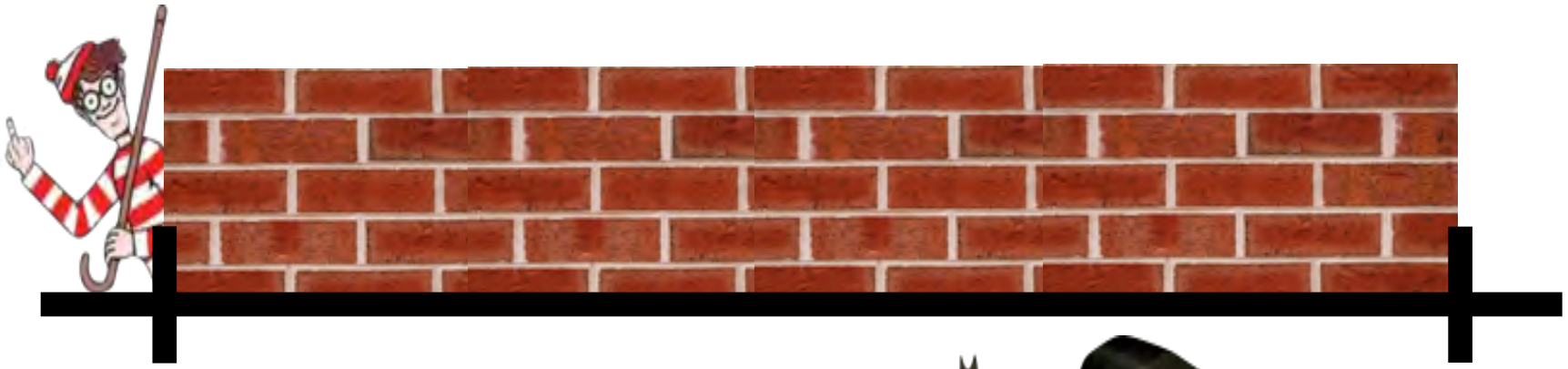

HTTPS
connection

Preloaded HSTS

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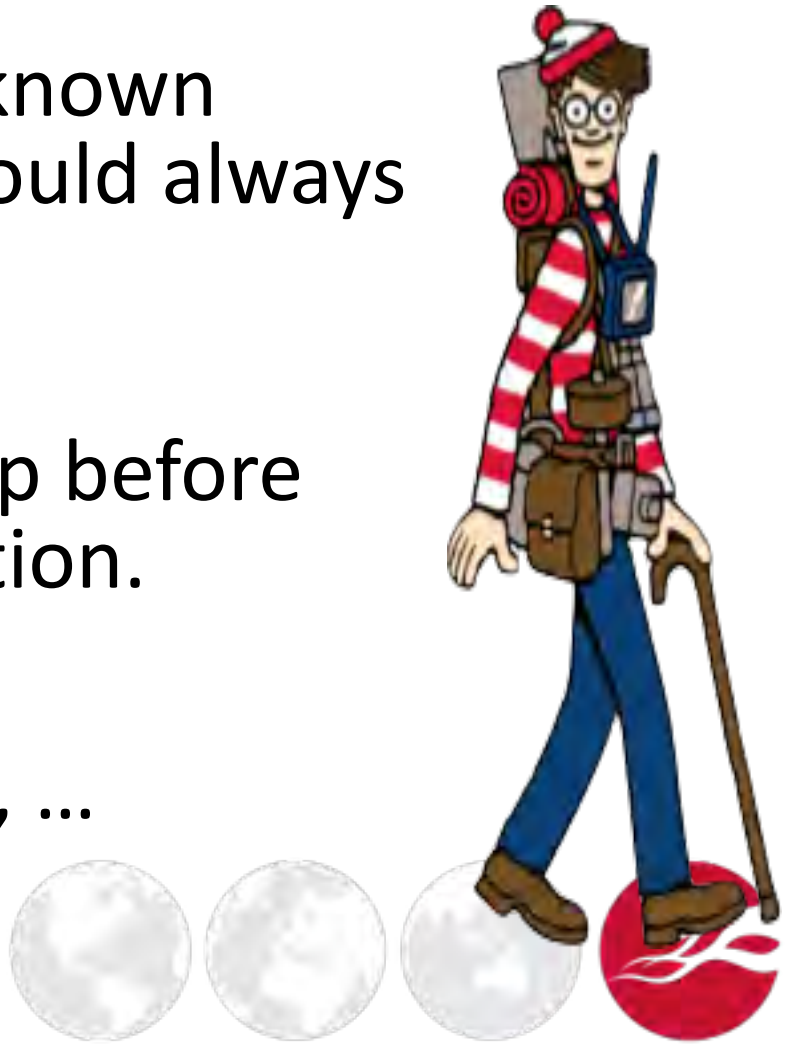
- Hardcoded list of well known website names that should always use HTTPS.
- Prevent the security gap before the first HTTPS connection.
- Google, Twitter, Paypal, …



Avoid protected names

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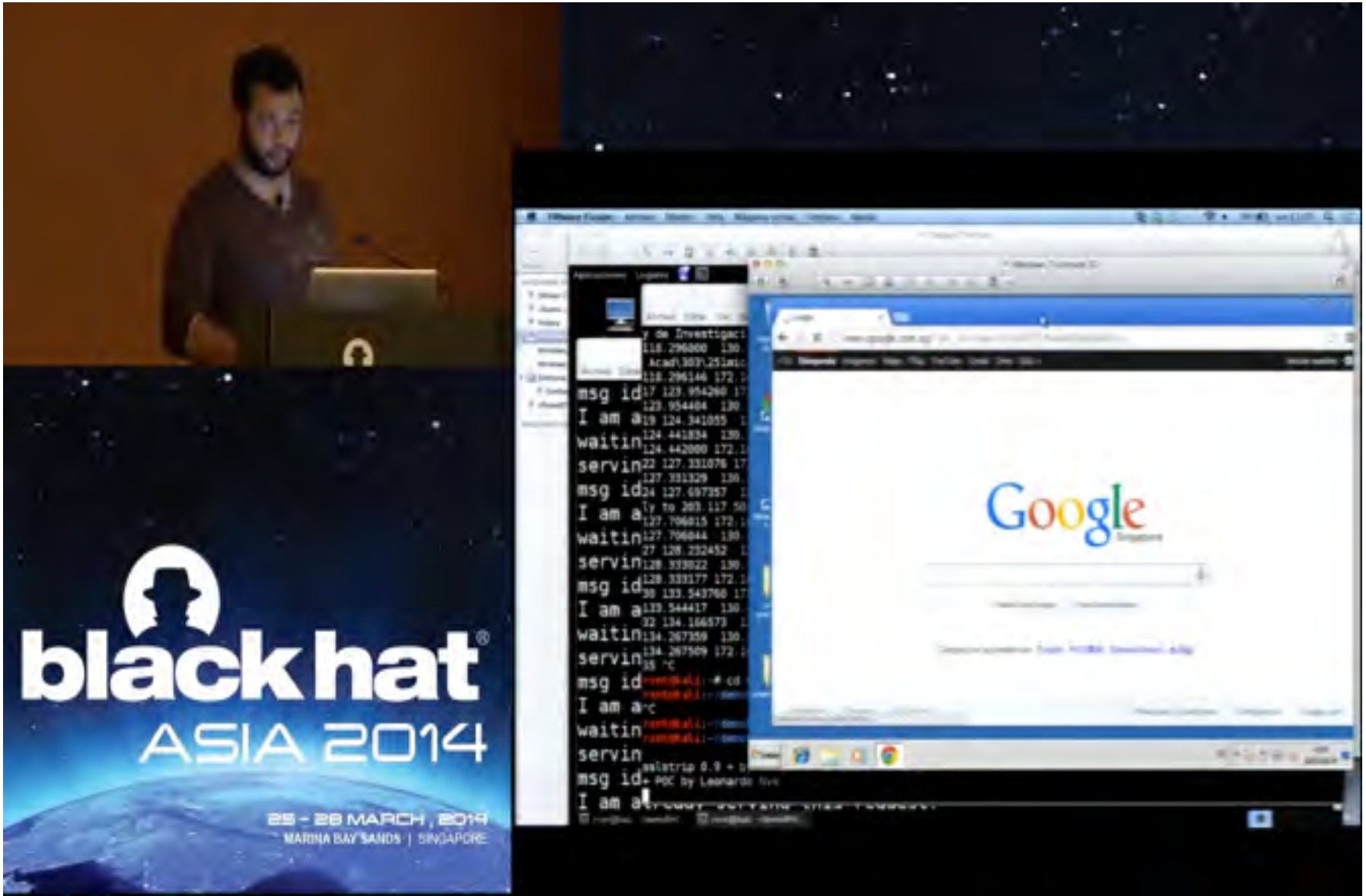

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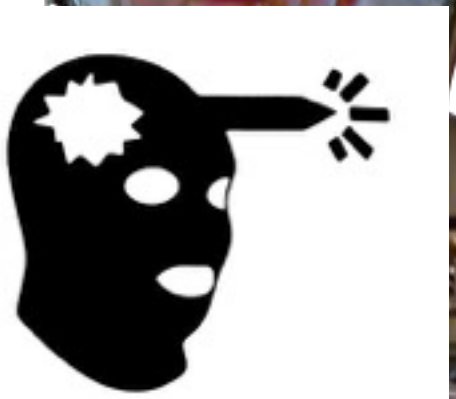
HTTPS
co



3153600
ecs later

Preloaded HSTS - Google

There is still a window where a user who has a fresh install, or who wipes out their local state, is vulnerable. Because of that, Chrome and Firefox share a "Preloaded HSTS" list. These domains will be configured for HSTS out of the box.

If you own a site that you would like to see included in the preloaded HSTS list you can submit it at https://hstspreload.appspot.com.

A selected subset of the members of the preloaded HSTS list:

- Google
- Paypal
- Twitter
- Simple
- Linode
- Stripe
- Lastpass

Check the source for the full list.

http://www.chromium.org/sts

Preloaded HSTS - Mozilla

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However, when connecting to an HSTS host for the first time, the browser won't know whether or not to use a secure connection, because it has never received an HSTS header from that host. Consequently, an active network attacker could prevent the browser from ever connecting securely (and even worse, the user may never realize something is amiss). To mitigate this attack, we have added to Firefox a list of hosts that want HSTS enforced by default. When a user connects to one of these hosts for the first time, the browser will know that it must use a secure connection. If a network attacker prevents secure connections to the server, the browser will not attempt to connect over an insecure protocol, thus maintaining the user's security.

https://blog.mozilla.org/security/2012/11/01/preloading-hsts/

Preloaded HSTS - Others

Currently [redacted] HSTS "max-age" value is four hours. We already aware of this and we have an existing plan to increase this value in near future. Additionally, Chrome and Firefox come with pre-loaded lists of popular websites (Including [redacted] for which HSTS is enforced by default

The real world attack window is negligible to conduct Man-In-Middle (MIM) by taking advantage of HSTS low "max-age" value. Because the MIM should target a victim with the condition which includes the following condition:

- Victim should be connecting to [redacted] for the **first time after 4 hours** of his last [redacted] access + Victim should type http:// [redacted] instead of https:// [redacted] + Victim should be using browser other than **Google Chrome** and **Mozilla Firefox**.

In addition to that, every web page in [redacted] domain is rendered over HTTPS and we have extensive risk detection to identify and prevent malicious transaction/activities. For all these reasons, We find the risk to be negligible in both its assertion as well as our practical experience

Chromium Source Code

nccgroup
freedom from doubt

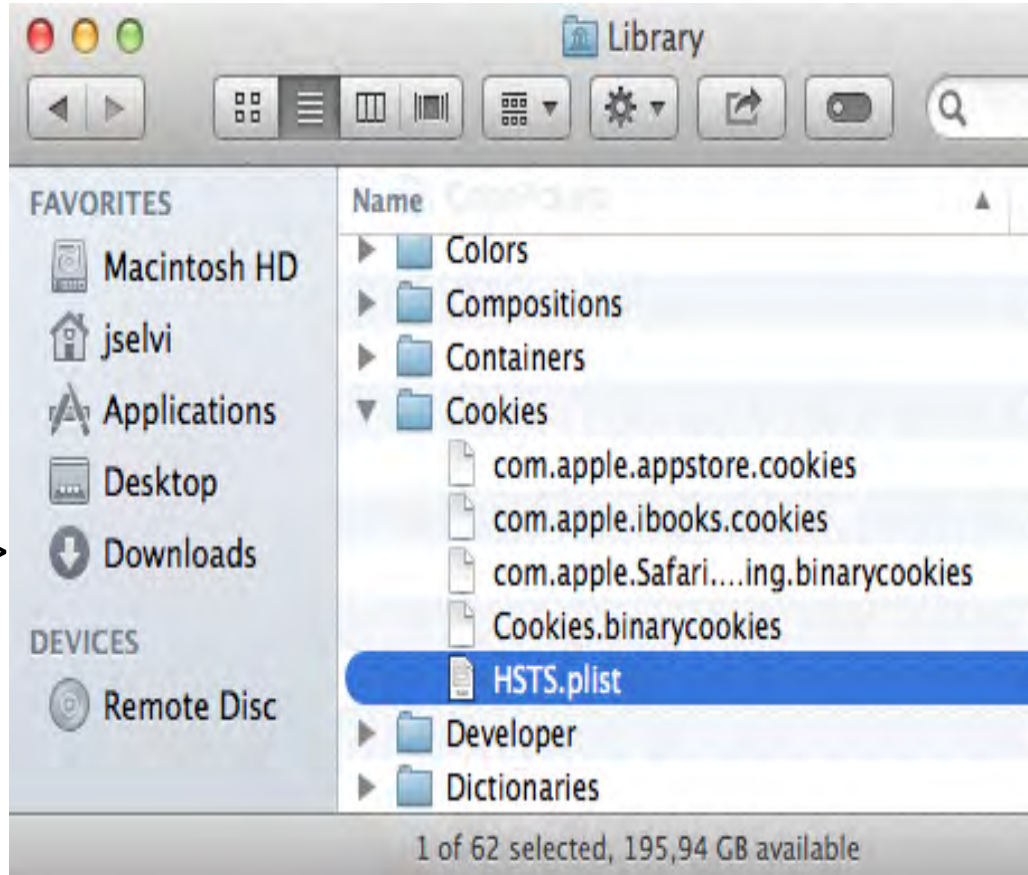
transport_security_state.cc

Layers

```
738   }
739
740   DCHECK(result.domain_id != DOMAIN_NOT_PINNED);
741
742   UMA_HISTOGRAM_SPARSE_SLOWLY(
743       "Net.PublicKeyPinFailureDomain", result.domain_id);
744 }
745
746 // static
747 bool TransportSecurityState::IsBuildTimely() {
748   // If the build metadata aren't embedded in the binary then we can't use the
749   // build time to determine if the build is timely, return true by default. If
750   // we're building an official build then keep using the build time, even if
751   // it's invalid it'd be a date in the past and this function will return
752   // false.
753 #if defined(DONT_EMBED_BUILD_METADATA) && !defined(OFFICIAL_BUILD)
754   return true;
755 #else
756   const base::Time build_time = base::GetBuildTime();
757   // We consider built-in information to be timely for 10 weeks.
758   return (base::Time::Now() - build_time).InDays() < 70 /* 10 weeks */;
759 #endif
760 }
761
```

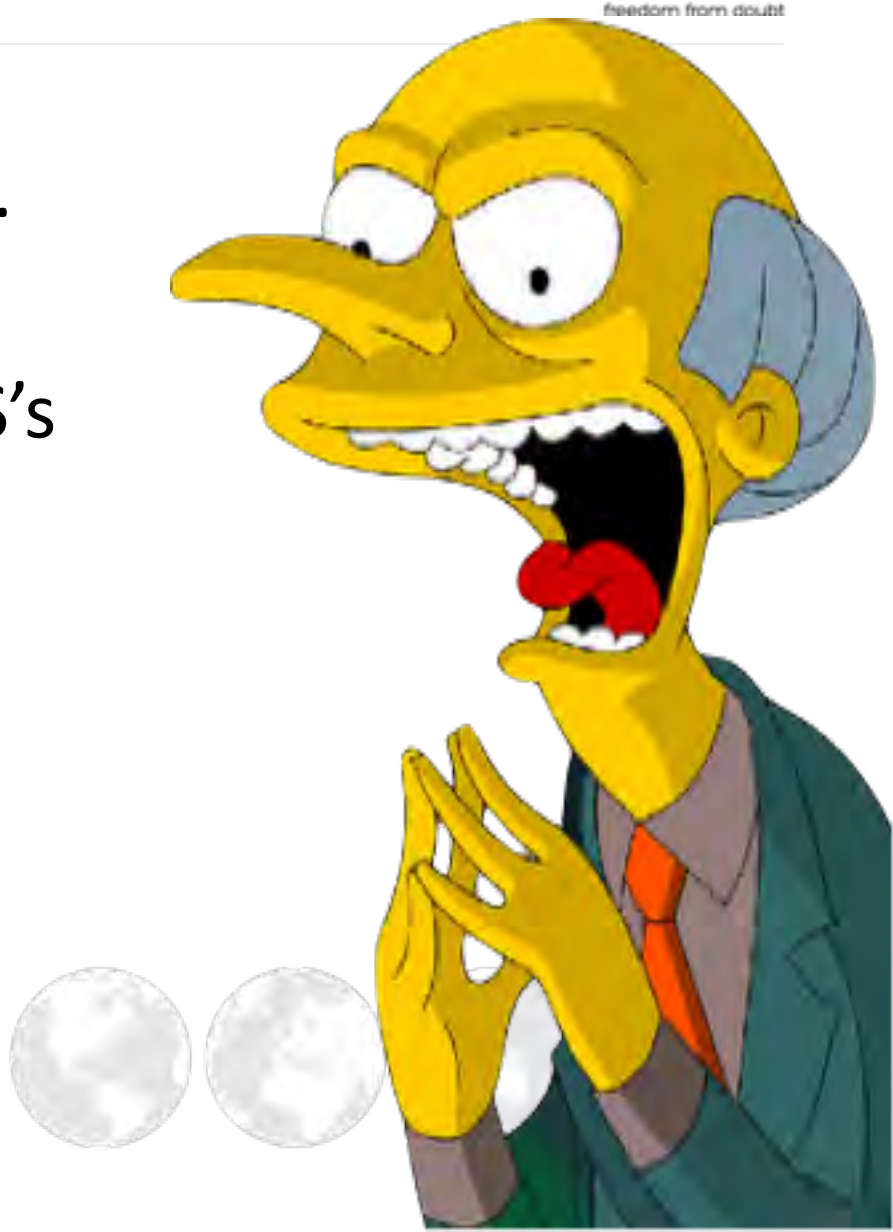
Safari plist

```
$ plutil -p HSTS.plist
{
  "com.apple.CFNetwork.defaultStorageSession" => {
    "ssl.google-analytics.com" => -inf
    "webmail.mayfirst.org" => -inf
    "braintreegateway.com" => -inf
    "code.google.com" => -inf
    "dm.mylookout.com" => inf
    "therapynotes.com" => inf
    "chrome.google.com" => -inf
    "sol.io" => -inf
    "www.sandbox.mydigipass.com" =>
[...]
```



HSTS weakness

- Its security relies on time.
- It completely trust the OS's current time.
- This looks like a job for Delorean!



DEMO

Public release

Google response

From: Adam <@google.com>
Date: Thu, 16 Oct 2014 14:28:38 -0700
Message-ID: <CAL9PXLx4yhqz37Mwfnh4Vss6xZbG1FJSjf5ogq9eq_-9WQXOtg@mail.gmail.com>
To: Anne <[redacted]>
Cc: John <[redacted]>, "public-webappsec@w3.org" <public-webappsec@w3.org>

Someone pointed out that the author did a demo so there must be
something there.

So I went back into the source code and the author really is mistaken
by the 1000 days bit in net-internals. However, we do have a timeout
for HSTS preloads which git blame says that I added, although I don't
remember it. The timeout is the same as our pinning timeout, which is
10 weeks from the build timestamp.

Cheers

From: Ad
Date: Thu
Message-I
To: Anne
Cc: John

On Thu,
> On Thu
>> https
>
> So the
> That seems like a pretty big flaw in OSs. Hopefully someone audits any
> other unauthenticated channels they may have.

This is the motivation for things like tlsdate
(https://github.com/ioerror/tlsdate) as used in parts of ChromeOS.

However, in section seven, where the author claims that preloaded
entries are added for 1000 days, that's only via the net-internals
debugging interface. (The code screenshot shown is also of code for
that debugging interface.) I believe that preloaded entries in Chrome
will always be enforced, no matter what the system time is.

Cheers

Lots of things goes wrong…

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Subject: Re: HSTS Attack Demo
From: Adam [redacted] <[redacted]@google.com>
Date: 17/10/2014 19:34
To: Adrienne [redacted] <[redacted]@google.com>
CC: Chris [redacted] <[redacted]@google.com>, Jose Selvi <jselvi@pentester.es>

On Thu, Oct 16, 2014 at 9:29 PM, Adrienne [redacted] <[redacted]@google.com> wrote:

> Is there a reason why pre-loaded HSTS rules expire?

So that we can effectively actually remove entries when needed.

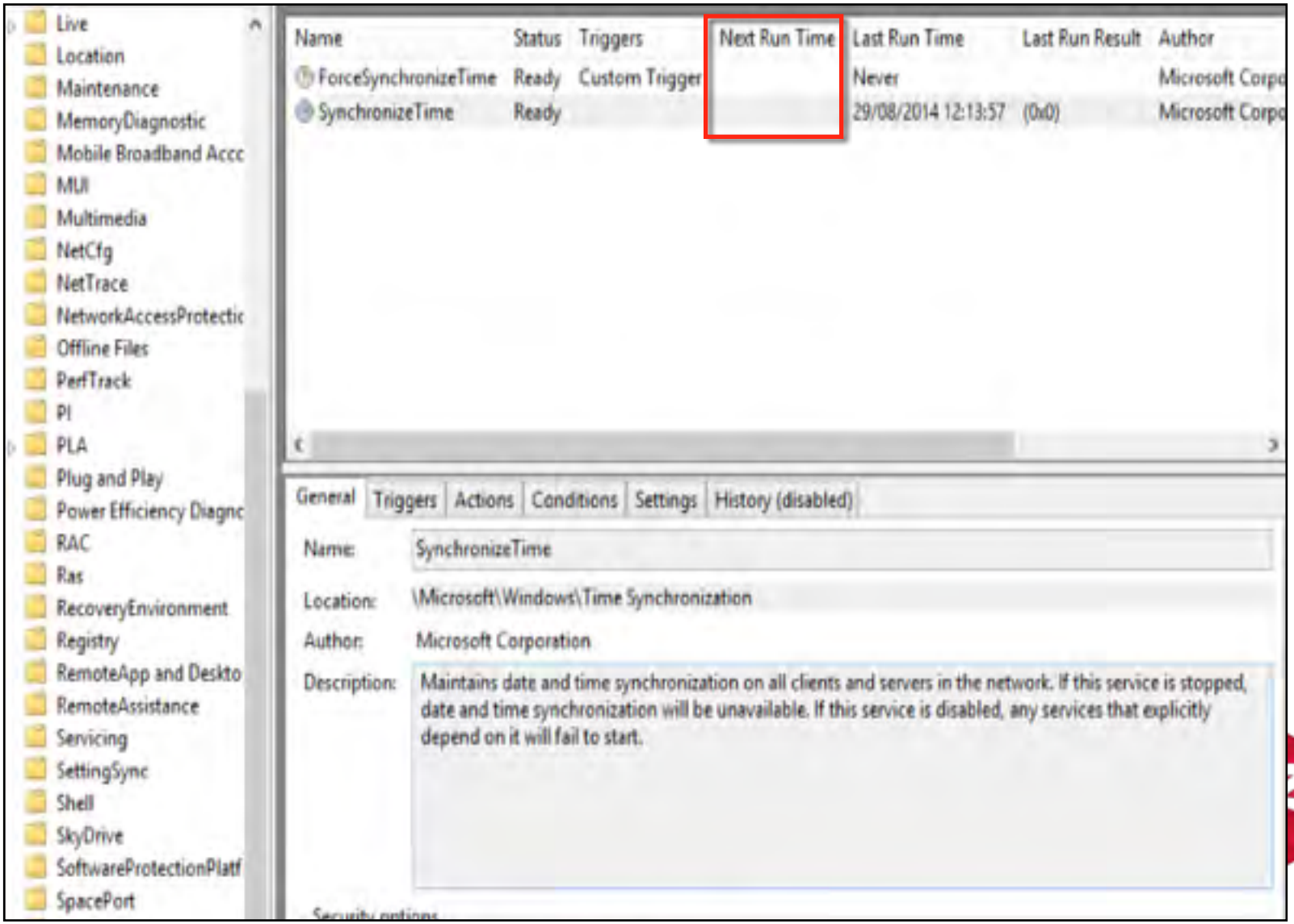
I agree that it's not a big deal and I'd also be ok with them not expiring. But I think that would be papering over a crack -- lots of things goes wrong when the clock is off.

Cheers

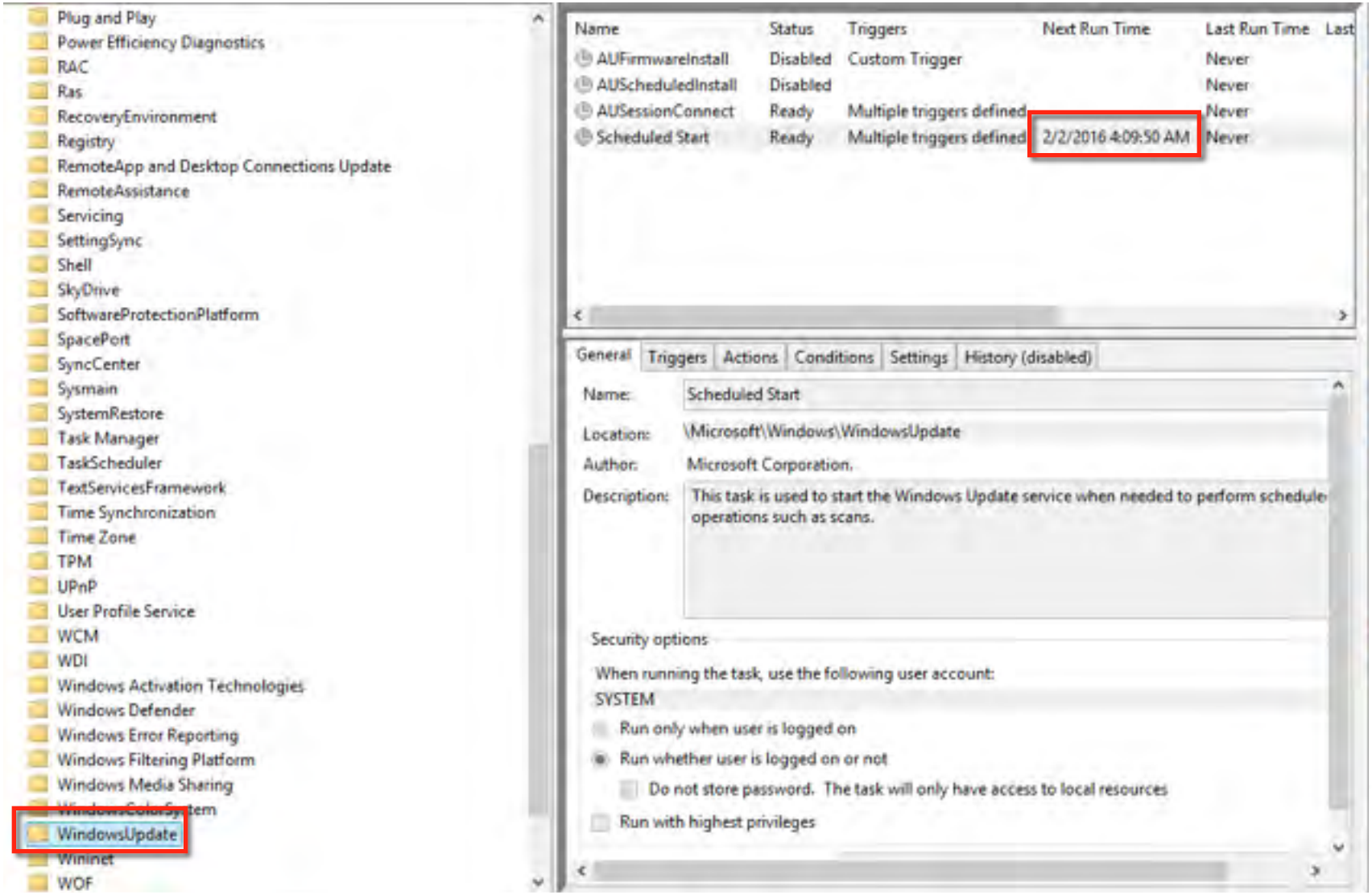
Let's Go!

- ~~Modern Time Synchronisation~~
- ~~Get in a Delorean~~
- ~~HTTP Strict Transport Security~~
- Windows task scheduler
- Public Key Infrastructure
- Conclusions & Recommendations

Task scheduler



Windows automatic updates



DEMO

Let's Go!

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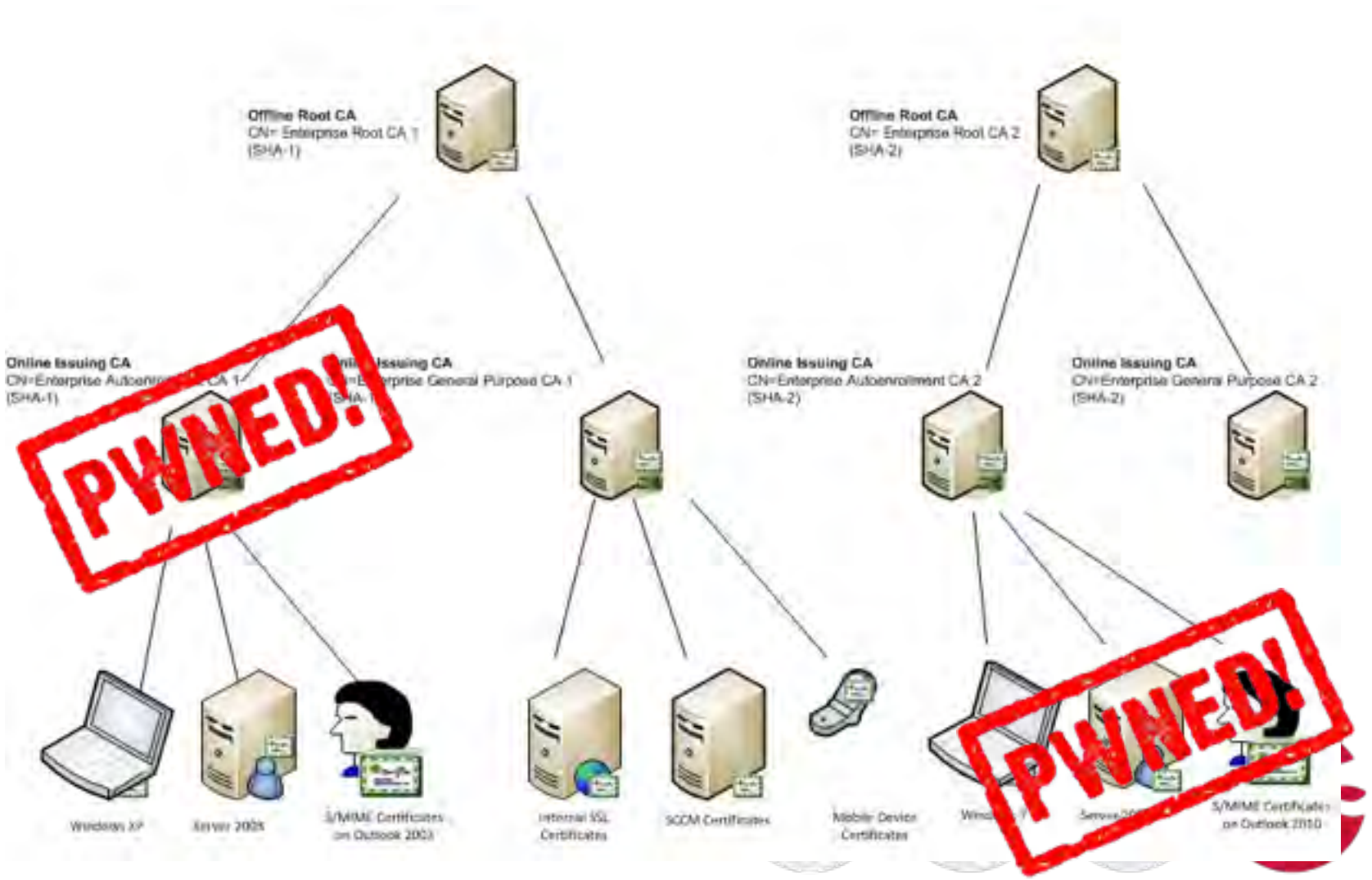
PKI, CAs & Certificates



Edo Tensei no Jutsu!

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Weak certificates


```
SELECT `Subject`
FROM `valid_certs`
WHERE `RSA_Modulus_Bits` <1024
AND `Validity:Not After` < '2015-08-01'
LIMIT 0 , 30
```

Profiling [Inline] [Edit] [Explain SQL] [Create PHP Code] [Refresh]

Page number: 1 > >>

Show : 30 row(s) starting from row # 30 in horizontal mode

and repeat headers after 100 cells

Sort by key: None

+ Options

	Subject
Edit Inline Edit Copy Delete	C=US, ST=Florida, L=Palm Harbor, O=Distribution V...
Edit Inline Edit Copy Delete	C=GB, O=www.arkwrightshomebrew.com, OU=GT39030207...
Edit Inline Edit Copy Delete	C=FI, ST=Uusimaa, L=Helsinki, O=SVoLi, OU=SVoLi, ...
Edit Inline Edit Copy Delete	C=VN, O=app.viethungthai.vn, OU=GT85977878, OU=Se...
Edit Inline Edit Copy Delete	O=www.javac.com.au, OU=Go to https://www.thawte.c...
Edit Inline Edit Copy Delete	C=JP, ST=Tokyo, L=Chiyoda-ku, O=INFOCOM CORPORATI...
Edit Inline Edit Copy Delete	C=JP, O=works.dml.co.jp, OU=GT80667075, OU=See ww...
Edit Inline Edit Copy Delete	C=JP, ST=Chiba-ken, L=Chiba-shi, O=Chiba Prefectu...
Edit Inline Edit Copy Delete	C=JP, ST=Tokyo, L=Minato-ku, O=Asuka Asset Manage...
Edit Inline Edit Copy Delete	C=TW/postalCode=10356, ST=Taiwan, L=Taipei/street...
Edit Inline Edit Copy Delete	C=CA/postalCode=N2L 0A1, ST=Ontario, L=Waterloo/s...
Edit Inline Edit Copy Delete	C=AU, O=webmail.novotech-cro.com, OU=GT78728570, ...

https://www.eff.org/observatory

Looking around Las Vegas

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Let's look any other…

DEMO

Leaked certificates

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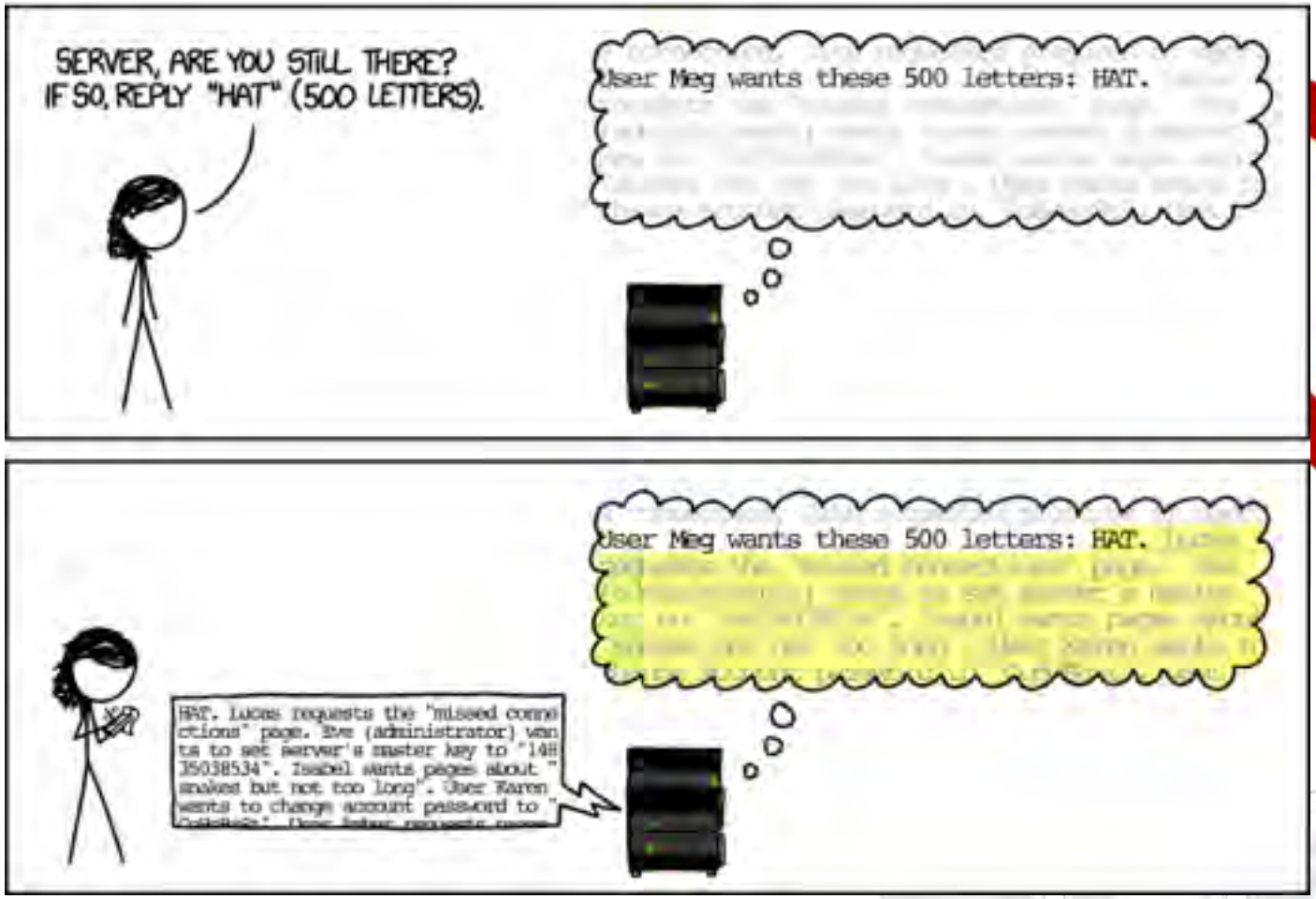
```
Certificate:
Data:
    Version: 3 (0x2)
    Serial Number:
        05:e2:e6:a4:cd:09:ea:54:d6:65:b0:75:fe:22:a2:56
    Signature Algorithm: sha1WithRSAEncryption
    Issuer:
        emailAddress            = info@diginotar.nl
        commonName              = DigiNotar Public CA 2025
        organizationName        = DigiNotar
        countryName             = NL
    Validity
        Not Before: Jul 10 19:06:30 2011 GMT
        Not After : Jul  9 19:06:30 2013 GMT
    Subject:
        commonName              = *.google.com
        serialNumber            = PK000229200002
        localityName            = Mountain View
        organizationName        = Google Inc
        countryName             = US
    Subject Public Key Info:
        Public Key Algorithm: rsaEncryption
        RSA Public Key: (2048 bit)
            Modulus (2048 bit):
```

Heartbleed


SERVER, ARE YOU STILL THERE? IF SO, REPLY "HAT" (500 LETTERS).
User Meg wants these 500 letters: HAT.
User Meg wants these 500 letters: HAT.
HAT. Lucas requests the "missed connections" page. Eve (administrator) wants to set server's master key to "14835038534". Isabel wants pages about "snakes but not too long". User Karen wants to change account password to "

Debian PRNG

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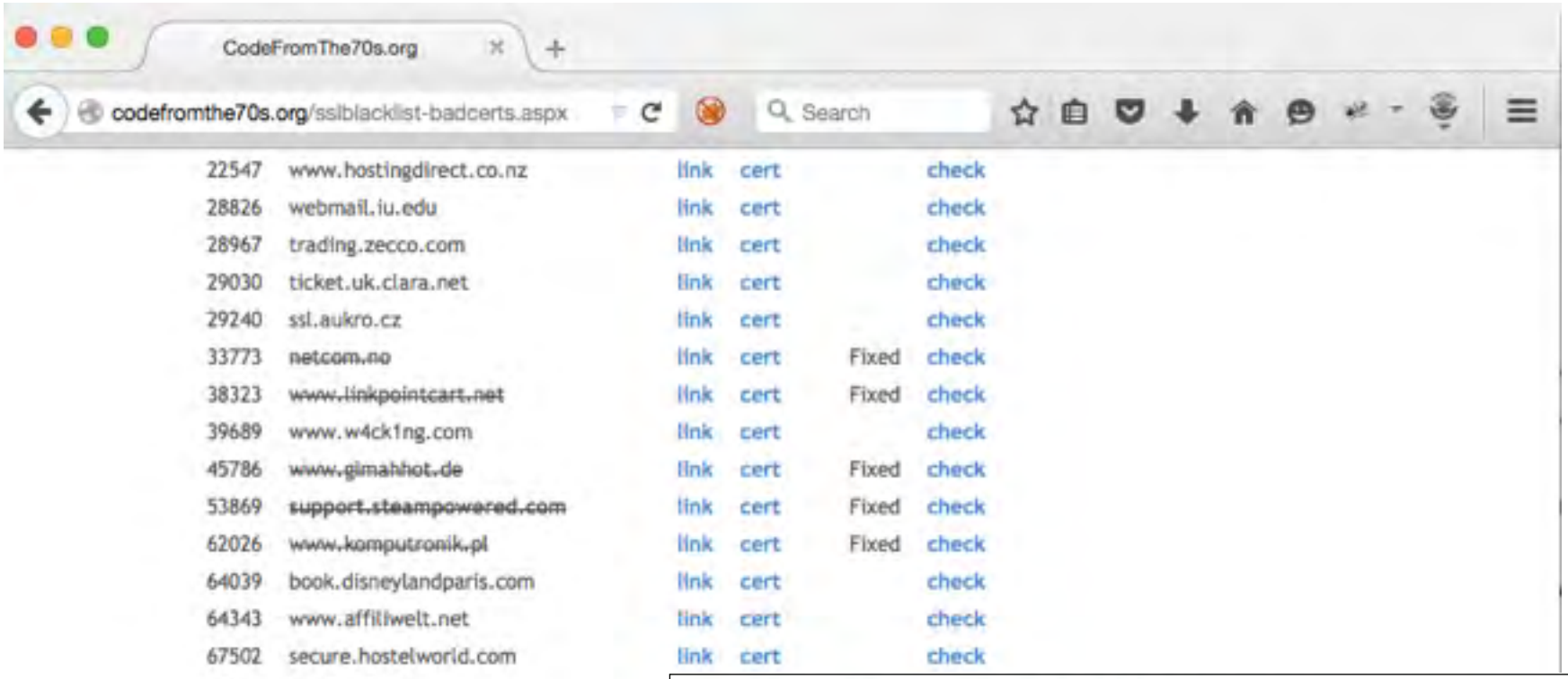
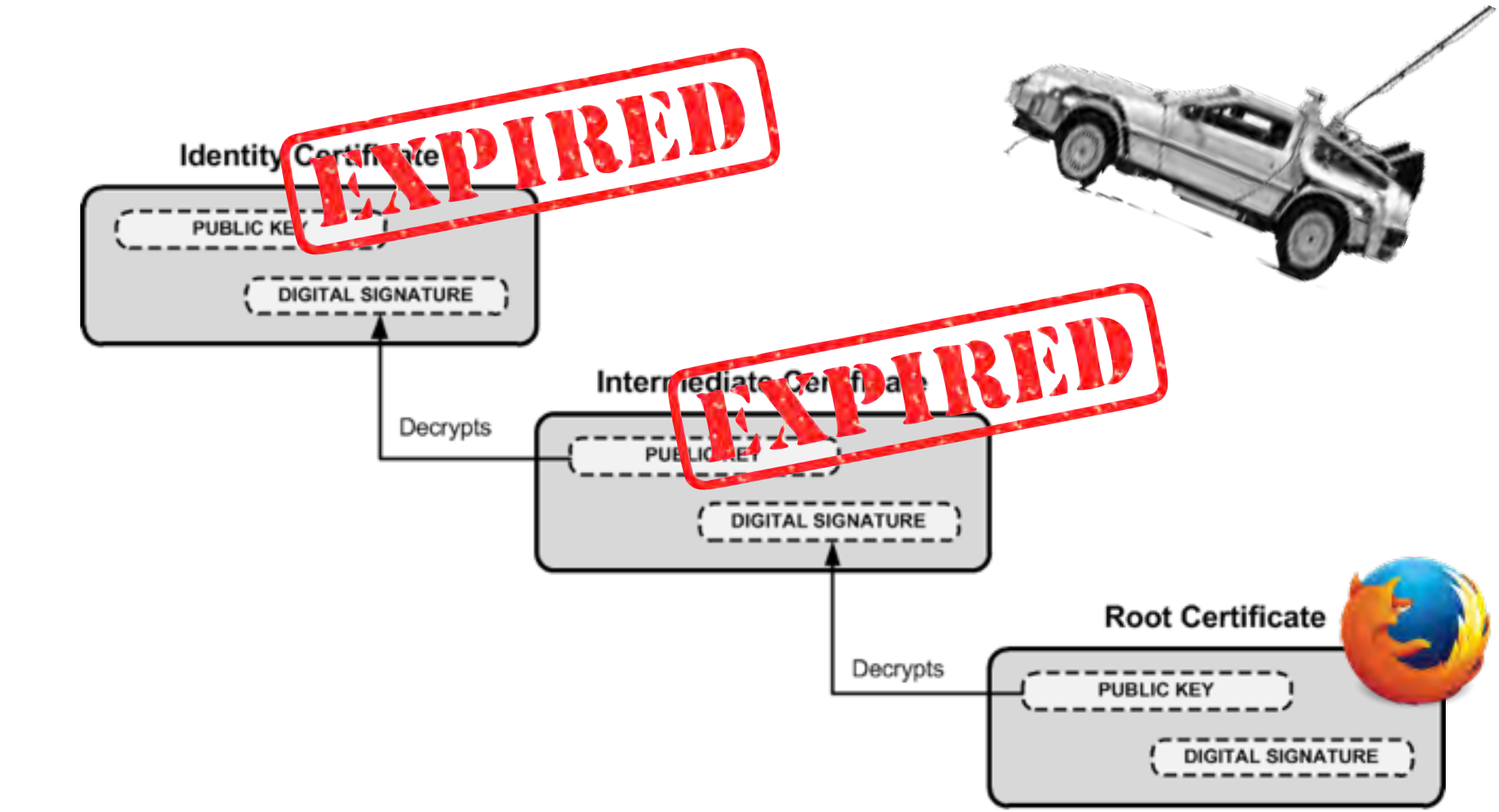


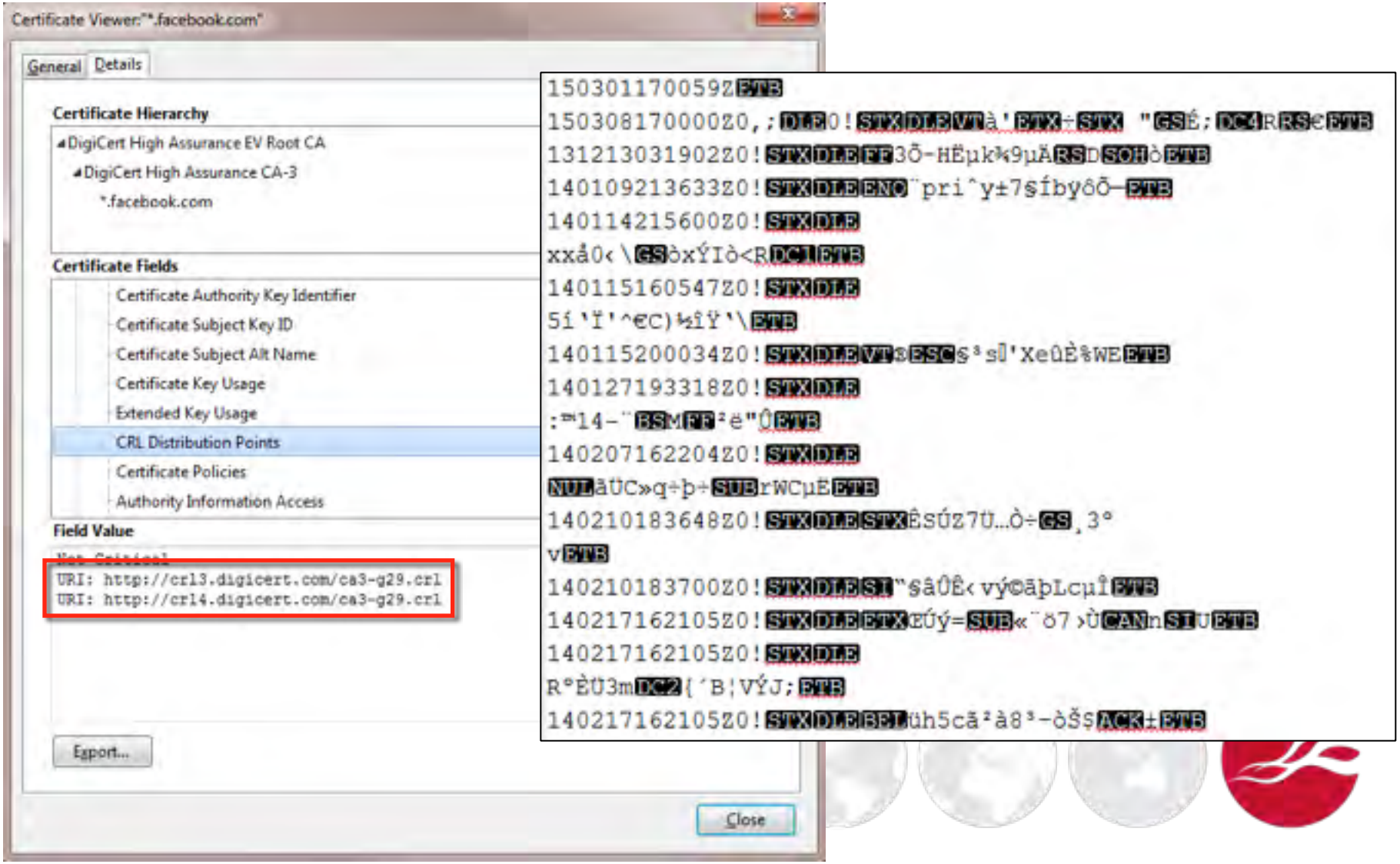
22547	www.hostingdirect.co.nz	link	cert		check
28826	webmail.iu.edu	link	cert		check
28967	trading.zecco.com	link	cert		check
29030	ticket.uk.clara.net	link	cert		check
29240	ssl.aukro.cz	link	cert		check
33773	~~netcom.no~~	link	cert	Fixed	check
38323	~~www.linkpointcart.net~~	link	cert	Fixed	check
39689	www.w4ck1ng.com	link	cert		check
45786	~~www.gimahhot.de~~	link	cert	Fixed	check
53869	~~support.steampowered.com~~	link	cert	Fixed	check
62026	~~www.komputronik.pl~~	link	cert	Fixed	check
64039	book.disneylandparis.com	link	cert		check
64343	www.affiliwelt.net	link	cert		check
67502	secure.hostelworld.com	link	cert		check
68172	mail.gandi.net				
69808	ssl.nordija.com				
73009	asiointi.elisa.fi				
74731	billing.gamigogames.de				
77002	~~payment.allopass.com~~				

```
int getRandomNumber()
{
    return 4;  // chosen by fair dice roll.
               // guaranteed to be random.
}
```

Certificate Chain



Revocation lists



An example…

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Purged CRLs???

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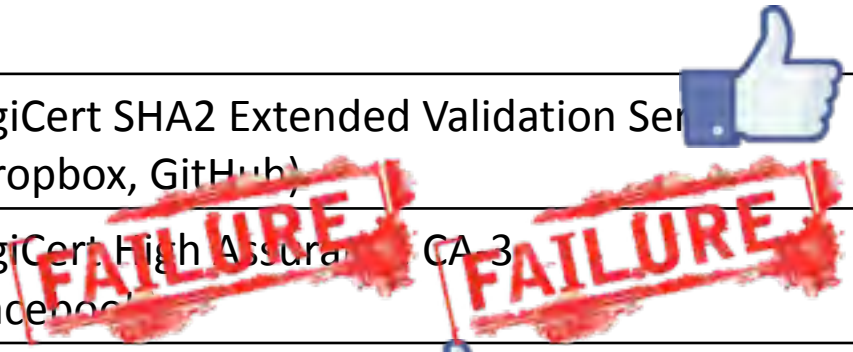
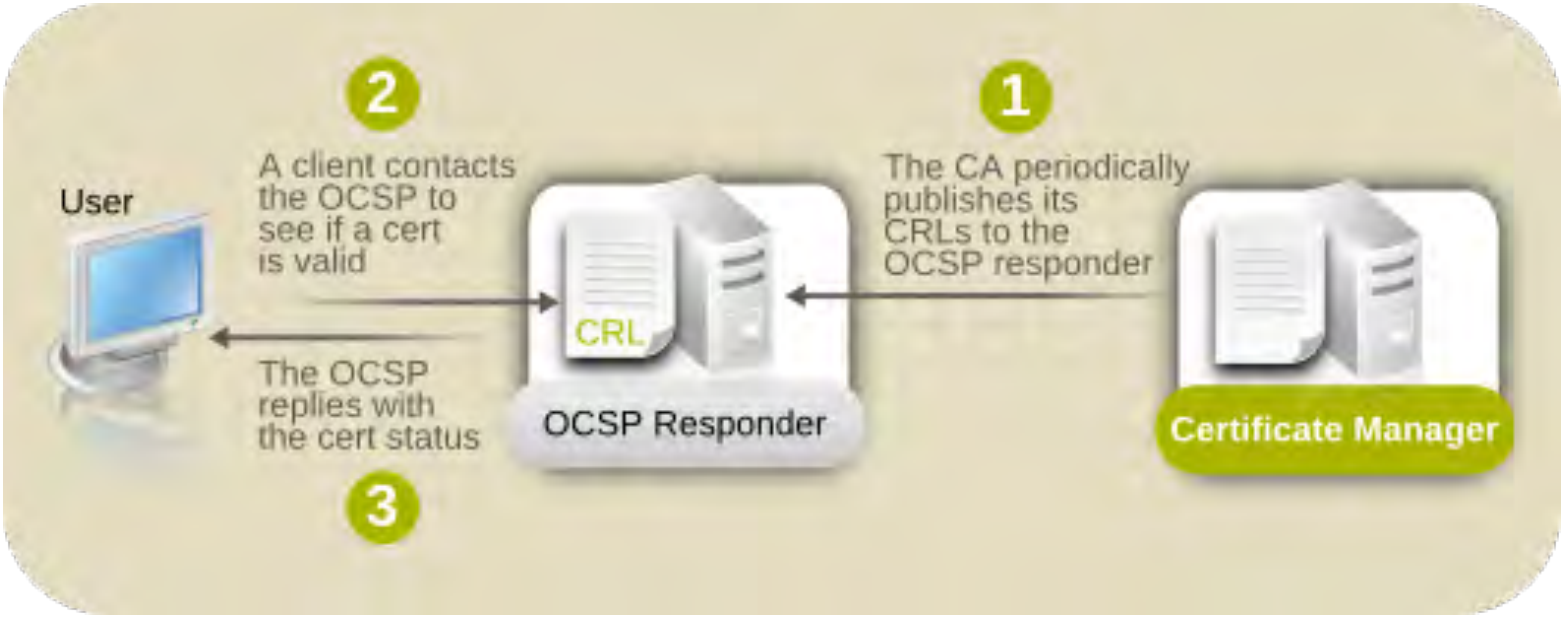
X.509 defines one method of certificate revocation. This method involves each CA periodically issuing a signed data structure called a certificate revocation list (CRL). A CRL is a time stamped list identifying revoked certificates which is signed by a CA or CRL issuer and made freely available in a public repository. Each revoked certificate is identified in a CRL by its certificate serial number. When a certificate-using system uses a certificate (e.g., for verifying a remote user's digital signature), that system not only checks the certificate signature and validity but also acquires a suitably-recent CRL and checks that the certificate serial number is not on that CRL. The meaning of "suitably-recent" may vary with local policy, but it usually means the most recently-issued CRL. A new CRL is issued on a regular periodic basis (e.g., hourly, daily, or weekly). An entry is added to the CRL as part of the next update following notification of revocation. An entry MUST NOT be removed from the CRL until it appears on one regularly scheduled CRL issued beyond the revoked certificate's validity period.

Purged CRLs???

CRL	ID más viejo	Fecha
DigiCert SHA2 Extended Validation Ser (Dropbox, GitHub)	13121303190 2Z0 (330 certs)	13/12/2013 03:19
DigiCert High Assura CA-3 (Facebo	12061417251 6Z0 14092719060 2Z0	14/06/2012 17:25 27/09/2014 19:06
GeoTrust Global CA (Google)	02052113480 4Z0 (9 certs)	21/05/2002 13:48
GlobalSign Organization Validation CA - SHA256 - G2 (LogmeIn)	14033102503 8Z0 (637 certs)	31/03/2014 02:50
VeriSign Class 3 Extended Validation SSL CA (Microsoft, Paypal, Twitter)	12120402025 3Z0 (1709 certs)	04/12/2012 02:02
VeriSign Class 3 Secure Server CA - G3 (Yahoo)	10101005524 2Z0 (41120 certs)	10/10/2010 05:52



Online Certificate Status Protocol



What if I can't connect?

https://www.grc.com/revocation/implementations.htm

DEMO

Let's Go!

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Conclusions & Recommendations

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Facts

- Time synchronisation isn't managed securely by most operating system vendors.
- Many security protections relies in time. If an attacker can control the local clock, lots of things can go wrong.

What to do

- Configure NTP synchronisation in a secure way (Microsoft does):
  - Signature.
  - Maximum drift.
- Block SSL certificates which expiry date is before the browser build date or the last update (Chrome does).

Thanks! Questions?

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