Security and Stuff

Geoff Huston

APNIC

What I'm working on at the moment..

Design Team Review of Plan for DNS Root Zone KSK Change

Follow Updates

Open Date	Close Date	Staff Report Due
6 Aug 2015 23:59 UTC	5 Oct 2015 23:59 UTC	19 Oct 2015 23:59 UTC

Comments Closed — Report of Public Comments

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- Comments Forum
- Report of Public Comments

Section I: Description, Explanation & Purpose
Section II: Background
Section III: Relevant Resources
Section IV: Additional Information
Section V: Reports
Staff Contact

Brief Overview

Purpose: This public comment proceeding seeks to review the Design Team's findings to date related to issues and plans for changing the cryptographic key used to originate the DNSSEC chain of trust.

Current Status: The Design Team has generated a preliminary report and will accept wider review.

Next Steps: After the public comment proceeding, the Design Team will finalize its report and plan for changing the cryptographic key.

Report of Public Comments

Section I: Description, Explanation, and Purpose

A design team consisting of seven independent DNS experts has produced a report examining previously proposed schemes for changing the DNSSEC root zone KSK, along with considerations related to Internet realities, in preparation for finalizing plans to change the current Root Zone KSK.

Section II: Background

In 2010, the Root Zone Management Partners (ICANN, Verisign, and NTIA) introduced the DNS Security Extensions to the operational root zone. After five years of operation, there is a requirement to change the top most cryptographic key in the hierarchy, the key called the Root Zone Key Signing Key. The challenge is to ensure that all copies of the publicly distributed key

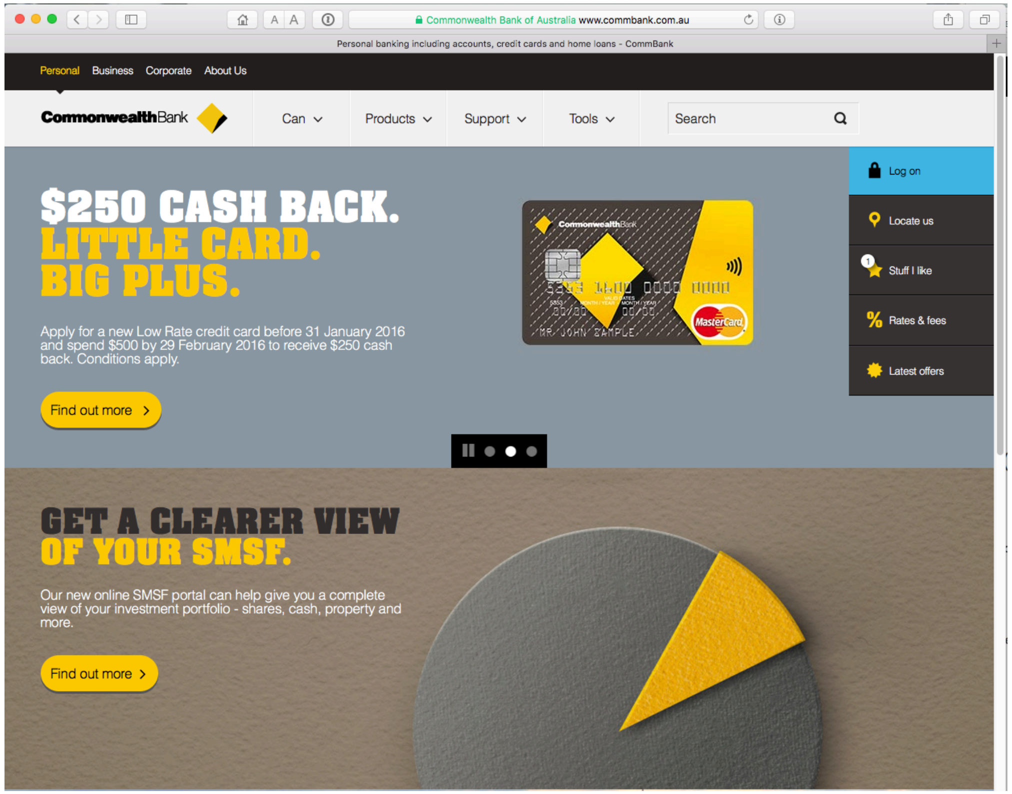
Why is this important?

- Rolling the value of the Key Signing key of the DNS is perhaps one of the more esoteric aspects of the management of Internet infrastructure
- So why should you care that this is done well?
- And what’s the problem if it all goes wrong?

Lets take a step back

Security on the Internet

How do you know that you are going to where you thought you were going to?



Connection Steps

Client:

DNS Query:

www.commbank.com.au?

DNS Response

104.97.235.12

TCP Session:

TCP Connect 104.97.235.12, port 443

Hang on…

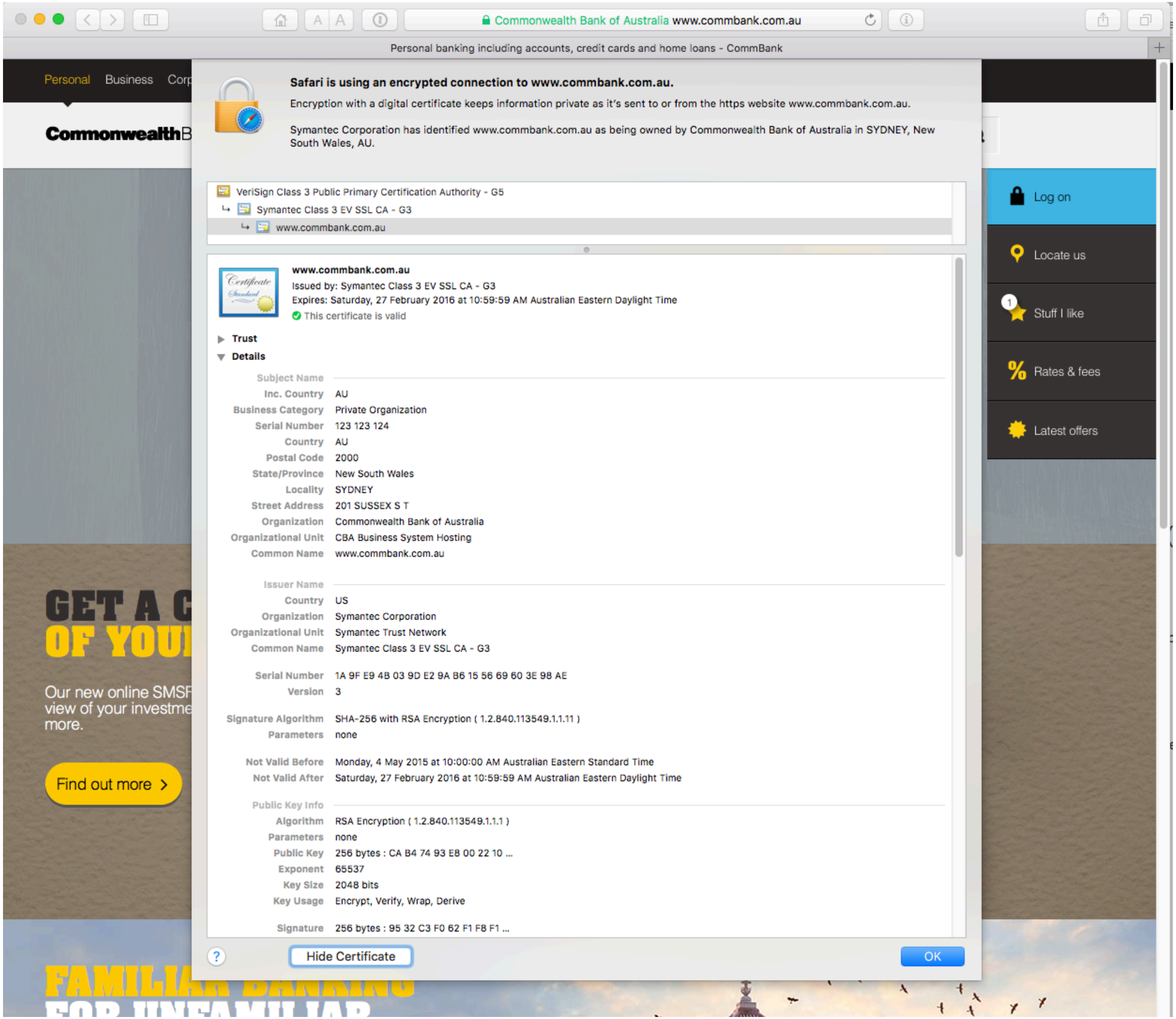
```
$ dig -x 104.97.235.12 +short
a104-97-235-12.deploy.static.akamaitechnologies.com.
```

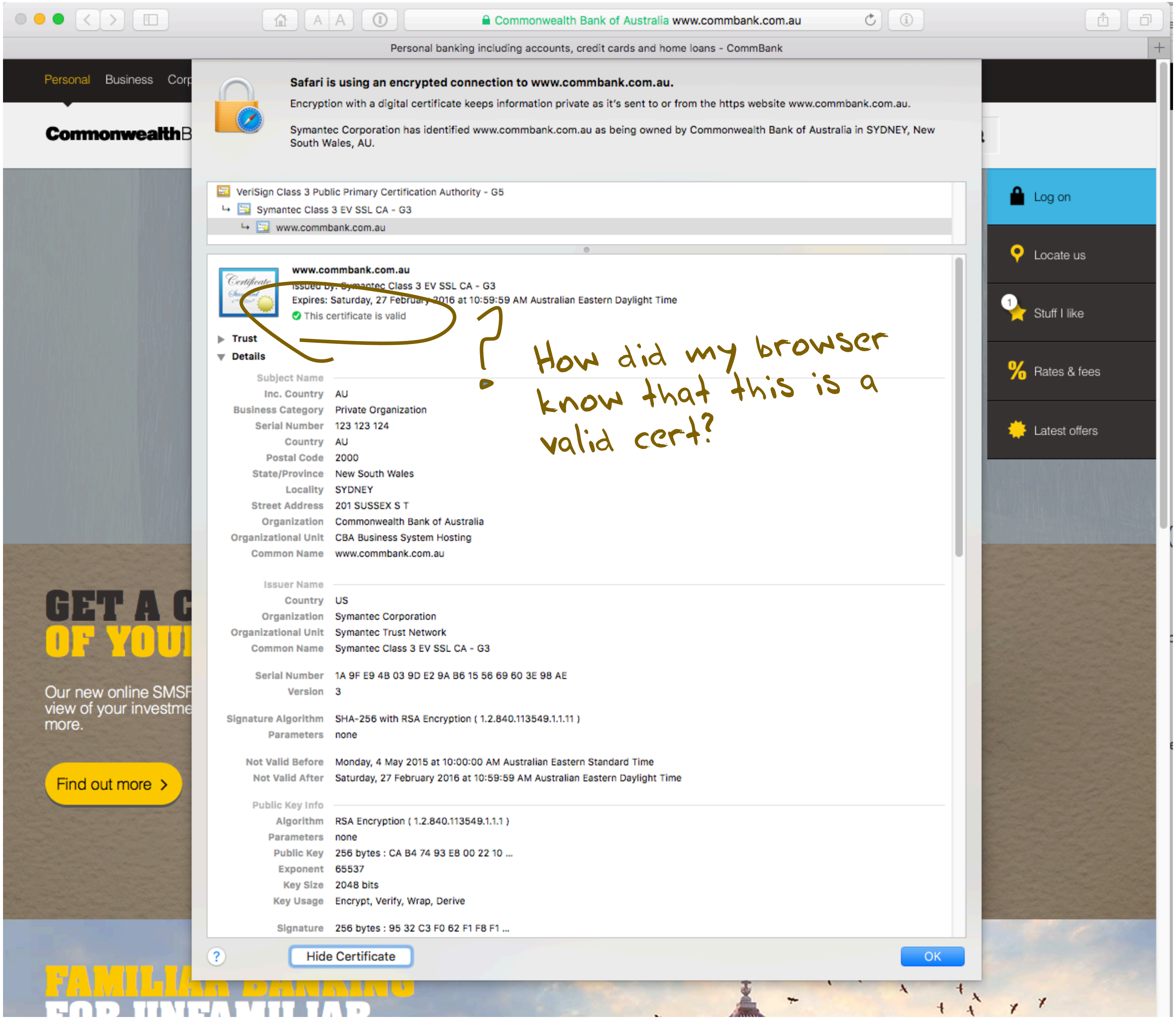
That's not an IP addresses that was allocated to the Commonwealth Bank.

The Commonwealth Bank of Australia has 140.168.0.0 - 140.168.255.255 and 203.17.185.0 - 203.17.185.255

So why should my browser trust that 104.97.235.12 is really the "proper" web site for the Commonwealth Bank of Australia and not some dastardly evil scam?

How can my browser tell the difference between an intended truth and a lie?


Commonwealth Bank of Australia www.commbank.com.au
Personal banking including accounts, credit cards and home loans - CommBank
Personal
Business
Safari is using an encrypted connection to www.commbank.com.au.
Encryption with a digital certificate keeps information private as it's sent to or from the https website www.commbank.com.au.
Symantec Corporation has identified www.commbank.com.au as being owned by Commonwealth Bank of Australia in SYDNEY, New South Wales, AU.
VeriSign Class 3 Public Primary Certification Authority - G5
Symantec Class 3 EV SSL CA - G3
www.commbank.com.au
www.commbank.com.au
Issued by: Symantec Class 3 EV SSL CA - G3
Expires: Saturday, 27 February 2016 at 10:59:59 AM Australian Eastern Daylight Time
This certificate is valid
Trust
Details
Subject Name
Inc. Country AU
Business Category Private Organization
Serial Number 123 123 124
Country AU
Postal Code 2000
State/Province New South Wales
Locality SYDNEY
Street Address 201 SUSSEX S T
Organization Commonwealth Bank of Australia
Organizational Unit CBA Business System Hosting
Common Name www.commbank.com.au
Issuer Name
Country US
Organization Symantec Corporation
Organizational Unit Symantec Trust Network
Common Name Symantec Class 3 EV SSL CA - G3
Serial Number 1A 9F E9 4B 03 9D E2 9A B6 15 56 69 60 3E 98 AE
Version 3
Signature Algorithm SHA-256 with RSA Encryption (1.2.840.113549.1.1.11)
Parameters none
Not Valid Before Monday, 4 May 2015 at 10:00:00 AM Australian Eastern Standard Time
Not Valid After Saturday, 27 February 2016 at 10:59:59 AM Australian Eastern Daylight Time
Public Key Info
Algorithm RSA Encryption (1.2.840.113549.1.1.1)
Parameters none
Public Key 256 bytes : CA B4 74 93 E8 00 22 10 ...
Exponent 65537
Key Size 2048 bits
Key Usage Encrypt, Verify, Wrap, Derive
Signature 256 bytes : 95 32 C3 F0 62 F1 F8 F1 ...
Hide Certificate
OK
Log on
Locate us
Stuff I like
Rates & fees
Latest offers
Find out more


Commonwealth Bank of Australia www.commbank.com.au
Personal banking including accounts, credit cards and home loans - CommBank
Personal
Business
Safari is using an encrypted connection to www.commbank.com.au.
Encryption with a digital certificate keeps information private as it's sent to or from the https website www.commbank.com.au.
Symantec Corporation has identified www.commbank.com.au as being owned by Commonwealth Bank of Australia in SYDNEY, New South Wales, AU.
VeriSign Class 3 Public Primary Certification Authority - G5
Symantec Class 3 EV SSL CA - G3
www.commbank.com.au
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Expires: Saturday, 27 February 2016 at 10:59:59 AM Australian Eastern Daylight Time
This certificate is valid
Trust
Details
Subject Name
Inc. Country AU
Business Category Private Organization
Serial Number 123 123 124
Country AU
Postal Code 2000
State/Province New South Wales
Locality SYDNEY
Street Address 201 SUSSEX S T
Organization Commonwealth Bank of Australia
Organizational Unit CBA Business System Hosting
Common Name www.commbank.com.au
Issuer Name
Country US
Organization Symantec Corporation
Organizational Unit Symantec Trust Network
Common Name Symantec Class 3 EV SSL CA - G3
Serial Number 1A 9F E9 4B 03 9D E2 9A B6 15 56 69 60 3E 98 AE
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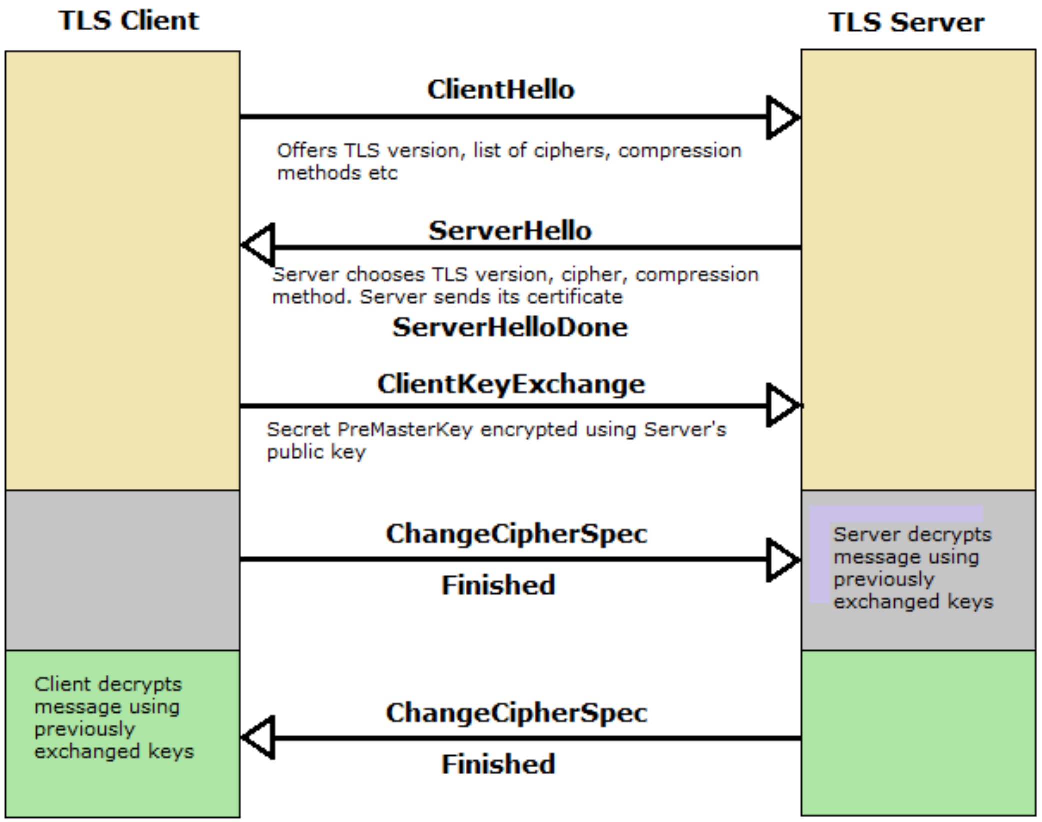
Signature 256 bytes : 95 32 C3 F0 62 F1 F8 F1 ...
Hide Certificate
OK
Log on
Locate us
Stuff I like
Rates & fees
Latest offers
Find out more
How did my browser know that this is a valid cert?

Domain Name Certification

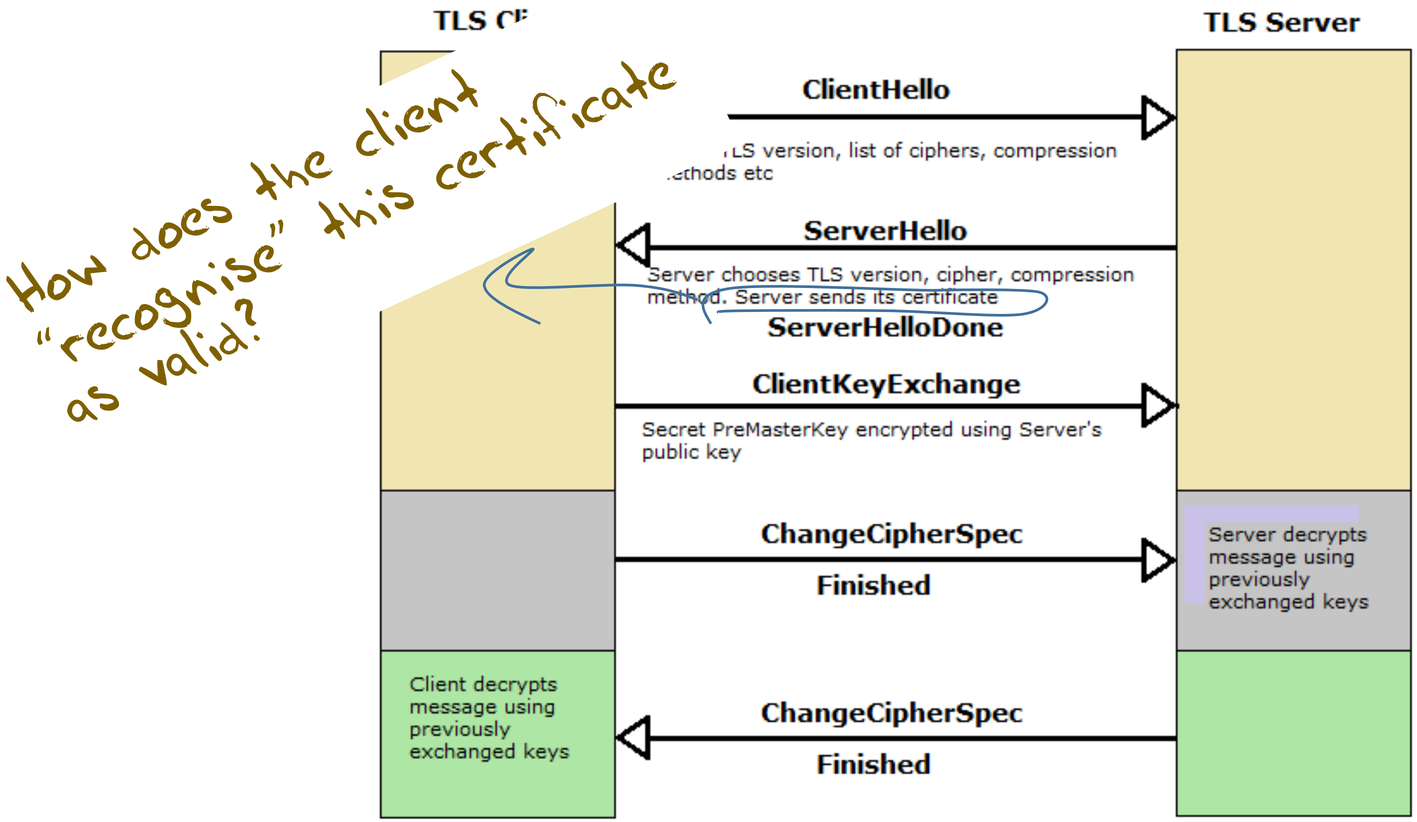
- The Commonwealth Bank of Australia has generated a key pair
- And they passed a certificate signing request to a company called "Verisign"
- Who is willing to vouch (in a certificate) that the entity who goes by the domain name of www.commbank.com.au has a certain public key value
- So if I can associate this public key with a connection then I have a high degree of confidence that I've connected to www.commbank.com.au, as long as I am prepared to trust Versign and the certificates that they issue

TLS Connections



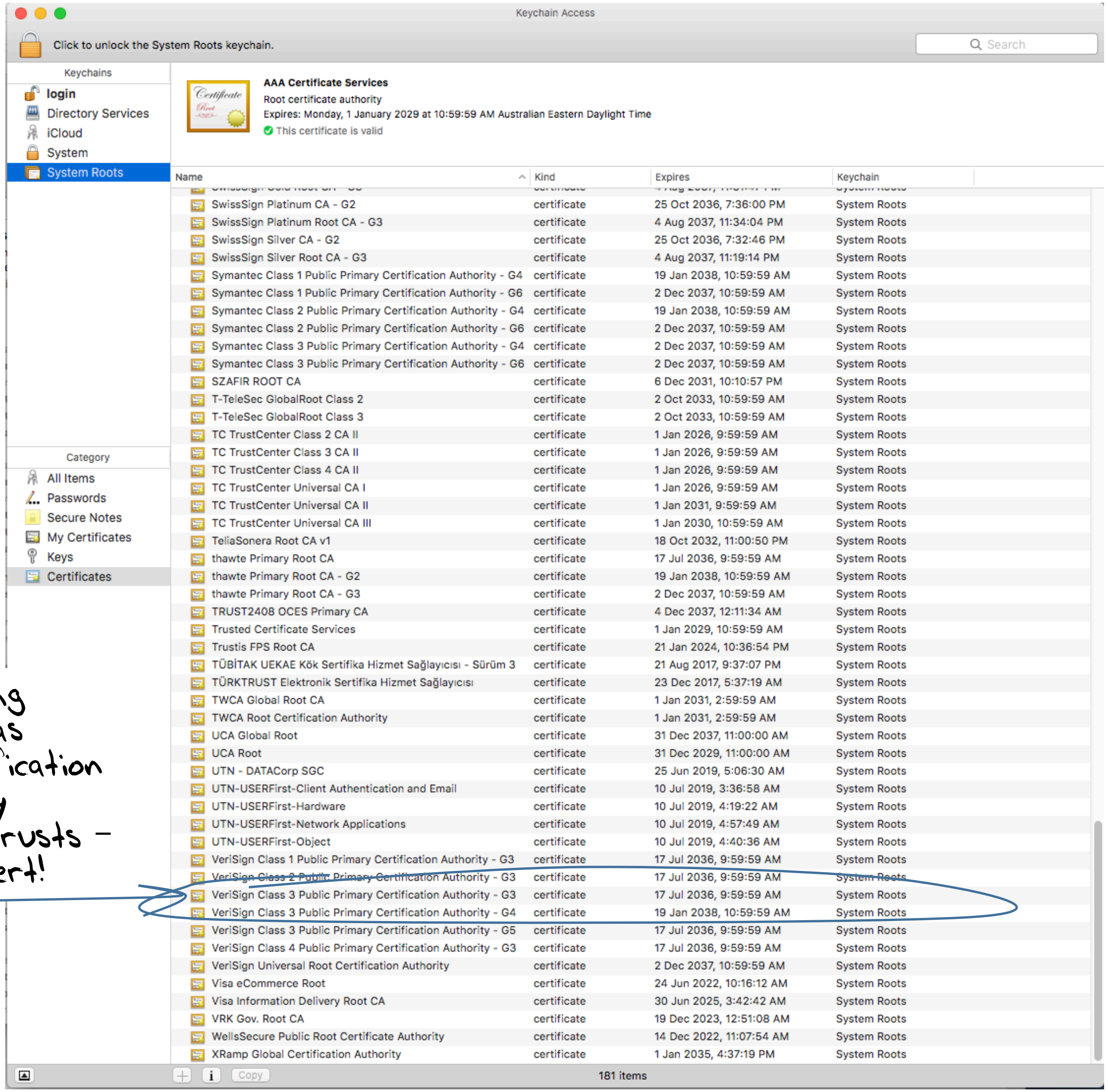
https://rhsecurity.wordpress.com/tag/tls/

TLS Connections



https://rhsecurity.wordpress.com/tag/tls/

Local Trust

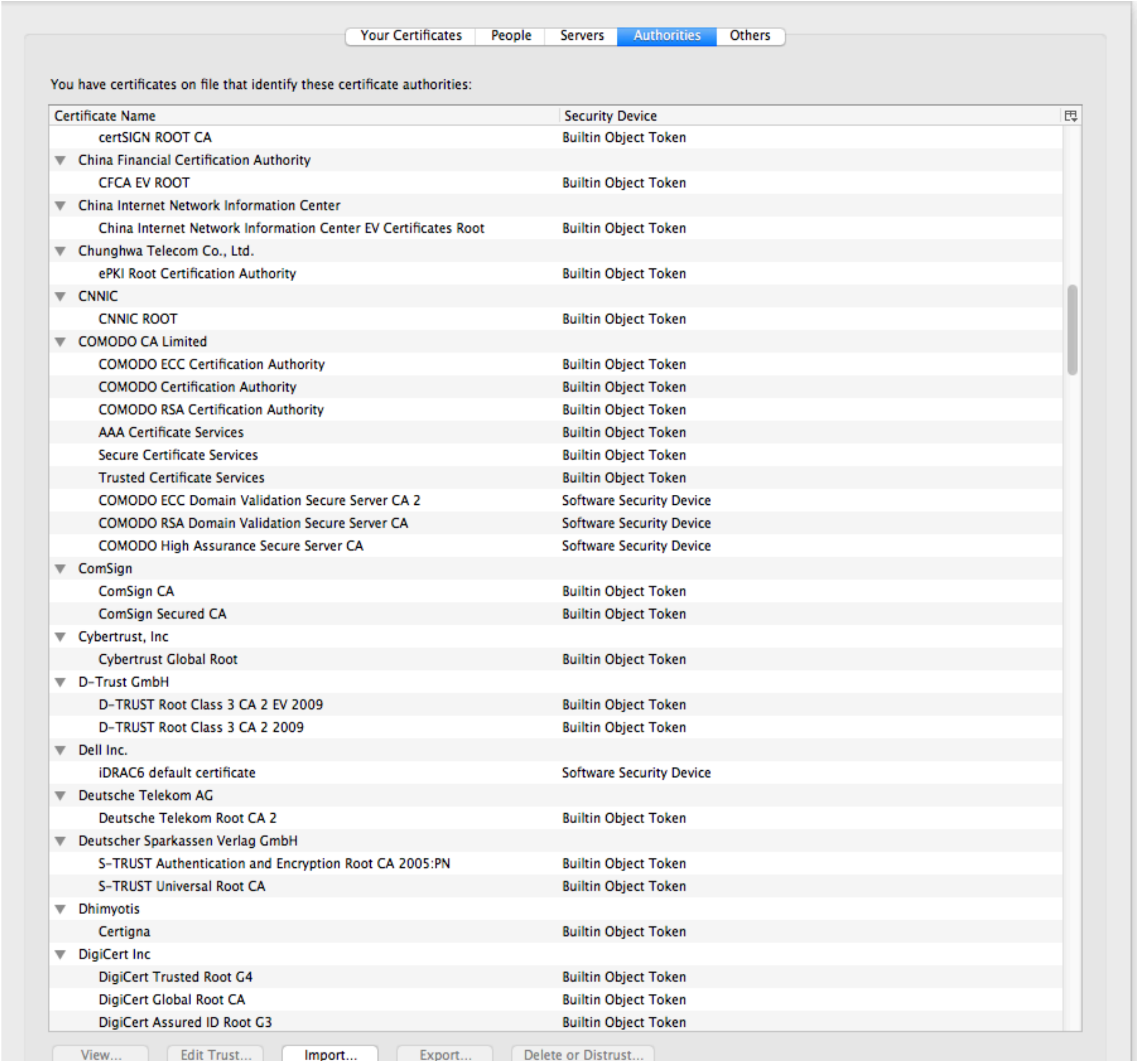


The cert i'm being asked to trust was issued by a certification authority that my browser already trusts – so i trust that cert!

Local Trust

That's a big list of people to Trust

Are they all trustable?



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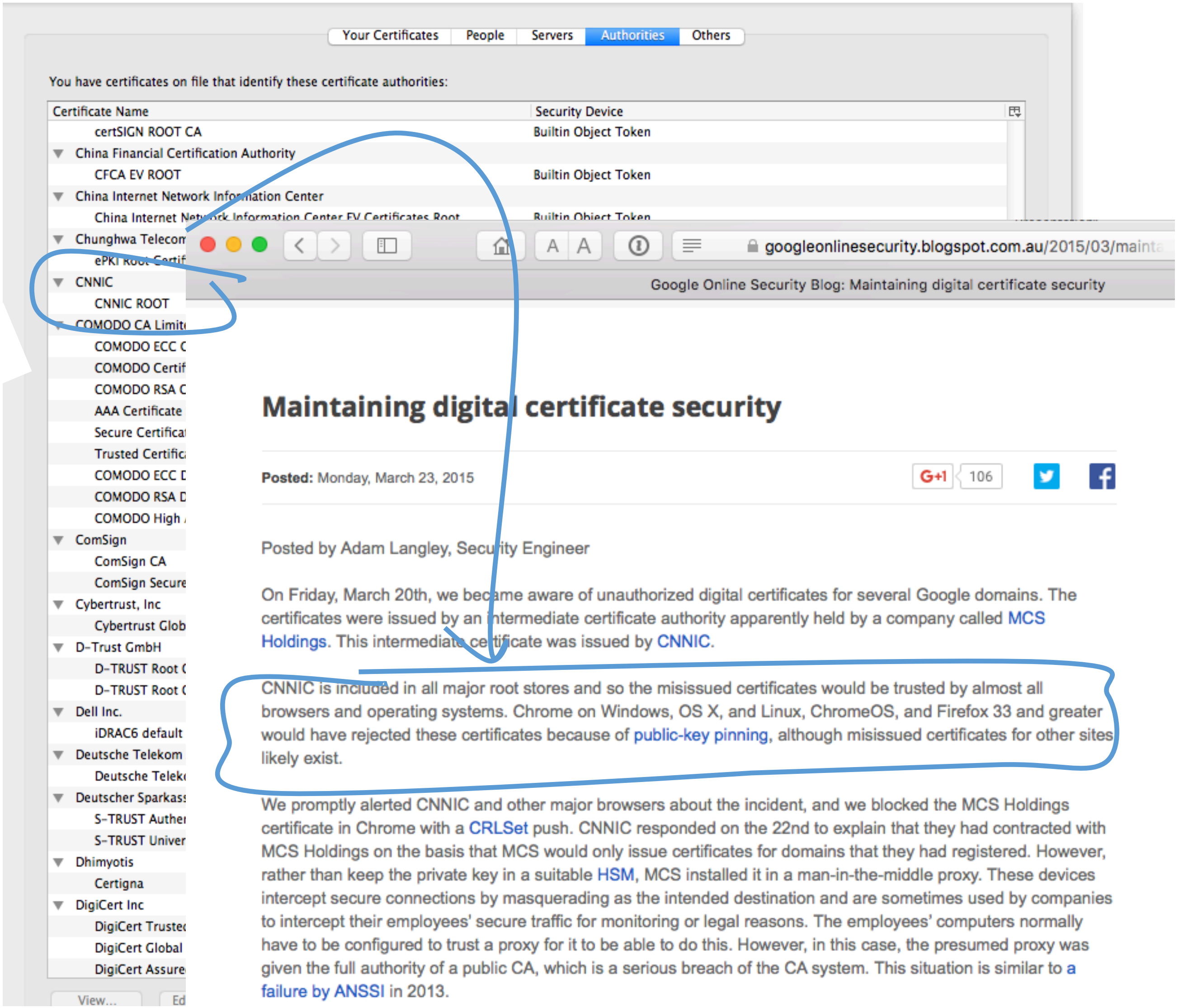
Evidently Not!



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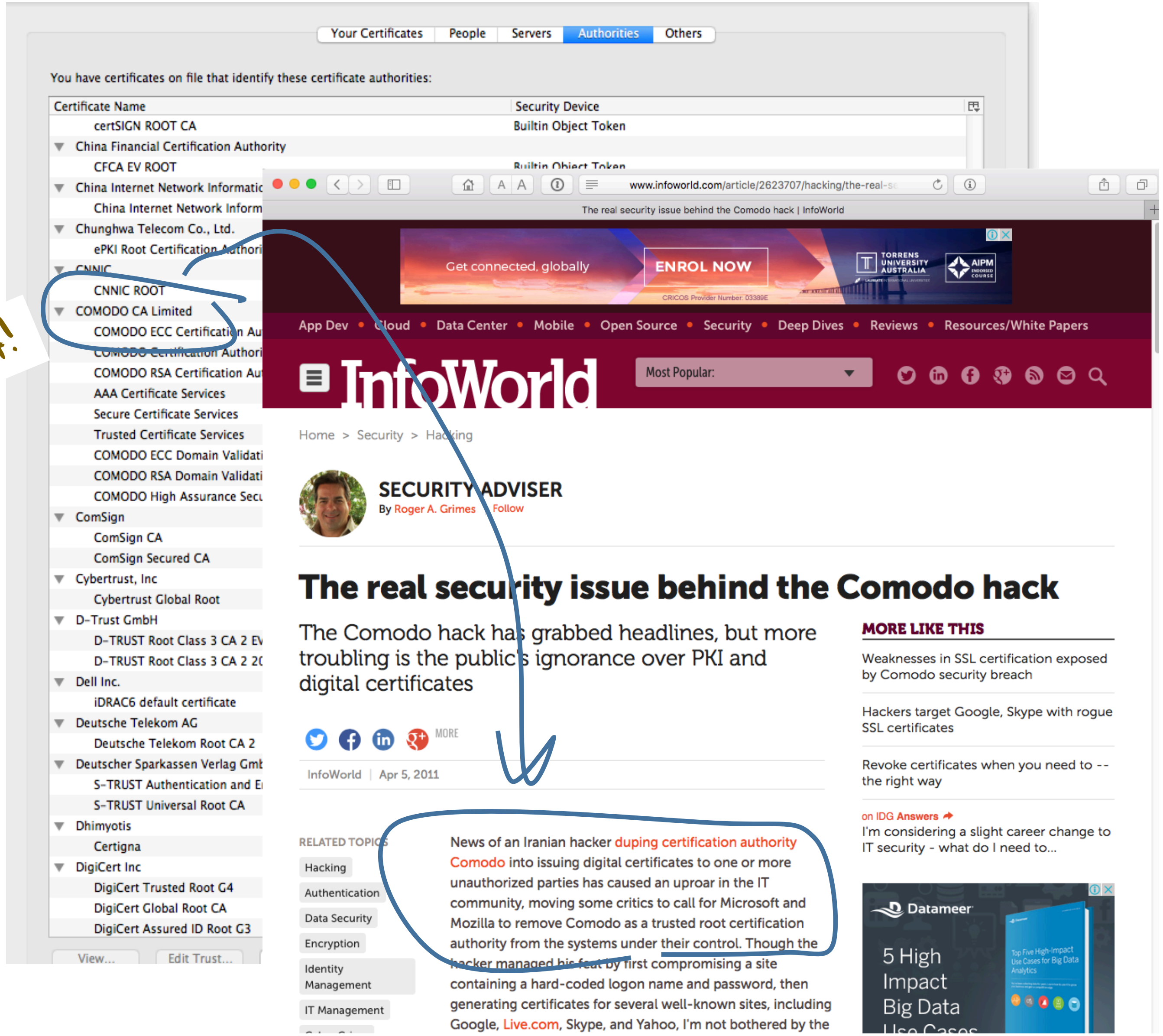


With unpleasant consequences
when it all goes wrong

With unpleasant consequences when it all goes wrong

Société Générale, BNP Paribas and Crédit Agricole, are considered integral actors in the French economy, lending

VOLATILITY IS THE NEW MARKET NORM
Large swings in share prices are more common now than at any other time in recent stock market history. *PAGE 16*

Iranian activists feel the chill as hacker taps into e-mails

BY SOMINI SENGUPTA

He claims to be 21 years old, a student of software engineering in Tehran who reveres Ayatollah Ali Khamenei and despises dissidents in his country.

He sneaked into the computer systems of a security firm on the outskirts of Amsterdam. He created fake credentials that could allow someone to spy on Internet connections that appeared to be secure. He then shared that bounty with people he declines to identify.

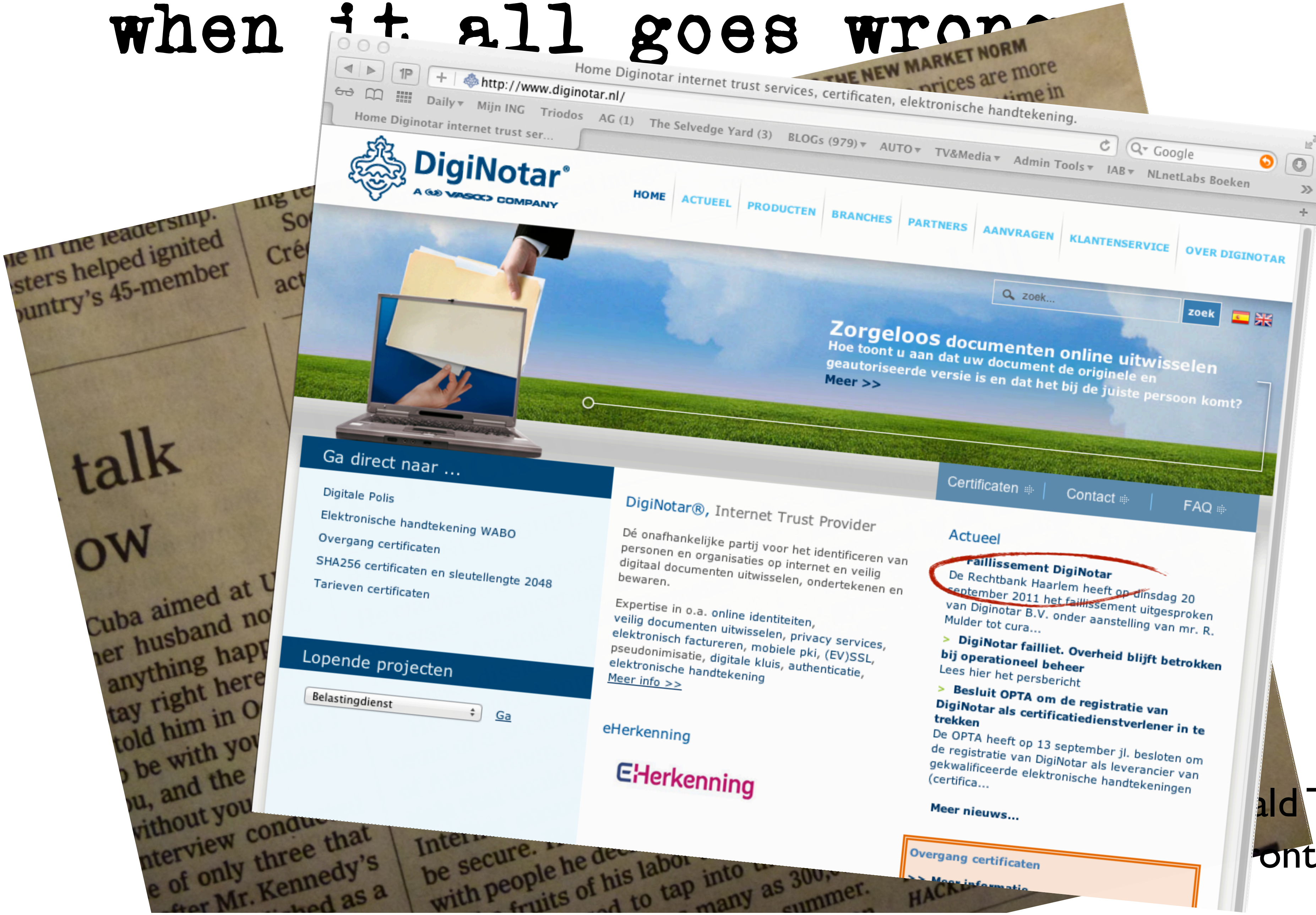
online security mechanism that is trusted by Internet users all over the world.

Comodohacker, as he calls himself, insists that he acted on his own and is unperturbed by the notion that his work might have been used to spy on anti-government compatriots.

"I'm totally independent," he said in an e-mail exchange with The New York Times. "I just share my findings with some people in Iran. They are free to do anything they want with my findings and things I share with them, but I'm not responsible."

International Herald Tribune
Sep 13, 2011 Front Page

With unpleasant consequences when it all goes wrong



ald Tribune
ont Page

What's going wrong here?

- The TLS handshake cannot specify WHICH CA should be used to validate the digital certificate
- Your browser will allow ANY CA to be used to validate a certificate

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- The TLS handshake cannot specify WHICH CA should be used t[illegible]igital certificate
- [illegible]owser will allow ANY CA to be used to validate a certificate

WOW! That's astonishingly bad!

What's going wrong here?

- The TLS handshake cannot spec… …HICH CA should be us… …ital certificate

WOW! That's astonishingly bad!

- …wser will allow ANY CA to be used to val…

Here's a lock – it might be the lock on your front door for all i know.

it might LOOK secure, but don't worry – literally ANY key can open it!

What's going wrong here?

- There is no incentive for quality in the CA marketplace
- Why pay more for any certificate when the entire CA structure is only as strong as the weakest CA
- And you browser trusts a LOT of CAs!
  - About 60 – 100 CA's
  - About 1,500 Subordinate RA's
  - Operated by 650 different organisations

See the EFF SSL observatory
http://www.eff.org/files/DefconSSLiverse.pdf

In a commercial environment

Where CA's compete with each other for market share

And quality offers no protection

Than what 'wins' in the market?

Where now?

Option A: Take all the money out of the system!

Where now?

Option A: Take all the money out of the system!

Will the automation of the Cert issuance coupled with a totally free service make the overall environment more or less secure?

We're probably going to find out real soon!

Where now?

Option B: White Listing and Pinning with HSTS

https://code.google.com/p/chromium/codesearch#chromium/src/net/http/transport_security_state_static.json

Where now?

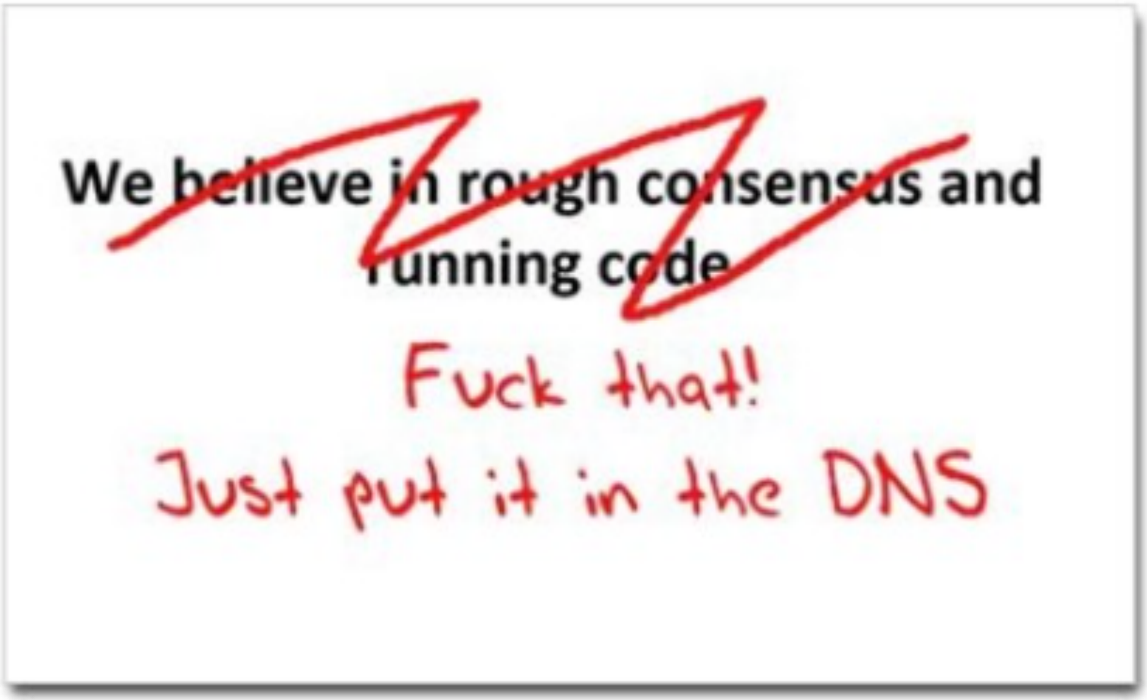
Option B: White Listing and Pinning with HSTS

https://code.google.com/p/chromium/codesearch#chromium/src/net/http/transport_security_state_static.json

This approach appears to be completely unscaleable!

Where now?

Option C: Use the DNS!



cafepress.com/nxdomain

Seriously

Where better to find out the public key associated with a DNS name than to look it up in the DNS?

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- Why not query the DNS for the HSTS record (pinning record)?

Seriously

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- Why not query the DNS for the HSTS record?
- Why not query the DNS for the issuer CA?

Seriously

Where better to find out the public key associated with a DNS name than to look it up in the DNS?

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- Why not query the DNS for the hash of the domain name cert?

Seriously

Where better to find out the public key associated with a DNS name than to look it up in the DNS?

- Why not query the DNS for the HSTS record?
- Why not query the DNS for the issuer CA?
- Why not query the DNS for the hash of the domain name cert?
- Why not query the DNS for the domain name public key cert as a simple self-signed cert?

Seriously

Where better to find out the pu[illegible] associated with a DNS name than to [illegible] in the DNS?

- Why not query th[illegible] the HSTS record?
- Why not [illegible] DNS for the issuer CA?
- W[illegible]ry the DNS for the hash of the domain [illegible]cert?
- Why not query the DNS for the domain name public key cert as a simple self-signed cert?

Who needs CA's anyway?

DANE

- Using the DNS to associated domain name public key certificates with domain name

[Docs] [txt|pdf] [draft-ietf-dane-p...] [Diff1] [Diff2] [Errata]

Updated by: 7218, 7671 PROPOSED STANDARD
Errata Exist

Internet Engineering Task Force (IETF)
Request for Comments: 6698
Category: Standards Track
ISSN: 2070-1721
August 2012

P. Hoffman
VPN Consortium
J. Schlyter
Kirei AB

**The DNS-Based Authentication of Named Entities (DANE)
Transport Layer Security (TLS) Protocol: TLSA**

Abstract

Encrypted communication on the Internet often uses Transport Layer Security (TLS), which depends on third parties to certify the keys used. This document improves on that situation by enabling the administrators of domain names to specify the keys used in that domain's TLS servers. This requires matching improvements in TLS client software, but no change in TLS server software.

Status of This Memo

This is an Internet Standards Track document.

DANE

TLSA RR

2.3. TLSA RR Examples

An example of a hashed (SHA-256) association of a PKIX CA certificate:

```
_443._tcp.www.example.com. IN TLSA (
   0 0 1 d2abde240d7cd3ee6b4b28c54df034b9
         7983a1d16e8a410e4561cb106618e971 )
```

CA Cert Hash

An example of a hashed (SHA-512) subject public key association of a PKIX end entity certificate:

```
_443._tcp.www.example.com. IN TLSA
   1 1 2 92003ba34942dc74152e2f2c408d29ec
         a5a520e7f2e06bb944f4dca346baf63c
         1b177615d466f6c4b71c216a50292bd5
         8c9ebdd2f74e38fe51ffd48c43326cbc )
```

EE Cert Hash

An example of a full certificate association of a PKIX trust anchor:

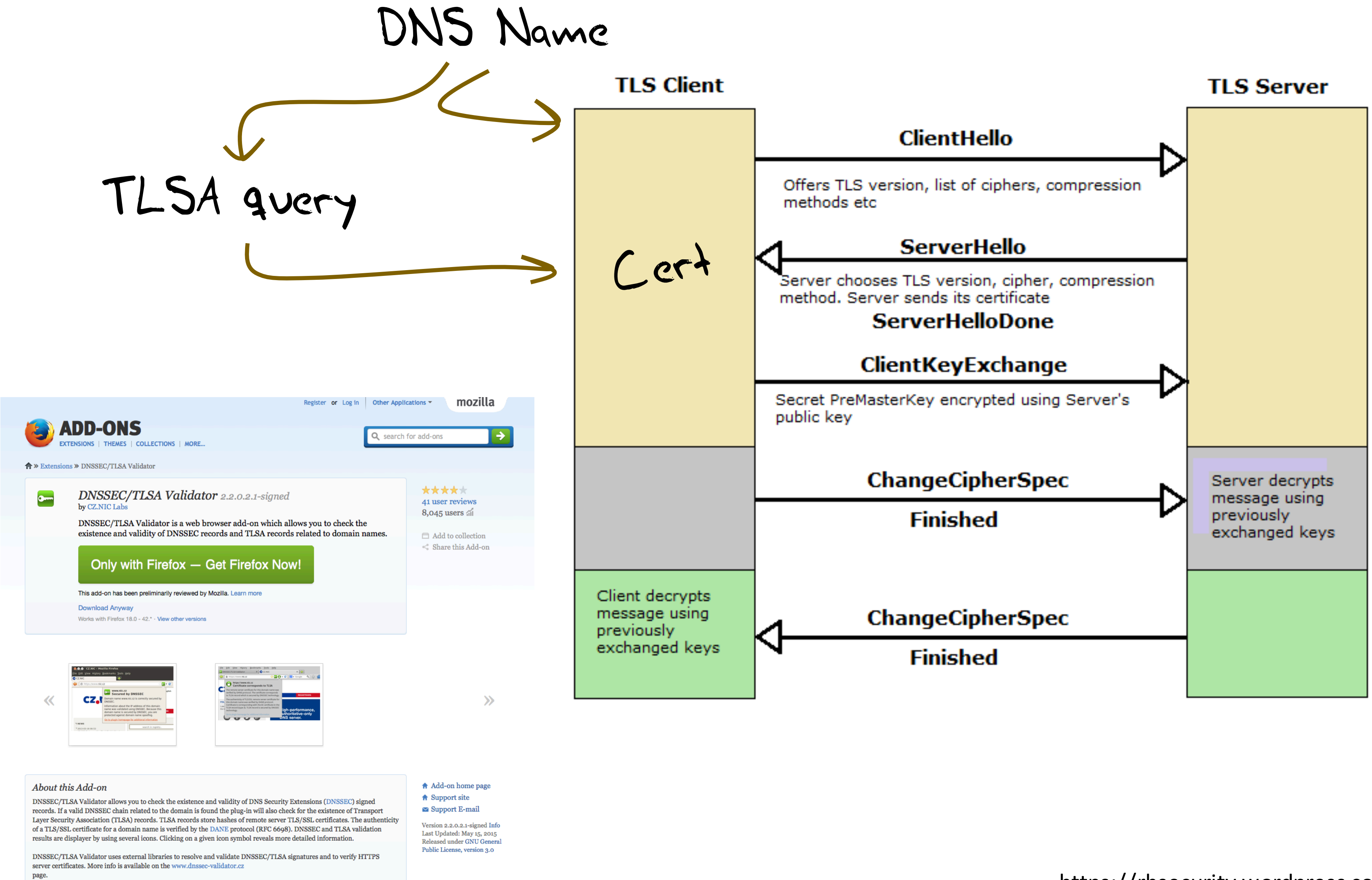
```
_443._tcp.www.example.com. IN TLSA
   2 0 0 30820307308201efa003020102020... )
```

Trust Anchor

TLS with DANE

- Client receives server cert in Server Hello
  - *Client lookups the DNS for the TLSA Resource Record of the domain name*
  - *Client validates the presented certificate against the TLSA RR*
- Client performs Client Key exchange

TLS Connections



https://rhsecurity.wordpress.com/tag/tls/

Just one problem…

- The DNS is full of liars and lies!
- And this can compromise the integrity of public key information embedded in the DNS
- Unless we fix the DNS we are no better off than before!

- We need to allow users to validate DNS responses for themselves
- And for this we need a Secure DNS framework
- Which we have – and its called DNSSEC

DNSSEC Interlocking Signatures

. (root)

. Key-Signing Key – signs over

. Zone-Signing Key – signs over

DS for .com (Key-Signing Key)

.com

.com Key-Signing Key – signs over

.com Zone-Signing Key – signs over

DS for example .com (Key-Signing Key)

.example.com

example.com Key-Signing Key – signs over

example.com Zone-Signing Key – signs over

www.example.com

www.example.com

DNSSEC Interlocking Signatures

. (root)

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DS for .com (Key-Signing Key)

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.com Key-Signing Key – signs over

.com Zone-Signing Key – signs over

DS for example .com (Key-Signing Key)

.example.com

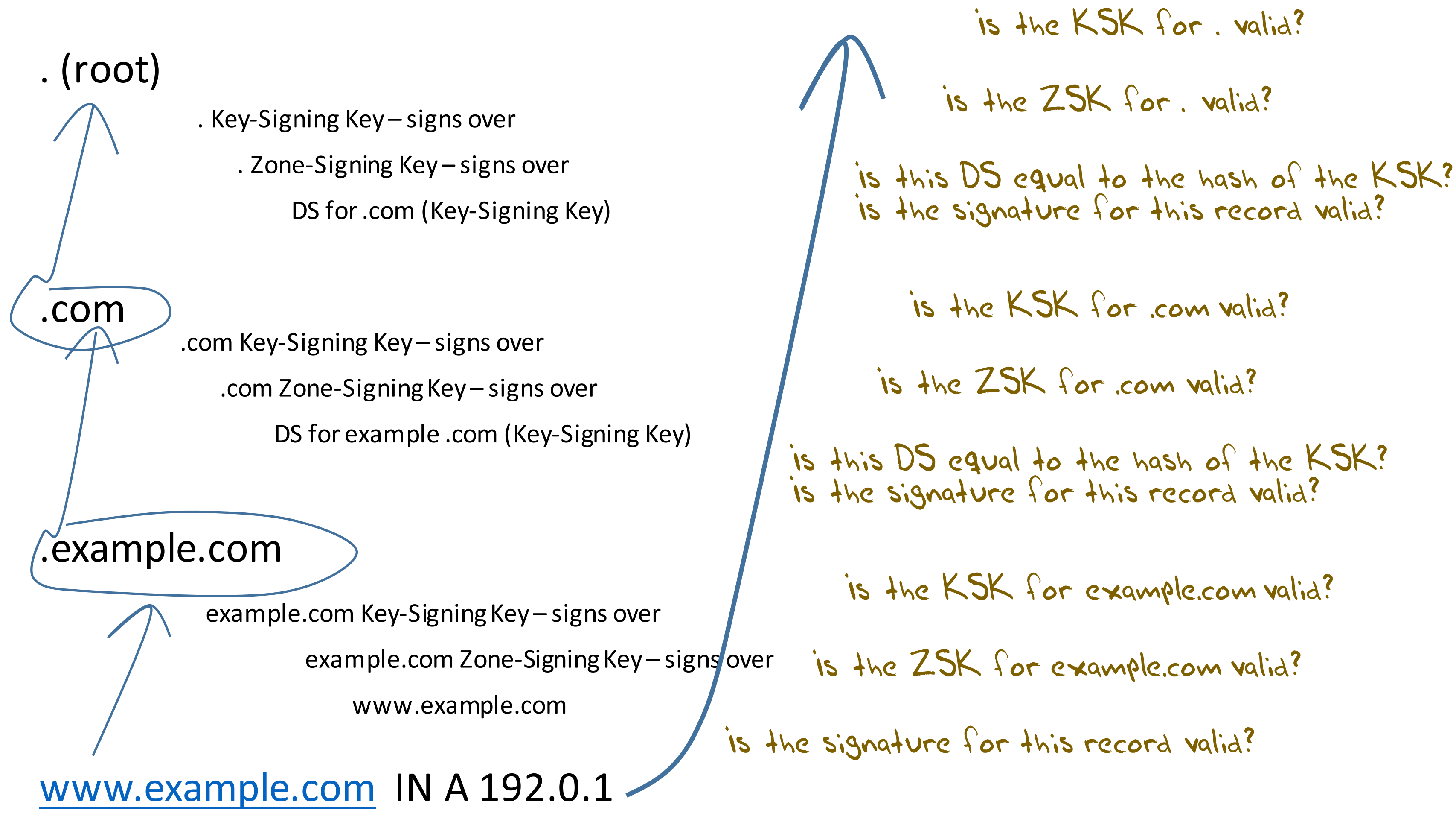
example.com Key-Signing Key – signs over

example.com Zone-Signing Key – signs over

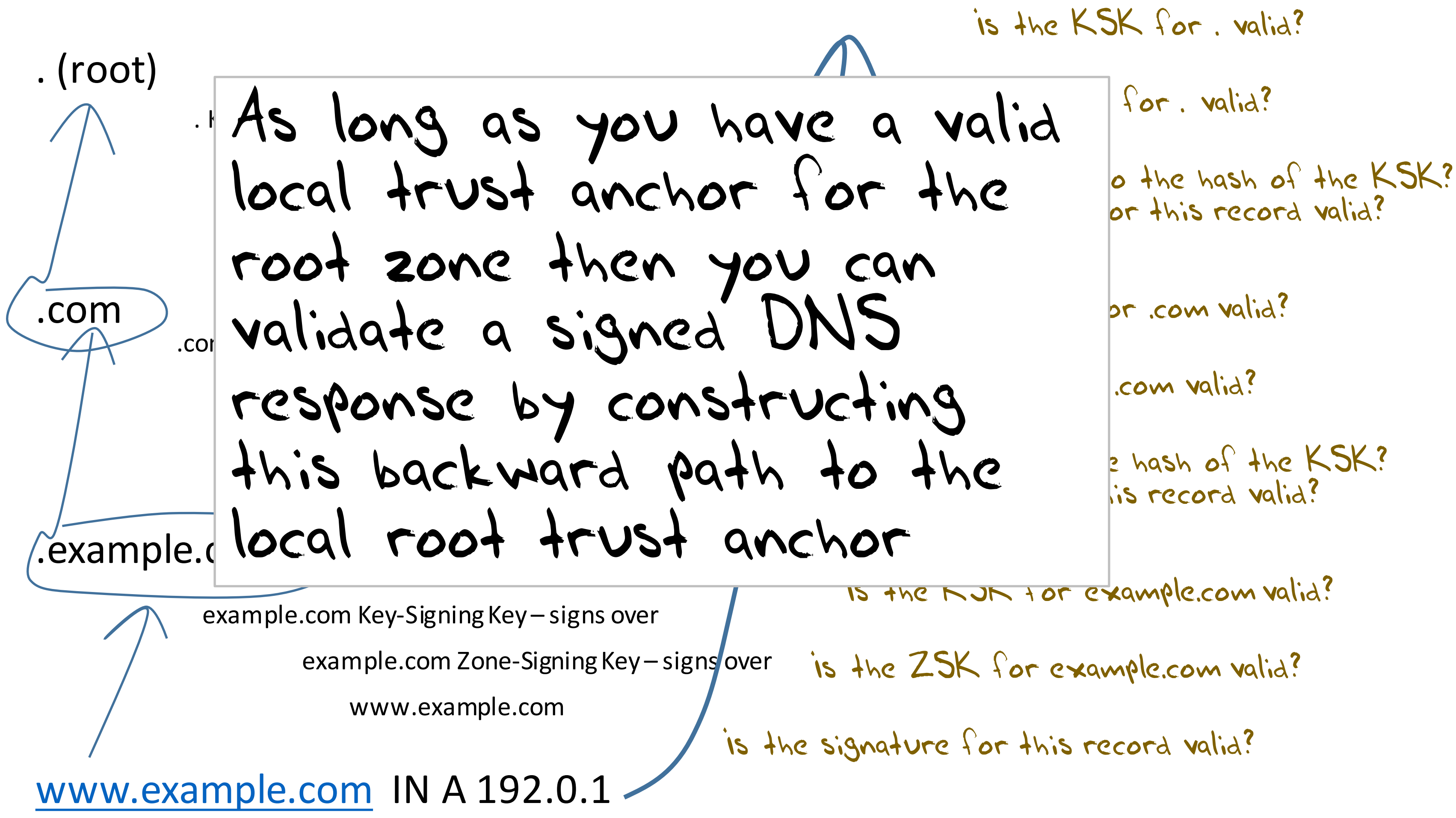
www.example.com

www.example.com IN A 192.0.1

DNSSEC Interlocking Signatures



DNSSEC Interlocking Signatures

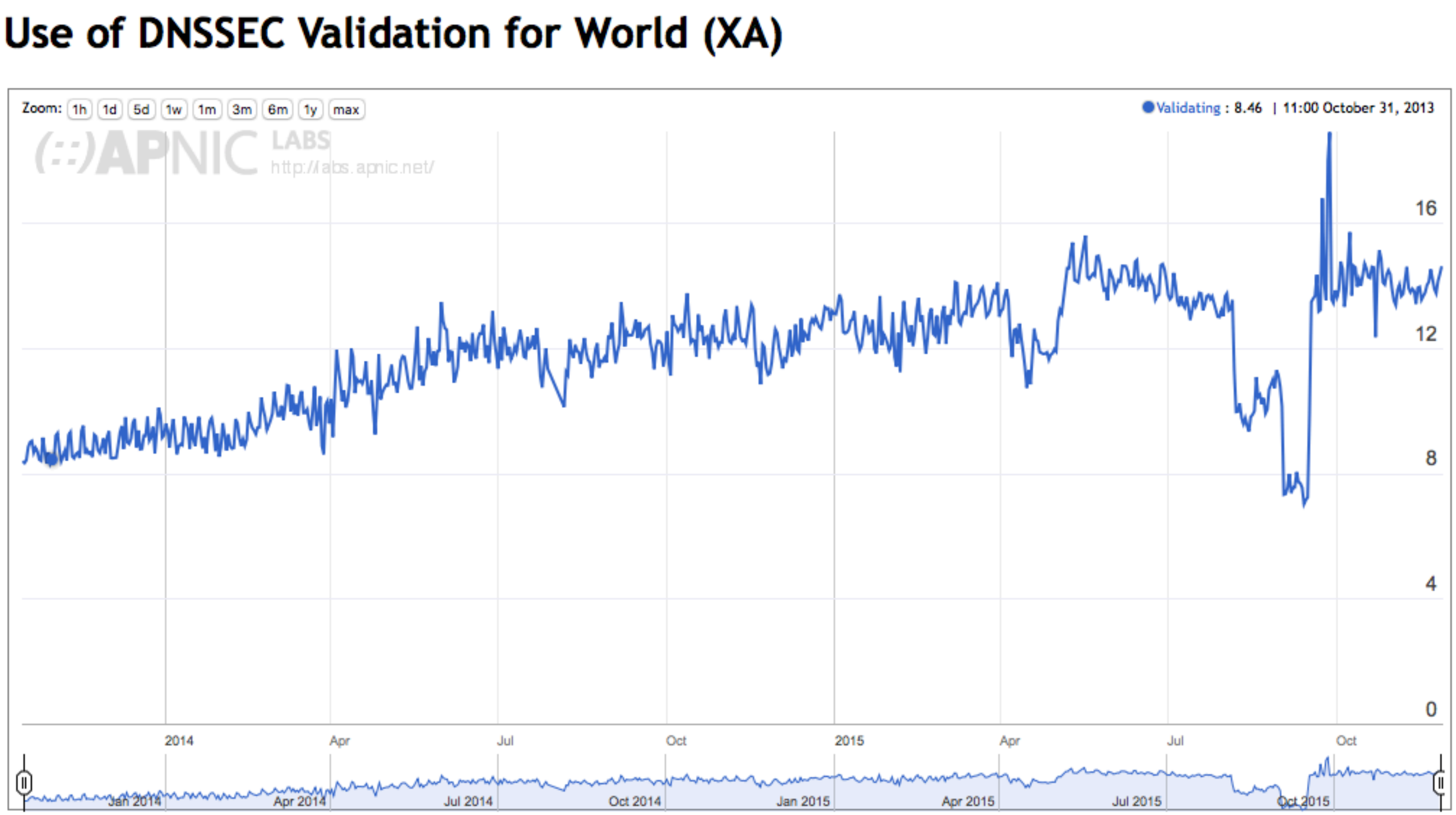


As long as you have a valid local trust anchor for the root zone then you can validate a signed DNS response by constructing this backward path to the local root trust anchor

Do we do DNSSEC Validation?

Do we do DNSSEC Validation?

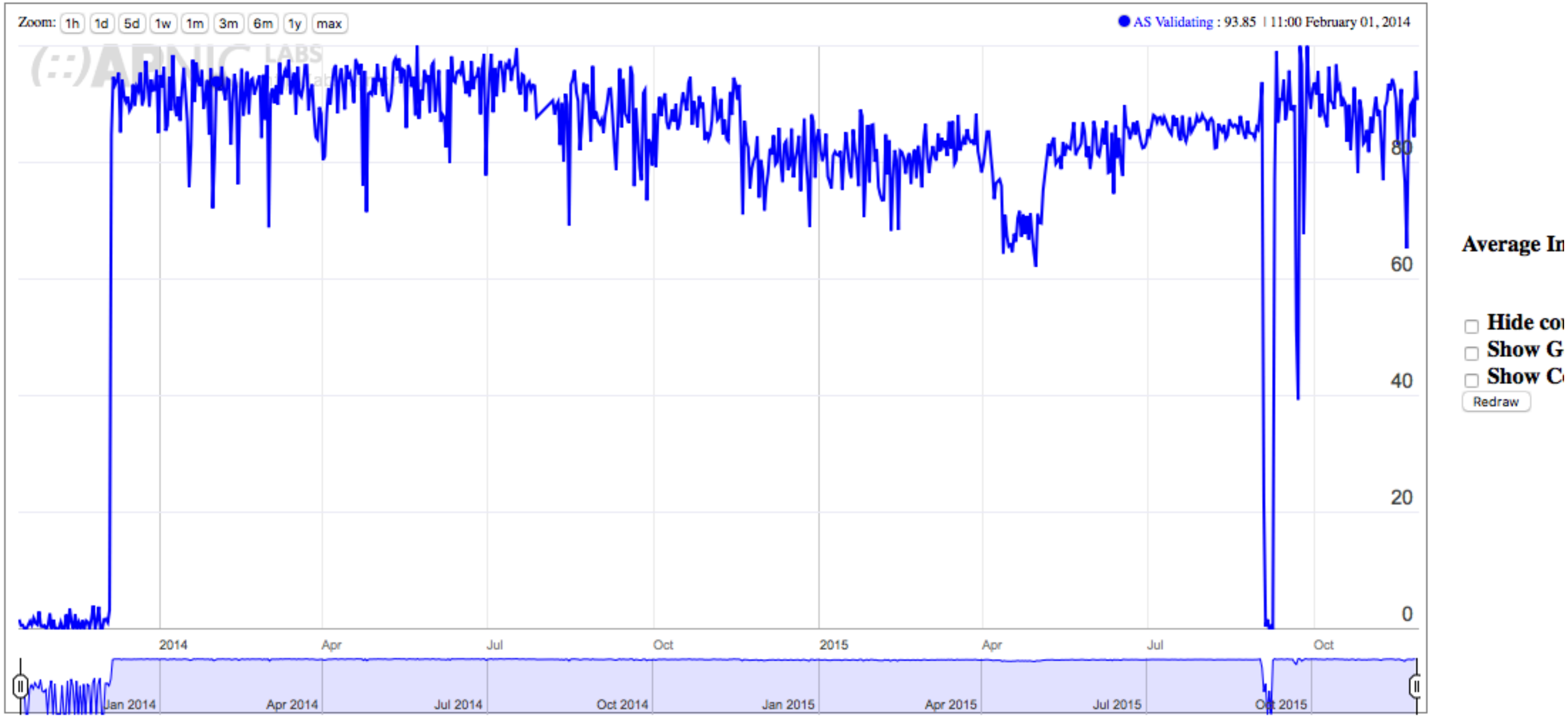
- Surprisingly, there is a lot of it out there!



stats.labs.apnic.net/dnssec

Optus has been running it for 2 years!

DNSSEC Country Deployment for AS4804: MPX-AS Microplex PTY LTD, Australia (AU)



So we're done - right?

- Um – well, if we’re not done, we’re well on the way!

So we're done - right?

- Um – well, if we're not done, we're well on the way!

But:

- We need to improve the use of DNSSEC validation in resolvers
- We need to load DNSSEC validation as a library for applications to use directly
- And we need to improve our day-to-day operational practices in managing DNSSEC
- And hopefully that will clear the path for the widespread adoption of DANE
- Because we have no other way to nail down the CA pinning problem in a reliable and secure manner

Operational Practices?

- Key Management
  - Registration of the DS record in the parent zone
  - Regular Key rotation

Rolling Keys

Rolling a ZSK for a zone:

(the issue here is that you need to be aware that resolvers will cache data, so any sudden move may isolate you from the net!)

- Add the new ZSK to the DNSKEY RRset for the zone
  (and sign across it with the KSK)
- Pause for breath (or at least a TTL)
- Remove the zone's old RRsigs (signed by the outgoing ZSK) and replace them with RRsigs signed by the new ZSK
- Pause for another breath
- Remove the old ZSK from the DNSKEY RRset

RFC6781

Rolling Keys

Rolling a KSK for a zone:

- Add the new KSK to the DNSKEY RRset for the zone

  (and sign across it with both the old and new KSKs)
- Pause for breath (or at least a TTL)
- Replace the parent's DS record for this zone with the DS record for the new KSK
- Pause for another breath (TTL)
- Remove the old KSK (and its RRSIG) from the DNSKEY RRset

RFC6781

But What about the Root Keys?

- The Root Key ZSK is just like any other ZSK
  - it's rolled every three months
  - And nobody appears to have a problem with this!

But What about the Root Keys?

- The Root Zone KSK is different

Why is the Root Zone KSK different?

- The KSK Public Key is used as the DNSSEC Validation trust anchor
  - This key is the root of all trust in the DNSSEC framework
  - It is distributed everywhere as “configuration data”
  - Most of the time the KSK itself is kept offline in highly secure facilities

But What about the Root Keys?

- The Root Zone KSK is different
- There is no “parent authority”
- And there is no real way to disseminate a new KSK other than using the DNS itself
- So rolling the KSK means that we have to use an “old signs new” approach to transitive trust
  (RFC 5011)
- And there is no Plan B here!

Five Years Ago…

ars technica

UNLOCK THE WORLD*
*Offrez-vous le monde

MAIN MENU | MY STORIES: 25 | FORUMS | SUBSCRIBE | JOBS | ARS CONSORTIUM

RISK ASSESSMENT / SECURITY & HACKTIVISM

DNS root zone finally signed, but security battle not over

The root of the DNS hierarchy is now protected with a cryptographic signature …

by Iljitsch van Beijnum - Jul 16, 2010 11:28pm CEST

Share Tweet 13

Yesterday, the DNS root zone was signed. This is an important step in the deployment of DNSSEC, the mechanism that will finally secure the DNS against manipulation by malicious third parties.

ICANN's First DNSSEC Key Ceremony for the Root Zone

The global deployment of Domain Name System Security Extensions (DNSSEC) will achieve an important milestone on June 16, 2010 as ICANN hosts the first production DNSSEC key ceremony in a high security data centre in Culpeper, VA, outside of Washington, DC.

, VA - location of first DNSSEC key signing ceremony

Schneier on Security

Blog | Newsletter | Books | Essays | News | Schedule | Crypto | About Me

← Pork-Filled Counter-Islamic Bomb Device

Security Vulnerabilities of Smart Electricity Meters →

DNSSEC Root Key Split Among Seven People

The DNSSEC root key has been divided among seven people:

> Part of ICANN's security scheme is the Domain Name System Security, a security protocol that ensures Web sites are registered and "signed" (this is the security measure built into the Web that ensures when you go to a URL you arrive at a real site and not an identical pirate site). Most major servers are a part of DNSSEC, as it's known, and during a major international attack, the system might sever connections between important servers to contain the damage.

The Eastern KSK Repository

Secure data center in Culpeper, VA - location of first DNSSEC key signing ceremony

The Western KSK Repository

El Segundo, California *

The Ultra Secret Third KSK Repository in Amsterdam

Five Years Ago…

Root DNSSEC Design Team

F. Ljunggren
Kirei
T. Okubo
VeriSign
R. Lamb
ICANN
J. Schlyter
Kirei
May 21, 2010

DNSSEC Practice Statement for the Root Zone KSK Operator

Abstract

This document is the DNSSEC Practice Statement (DPS) for the Root Zone Key Signing Key (KSK) Operator. It states the practices and provisions that are used to provide Root Zone Key Signing and Key Distribution services. These include, but are not limited to: issuing, managing, changing and distributing DNS keys in accordance with the specific requirements of the U.S. Department of Commerce.

6.3. Signature format

The cryptographic hash function used in conjunction with the signing algorithm is required to be sufficiently resistant to preimage attacks during the time in which the signature is valid.

The RZ KSK signatures will be generated by encrypting SHA-256 hashes using RSA [RFC5702].

6.4. Zone signing key roll-over

ZSK rollover is carried out quarterly automatically by the Root Zone ZSK Operator's system as described in the Root Zone ZSK Operator's DPS.

6.5. Key signing key roll-over

Each RZ KSK will be scheduled to be rolled over through a key ceremony as required, or after 5 years of operation.

RZ KSK roll-over is scheduled to facilitate automatic updates of resolvers' Trust Anchors as described in RFC 5011 [RFC5011].

After a RZ KSK has been removed from the key set, it will be retained after its operational period until the next scheduled key ceremony, when the private component will be destroyed in accordance with section 5.2.10.

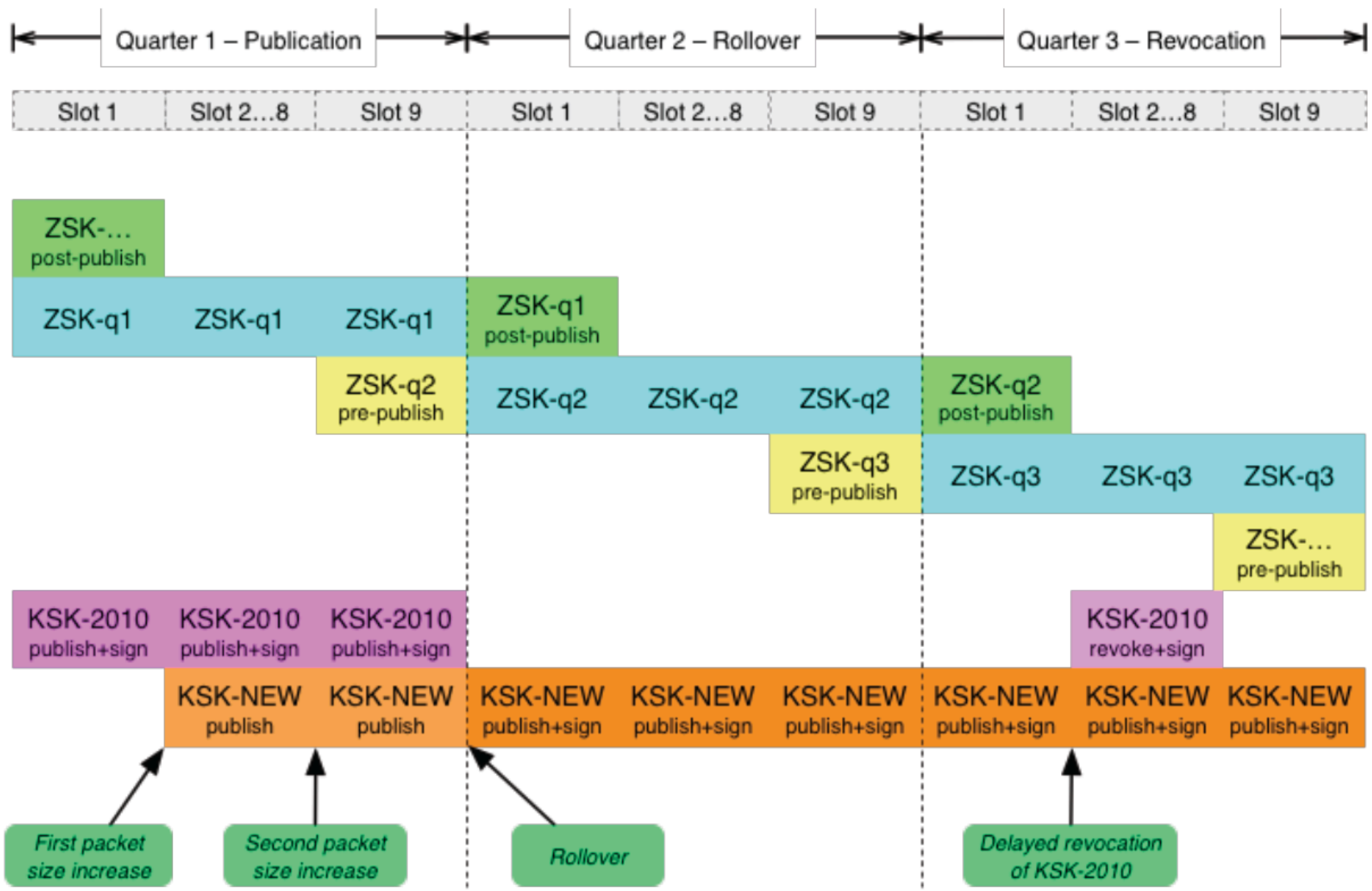
Rolling the KSK?

- All DNS resolvers that perform validation of DNS responses use a local copy of the KSK
- They will need to load a new KSK public key and replace the existing trust anchor with this new value at the appropriate time
- This key roll could have a public impact, particularly if DNSSEC-validating resolvers do not load the new KSK
    - These resolvers will go dark and will not resolve signed responses

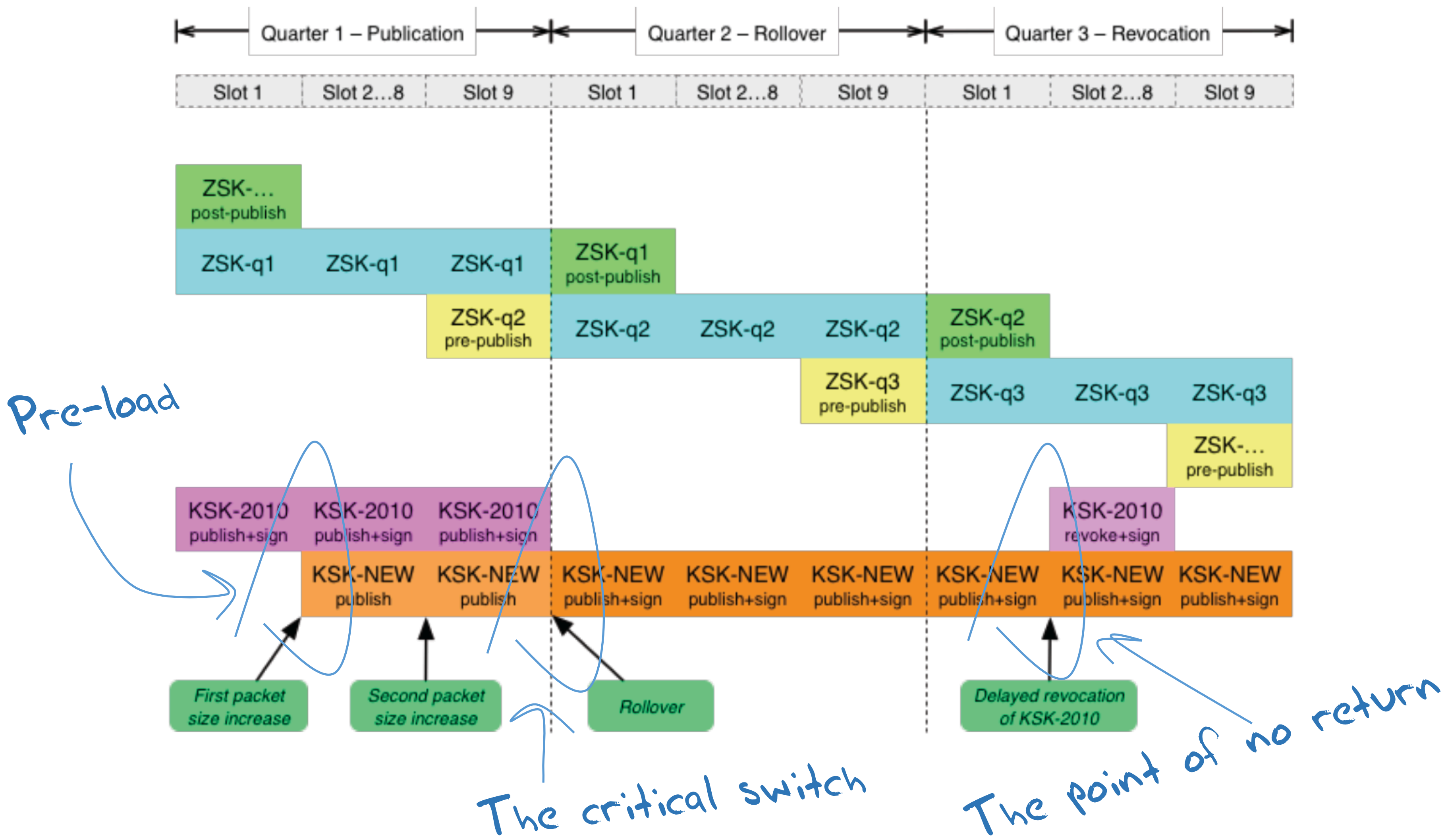
Easy, Right?

- Publish a new KSK and include it in DNSKEY responses
- Use the new KSK to sign the ZSK, as well as the old KSK signature
  - Resolvers use old-signs-over-new to pick up the new KSK, validate it using the old KSK, and replace the local trust anchor material with the new KSK
- Withdraw the old signature signed via the old KSK
- Revoke the old KSK

The RFC5011 Approach



The RFC5011 Approach



Just Like Last Time?

Roll Over and Die?

February 2010

George Michaelson
Patrik Wallström
Roy Arends
Geoff Huston

In this month's column I have the pleasure of being joined by George Michaelson, Patrik Wallström and Roy Arends to present some critical results following recent investigations on the behaviour of DNS resolvers with DNSSEC. It's a little longer than usual, but I trust that its well worth the read.
-- *Geoff*

It is considered good security practice to treat cryptographic keys with a healthy level of respect. The conventional wisdom appears to be that the more material you sign with a given private key the more clues you are leaving behind that could enable some form of effective key guessing. As RFC4641 states: "the longer a key is in use, the greater the probability that it will have been compromised through carelessness, accident, espionage, or cryptanalysis." Even though the risk is considered slight if you have chosen to use a decent key length, RFC 4641 recommends, as good operational practice, that you should "roll" your key at regular intervals. Evidently it's a popular view that fresh keys are better keys!

The standard practice for a "staged" key rollover is to generate a new key pair, and then have the two public keys co-exist at the publication point for a period of time, allowing relying parties, or clients, some period of time to pick up the new public key part. Where possible during this period, signing is performed twice, once with each key, so that the validation test can be performed using either key. After an appropriate interval of parallel operation the old key pair can be deprecated and the new key can be used for signing.

This practice of staged rollover as part of key management is used in X.509 certificates, and is also used in signing the DNS, using DNSSEC. A zone operator who wants to roll the DNSSEC key value would provide notice of a pending key change, publish the public key part of a new key pair, and then use the new and old private keys in parallel for a period. On the face of it, this process sounds quite straightforward.

What could possibly go wrong?

But that was then…

And this is now:

- Resolvers are now not so aggressive in searching for alternate validation paths when validation fails

  (as long as resolvers keep their code up to date, which everyone does – right?)

- And now we ***all*** support RFC5011 key roll processes
- And ***everyone*** can cope with large DNS responses

So all this will go without a hitch

Nobody will even notice the KSK roll at the root

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And this is now:

- Resolvers are now not so aggressive in searching for alternate validation path[illegible]en validation fails
  - (as long [illegible] up to date, which everyone does – right? [illegible]
- And now [illegible] .1 key roll processes
- And ***every***[illegible] large DNS responses

So all this will [illegible] without a hitch

Nobody will even notice the KSK roll at the root

Not!

What we all should be concerned about…

That resolvers who validate DNS responses will fail to pick up the new DNS root key automatically

- i.e. they do not have code that follows RFC5011 procedures for the introduction of a new KSK

The resolvers will be unable to receive the larger DNS responses that will occur during the dual signature phase of the rollover

Technical Concerns

- Some DNSSEC validating resolvers do not support RFC5011
  - How many resolvers may be affected in this way?
  - How many users may be affected?
  - What will the resolvers do when validation fails?
    - Will they perform lookup ‘thrashing’
  - What will users do when resolvers return SERVFAIL?
    - How many users will redirect their query to a non-validating resolver

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Really hard to test this in the wild with recursive resolvers

Some Observations - 1

There is a LOT of DNSSEC validation out there!

- 87% of all queries have DNSSEC-OK set
- 30% of all DNSSEC-OK queries attempt to validate the response
- 25% of end users are using DNS resolvers that will validate what they are told
- 12% of end users don't believe bad validation news and turn to other non-validating resolvers when validation fails.

Some Observations - 2

ECDSA is viable – sort of

- 1 in 5 clients who use resolvers that validate RSA-signed responses are unable to validate the same response when signed using ECDSA
- But they fail to “unsigned” rather than “invalid” so it’s a (sort of) safe fail

Some Observations - 3

The larger DNS responses will probably work, but not for everyone

- The "fall back to TCP" will rise to 6% of queries when the response size get to around 1,350 octets
- But around 16% of visible resolvers appear not to use TCP at all
- So the DNS failure rate appears to rise by around 1 - 2 % of end users

BUT .org currently runs at 1,650 octets and nobody is screaming failure

- So it will probably work

Some Observations - 4

We can't measure automated key take up

- We can't see how many resolvers fail to use RFC5011 notices to pick up the new KSK as a Truct Anchor in advance
- We will only see it via failure on key roll

Where are we?

- A key roll of the Root Zone KSK will cause some resolvers to fail:
  - Resolvers who do not pick up the new key in the manner described by RFC5011
  - Resolvers who cannot receive a DNS response of ~1,300 octets
- Many users who use these failing resolvers will just switch over to use a non-validating resolver
- A small pool of users will be affected with no DNS

What can I do?

Check your recursive resolver config!

Good Dog!

```
# // recursive resolver configuration - Bind
…
managed-keys {
        . initial-key 257 3 5 "AwEAAfdqNV
          JMRMzrppU1WnNW0PWrGn4x9dPg
…
          =„; };
```

Bad Dog!

```
# // recursive resolver configuration - Bind
…
trusted-keys {
        . 257 3 5 "AwEAAfdqNV
          JMRMzrppU1WnNW0PWrGn4x9dPg
…
          =„; };
```

Thanks!