DNSSEC: Where We Are (and how we get to where we want to be)

APNIC 34, Phnom Penh, Cambodia

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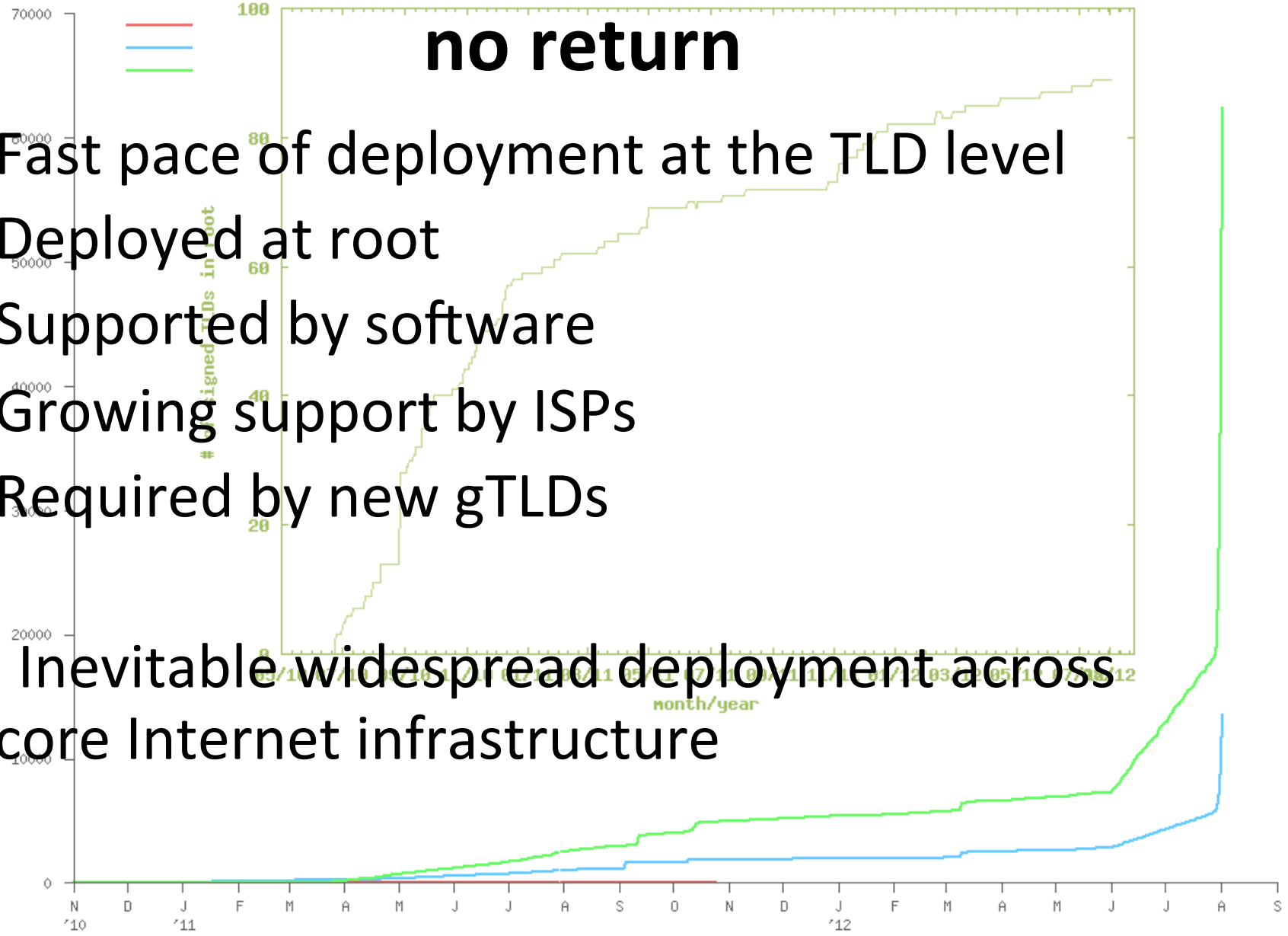
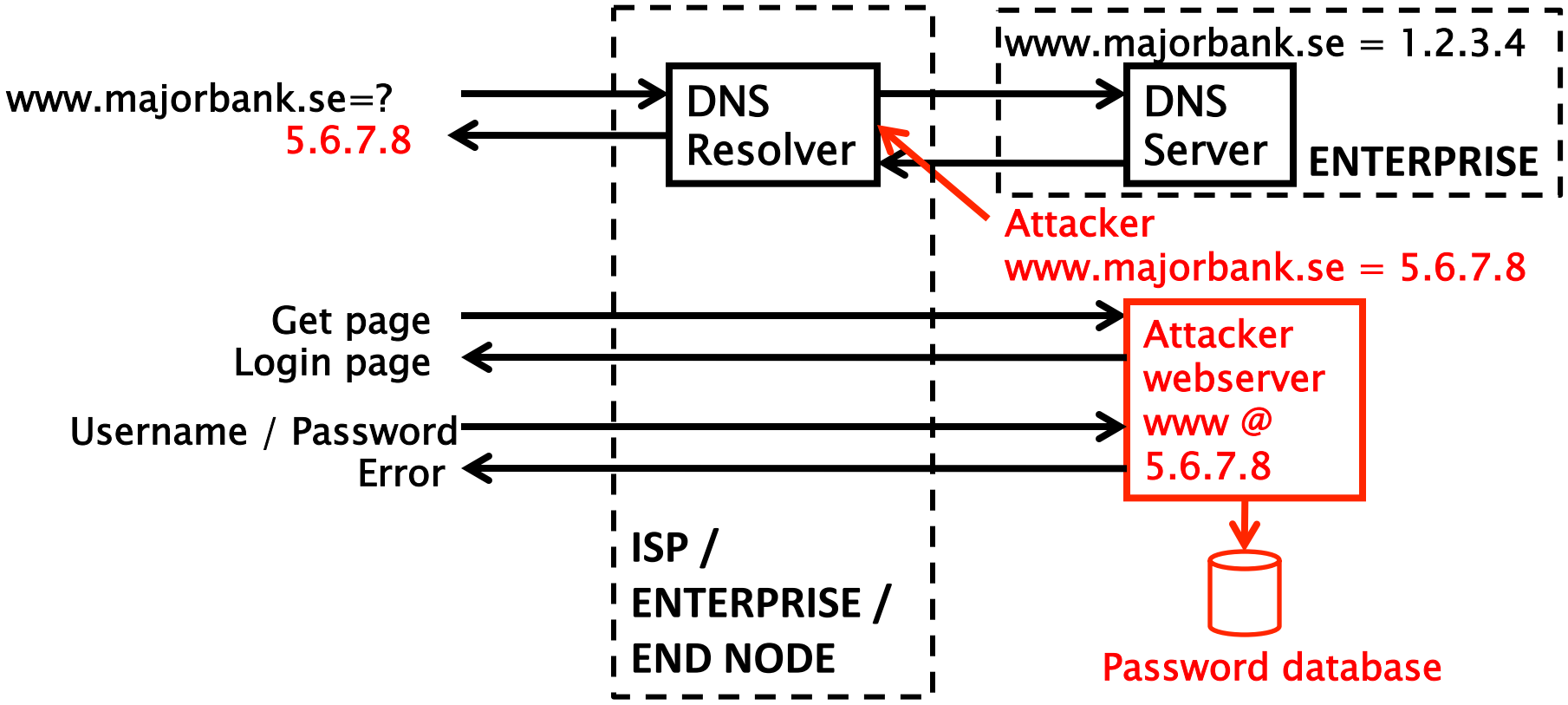
DNSSEC: We have passed the point of no return

- Fast pace of deployment at the TLD level
- Deployed at root
- Supported by software
- Growing support by ISPs
- Required by new gTLDs

→ Inevitable widespread deployment across core Internet infrastructure



The Problem:
DNS Cache Poisoning Attack



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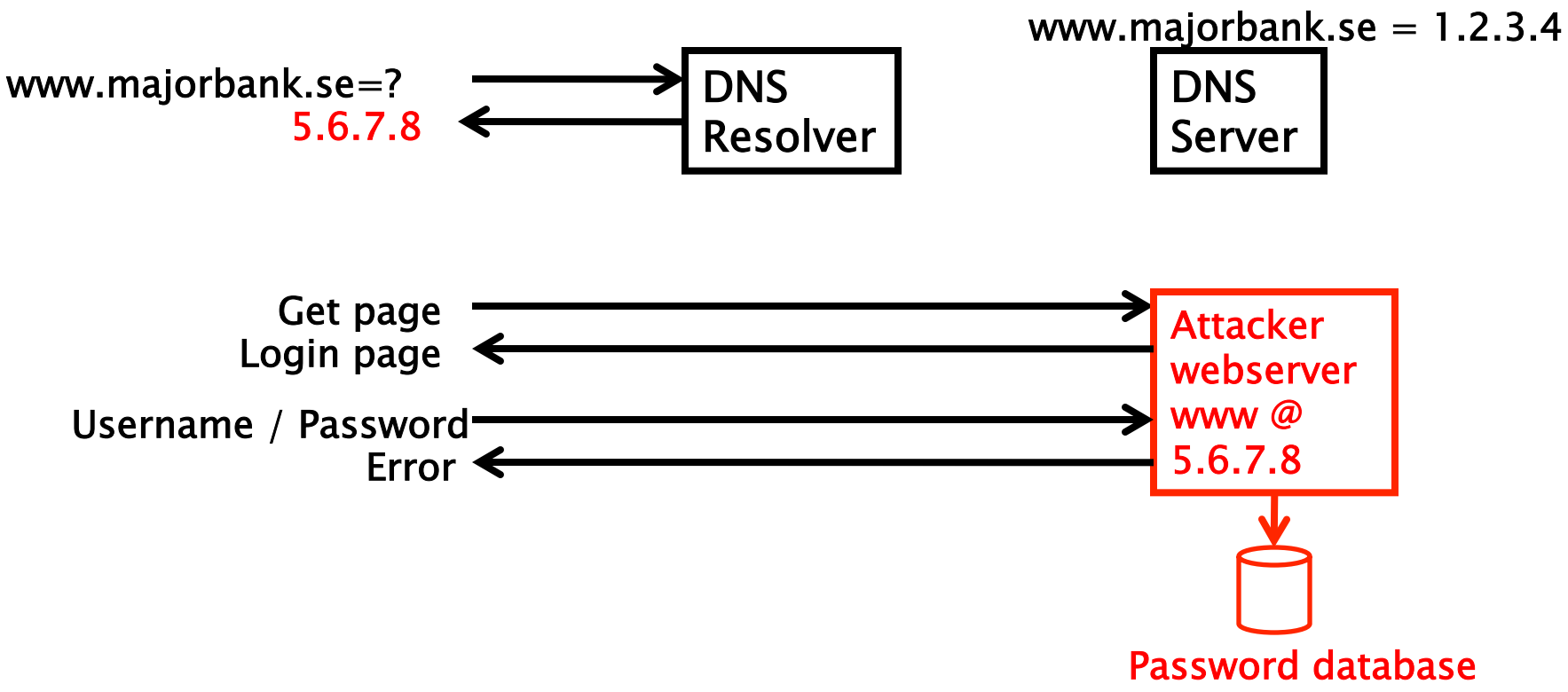
Argghh! Now all ISP customers get sent to attacker.



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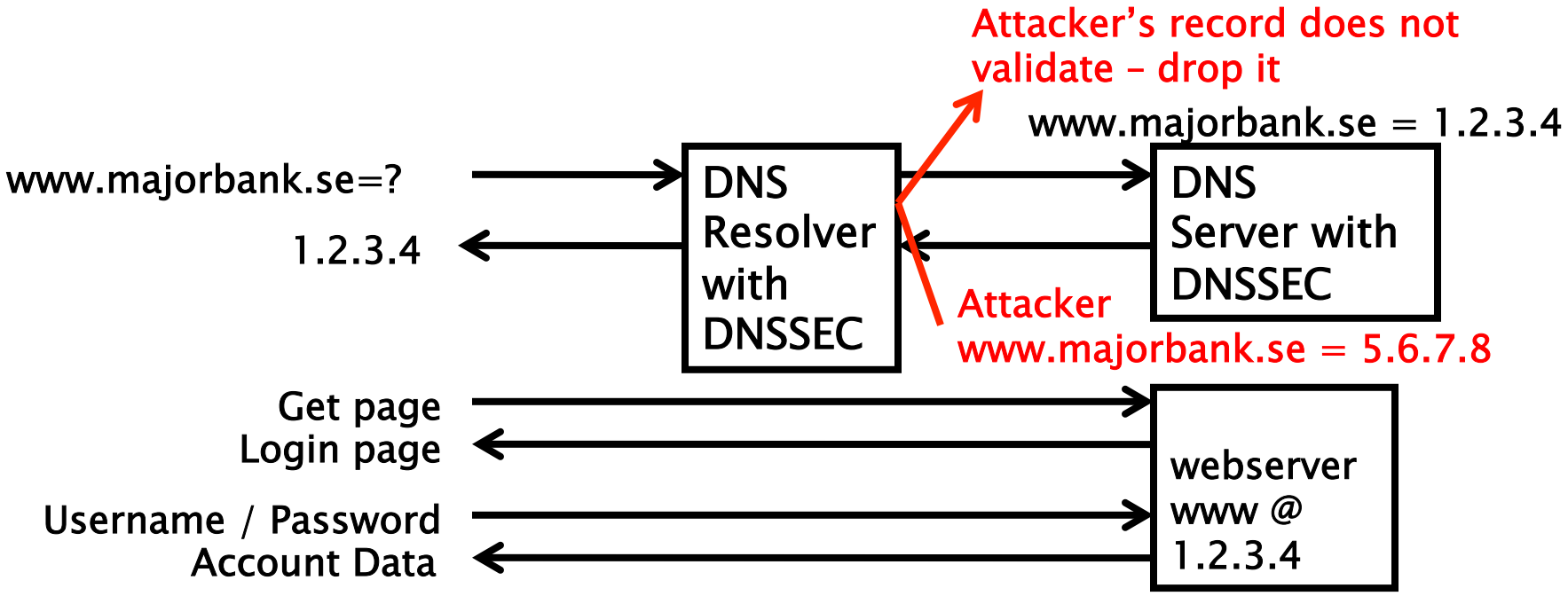
Securing The Phone Book - DNS Security Extensions (DNSSEC)



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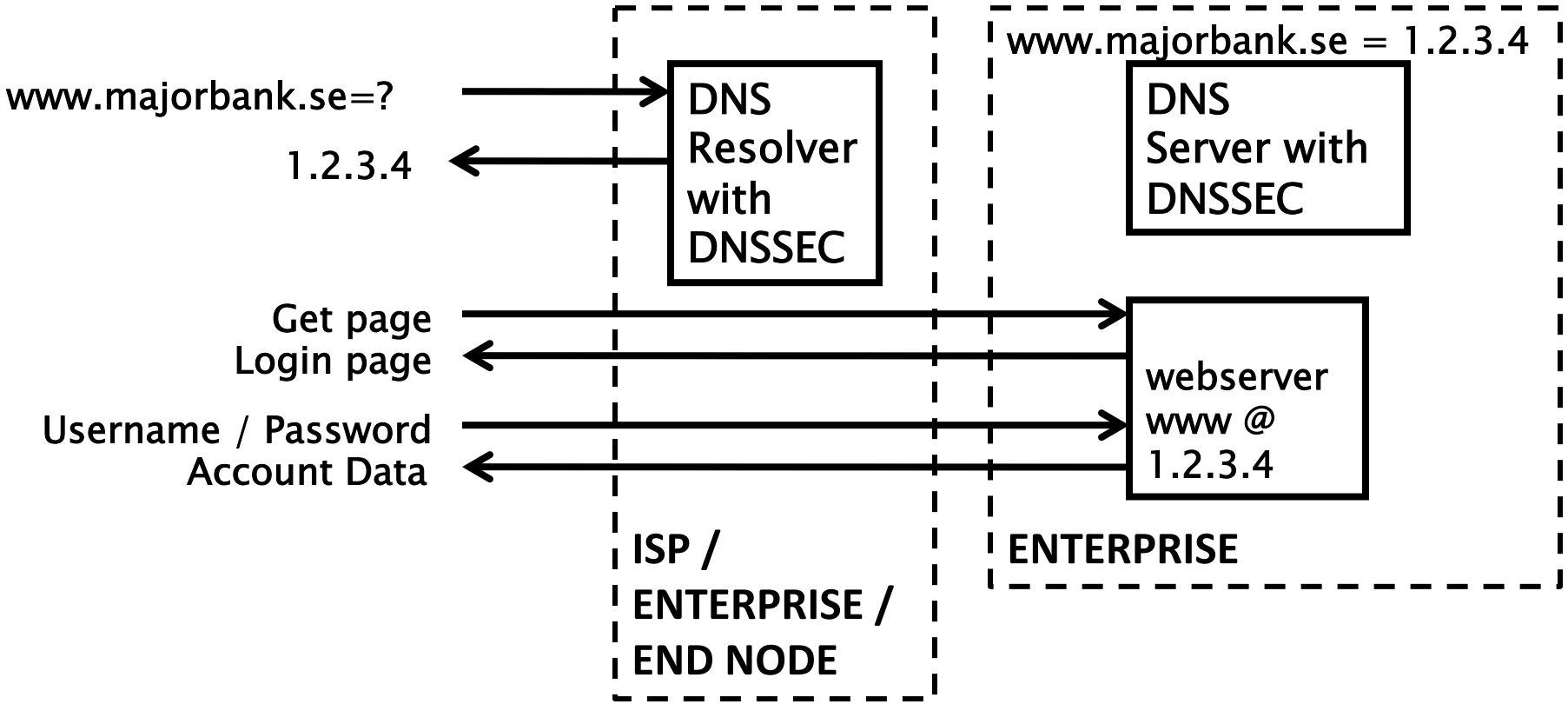
Resolver only caches validated records



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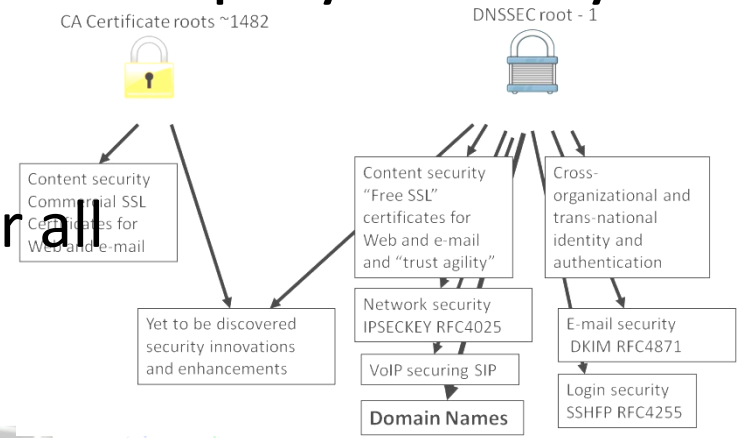
DNSSEC: Plenty of Motivation

- DNSChanger (Nov 2011), calls for deployment by government, etc…
- DANE
  - Improved Web TLS and certs for all
  - Email S/MIME for all
- …and
  - SSH, IPSEC, VoIP
  - Digital identity
  - Other content (e.g. configurations, XML, app updates)
  - Smart Grid
  - A global PKI

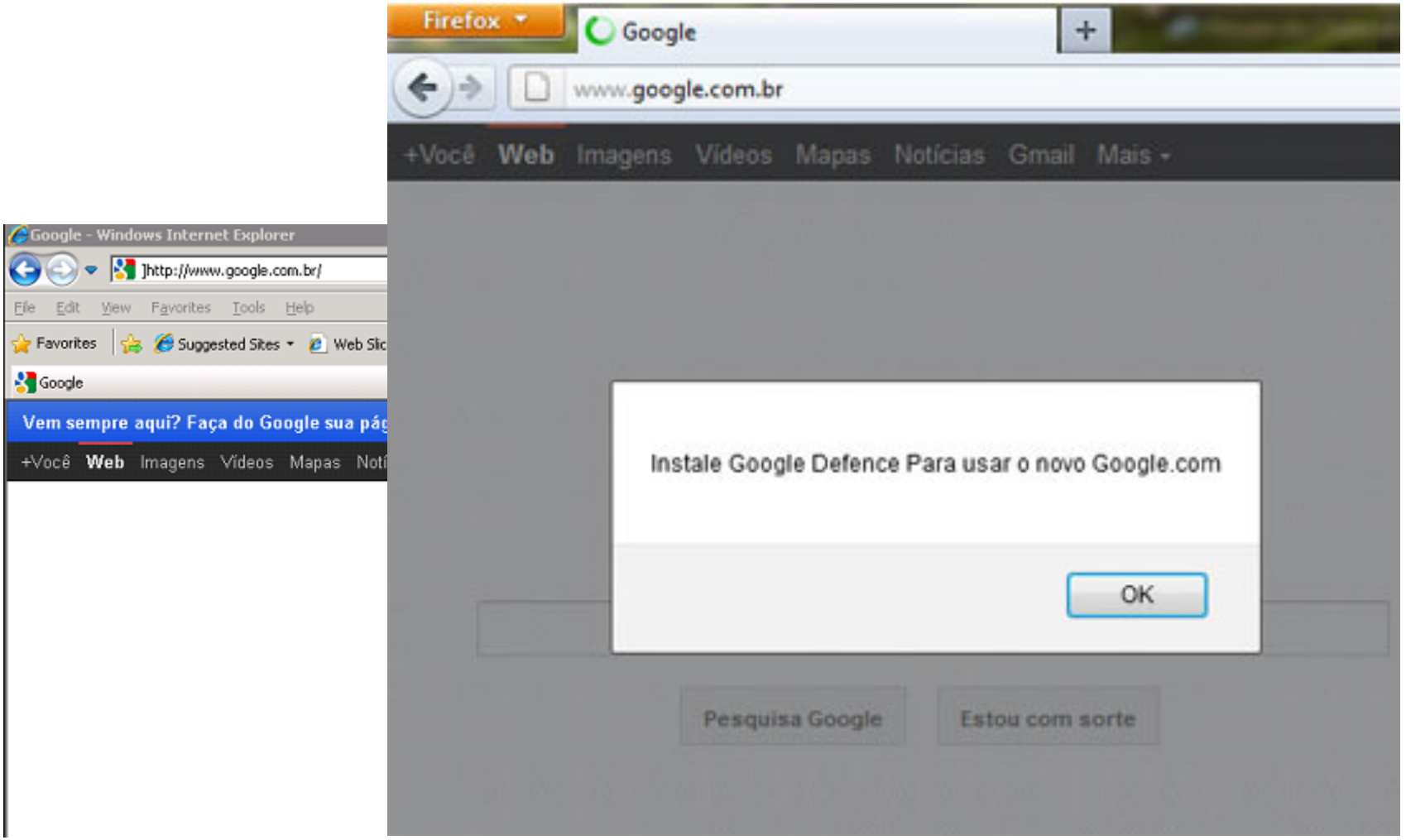


A good ref http://www.internetsociety.org/deploy360/dnssec/

The BAD: DNSChanger - 'Biggest Cybercriminal Takedown in History' – 4M machines, 100 countries, $14M

Nov 2011 http://krebsonsecurity.com/2011/11/malware-click-fraud-kingpins-arrested-in-estonia/
End-2-end DNSSEC validation would have avoided the problems

The BAD: Brazilian ISP fall victim to a series of DNS attacks



7 Nov 2011 http://www.securelist.com/en/blog/208193214/Massive_DNS_poisoning_attacks_in_Brazil

End-2-end DNSSEC validation would have avoided the problems

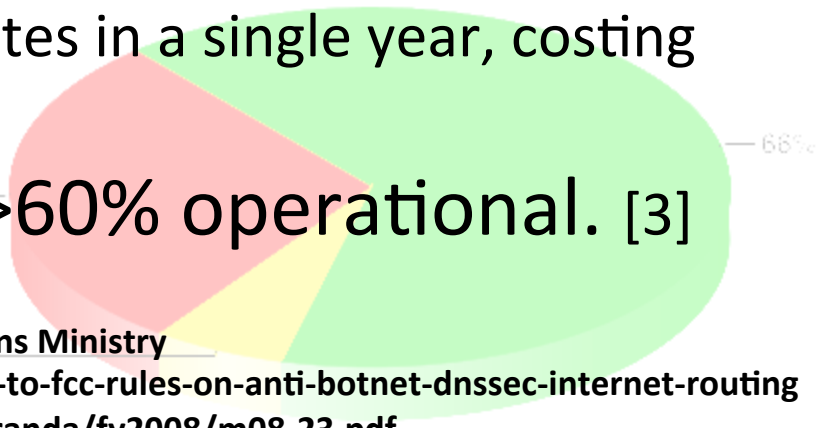
The BAD: Other DNS hijacks*

- 25 Dec 2010 - Russian e-Payment Giant ChronoPay Hacked
- 18 Dec 2009 – Twitter – “Iranian cyber army”
- 13 Aug 2010 - Chinese gmail phishing attack
- 25 Dec 2010 Tunisia DNS Hijack
- 2009-2012 google.*
  - April 28 2009 Google Puerto Rico sites redirected in DNS attack
  - May 9 2009 Morocco temporarily seize Google domain name
- 9 Sep 2011 - Diginotar certificate compromise for Iranian users
- SSL / TLS doesn't tell you if you've been sent to the correct site, it only tells you if the DNS matches the name in the certificate. Unfortunately, majority of Web site certificates rely on DNS to validate identity.
- DNS is relied on for unexpected things though insecure.

*A Brief History of DNS Hijacking - Google
http://costarica43.icann.org/meetings/sanjose2012/presentation-dns-hijackings-marquis-boire-12mar12-en.pdf

DNSSEC support from government

- Sweden, Brazil, and others encourage DNSSEC deployment
- Mar 2012 - AT&T, CenturyLink (Qwest), Comcast, Cox, Sprint, TimeWarner Cable, and Verizon have pledged to comply and abide by US FCC [1] recommendations that include DNSSEC.. "A report by Gartner found 3.6 million Americans getting redirected to bogus websites in a single year, costing them $3.2 billion.,"[2].
- 2008 US .gov mandate. >60% operational. [3]



[1] FCC=Federal Communications Commission=US communications Ministry
[2] http://securitywatch.pcmag.com/security/295722-isps-agree-to-fcc-rules-on-anti-botnet-dnssec-internet-routing
[3] http://www.whitehouse.gov/sites/default/files/omb/memoranda/fy2008/m08-23.pdf

DNSSEC = Global PKI

CA Certificate roots ~1482

DNSSEC root - 1

Content security
Commercial SSL
Certificates for
Web and e-mail

Content security
"Free SSL"
certificates for Web
and e-mail and "trust
agility" (DANE)

Cross-
organizational and
trans-national
identity and
authentication

Yet to be discovered
security innovations,
enhancements, and
synergies

Network security
IPSECKEY RFC4025

Securing VoIP

Domain Names

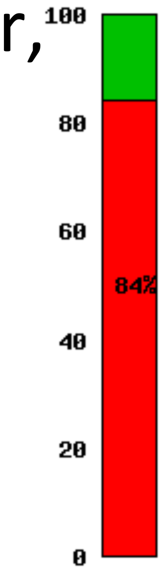
E-mail security
DKIM RFC4871

Login security
SSHFP RFC4255

https://www.eff.org/observatory
http://royal.pingdom.com/2011/01/12/internet-2010-in-numbers/

DNSSEC: Where we are

- Deployed on 92/315 TLDs (.asia, .tw 台灣 台湾, .kr 한국, .jp, .in, .lk, .kg, .tm, .am, .mm, .ua, .cr, .cz, .br, .se, .uk, .fr, .com, .tt, …post)
- Root signed** and audited
- >84% of domain names could have DNSSEC
- Growing ISP support*
- 3rd party signing solutions are appearing (e.g., GoDaddy, VeriSign, Binero,…)
- Unbound, BIND, DNSSEC-trigger, vsResolver and other s/w support and secure last-mile
- IETF DANE Certificate support RFC almost out

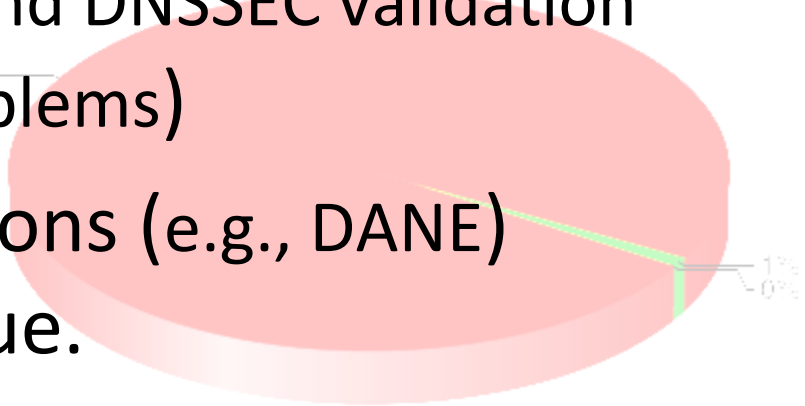


*COMCAST Internet (18M), TeliaSonera SE, Sprint, Vodafone CZ, Telefonica CZ, T-mobile NL, SurfNet NL, SANYO Information Technology Solutions JP, others..

**21 TCRs from: TT, BF, RU, CN, US, SE, NL, UG, BR, Benin, PT, NP, Mauritius, CZ, CA, JP, UK,

But…

- But deployed on < 1% of 2nd level domains. Many have plans. Few have taken the step (e.g., yandex.com, paypal.com*, comcast.com).
- DNSChanger and other attacks highlight today's need. (e.g end-2-end DNSSEC validation would have avoided the problems)
- Innovative security solutions (e.g., DANE) highlight tomorrow's value.



* http://fedv6-deployment.antd.nist.gov/cgi-bin/generate-com http://www.thesecuritypractice.com/the_security_practice/2011/12/all-paypal-domains-are-now-using-dnssec.html
http://www.nacion.com/2012-03-15/Tecnologia/Sitios-web-de-bancos-ticos-podran-ser-mas-seguros.aspx

DNSSEC: So what's the problem?

- Not enough enterprise IT departments know about it or are busy putting out other fires.
- When they do look into it they hear FUD and lack of turnkey solutions.
- Registrars/DNS providers see no demand

Barriers to success

- Lack of Awareness at enterprise and customer level (e.g., security implications)
- Lack of Registrar support* and/or expertise or turn-key solutions
  - Chicken and egg
  - Justifying cost
- Implementation F.U.D.
  - Security/crypto/key management/complexity
  - Effect on existing enterprise operations: e.g. expiry, LB, CDN, etc..
- Un-trustworthy deployment
  - Yet another security thing to manage: “email the keys to everyone”
  - Insecure practices and processes
  - Garbage in, garbage out - what does signing my zone buy me?

***Partial list of Registrars supporting DNSSEC**
http://www.icann.org/en/news/in-focus/dnssec/deployment

"What You Can Do"

- Raise Awareness of DNSSEC and its security value in your enterprises. Deploy on your domain names – it is “a feature”.
- Start DNSSEC implementation early, combine with other upgrades. Later, offer hosting as a service.
- At minimum ensure network and resolvers pass DNSSEC responses to end users unscathed to allow validation to occur there.

Solutions

- Raise awareness of domain holders, end users, h/w+s/w vendors [1]
  - Point to improved security as differentiator and the disadvantage of not adopting
  - New opportunities for O/S (mobile and desktop) and browser vendors
  - Added security for hardware products (e.g., validator in CPE)
  - Meet with Registrars and DNS providers
- Ease Implementation:
  - Take advantage of DNSSEC training[2] and learn from existing implementations
  - Automate key management and monitoring
  - Crypto: HSM? Smartcard? TPM chip? Soft keys? - all good
  - Seek "click and sign" interface simplicity
  - Start implementation early since to get ahead in learning curve
  - For ISPs, at minimum ensure validation can occur downstream to support end2end security
- Make it trustworthy:
  - Transparent and secure processes and practices
  - Writing a DPS creates the right mindset for:
    - Separation of duties
    - Documented procedures
    - Audit logging
  - Opportunity to improve overall operations using DNSSEC as an excuse [3]

[1] DNSSEC.jp and other groups are excellent examples
[2] APNIC, NSRC, ISOC, ICANN offer training
[3] ENISA report on DNSSEC deployment

Trustworthy Implementation

Building in security

- Getting the machinery for DNSSEC is easy (BIND, NSD/Unbound, OpenDNSSEC, etc..).

- Finding good security practices to run it is not.

Learn from CA successes (and mistakes)

- The good:
  - The people
  - The mindset
  - The practices
  - The legal framework
  - The audit against international accounting and technical standards

COMODO
Creating Trust Online®

- The bad:
  - Diluted trust with a race to the bottom (>1400 CA's)
  - DigiNotar
    - Weak and inconsistent polices and controls
    - Lack of compromise notification (non-transparent)
    - Audits don't solve everything (ETSI audit)

DigiNotar®
A VASCO COMPANY

An implementation can be thi$

…or this

FIPS 140-2 Vali

FIPS VALIDATED 140-2

The Communications Security Establishment of the Government of Canada

Level 3		
Level 3		
Level 4	*Cryptographic Key Management:*	Level 3
Level 3	*Self-Tests:*	Level 3
Level 3	*Mitigation of Other Attacks:*	Level 3
Level N/A	*tested in the following configuration(s):* N/A	

Algorithms are used: **Triple-DES (Cert. #560); Triple-DES MAC (Triple-DES Cert. #560, vendor affirmed); AES (Cert. #577); SHS (Cert. #633); RNG (Cert. #332); RSA (Cert. #264)**

following non-FIPS approved algorithms: **RSA (key wrapping; key establishment methodology provides between 80 and 112 bits of encryption strength)**

Overall Level Achieved: 3

Signed on behalf of the Government of the United States

Signature: William Baker

Dated: March 31, 2008

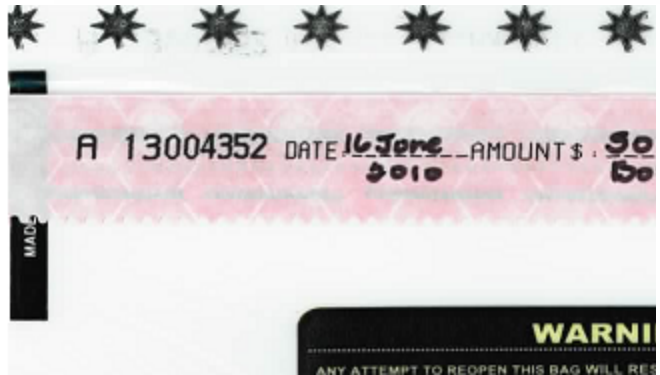
Chief, Computer Security Division
National Institute of Standards and Technology

Signed on behalf of the Government of Canada

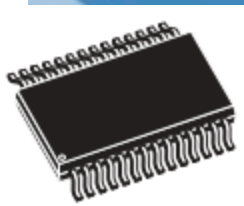
Signature:

Dated: 20 March 2008

Director, Industry Program Group
Communications Security Establishment



..or this (CR NIC)



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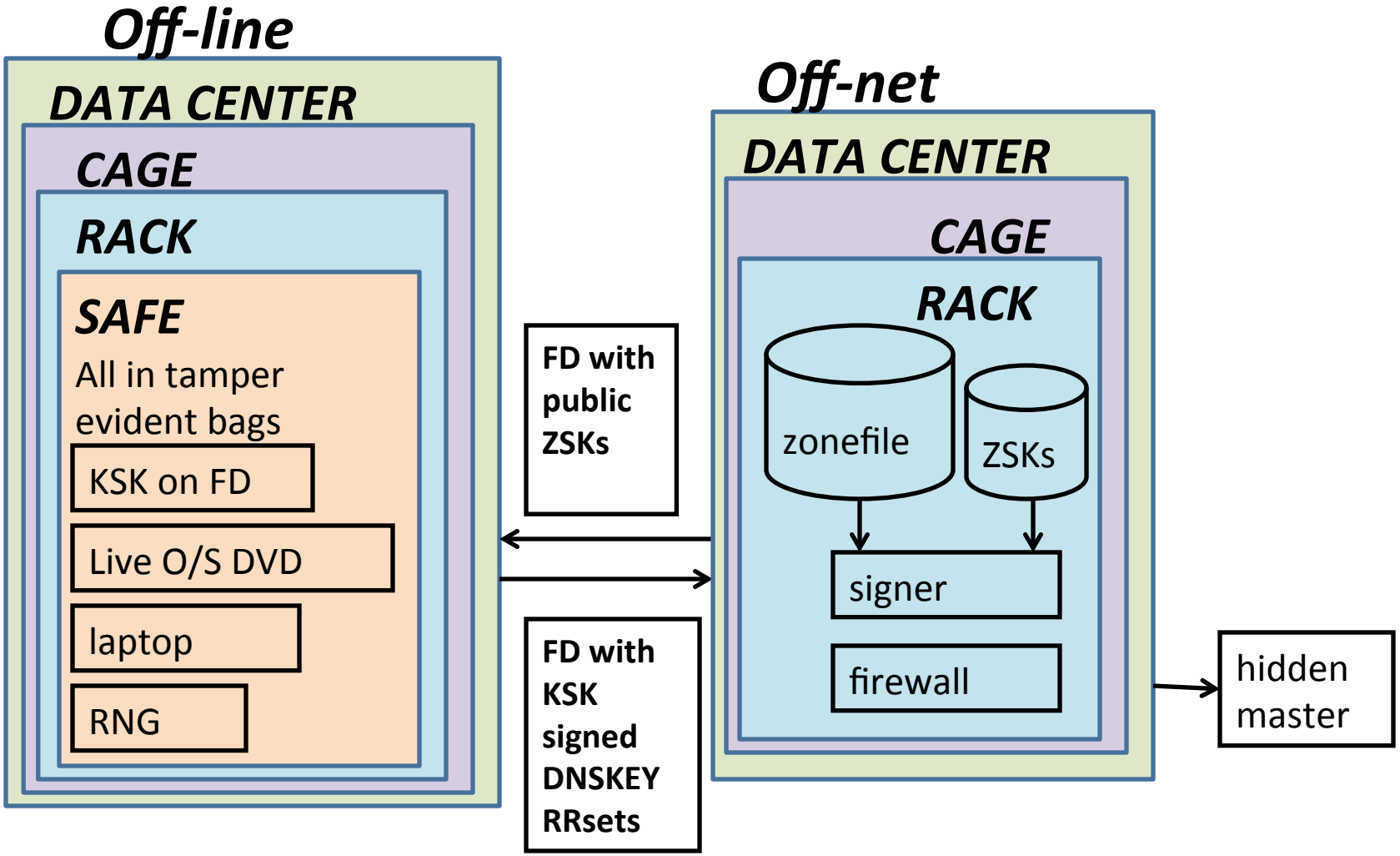
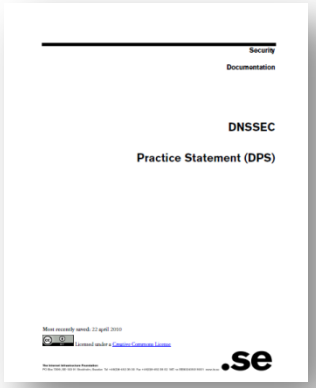
…or even this


Off-line
DATA CENTER
CAGE
RACK
SAFE
All in tamper evident bags
KSK on FD
Live O/S DVD
laptop
RNG
FD with public ZSKs
FD with KSK signed DNSKEY RRsets
Off-net
DATA CENTER
CAGE
RACK
zonefile
ZSKs
signer
firewall
hidden master

But all must have:

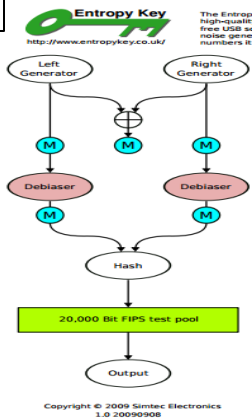
- Published practice statement
  - Overview of operations
  - Setting expectations
    - Normal
    - Emergency
  - Limiting liability
- Documented procedures
- Multi person access requirements
- Audit logs
- Monitoring (e.g., for signature expiry)
- Good Random Number Generators




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

Intel RdRand

DRBGs
FIPS 140



Useful IETF RFCs:
DNSSEC Operational Practices http://tools.ietf.org/html/draft-ietf-dnsop-rfc4641bis
A Framework for DNSSEC Policies and DNSSEC Practice Statements http://tools.ietf.org/html/draft-ietf-dnsop-dnssec-dps-framework

Summary

- DNSSEC has left the starting gate but without greater support by Registrars, demand from domain name holders and trustworthy deployment by operators, it will die on the vine
- Building awareness amongst a larger audience based on recent attacks and increased interest in cyber security may be one solution
- Drawing on lessons learned from certificate authorities and other existing sources of trust on the Internet can make DNSSEC a source of innovation and opportunity for all

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VoIP

US-NSTIC

DNS is a part of all ecosystems

Google
OpenID

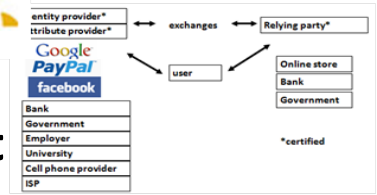
facebook

ebay

AADHAAR

PayPal

OECS ID effort



amazon Prime

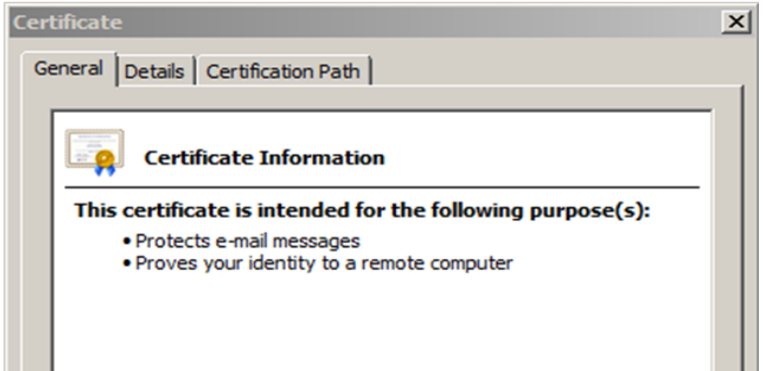
e-Passport symbol

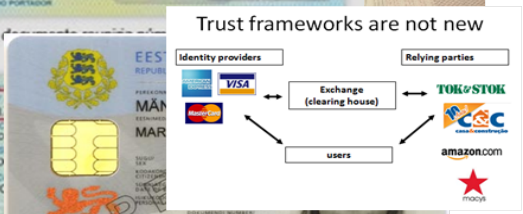
ICP Brasil
O Brasil na era da certificação digital

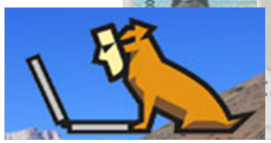
DigiNotar
A VASCO COMPANY

COMODO
Creating Trust Online

Smart Electrical Grid





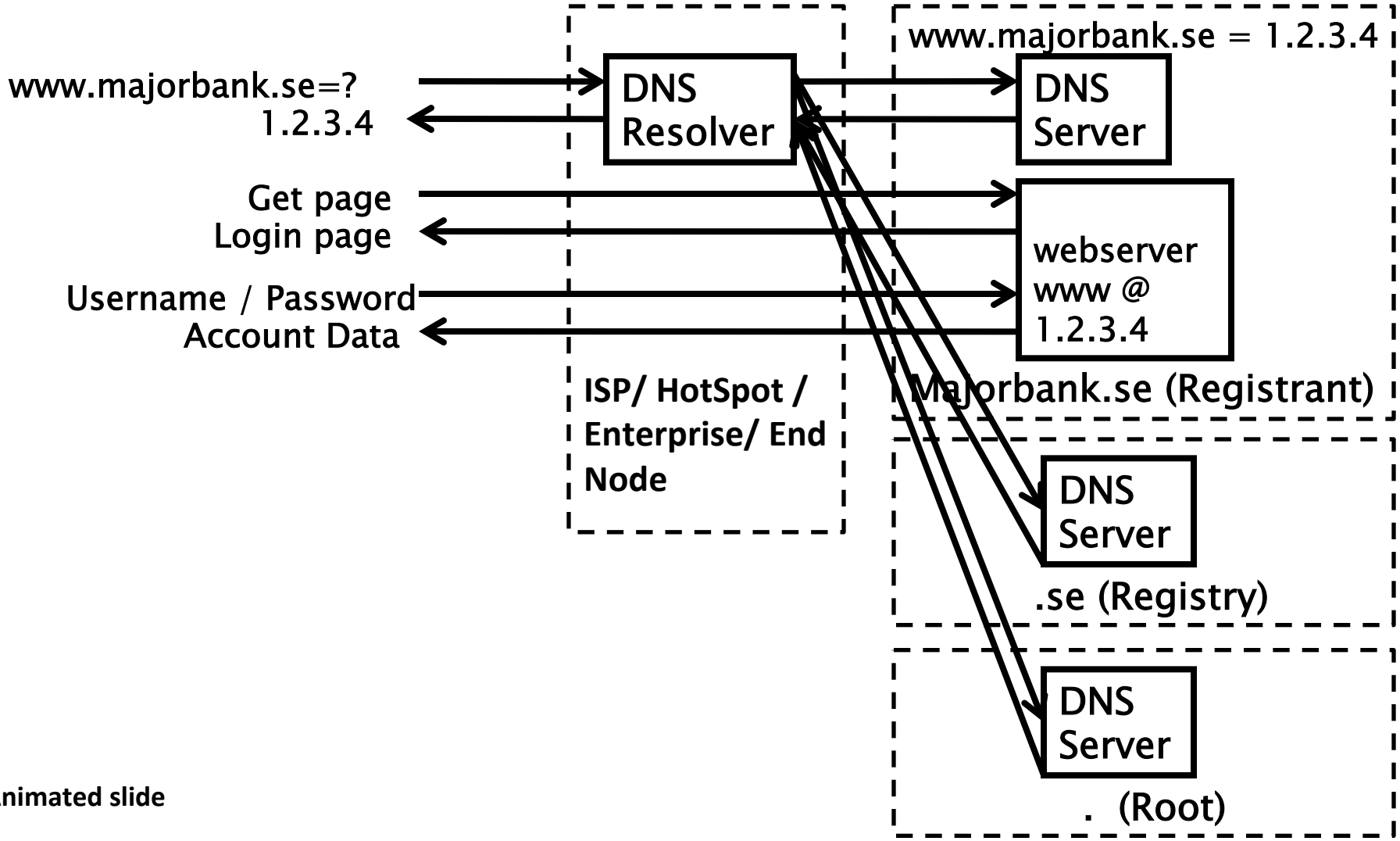


Norton SECURED
powered by VeriSign

lamb@xtcn.com

mydomainname.com

The Internet's Phone Book - Domain Name System (DNS+DNSSEC)



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