One year of DANE
Tales and Lessons Learned

sys4.de

DANE secures Security

Why secure Security?

Encryption Models

Opportunistic Encryption

- Expect anything
- Proceed if absent
- Try if offered
- Proceed unencrypted on failure
- Silent on failure

Mandatory Encryption

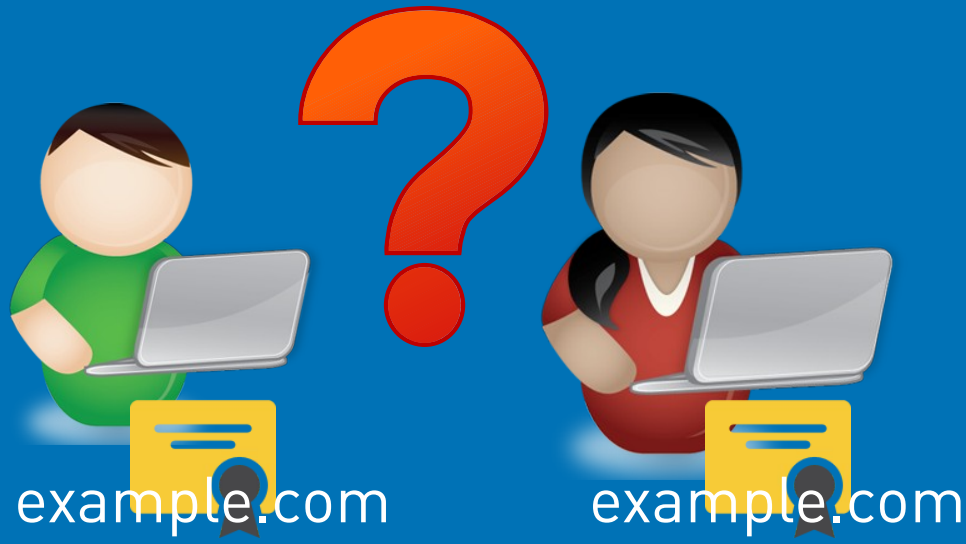
- Expect encryption
- Fail and alarm if absent
- Identify other side
- Fail and alarm if identity mismatch
- Encrypt or fail
- Alarm on failure

Issues with opportunistic TLS

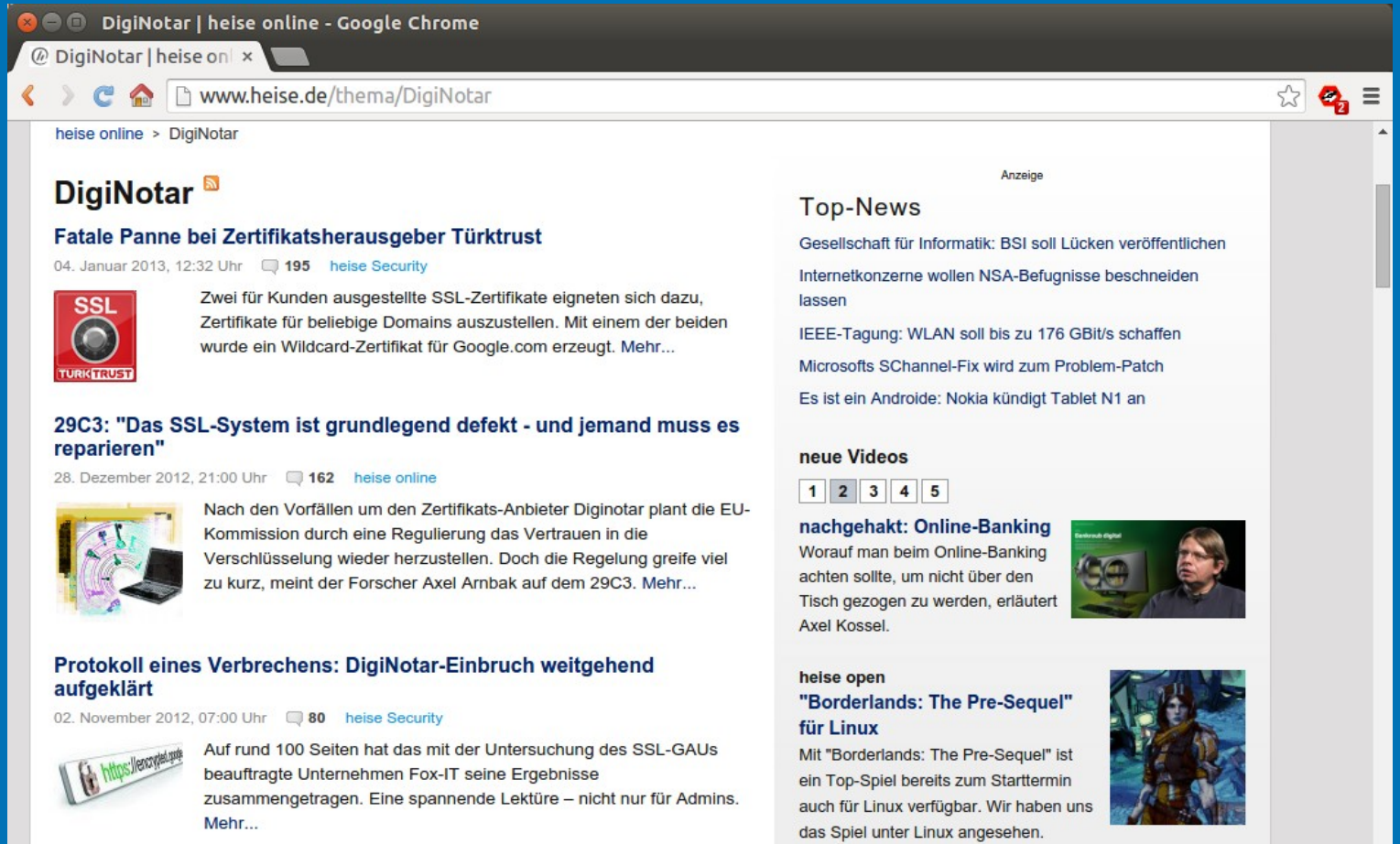
- CA model
- Downgrade Attack
- MITM attack
- Incomplete automation for certification rollover

BrOken CA Model

- **Any CA** can issue certificates for **any domain**
- **CAs have been compromised** in the past
- CAs have issued wrong or **unauthorized certificates**
- Declining Trust in CA root-certificates since Snowden



Türktrust? Diginotar?

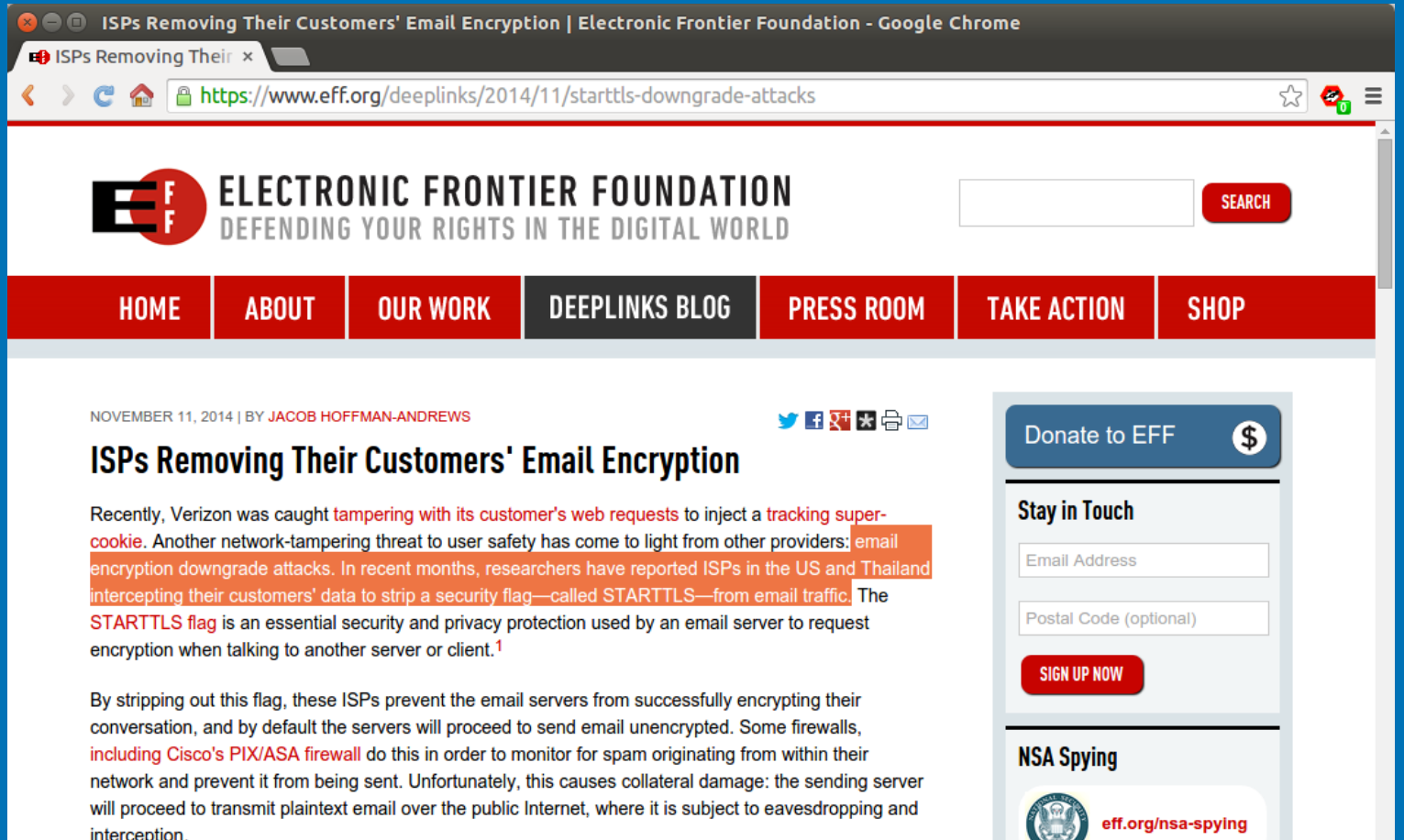


Session downgrade

- TLS comes without policy channel
- Client can't know server supports STARTTLS before SMTP Session starts
- MITM-Attacker may downgrade session to „Non-TLS“

```
220 mail.example.com ESMTP
EHLO client.example.com
250-mail.example.com
250-PIPELINING
250-SIZE 40960000
250-ETRN
~~250-STARTTLS~~
250-ENHANCEDSTATUSCODES
250-8BITMIME
250 DSN
```

Session downgrade



MITM Attack

- Attacker can intercept TLS secured communication with a matching certificate (Common Name)
- Easily done since everyone accepts self signed certificates...

example.com

example.com

Automation. NOT!

- Certification Authority is warrantor
- Manual verification
- Verification requires knowledge
- Verification requires presence
- Need to monitor certificate change

Securing Security

The Plan

- Add a policy channel
- Add a trust layer
- Indicate encryption
- Indicate identity

Welcome to DANE!

DANE

"DNS-based Authentication of Named Entities" (RFC 6698)

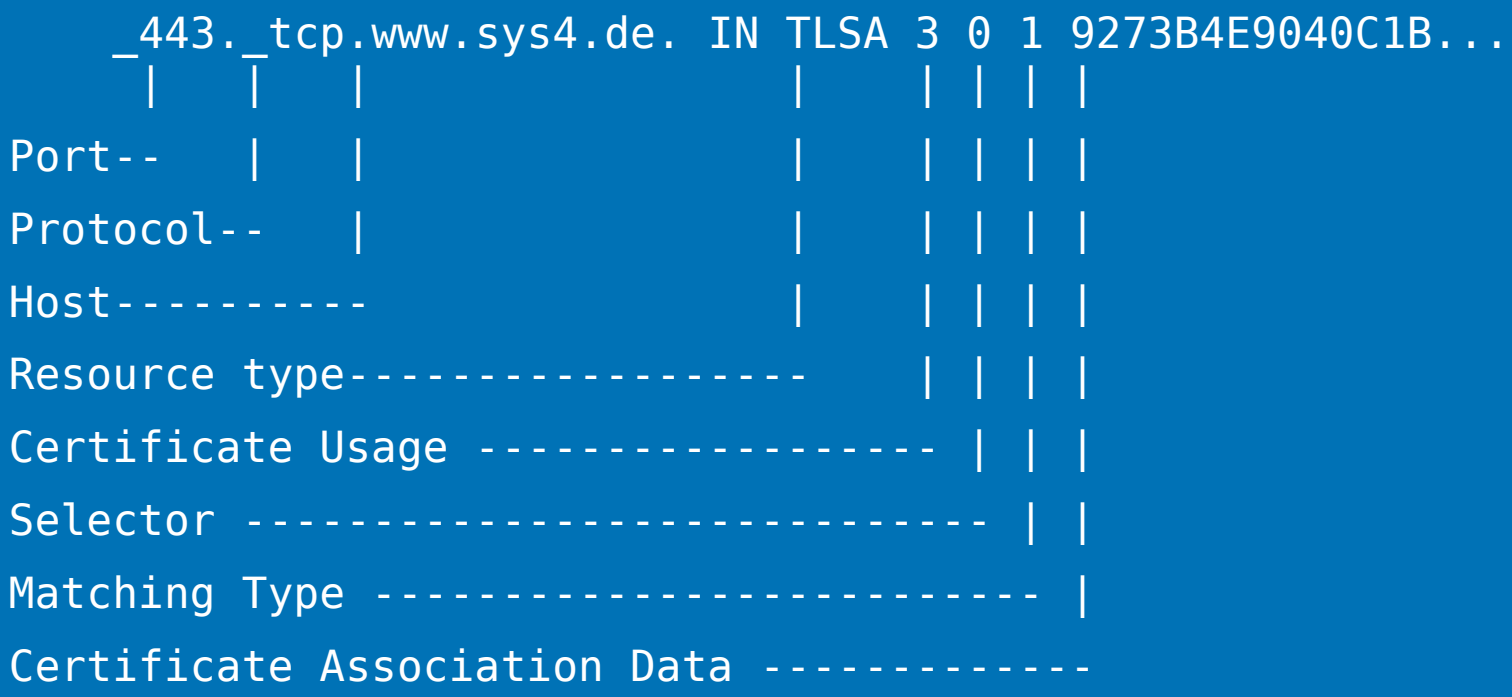
- DANE uses/requires DNSSEC
  - DNS becomes policy channel
  - DNSSEC adds trust layer
- New Resource Records
  - Presence indicates service availability
  - Record carries service specific data

Current Use Cases

- **HTTPS**
  Connect service/server to a certificate
- **SMTP**
  Connect service/server to a certificate
- **OpenPGP**
  Associate Public Keys to email address
- **S/MIME**
  Associate Certificates with Domain Names and email addresses

HTTPS

TLSA Resource Record



TLSA RR query

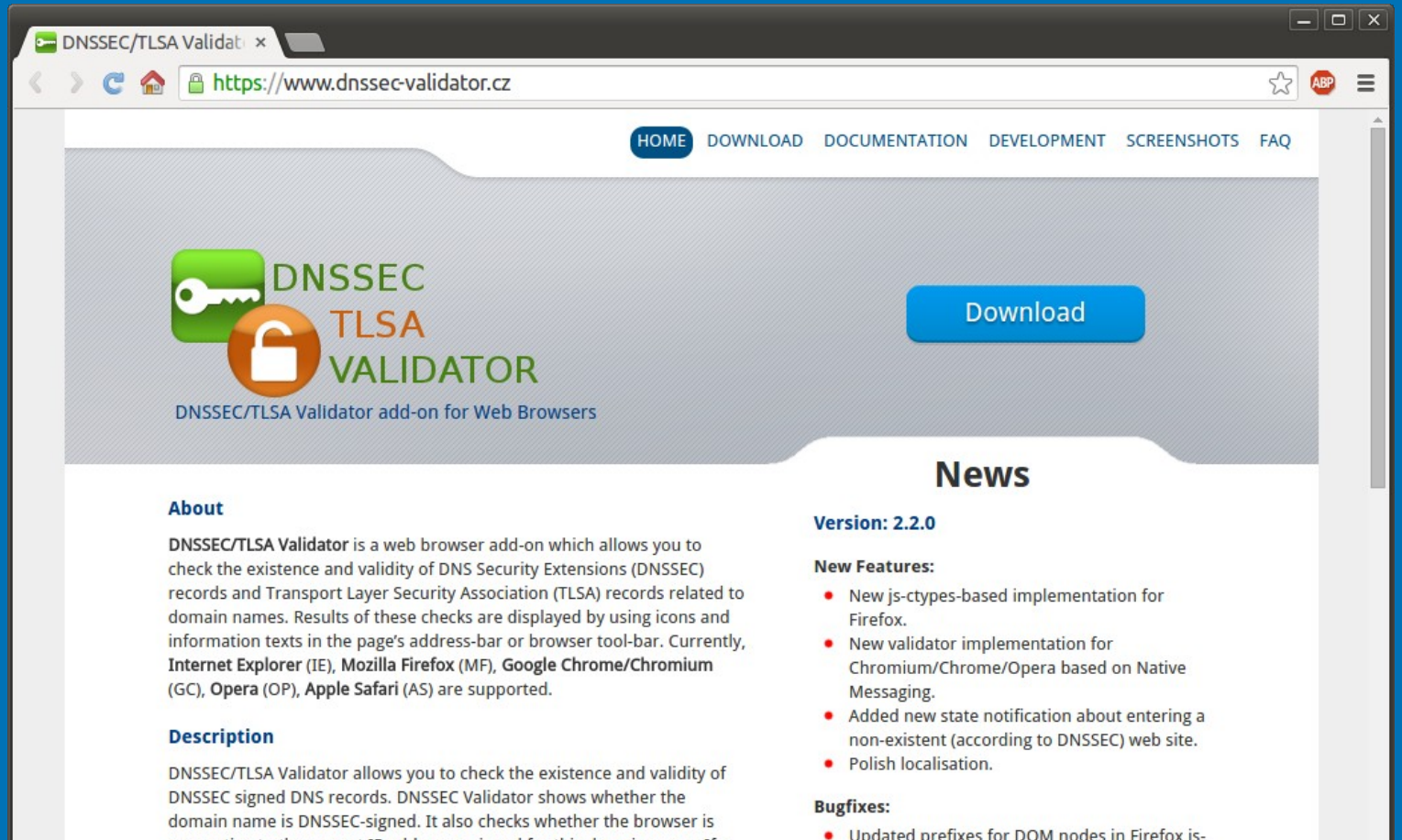
```
$ dig +dnssec TLSA _443._tcp.www.sys4.de

_443._tcp.mail.sys4.de.3600 IN  TLSA 3 0 1 (
      9273B4E9040C1B9EE7C946EFC0BA8AAF2C6E5F05A1B2
      C960C41655E32B15CBE0 )
_443._tcp.mail.sys4.de.3600 IN  RRSIG TLSA 8 5 3600 (
      20141124104604 20141117195102 19786 sys4.de.
      afEJbtmKZVn995XiI2BFQwYKC1ZfcsIK/j2JA9C8oYSp
      pneBLVYuX8C0ZW9zTHCExtXS1kJrNf48sFRaOWwbZvPy
      1vRiB+c46QRG0kwceDUjzZGtpG3Al2LKBVKw4bxMMOzu
      DeqECrf/n1W8XF6UQcrB0PdTY81Y6IZTUovYhak= )
```

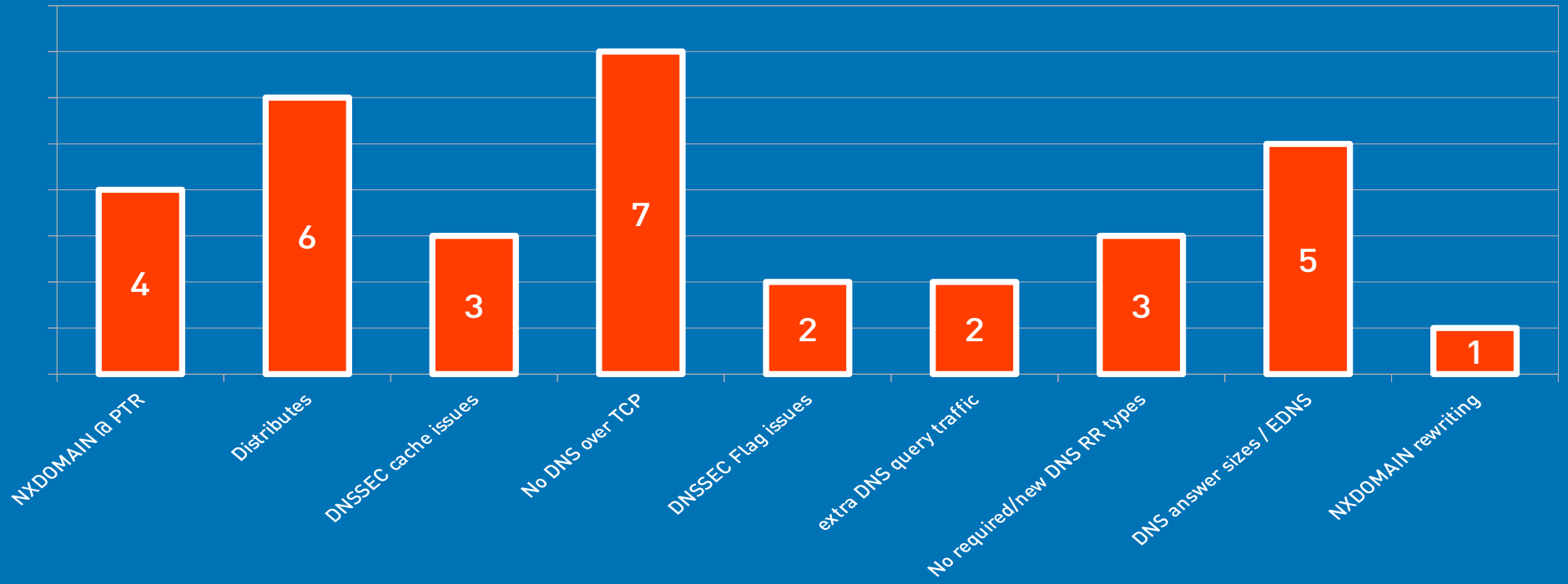
HTTPS


sys4 Enterprise Experts - Home - Mozilla Firefox
[*] sys4 Enterprise Expert...
https://sys4.de/de/
LEO Eng-Deu
https://sys4.de
Zertifikat entspricht TLSA
Das Serverzertifikat für diese Domäne wurde durch DANE Protokoll bestätigt. Das Zertifikat entspricht dem durch DNSSEC gesicherten TLSA Eintrag.
Mehr info
English
Über uns
Kontakt
Messaging
Automation
dentity Management
BLOG
Wir sind ein Team namhafter Open-Source-Experten.

Browser Plugin



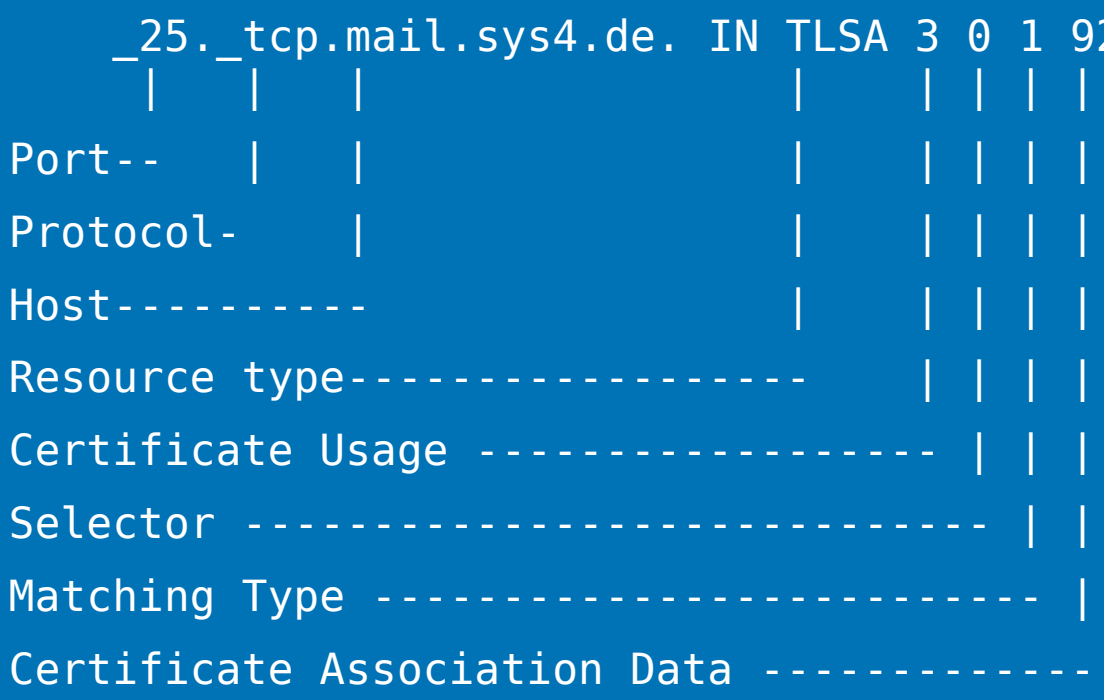
Consumer Market Problems



DNS-Proxy issues, CPE-modem study over 15 common CPE devices
sys4 for Unitymedia Deutschland, August 2014

SMTP

TLSA Resource Record



SMTP Security via Opportunistic DANE TLS

- Initial RFC draft published 2013
  Wes Hardaker, Viktor Dukhovni
- Currently in DANE WG „Last Call“ ends 2015-05-07
- First implementations
  - Postfix
  - OpenSMTPd
  - Exim
- In production @sys4 since 12/2013

„Verified“ makes all the difference

Today

```
Jul 14 11:03:31 mail postfix/smtp[6477]:
  Trusted TLS connection established to mx-ha03.web.de
  [213.165.67.104]:25: TLSv1.1 with cipher
  DHE-RSA-AES256-SHA (256/256 bits)
```

DANE

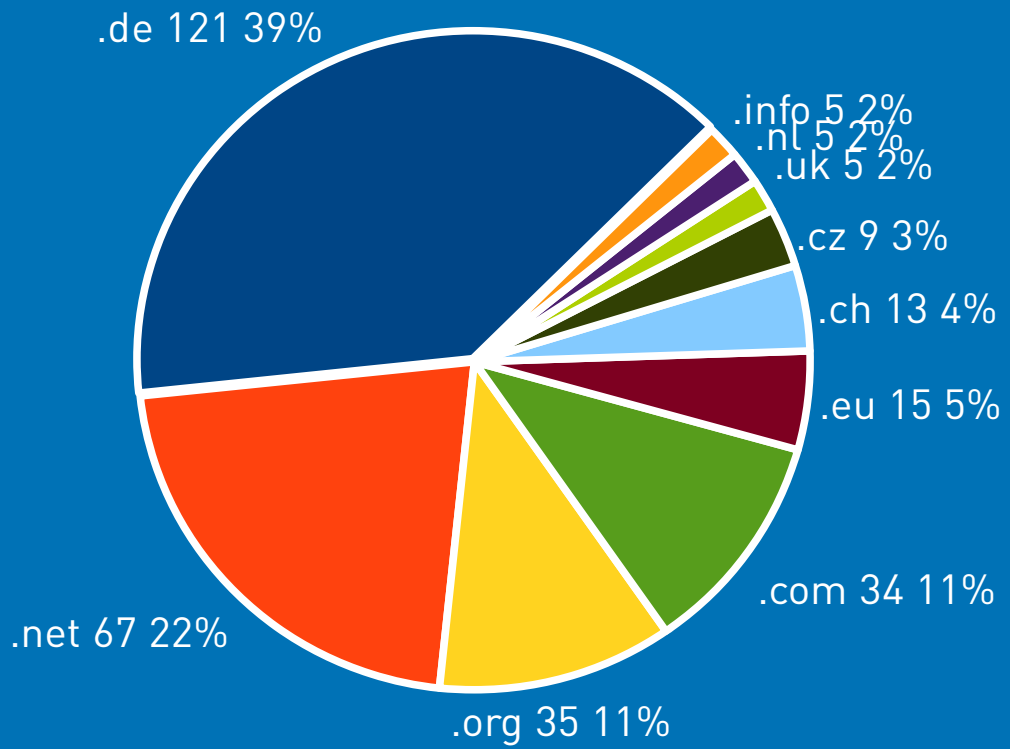
```
Jul 14 11:04:44 mail postfix/smtp[6409]:
  Verified TLS connection established to mail.sys4.de
  [194.126.158.139]:25: TLSv1 with cipher
  ECDHE-RSA-AES256-SHA (256/256 bits)
```

DANE over SMTP Adoption

Currently about 1.200 email domains

- posteo.de
- mailbox.org
- bund.de
- Unitymedia (UPC Germany)
- bayern.de
- SWITCH
- IETF

Top 10 DANE TLDs



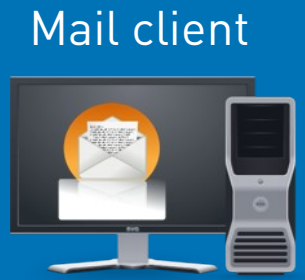
Viktor Dukhovni on IETF DANE mailinglist, 14.11.2014

PGP

OPENPGPKEY Resource Record

- Publish PGP/GPG public keys in DNS
- Local part of mail address hashed
- Replace or augment PGP-keyserver
- Benefits over current Keyservers:
  - Key removal!
  - Keys authenticated by DNSSEC domain ownership and web-of-trust

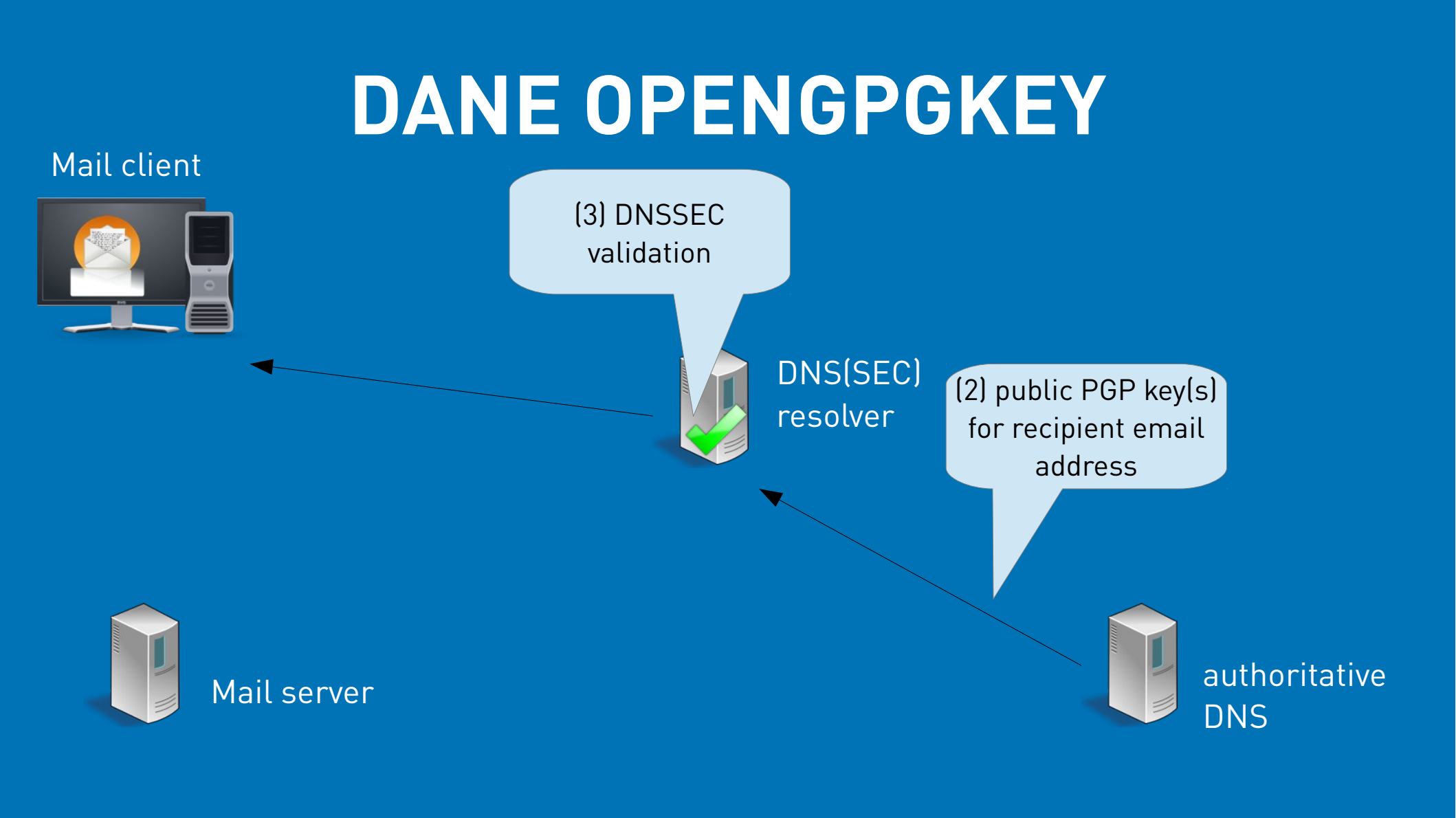
DANE OPENGPGKEY



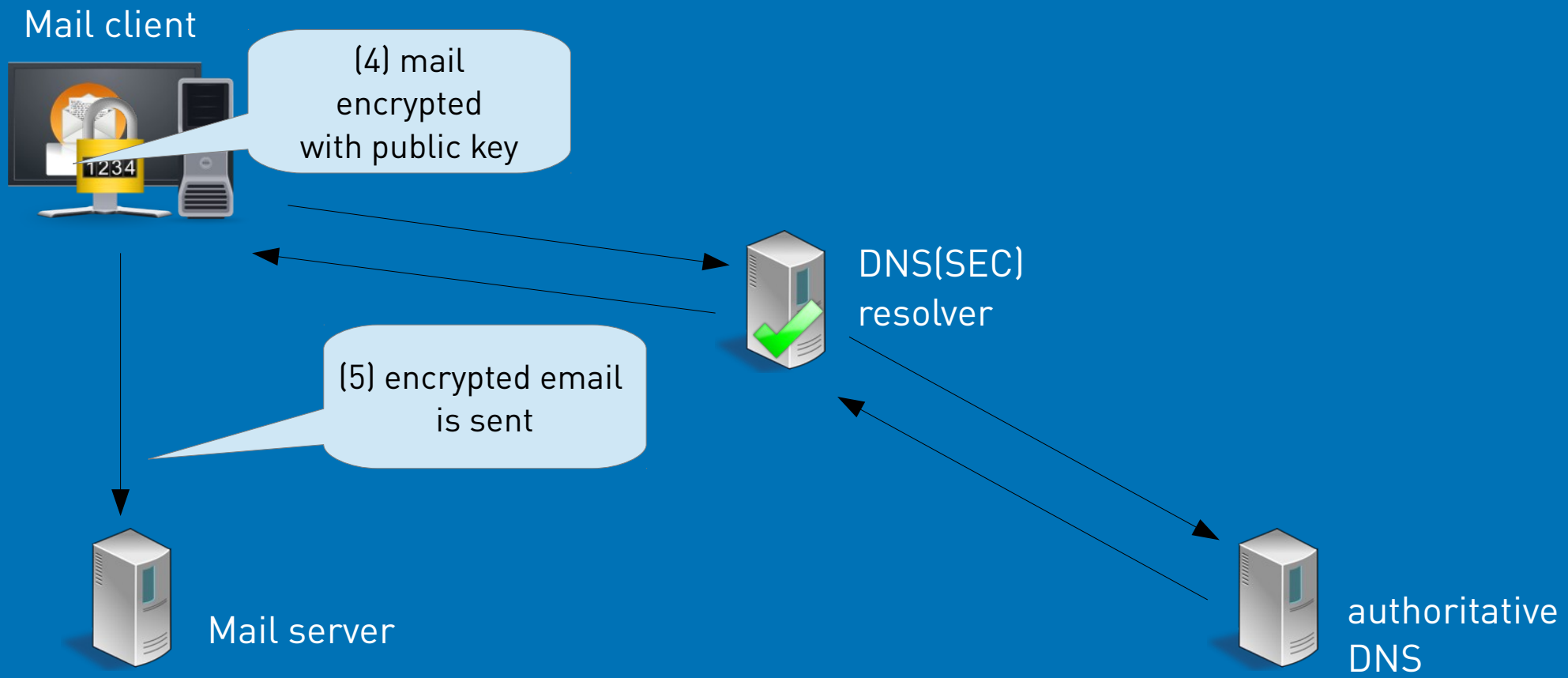
(1) request for OPENPGPKEY record(s)

(1) request for OPENPGPKEY record(s)

DANE OPENGPGKEY



DANE OPENGPGKEY



SMIME

SMIMEA Resource Record

- Authenticates email x509 certificates for S/MIME
- Store hash or certificate in DNSSEC secured domain
- Email localpart hashed
  - email clients (MUA, mail user agent) validate x509 certificate/public-key in incoming email
  - email clients fetch x509 public key certificates from DNS

DANE S/MIME

Alice

Bob

(1) Bob sends Alice email with S/MIME cert attached

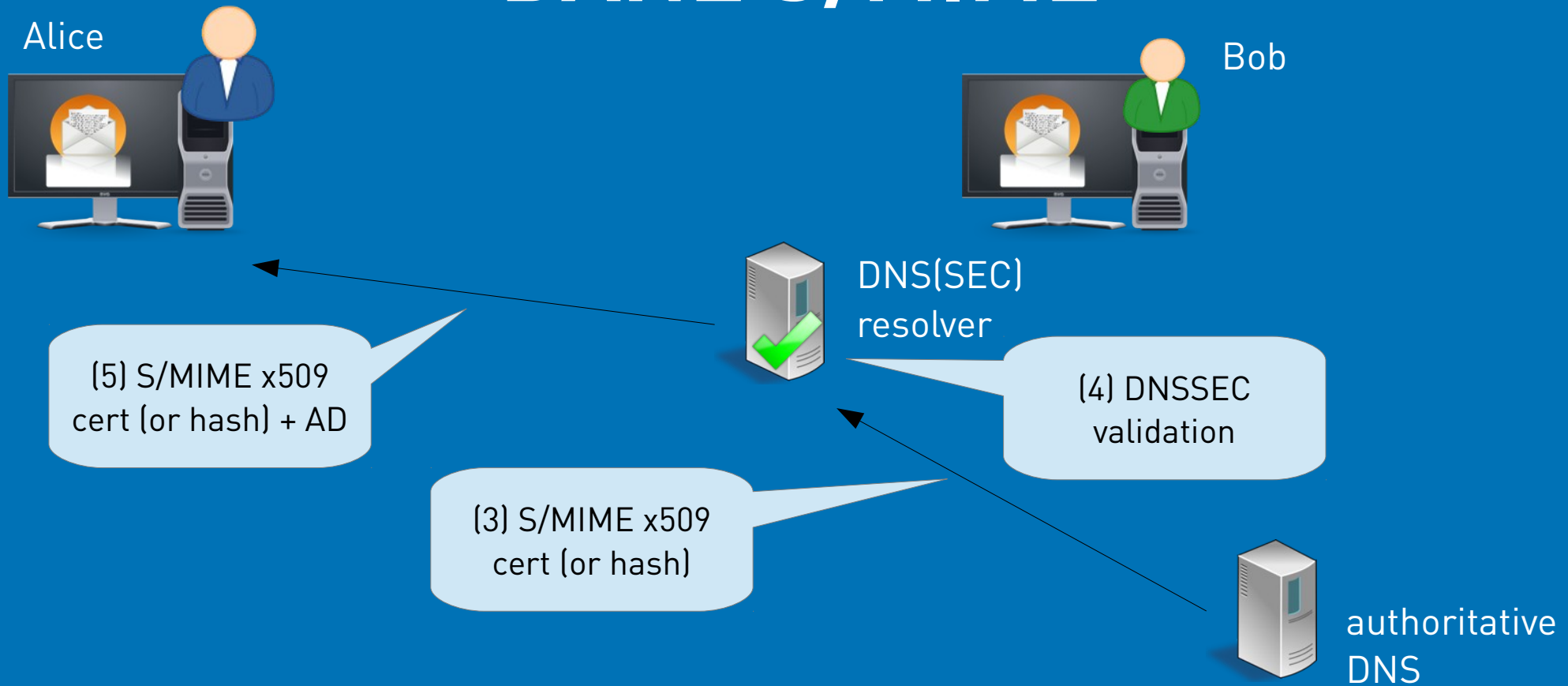
DNS(SEC) resolver

authoritative DNS

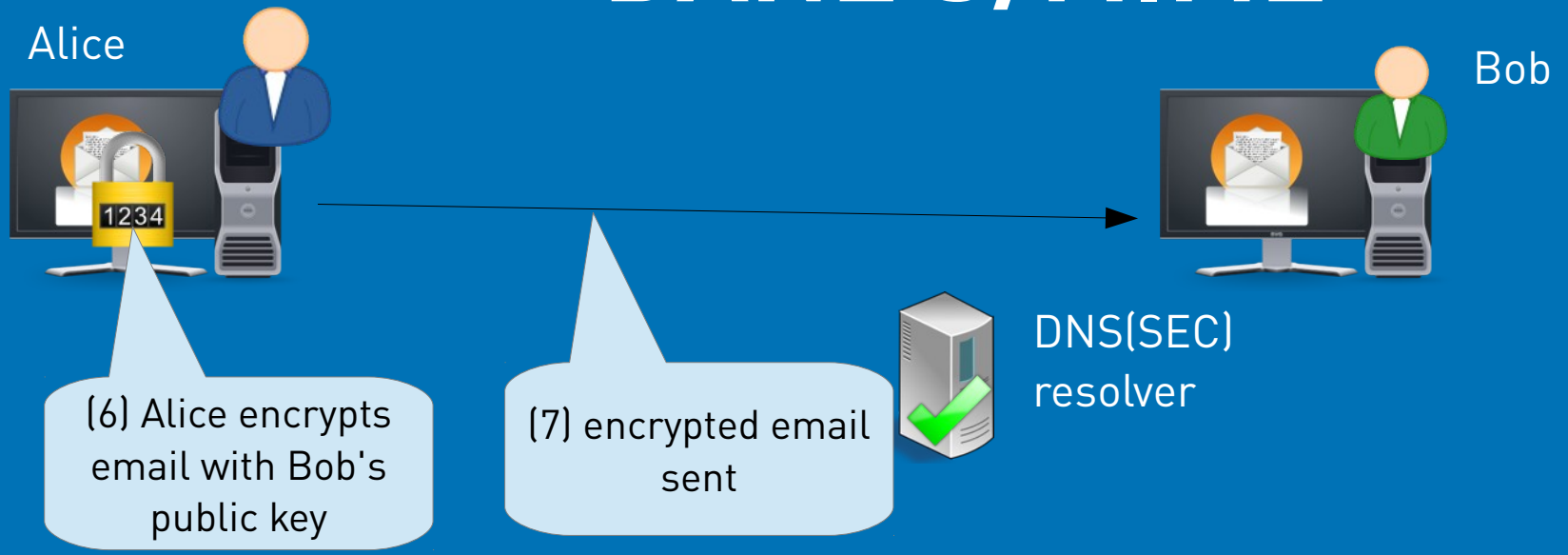
DANE S/MIME


Alice
(2) request for SMIMEA records
Bob
DNS(SEC) resolver
(2) request for SMIMEA records
authoritative DNS

DANE S/MIME


Alice
Bob
DNS(SEC)
resolver
(5) S/MIME x509
cert (or hash) + AD
(4) DNSSEC
validation
(3) S/MIME x509
cert (or hash)
authoritative
DNS

DANE S/MIME


Alice
1234
Bob
(6) Alice encrypts email with Bob's public key
(7) encrypted email sent
DNS(SEC) resolver
authoritative DNS

smilla

- SMIMEA aware Milter
- „Smilla's Sense of Snow*den*“
- Transparent for users
- In- and outbound encryption
- To be released as Open Source as soon as RFC becomes standard at https://github.com/sys4/

Next Steps DANE WG

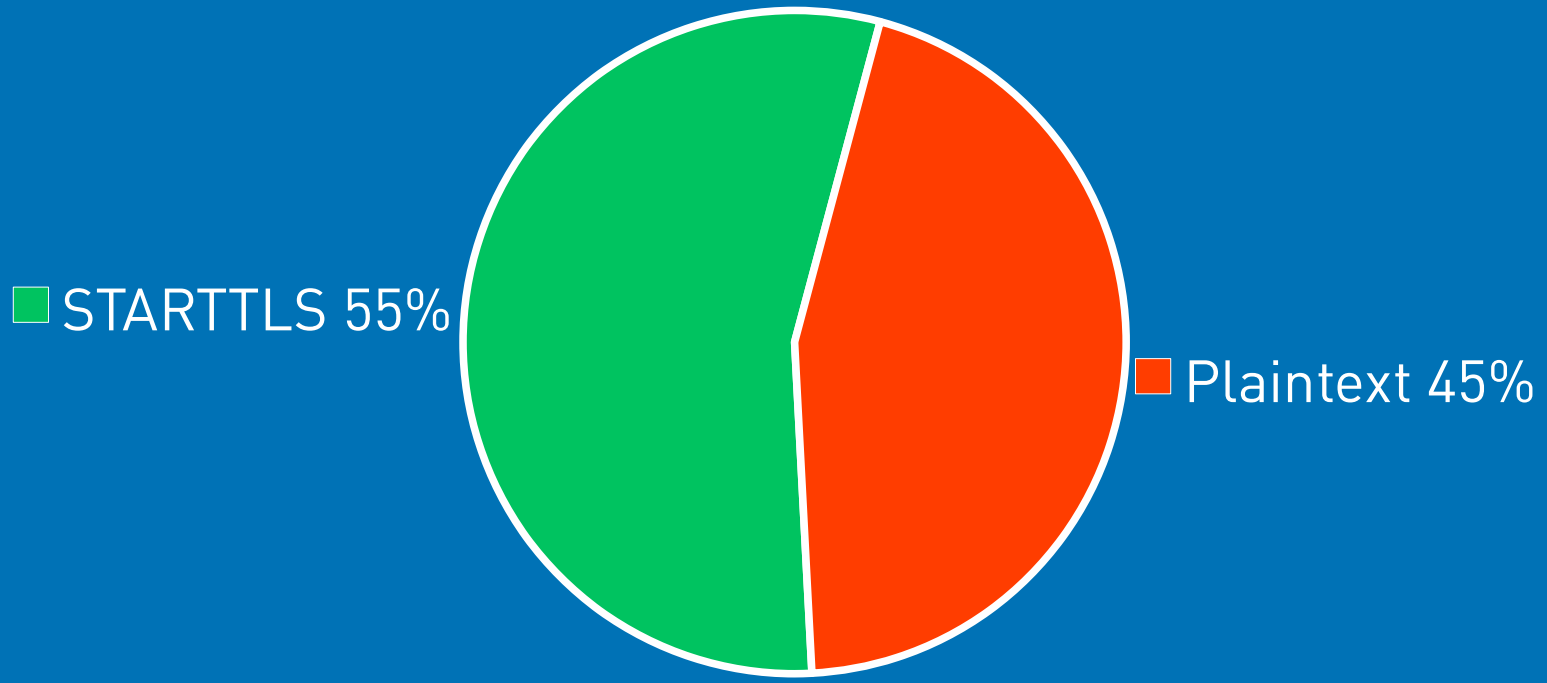
- **raw-Certificates**
- **Mutual Authentication**
  client-side authentication via TLSA RR
- **Payment Association Records**
  Link account information/bitcoin wallet to a email adress

Markets for DANE

Who benefits from DANE?

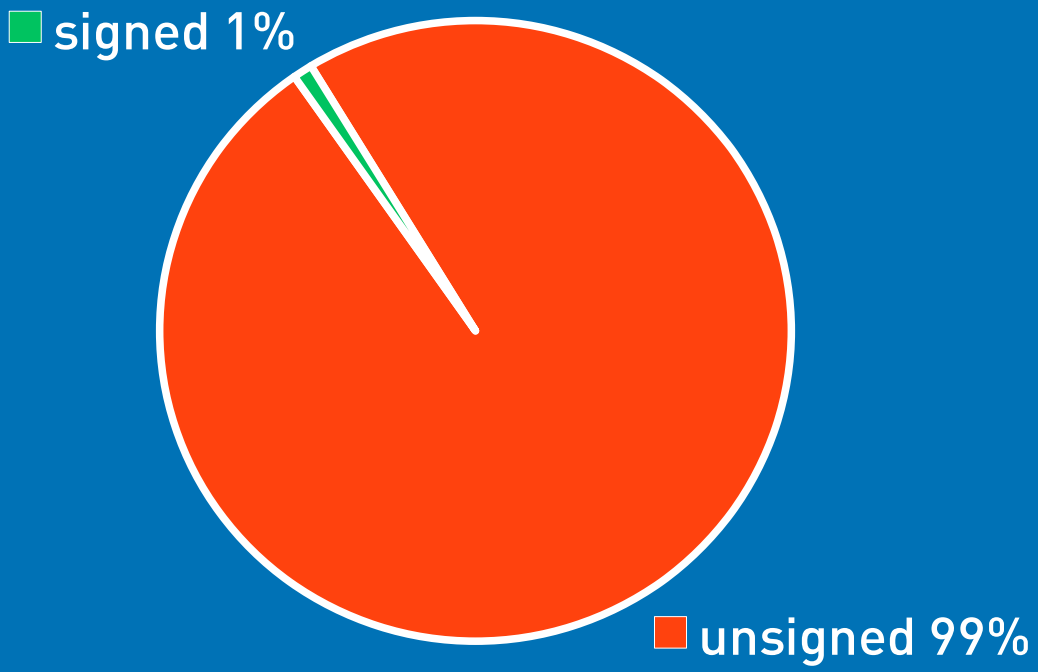
- „Security services“ providers
- Email users with „defined“ security requirements
- Online-Payment, insurance, banks
- Enterprises
- Subcontractor

TLS in .de



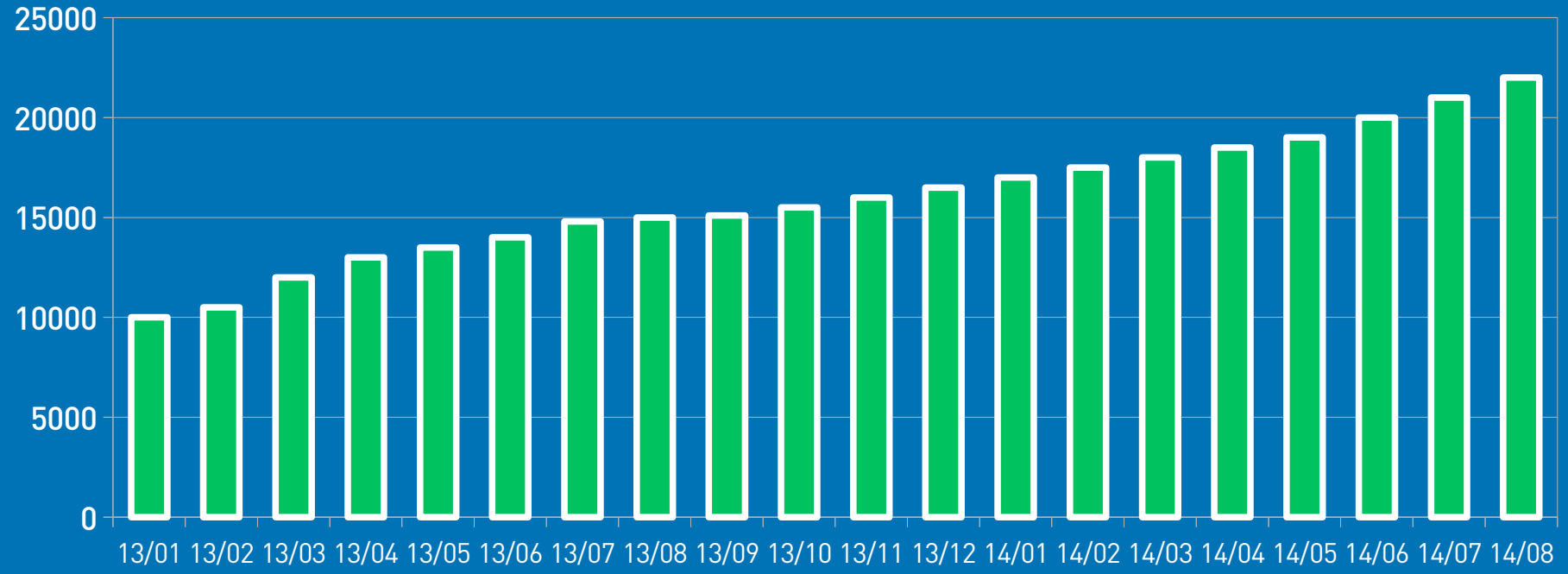
2,7 Mio. MX RR > 275.000 MTAs with 12.092 IPv6 \o/ MTAs

DNSSEC in .DE



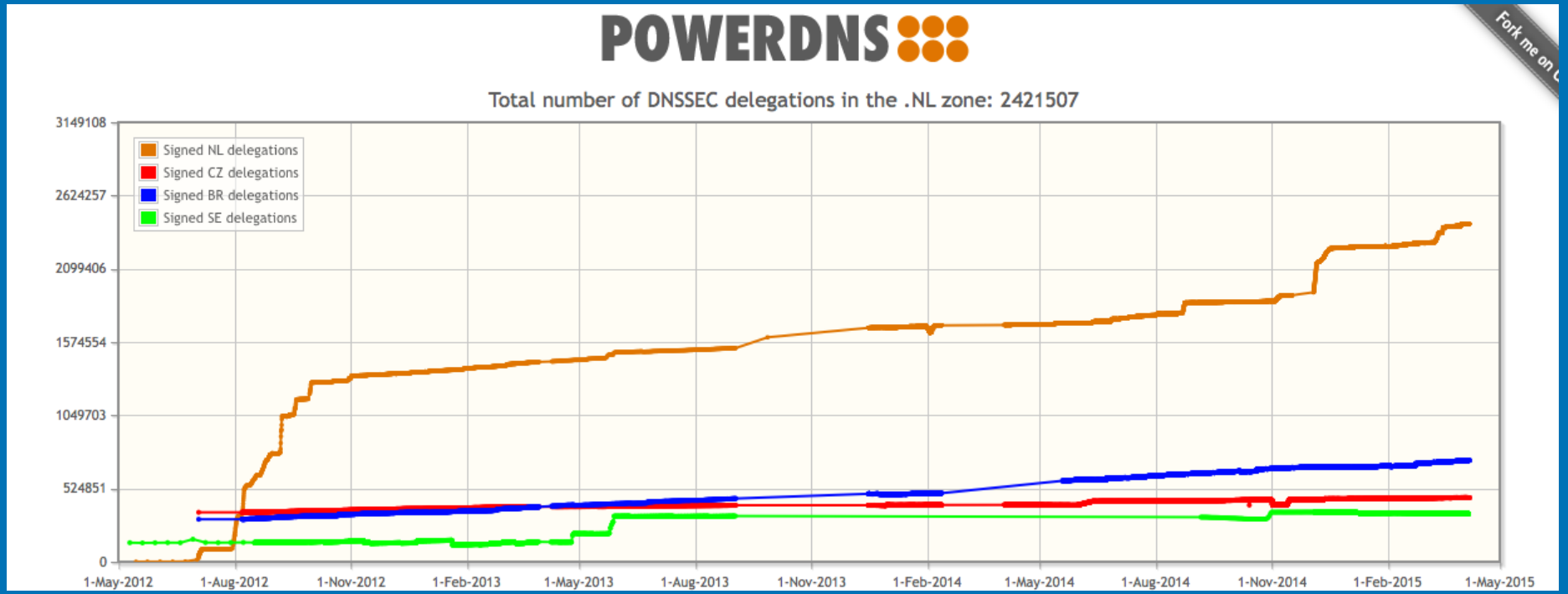
„SMTP, STARTTLS, DANE - Wer spielt mit wem?“, Peter Koch, DENIC eG
DENIC – Technisches Meeting, Frankfurt, 2014-09-30

DNSSEC growth in .de



„SMTP, STARTTLS, DANE - Wer spielt mit wem?“, Peter Koch, DENIC eG
DENIC – Technisches Meeting, Frankfurt, 2014-09-30

DNSSEC growth in .NL



PowerDNS DNSSEC deployment graph:
https://xs.powerdns.com/dnssec-nl-graph/

DANE road-blocks?

What people tell

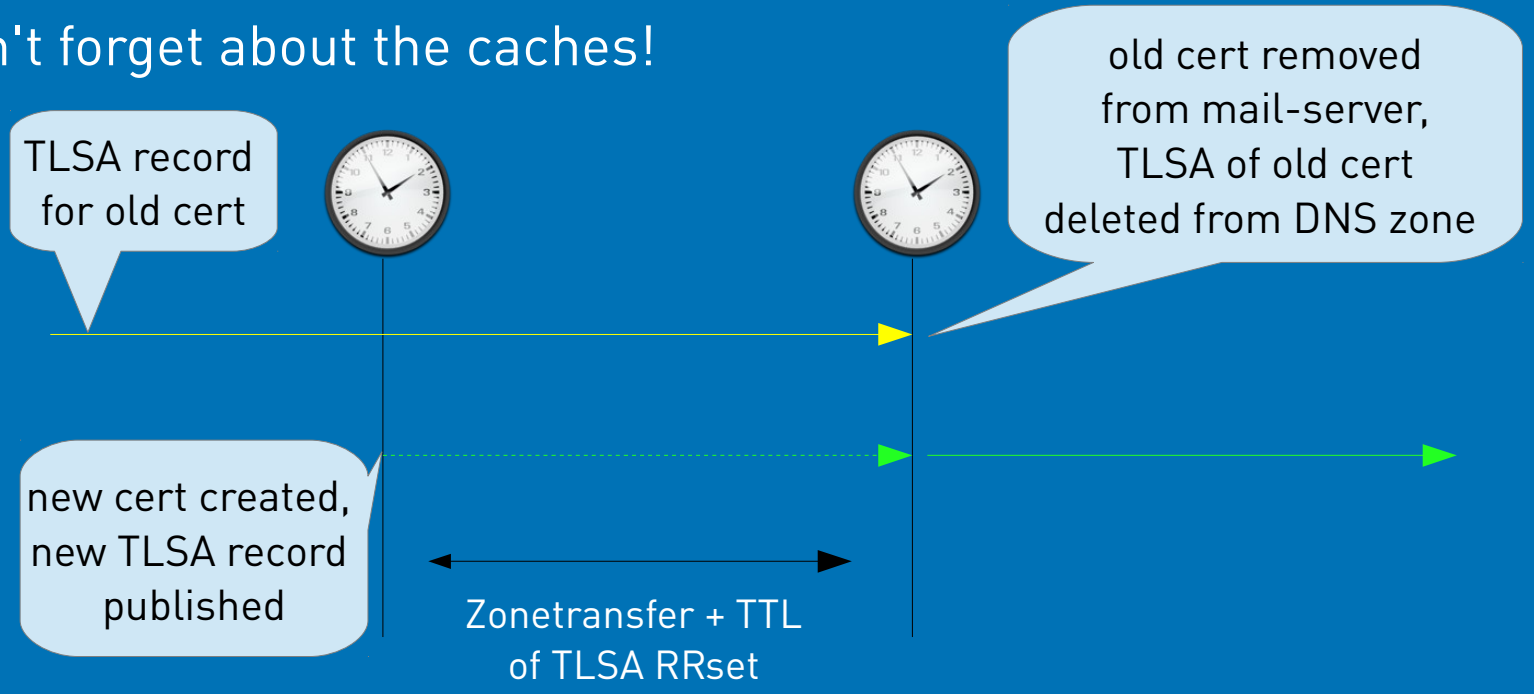
- DNS provider with incomplete or non-existent DNSSEC-support
- DNSSEC is technology but not a use case
- With DNSSEC issues become mission critical
- Missing DNSSEC/DANE monitoring and alarming
- Missing know-how for automated certificate-management and DNSSEC signing
- Missing toolchain for automated management

Registrars

- Major registrars do not offer DNSSEC
- Costs/risks of moving domains between registrars

Coordination

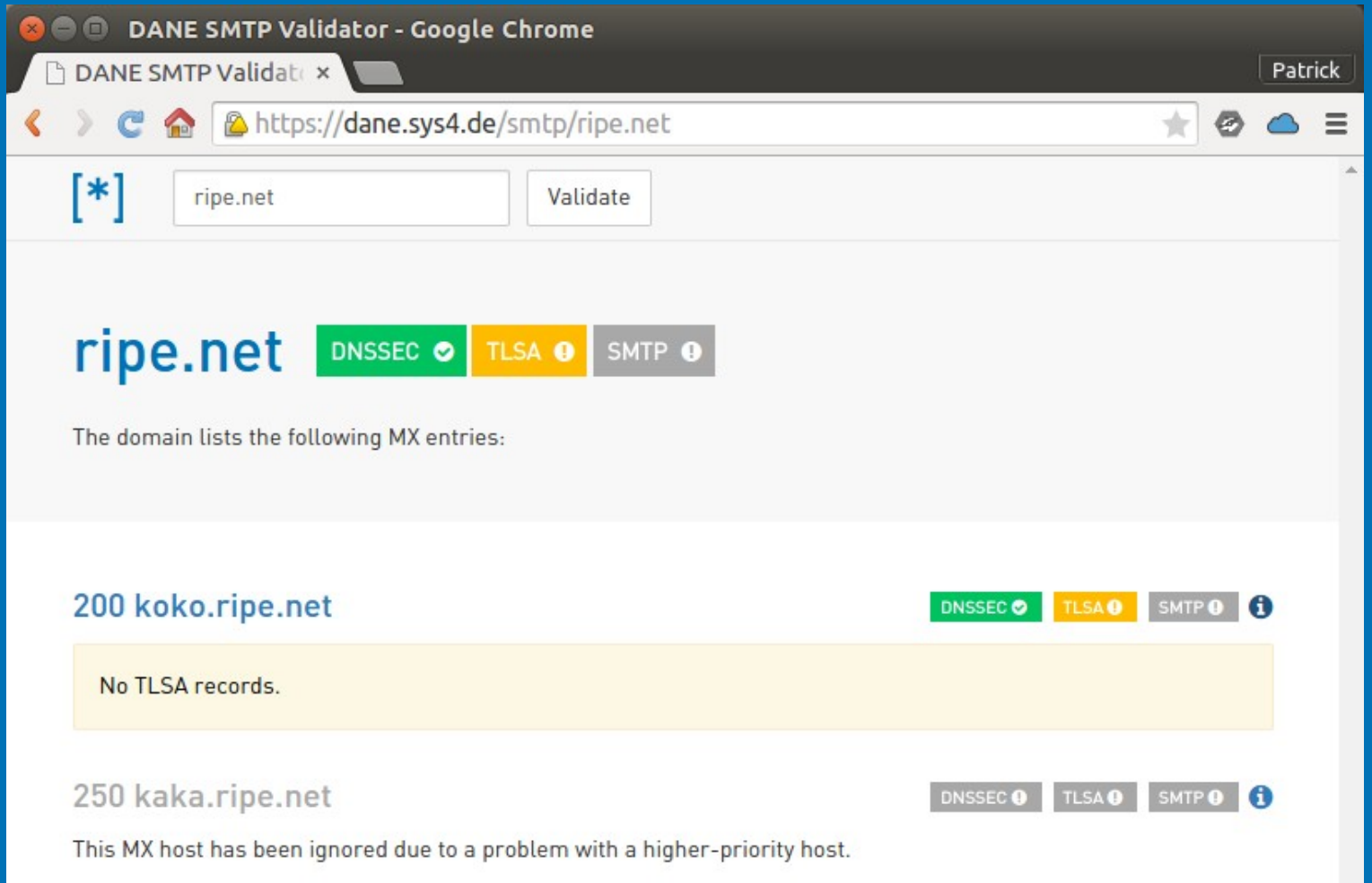
- x509 certs, PGP keys in DNS
- DNS is a loosely consistent database
  - don't forget about the caches!



DNSSEC is Mission Critical

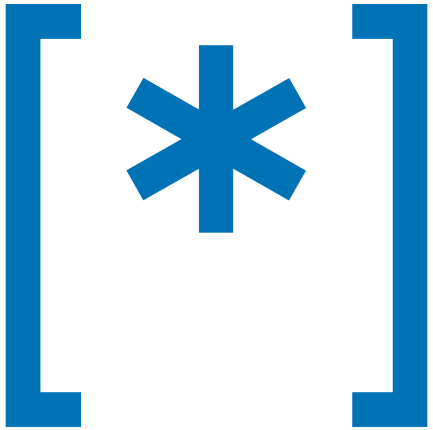
- DNS is the „ugly duckling“ of network management
- DNSSEC might require a new/better DNS design
- DNSSEC requires „trusted peers“
- Expired DNSSEC signatures can make domain „vanish“ (until the SIGs are renewed)

DANE Validator



Takeaway

- DNSSEC as a „one-time-cost“
- Open standard
- DANE allows scalable and secure trust-management
- Reduces management costs
- Automates rollover
- Software support is here: Postfix, Exim, OpenSMTPd, OpenPGPKEY milter, smilla



We do ASCII

sys4.de

https://sys4.de/download/dane-ripe.pdf