DNS, DNSSEC, DANE, DPRIVE

IETF 94 Hackathon

Results!

DNS Team Hackathon Projects

- DNS Privacy topics
  - **getdnsapi extension (call debugging) implemented with changes so user learns transport/privacy results**
  - **edns0-client-subnet privacy election**
  - edns0-padding option (implementation under way)
  - **Check TLS at Recursive - node.js application**
- DNSSEC topics
  - **DNSSEC roadblock avoidance - proposed new extension for getdnsapi**
  - **CDS/CDNSKEY -**

  …

DNS Team Hackathon Projects

- DANE-related
  - Sketch for OPENPGPKEY RRs in an ietf.org zone for IETF's role-based email addresses – Allison Mankin and Tomofumi C

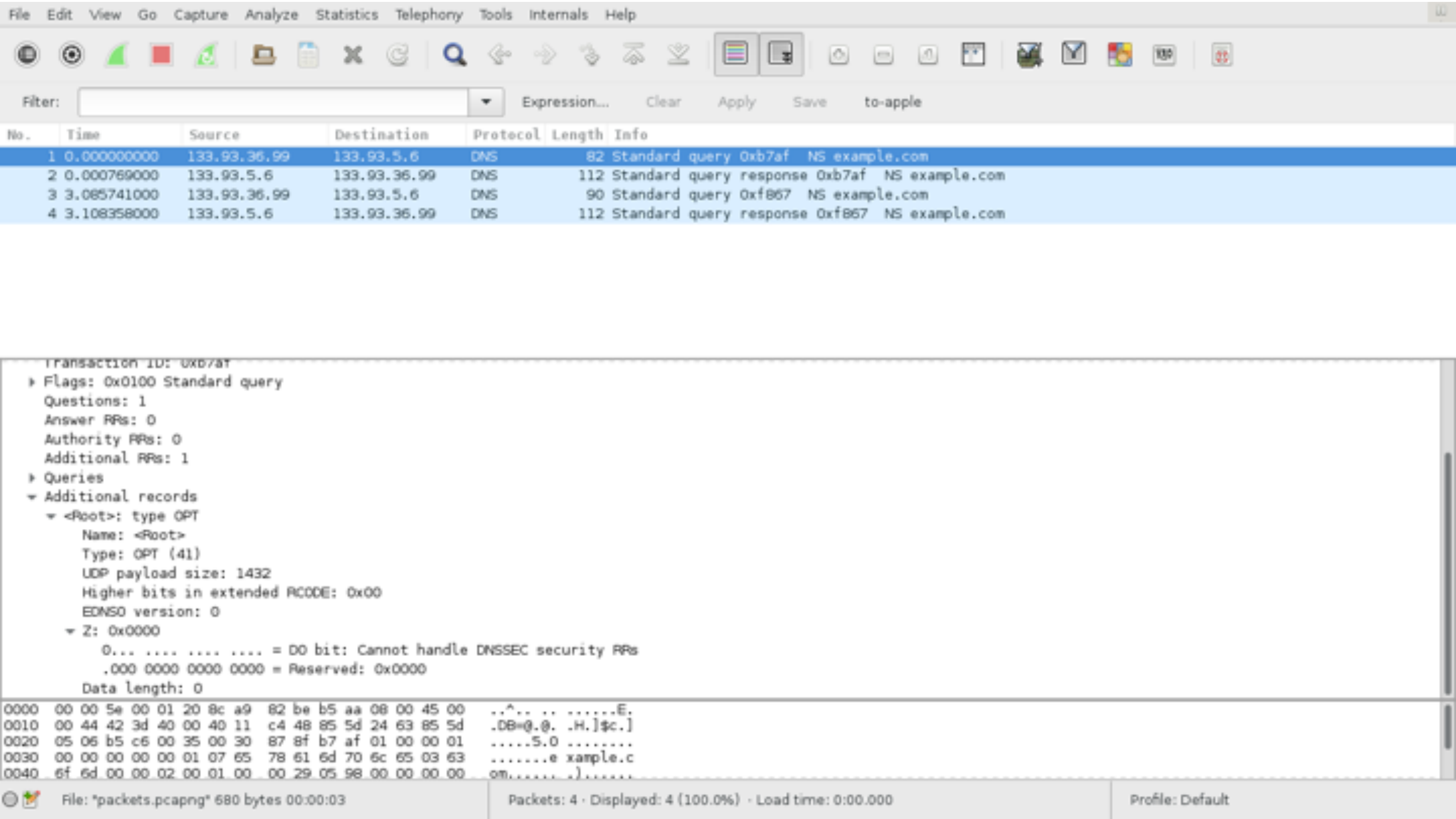
- Other
  - getdns built for OpenBSD – Melinda Shore
  - getdns brew formula updated – Matt Miller
  - getdns PHP bindings updated to new release features – Scott Hollenbeck
  - Miscellaneous engagements with other tables

DNS Privacy

- Every Internet flow begins with queries to DNS
- DNS queries are meta-data
- Example of user exposing possible travel planning
- Someone monitoring

A? AAAA? hotel.example.berlin
A? AAAA? buytix.example.de

Client Privacy from draft-ietf-dnsop-client-subnet-04 - Daniel Kahn Gillmor (DKG)


File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression... Clear Apply Save to-apple

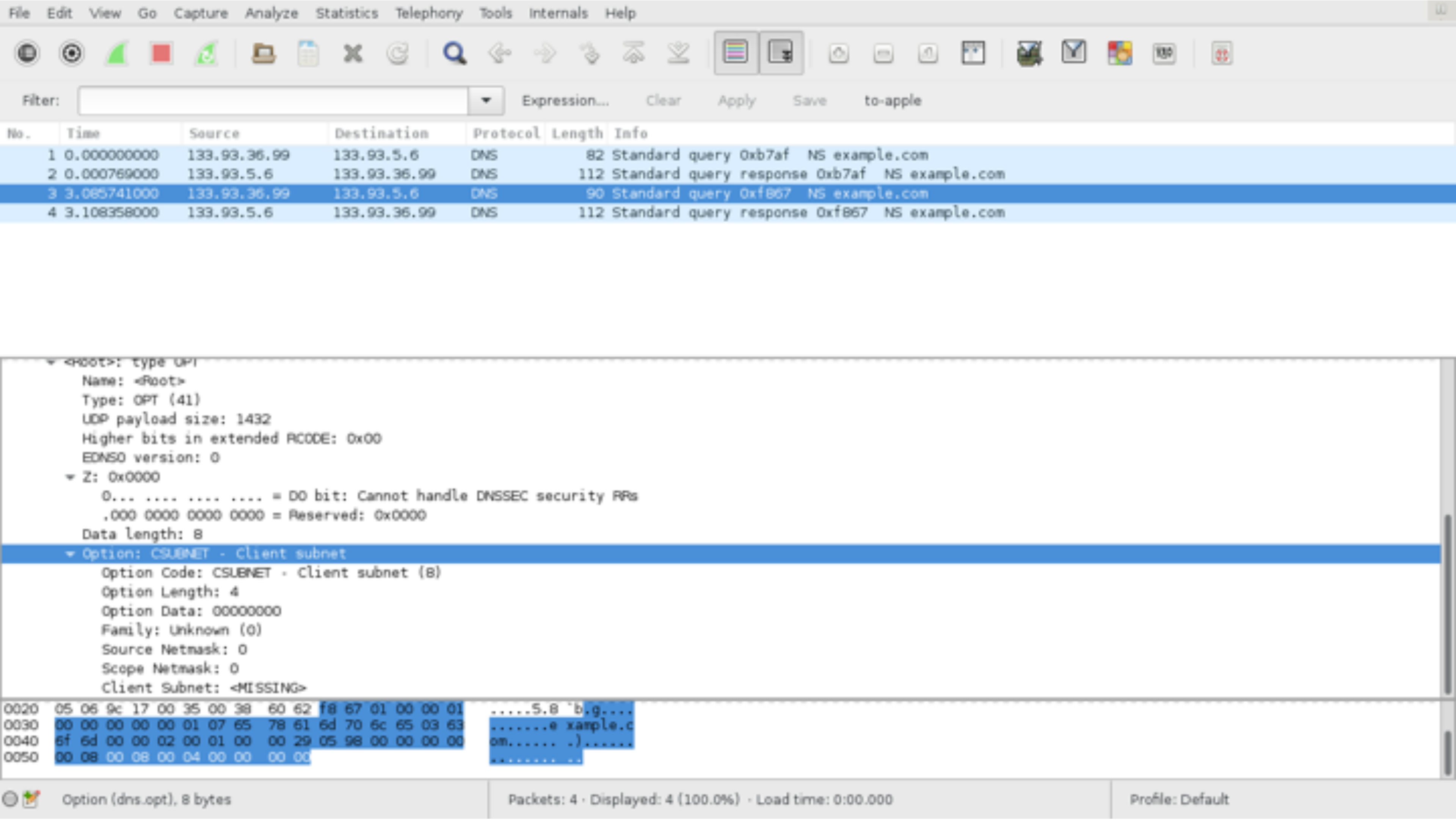
```
No.  Time          Source        Destination   Protocol Length Info
   1 0.000000000   133.93.36.99  133.93.5.6    DNS          82 Standard query 0xb7af  NS example.com
   2 0.000769000   133.93.5.6    133.93.36.99  DNS         112 Standard query response 0xb7af  NS example.com
   3 3.085741000   133.93.36.99  133.93.5.6    DNS          90 Standard query 0xf867  NS example.com
   4 3.108358000   133.93.5.6    133.93.36.99  DNS         112 Standard query response 0xf867  NS example.com
```

```
  Transaction ID: 0xb7af
▸ Flags: 0x0100 Standard query
  Questions: 1
  Answer RRs: 0
  Authority RRs: 0
  Additional RRs: 1
▸ Queries
▾ Additional records
  ▾ <Root>: type OPT
      Name: <Root>
      Type: OPT (41)
      UDP payload size: 1432
      Higher bits in extended RCODE: 0x00
      EDNS0 version: 0
    ▾ Z: 0x0000
        0... .... .... .... = DO bit: Cannot handle DNSSEC security RRs
        .000 0000 0000 0000 = Reserved: 0x0000
      Data length: 0
```

```
0000   00 00 5e 00 01 20 8c a9  82 be b5 aa 08 00 45 00    ..^.. .. ......E.
0010   00 44 42 3d 40 00 40 11  c4 48 85 5d 24 63 85 5d    .DB=@.@. .H.]$c.]
0020   05 06 b5 c6 00 35 00 30  87 8f b7 af 01 00 00 01    .....5.0 ........
0030   00 00 00 00 00 01 07 65  78 61 6d 70 6c 65 03 63    .......e xample.c
0040   6f 6d 00 00 02 00 01 00  00 29 05 98 00 00 00 00    om...... .)......
```

File: "packets.pcapng" 680 bytes 00:00:03 | Packets: 4 · Displayed: 4 (100.0%) · Load time: 0:00.000 | Profile: Default

Client sends value of 0 to opt out



```
No.  Time          Source          Destination     Protocol Length Info
   1 0.000000000   133.93.36.99    133.93.5.6      DNS          82 Standard query 0xb7af  NS example.com
   2 0.000769000   133.93.5.6      133.93.36.99    DNS         112 Standard query response 0xb7af  NS example.com
   3 3.085741000   133.93.36.99    133.93.5.6      DNS          90 Standard query 0xf867  NS example.com
   4 3.108358000   133.93.5.6      133.93.36.99    DNS         112 Standard query response 0xf867  NS example.com
```

```
  ▾ <Root>: type OPT
      Name: <Root>
      Type: OPT (41)
      UDP payload size: 1432
      Higher bits in extended RCODE: 0x00
      EDNS0 version: 0
    ▾ Z: 0x0000
        0... .... .... .... = DO bit: Cannot handle DNSSEC security RRs
        .000 0000 0000 0000 = Reserved: 0x0000
      Data length: 8
    ▾ Option: CSUBNET - Client subnet
        Option Code: CSUBNET - Client subnet (8)
        Option Length: 4
        Option Data: 00000000
        Family: Unknown (0)
        Source Netmask: 0
        Scope Netmask: 0
        Client Subnet: <MISSING>
```

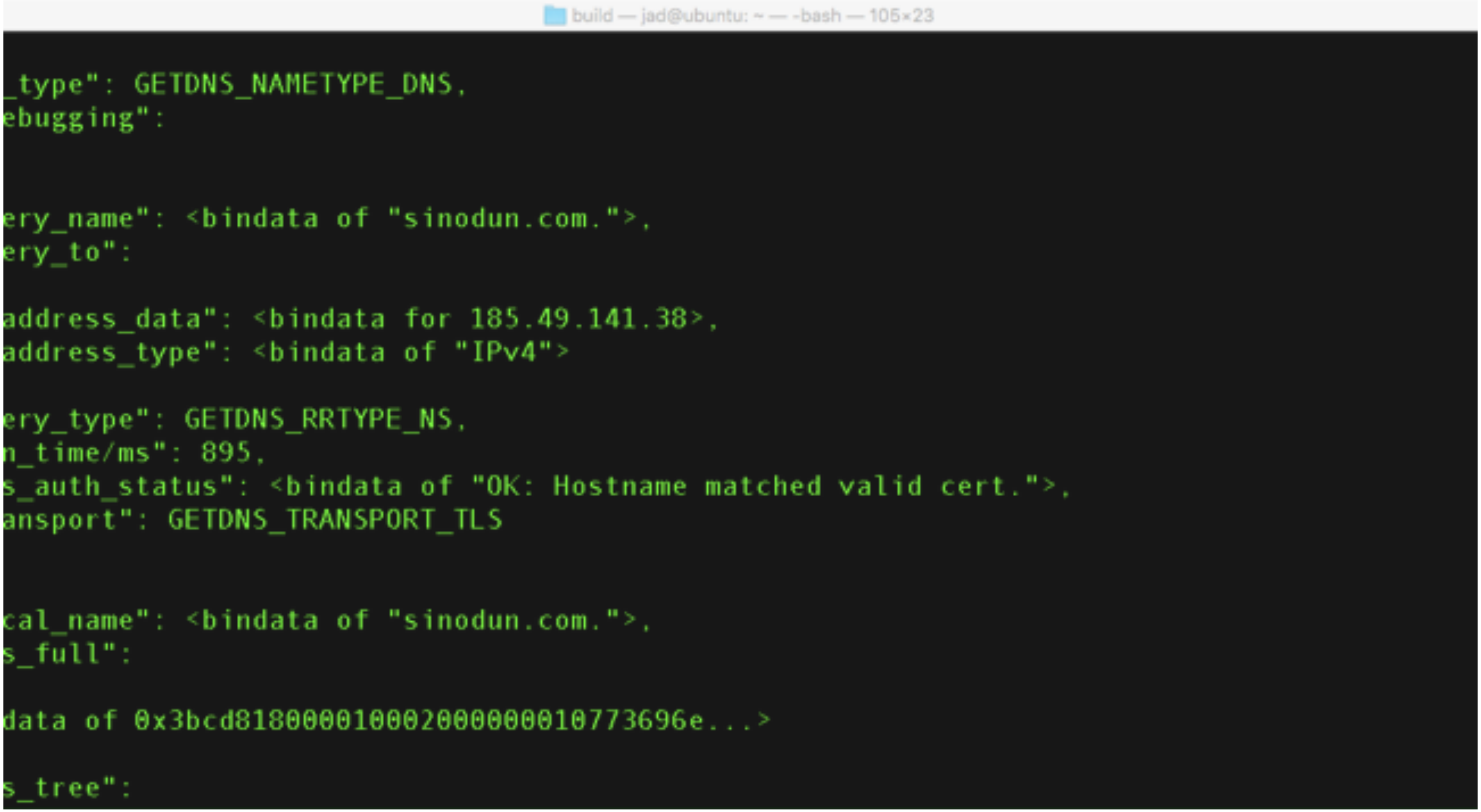
```
0020  05 06 9c 17 00 35 00 38  60 62 f8 67 01 00 00 01   .....5.8 `b.g....
0030  00 00 00 00 00 01 07 65  78 61 6d 70 6c 65 03 63   .......e xample.c
0040  6f 6d 00 00 02 00 01 00  00 29 05 98 00 00 00 00   om...... .)......
0050  00 08 00 08 00 04 00 00  00 00                     ........ ..
```

Option (dns.opt), 8 bytes

Packets: 4 · Displayed: 4 (100.0%) · Load time: 0:00.000

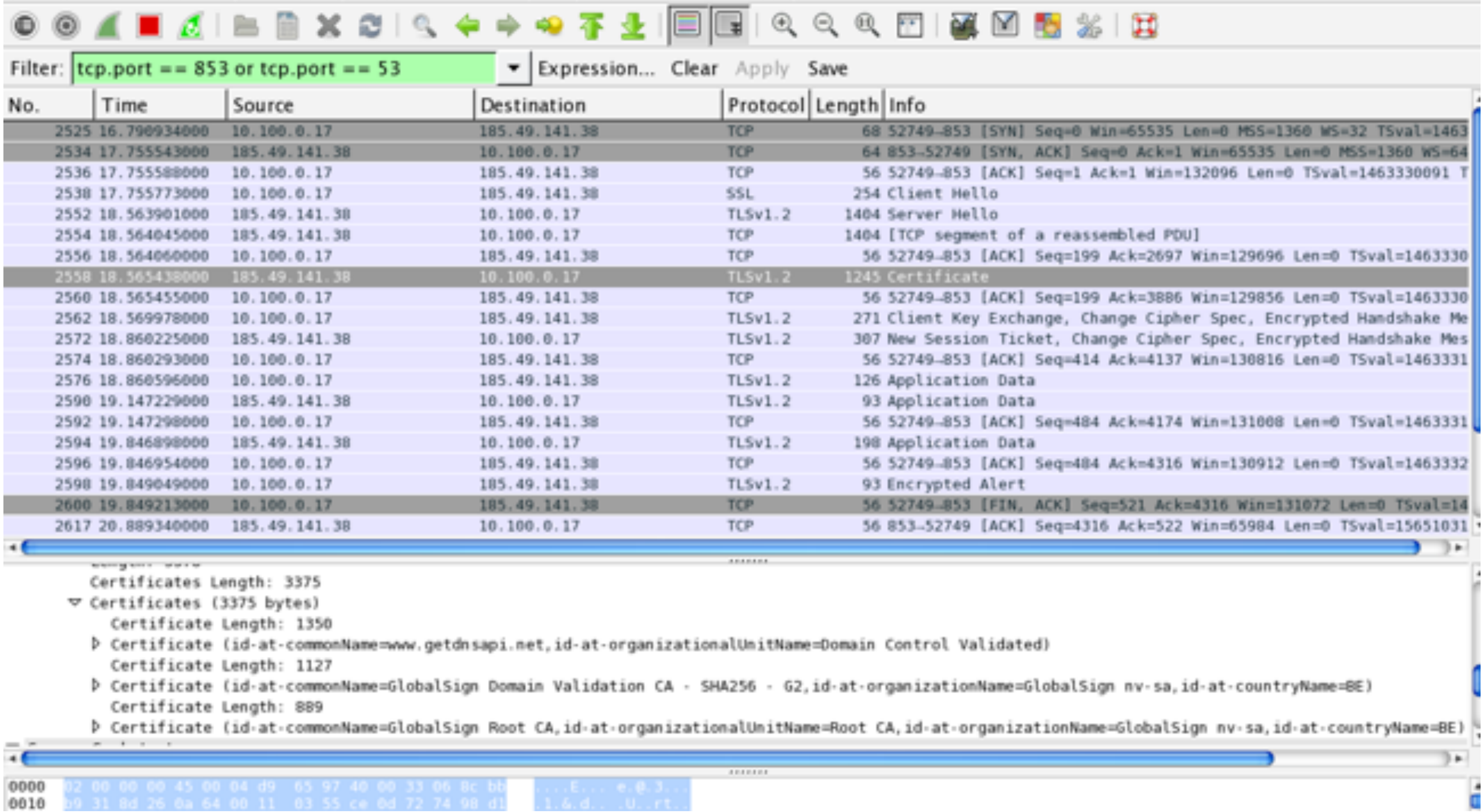
Profile: Default

John/Sara Dickinson - Transport and Privacy Results from getdns



```
_type": GETDNS_NAMETYPE_DNS,
ebugging":


ery_name": <bindata of "sinodun.com.">,
ery_to":

address_data": <bindata for 185.49.141.38>,
address_type": <bindata of "IPv4">

ery_type": GETDNS_RRTYPE_NS,
n_time/ms": 895,
s_auth_status": <bindata of "OK: Hostname matched valid cert.">,
ansport": GETDNS_TRANSPORT_TLS


cal_name": <bindata of "sinodun.com.">,
s_full":

data of 0x3bcd818000010002000000010773696e...>

s_tree":
```

Gowri Visweswaran/Sara Dickinson - getdns node.js Tool to Check TLS at Recursive



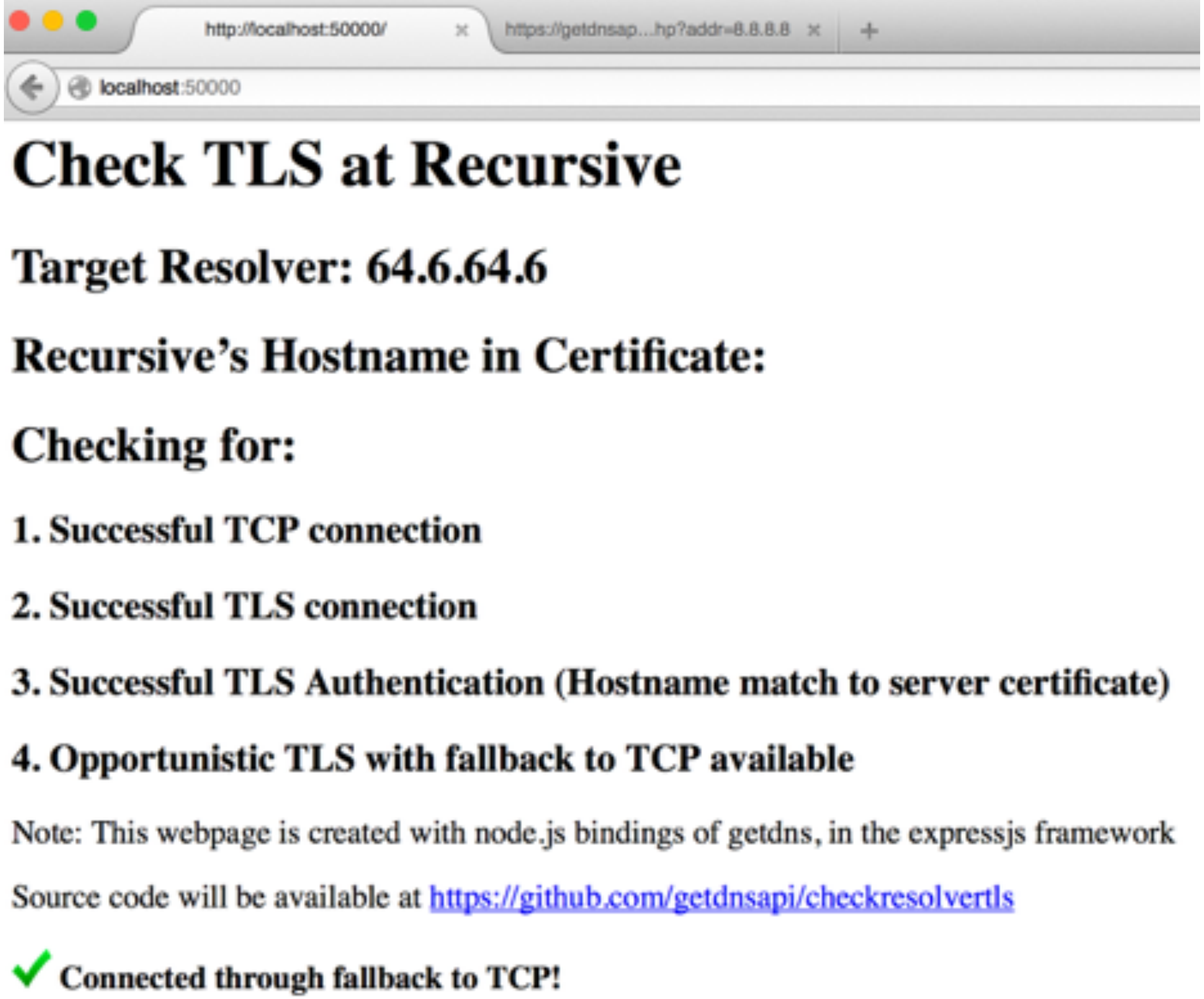
Filter: tcp.port == 853 or tcp.port == 53

No.	Time	Source	Destination	Protocol	Length	Info
2525	16.790934000	10.100.0.17	185.49.141.38	TCP	68	52749→853 [SYN] Seq=0 Win=65535 Len=0 MSS=1360 WS=32 TSval=1463
2534	17.755543000	185.49.141.38	10.100.0.17	TCP	64	853→52749 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1360 WS=64
2536	17.755588000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [ACK] Seq=1 Ack=1 Win=132096 Len=0 TSval=1463330091 T
2538	17.755773000	10.100.0.17	185.49.141.38	SSL	254	Client Hello
2552	18.563901000	185.49.141.38	10.100.0.17	TLSv1.2	1404	Server Hello
2554	18.564045000	185.49.141.38	10.100.0.17	TCP	1404	[TCP segment of a reassembled PDU]
2556	18.564060000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [ACK] Seq=199 Ack=2697 Win=129696 Len=0 TSval=1463330
2558	18.565438000	185.49.141.38	10.100.0.17	TLSv1.2	1245	Certificate
2560	18.565455000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [ACK] Seq=199 Ack=3886 Win=129856 Len=0 TSval=1463330
2562	18.569978000	10.100.0.17	185.49.141.38	TLSv1.2	271	Client Key Exchange, Change Cipher Spec, Encrypted Handshake Me
2572	18.860225000	185.49.141.38	10.100.0.17	TLSv1.2	307	New Session Ticket, Change Cipher Spec, Encrypted Handshake Mes
2574	18.860293000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [ACK] Seq=414 Ack=4137 Win=130816 Len=0 TSval=1463331
2576	18.860596000	10.100.0.17	185.49.141.38	TLSv1.2	126	Application Data
2590	19.147229000	185.49.141.38	10.100.0.17	TLSv1.2	93	Application Data
2592	19.147298000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [ACK] Seq=484 Ack=4174 Win=131008 Len=0 TSval=1463331
2594	19.846898000	185.49.141.38	10.100.0.17	TLSv1.2	198	Application Data
2596	19.846954000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [ACK] Seq=484 Ack=4316 Win=130912 Len=0 TSval=1463332
2598	19.849049000	10.100.0.17	185.49.141.38	TLSv1.2	93	Encrypted Alert
2600	19.849213000	10.100.0.17	185.49.141.38	TCP	56	52749→853 [FIN, ACK] Seq=521 Ack=4316 Win=131072 Len=0 TSval=14
2617	20.889340000	185.49.141.38	10.100.0.17	TCP	56	853→52749 [ACK] Seq=4316 Ack=522 Win=65984 Len=0 TSval=15651031

```
    Certificates Length: 3375
  ▽ Certificates (3375 bytes)
      Certificate Length: 1350
    ▷ Certificate (id-at-commonName=www.getdnsapi.net,id-at-organizationalUnitName=Domain Control Validated)
      Certificate Length: 1127
    ▷ Certificate (id-at-commonName=GlobalSign Domain Validation CA - SHA256 - G2,id-at-organizationName=GlobalSign nv-sa,id-at-countryName=BE)
      Certificate Length: 889
    ▷ Certificate (id-at-commonName=GlobalSign Root CA,id-at-organizationalUnitName=Root CA,id-at-organizationName=GlobalSign nv-sa,id-at-countryName=BE)
```

```
0000  02 00 00 00 45 00 04 d9  65 97 40 00 33 06 8c bb   ....E... e.@.3...
0010  b9 31 8d 26 0a 64 00 11  03 55 ce 0d 72 74 98 d1   .1.&.d.. .U..rt..
```

(draft-ietf-dprive-dns-over-tls)



Check TLS at Recursive

Target Resolver: 64.6.64.6

Recursive’s Hostname in Certificate:

Checking for:

1. Successful TCP connection

2. Successful TLS connection

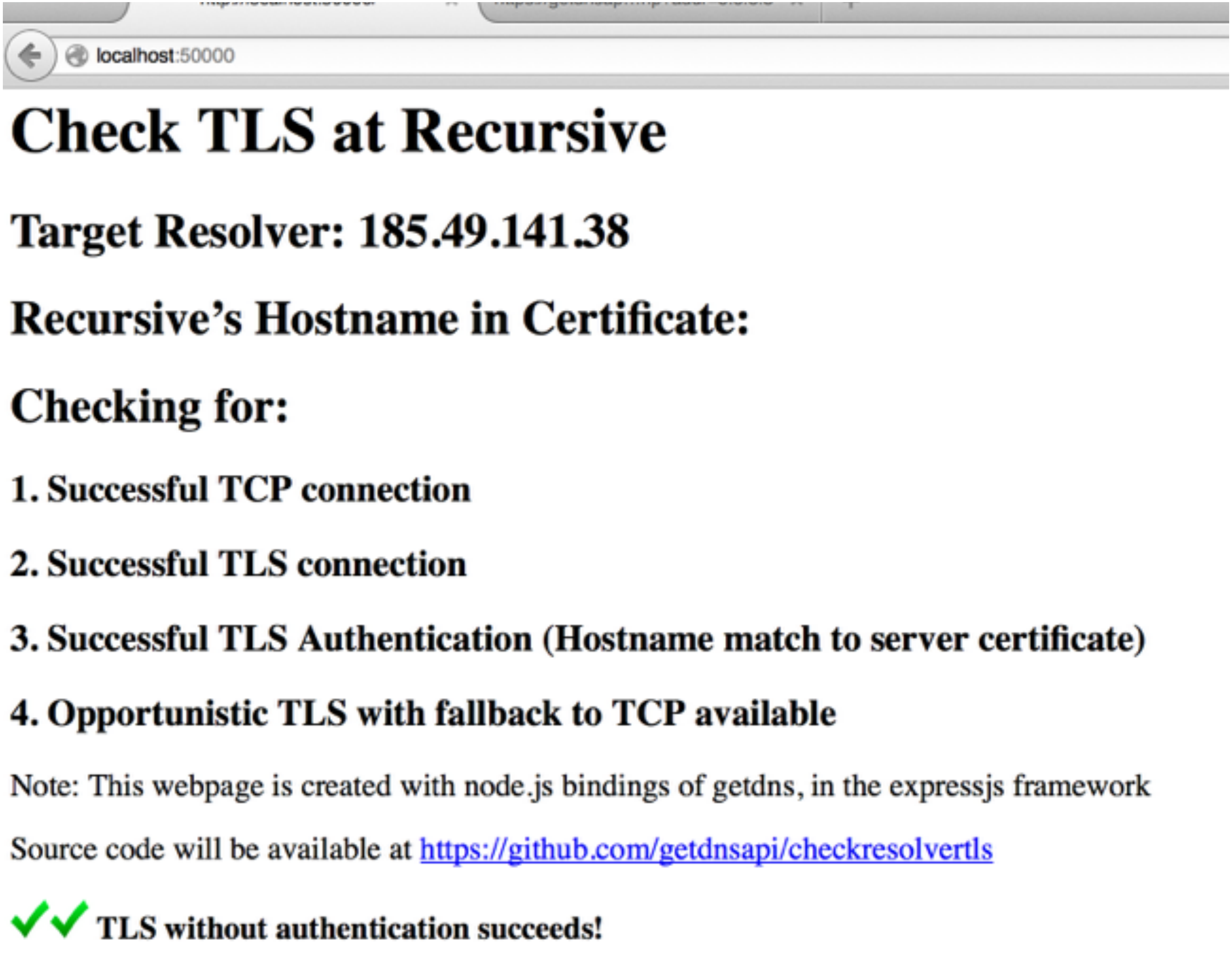
3. Successful TLS Authentication (Hostname match to server certificate)

4. Opportunistic TLS with fallback to TCP available

Note: This webpage is created with node.js bindings of getdns, in the expressjs framework

Source code will be available at https://github.com/getdnsapi/checkresolvertls

✓ **Connected through fallback to TCP!**



Check TLS at Recursive

Target Resolver: 185.49.141.38

Recursive's Hostname in Certificate:

Checking for:

1. Successful TCP connection

2. Successful TLS connection

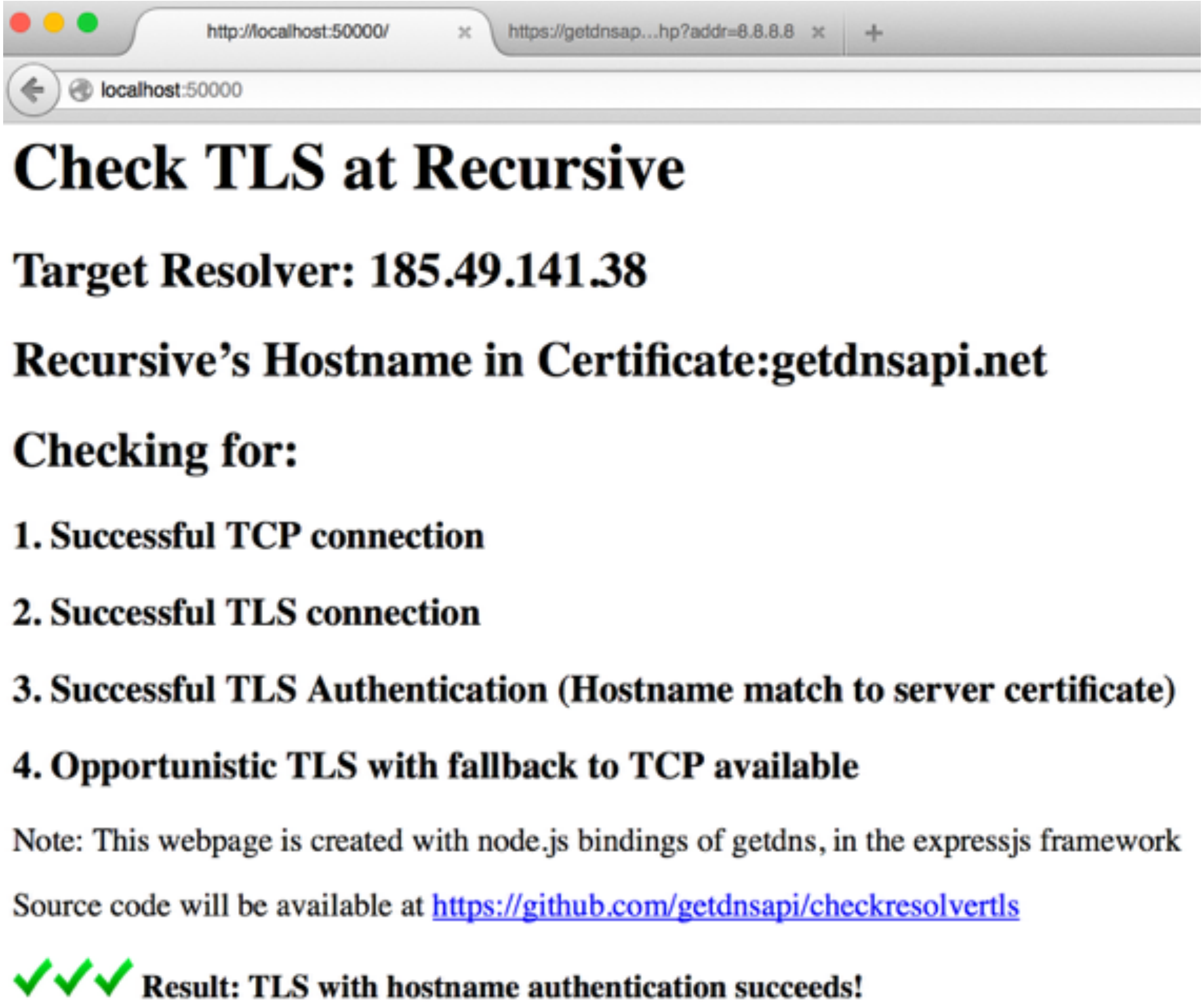
3. Successful TLS Authentication (Hostname match to server certificate)

4. Opportunistic TLS with fallback to TCP available

Note: This webpage is created with node.js bindings of getdns, in the expressjs framework

Source code will be available at https://github.com/getdnsapi/checkresolvertls

✓✓ **TLS without authentication succeeds!**



Check TLS at Recursive

Target Resolver: 185.49.141.38

Recursive's Hostname in Certificate:getdnsapi.net

Checking for:

1. Successful TCP connection

2. Successful TLS connection

3. Successful TLS Authentication (Hostname match to server certificate)

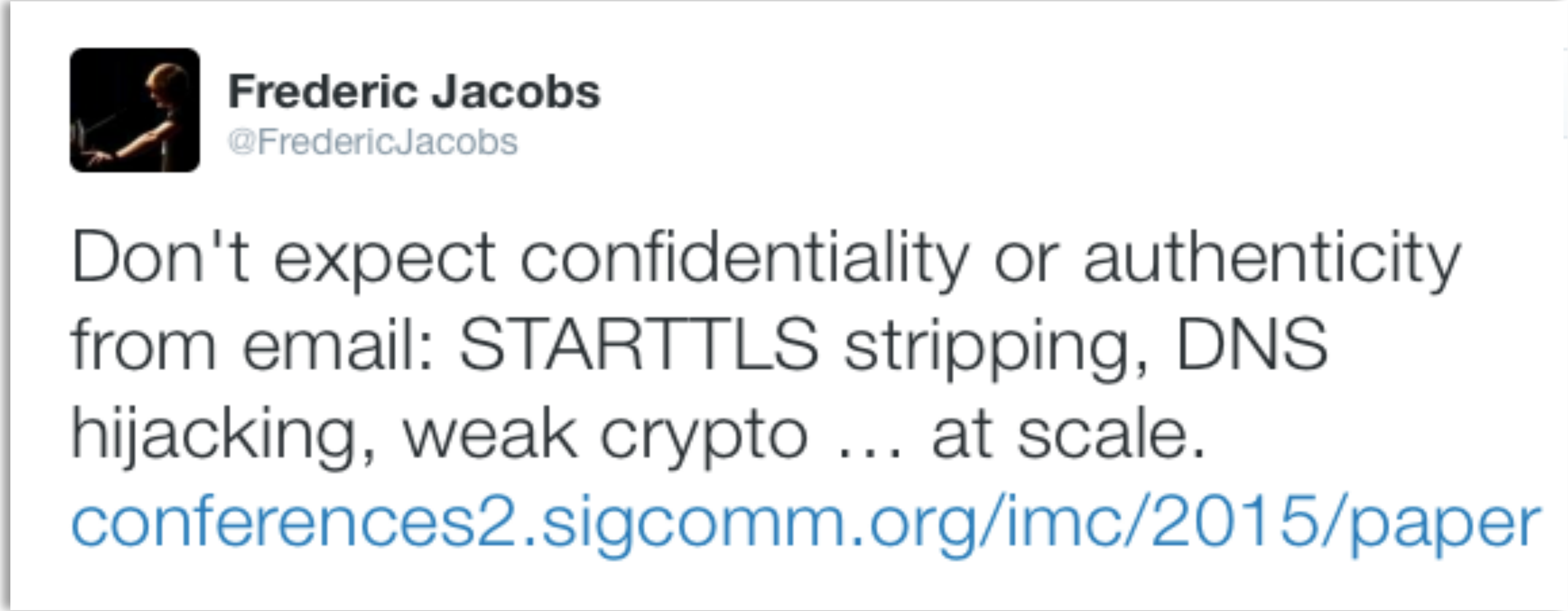
4. Opportunistic TLS with fallback to TCP available

Note: This webpage is created with node.js bindings of getdns, in the expressjs framework

Source code will be available at https://github.com/getdnsapi/checkresolvertls

✓✓✓ **Result: TLS with hostname authentication succeeds!**

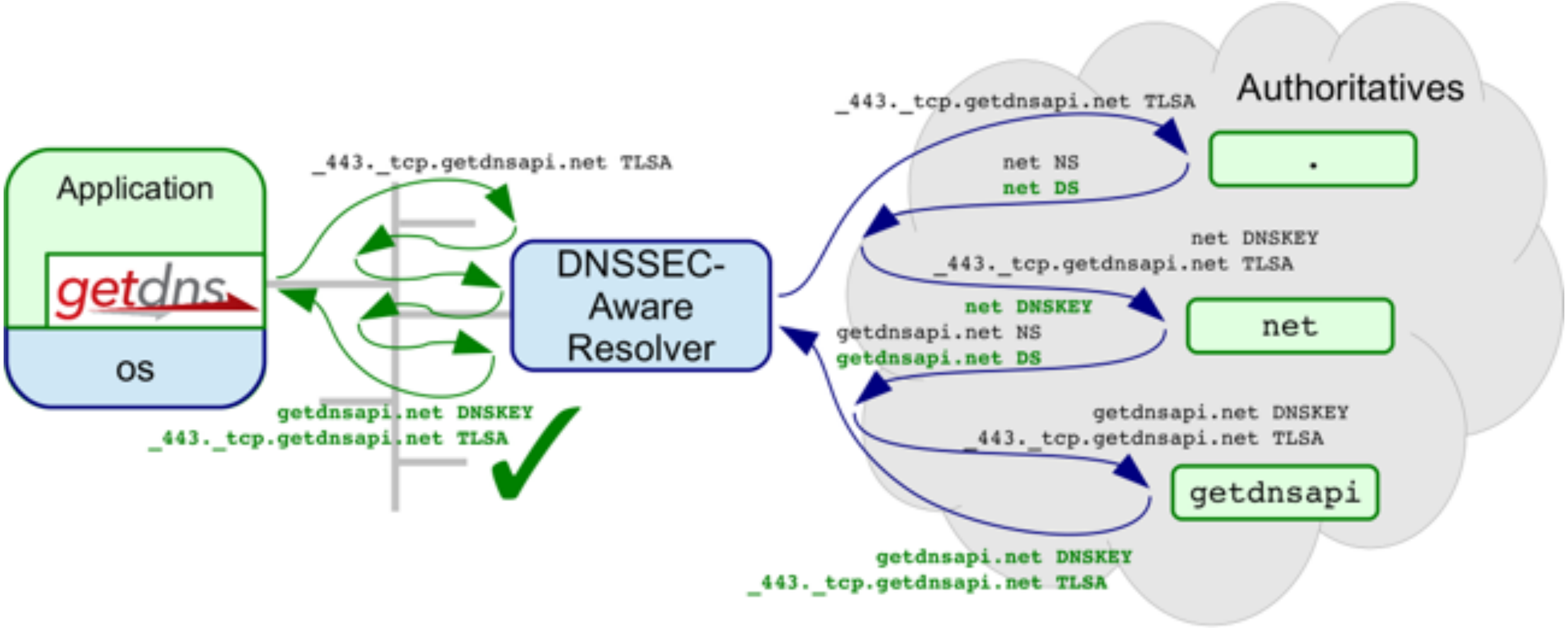
Extra Motivation for DNSSEC as well as DNS Privacy Work



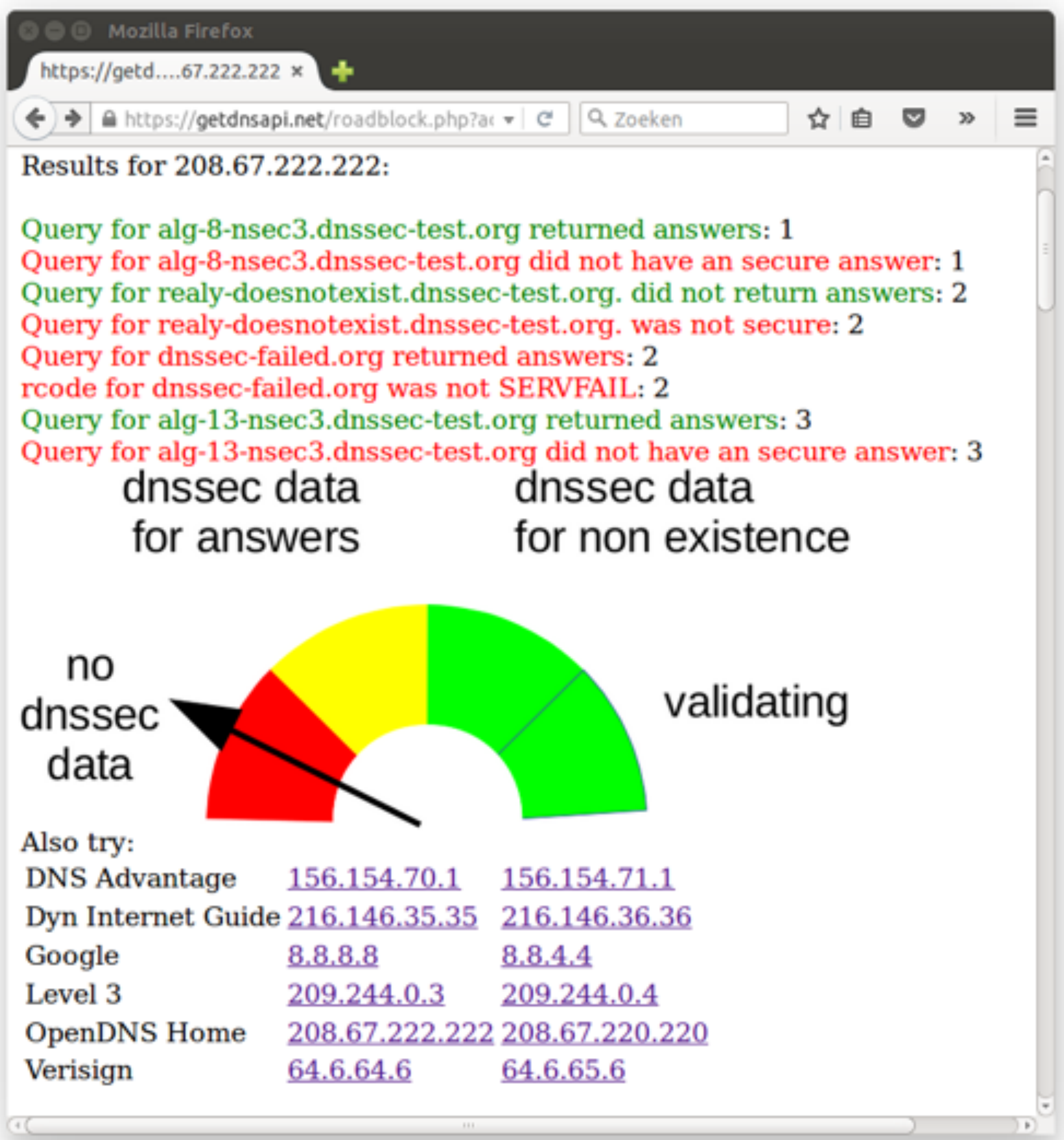
Frederic Jacobs
@FredericJacobs

Don't expect confidentiality or authenticity from email: STARTTLS stripping, DNS hijacking, weak crypto … at scale. conferences2.sigcomm.org/imc/2015/paper

Willem Toorop/Benno Overeinder - DNSSEC Roadblock Avoidance



The recursive resolver needs to be DNSSEC-Aware
There are many middle boxes and others that are not.
draft-ietf-dnsop-dnssec-roadblock-avoidance


Mozilla Firefox
https://getd....67.222.222
https://getdnsapi.net/roadblock.php?ac
Zoeken

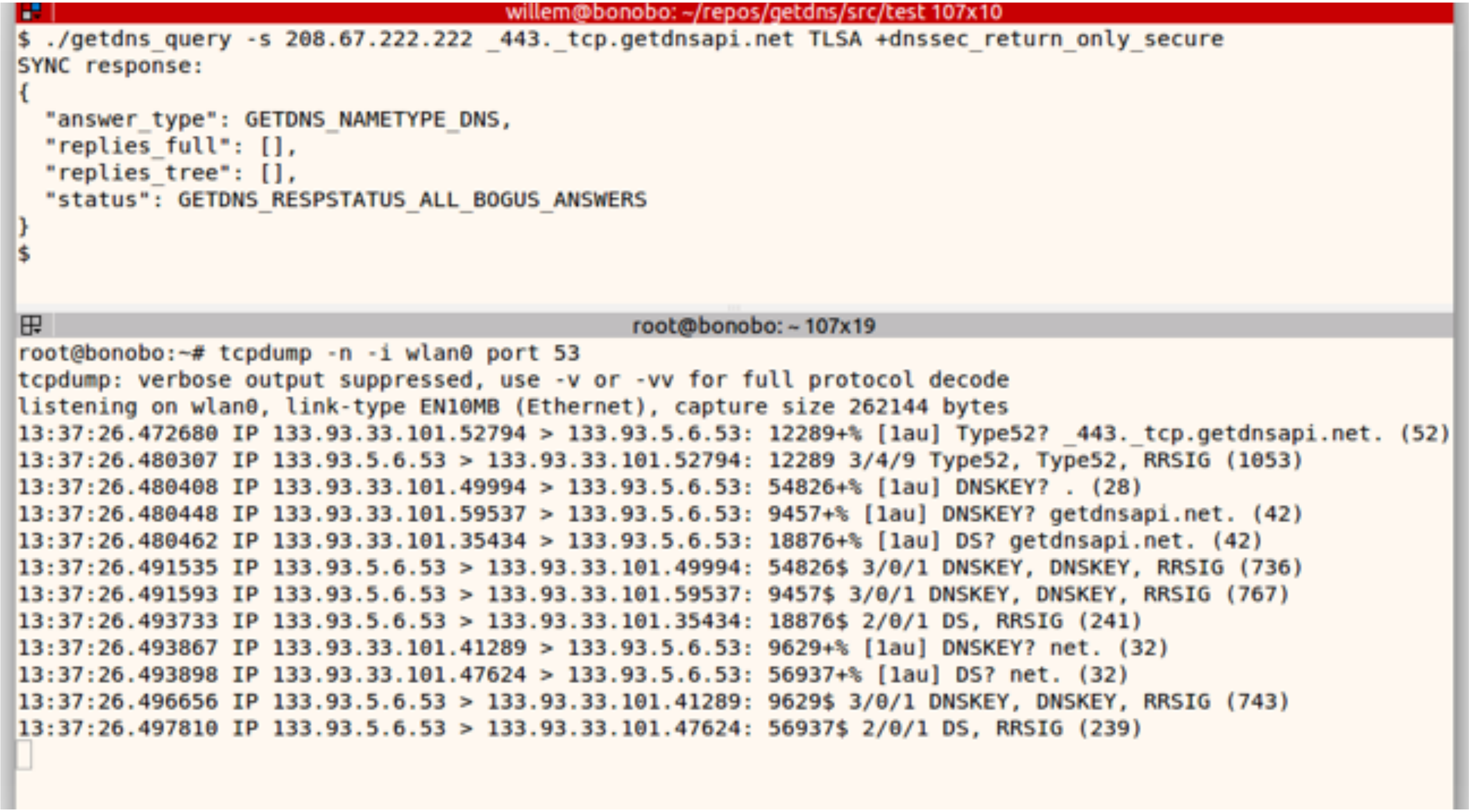
Results for 208.67.222.222:

Query for alg-8-nsec3.dnssec-test.org returned answers: 1
Query for alg-8-nsec3.dnssec-test.org did not have an secure answer: 1
Query for realy-doesnotexist.dnssec-test.org. did not return answers: 2
Query for realy-doesnotexist.dnssec-test.org. was not secure: 2
Query for dnssec-failed.org returned answers: 2
rcode for dnssec-failed.org was not SERVFAIL: 2
Query for alg-13-nsec3.dnssec-test.org returned answers: 3
Query for alg-13-nsec3.dnssec-test.org did not have an secure answer: 3

Also try:

DNS Advantage	156.154.70.1	156.154.71.1
Dyn Internet Guide	216.146.35.35	216.146.36.36
Google	8.8.8.8	8.8.4.4
Level 3	209.244.0.3	209.244.0.4
OpenDNS Home	208.67.222.222	208.67.220.220
Verisign	64.6.64.6	64.6.65.6

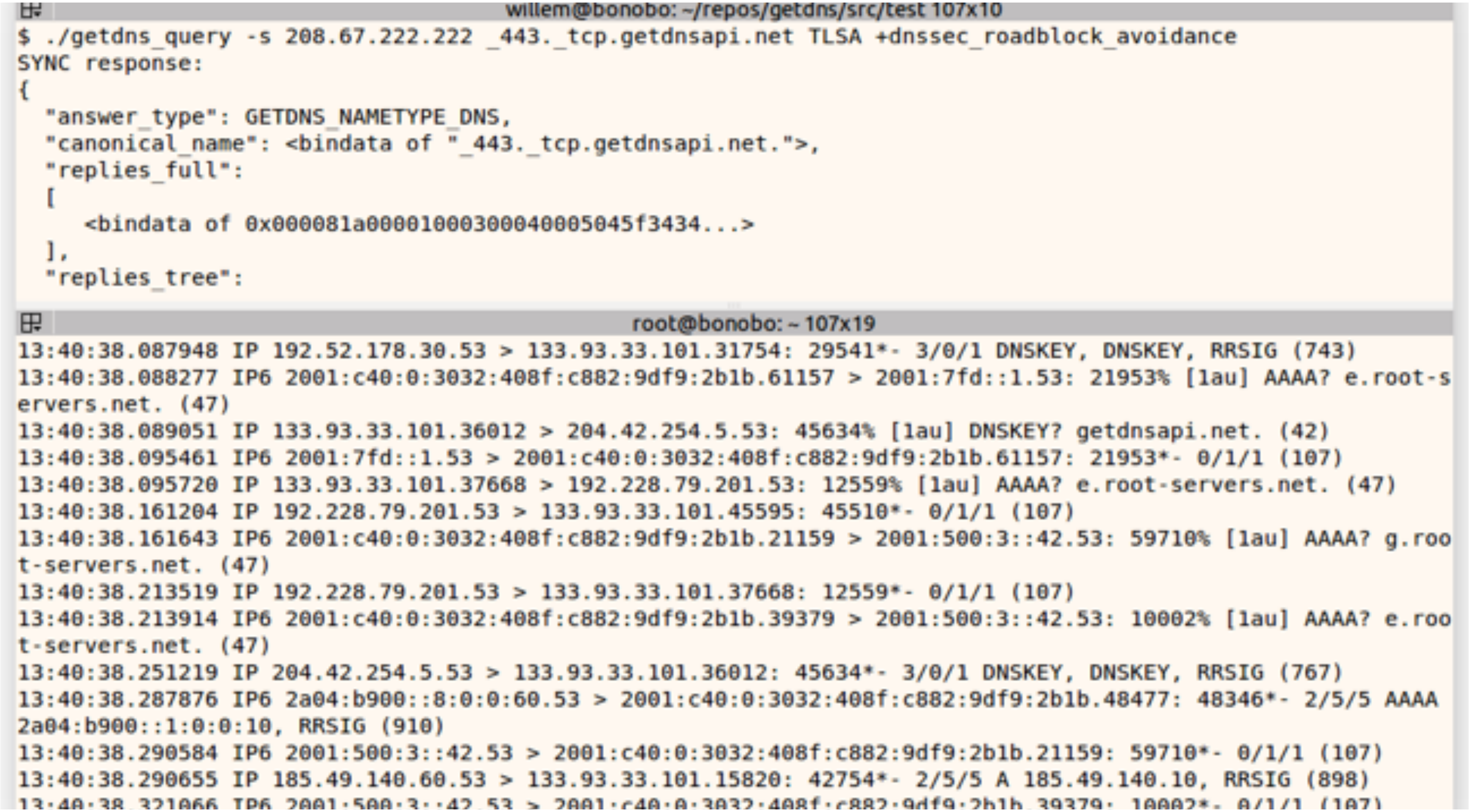
Roadblock



```
$ ./getdns_query -s 208.67.222.222 _443._tcp.getdnsapi.net TLSA +dnssec_return_only_secure
SYNC response:
{
  "answer_type": GETDNS_NAMETYPE_DNS,
  "replies_full": [],
  "replies_tree": [],
  "status": GETDNS_RESPSTATUS_ALL_BOGUS_ANSWERS
}
$
```

```
root@bonobo:~# tcpdump -n -i wlan0 port 53
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on wlan0, link-type EN10MB (Ethernet), capture size 262144 bytes
13:37:26.472680 IP 133.93.33.101.52794 > 133.93.5.6.53: 12289+% [1au] Type52? _443._tcp.getdnsapi.net. (52)
13:37:26.480307 IP 133.93.5.6.53 > 133.93.33.101.52794: 12289 3/4/9 Type52, Type52, RRSIG (1053)
13:37:26.480408 IP 133.93.33.101.49994 > 133.93.5.6.53: 54826+% [1au] DNSKEY? . (28)
13:37:26.480448 IP 133.93.33.101.59537 > 133.93.5.6.53: 9457+% [1au] DNSKEY? getdnsapi.net. (42)
13:37:26.480462 IP 133.93.33.101.35434 > 133.93.5.6.53: 18876+% [1au] DS? getdnsapi.net. (42)
13:37:26.491535 IP 133.93.5.6.53 > 133.93.33.101.49994: 54826$ 3/0/1 DNSKEY, DNSKEY, RRSIG (736)
13:37:26.491593 IP 133.93.5.6.53 > 133.93.33.101.59537: 9457$ 3/0/1 DNSKEY, DNSKEY, RRSIG (767)
13:37:26.493733 IP 133.93.5.6.53 > 133.93.33.101.35434: 18876$ 2/0/1 DS, RRSIG (241)
13:37:26.493867 IP 133.93.33.101.41289 > 133.93.5.6.53: 9629+% [1au] DNSKEY? net. (32)
13:37:26.493898 IP 133.93.33.101.47624 > 133.93.5.6.53: 56937+% [1au] DS? net. (32)
13:37:26.496656 IP 133.93.5.6.53 > 133.93.33.101.41289: 9629$ 3/0/1 DNSKEY, DNSKEY, RRSIG (743)
13:37:26.497810 IP 133.93.5.6.53 > 133.93.33.101.47624: 56937$ 2/0/1 DS, RRSIG (239)
```

Roadblock Avoidance

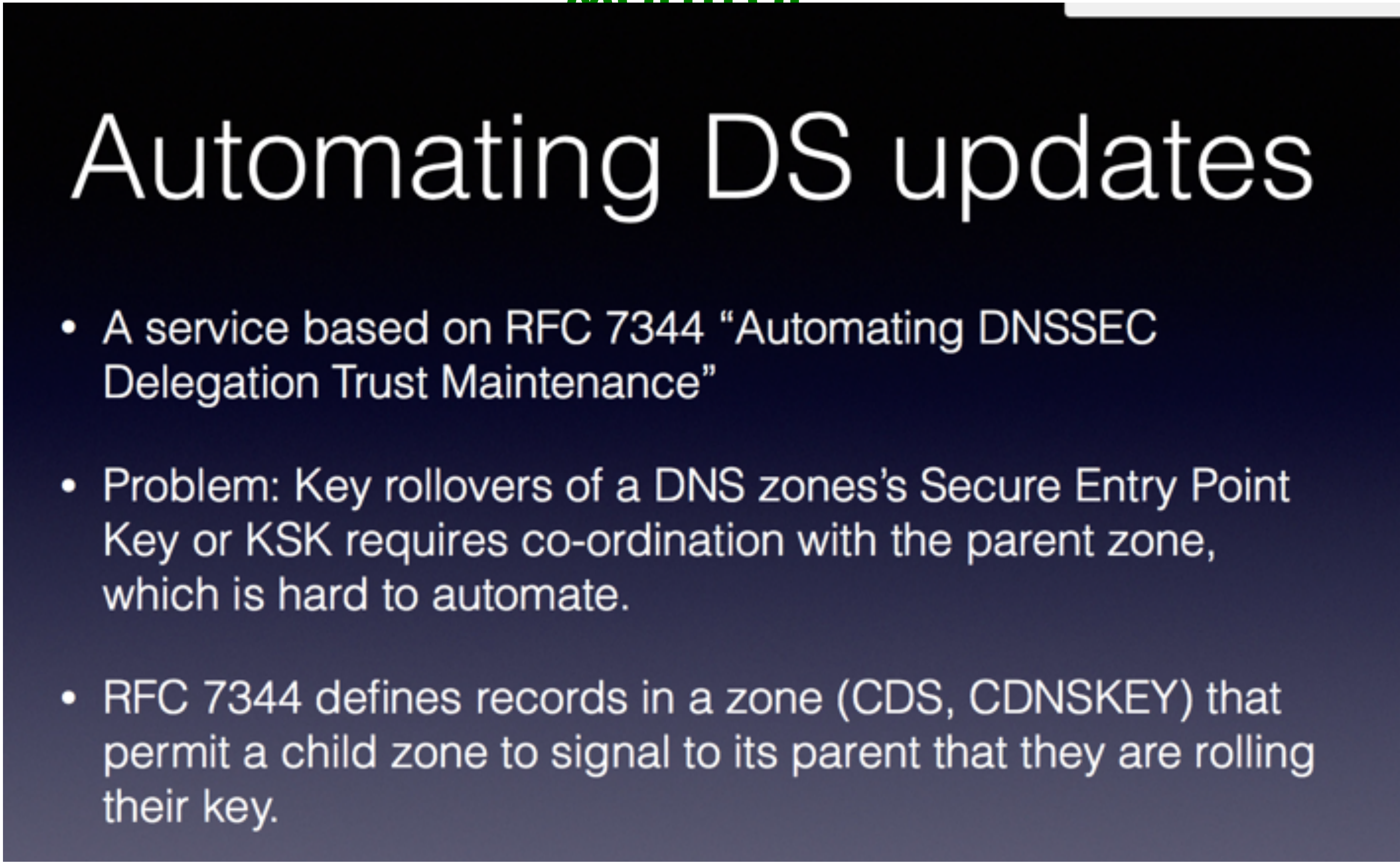


```
$ ./getdns_query -s 208.67.222.222 _443._tcp.getdnsapi.net TLSA +dnssec_roadblock_avoidance
SYNC response:
{
  "answer_type": GETDNS_NAMETYPE_DNS,
  "canonical_name": <bindata of "_443._tcp.getdnsapi.net.">,
  "replies_full":
  [
     <bindata of 0x000081a000010003000400005045f3434...>
  ],
  "replies_tree":
```

```
13:40:38.087948 IP 192.52.178.30.53 > 133.93.33.101.31754: 29541*- 3/0/1 DNSKEY, DNSKEY, RRSIG (743)
13:40:38.088277 IP6 2001:c40:0:3032:408f:c882:9df9:2b1b.61157 > 2001:7fd::1.53: 21953% [1au] AAAA? e.root-s
ervers.net. (47)
13:40:38.089051 IP 133.93.33.101.36012 > 204.42.254.5.53: 45634% [1au] DNSKEY? getdnsapi.net. (42)
13:40:38.095461 IP6 2001:7fd::1.53 > 2001:c40:0:3032:408f:c882:9df9:2b1b.61157: 21953*- 0/1/1 (107)
13:40:38.095720 IP 133.93.33.101.37668 > 192.228.79.201.53: 12559% [1au] AAAA? e.root-servers.net. (47)
13:40:38.161204 IP 192.228.79.201.53 > 133.93.33.101.45595: 45510*- 0/1/1 (107)
13:40:38.161643 IP6 2001:c40:0:3032:408f:c882:9df9:2b1b.21159 > 2001:500:3::42.53: 59710% [1au] AAAA? g.roo
t-servers.net. (47)
13:40:38.213519 IP 192.228.79.201.53 > 133.93.33.101.37668: 12559*- 0/1/1 (107)
13:40:38.213914 IP6 2001:c40:0:3032:408f:c882:9df9:2b1b.39379 > 2001:500:3::42.53: 10002% [1au] AAAA? e.roo
t-servers.net. (47)
13:40:38.251219 IP 204.42.254.5.53 > 133.93.33.101.36012: 45634*- 3/0/1 DNSKEY, DNSKEY, RRSIG (767)
13:40:38.287876 IP6 2a04:b900::8:0:0:60.53 > 2001:c40:0:3032:408f:c882:9df9:2b1b.48477: 48346*- 2/5/5 AAAA
2a04:b900::1:0:0:10, RRSIG (910)
13:40:38.290584 IP6 2001:500:3::42.53 > 2001:c40:0:3032:408f:c882:9df9:2b1b.21159: 59710*- 0/1/1 (107)
13:40:38.290655 IP 185.49.140.60.53 > 133.93.33.101.15820: 42754*- 2/5/5 A 185.49.140.10, RRSIG (898)
13:40:38.321066 IP6 2001:500:3::42.53 > 2001:c40:0:3032:408f:c882:9df9:2b1b.39379: 10002*- 0/1/1 (107)
```

Getdns release candidate containing this later this week!

Shumon Huque and Jan Včelák - CDS Monitor



Automating DS updates

- A service based on RFC 7344 “Automating DNSSEC Delegation Trust Maintenance”
- Problem: Key rollovers of a DNS zones’s Secure Entry Point Key or KSK requires co-ordination with the parent zone, which is hard to automate.
- RFC 7344 defines records in a zone (CDS, CDNSKEY) that permit a child zone to signal to its parent that they are rolling their key.

Automating DS updates

- “CDS Monitor”: A standalone service that:
  - allows input of ‘zone delegations’ from parent (via zone xfer or zonefile submission)
  - monitors the child zones for presence of CDS records and changes to them
  - Reacts to changes by issuing (authenticated) DNS dynamic updates to the parent zone
  - https://github.com/fcelda/cds-monitor (work in progress)

```
05:51:58,754 DEBUG: bbb.example.com, DS '1134 8 2 66d56a6750095...
05:51:58,757 DEBUG: bbb.example.com, CDS '1134 8 2 66d56a675009...
05:51:58,757 DEBUG: bbb.example.com, CDS '4242 8 2 a3999a9cbc20...
05:51:58,757 INFO:  bbb.example.com, sending update
05:51:58,762 DEBUG: aaa.example.com, DS '12345 8 2 5852f08d0d47...
05:51:58,928 INFO:  aaa.example.com, CDS not present
05:51:59,042 DEBUG: refresh in 9.68 seconds
05:52:08,751 DEBUG: bbb.example.com, DS '1134 8 2 66d56a6750095...
05:52:08,752 DEBUG: bbb.example.com, DS '4242 8 2 a3999a9cbc206...
05:52:08,753 DEBUG: bbb.example.com, CDS '1134 8 2 66d56a675009...
05:52:08,753 DEBUG: bbb.example.com, CDS '4242 8 2 a3999a9cbc20...
05:52:08,753 INFO:  bbb.example.com, is up-to-date
05:52:08,753 DEBUG: aaa.example.com, DS '12345 8 2 5852f08d0d47...
05:52:08,823 INFO:  aaa.example.com, CDS not present
05:52:08,830 DEBUG: refresh in 9.91 seconds
```

Champions and More Champions

- Dickinson, Sara
- Kahn Gillmor, Daniel
- Mankin, Allison
- Shore, Melinda
- Toorop, Willem
- Wicinski, Tim
- Včelák, Jan
- Cathrow, Andy
- Dickinson, John
- Huque, Shumon
- Miller, Matt
- Tomofumi Okubo
- Overeinder, Benno
- Seltzer, Wendy
- Visweswaran, Gowri