Hands on getdns

Unbound security

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afnic

JOURNÉE DU CONSEIL SCIENTIFIQUE DE L'AFNIC

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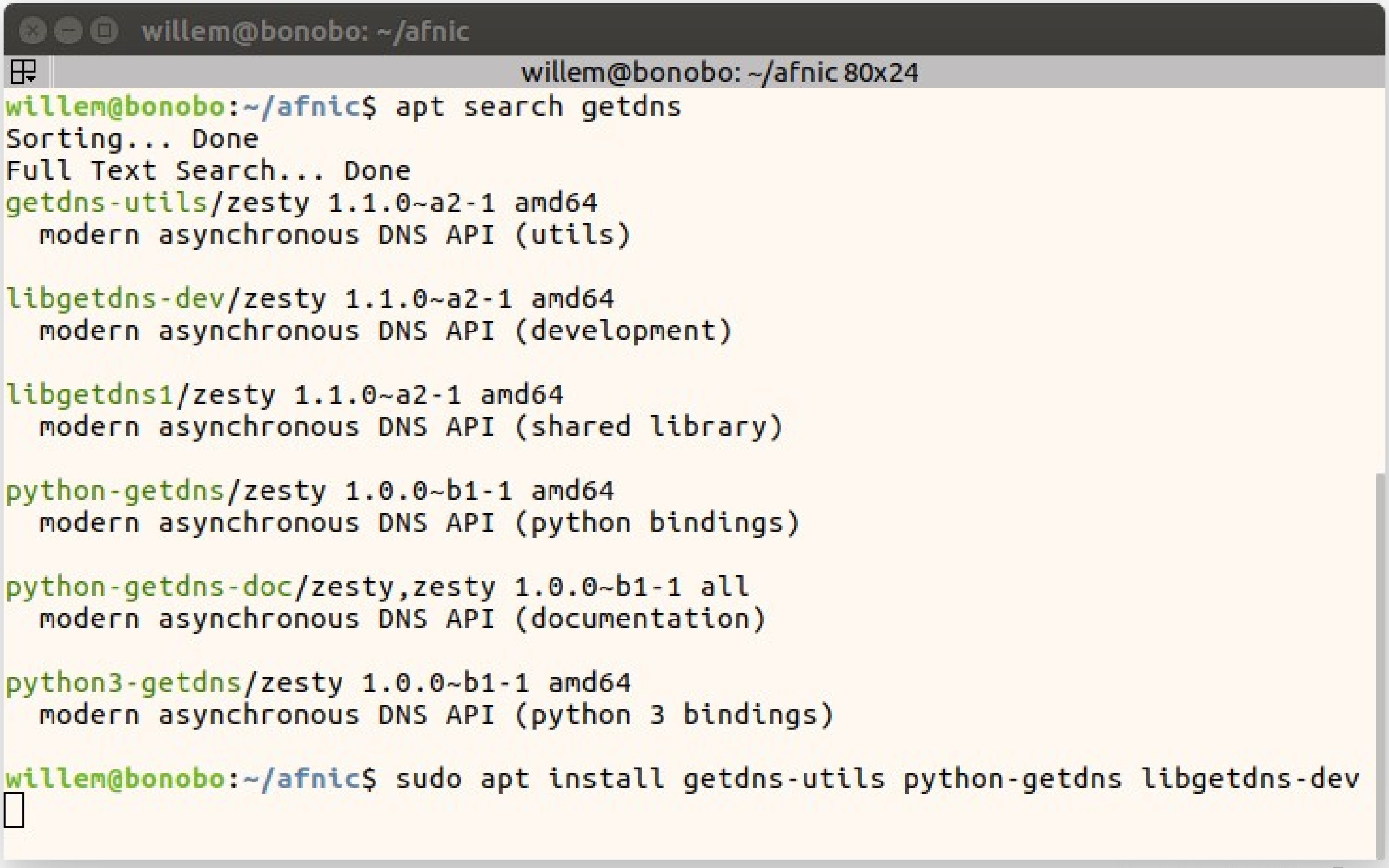
Hands on getdns Overview

- What is the getdns API
- What can the getdns library do for you
- Guided tour of the API
- Examples uses (code!)
- Demo of Stubby (time permitting)

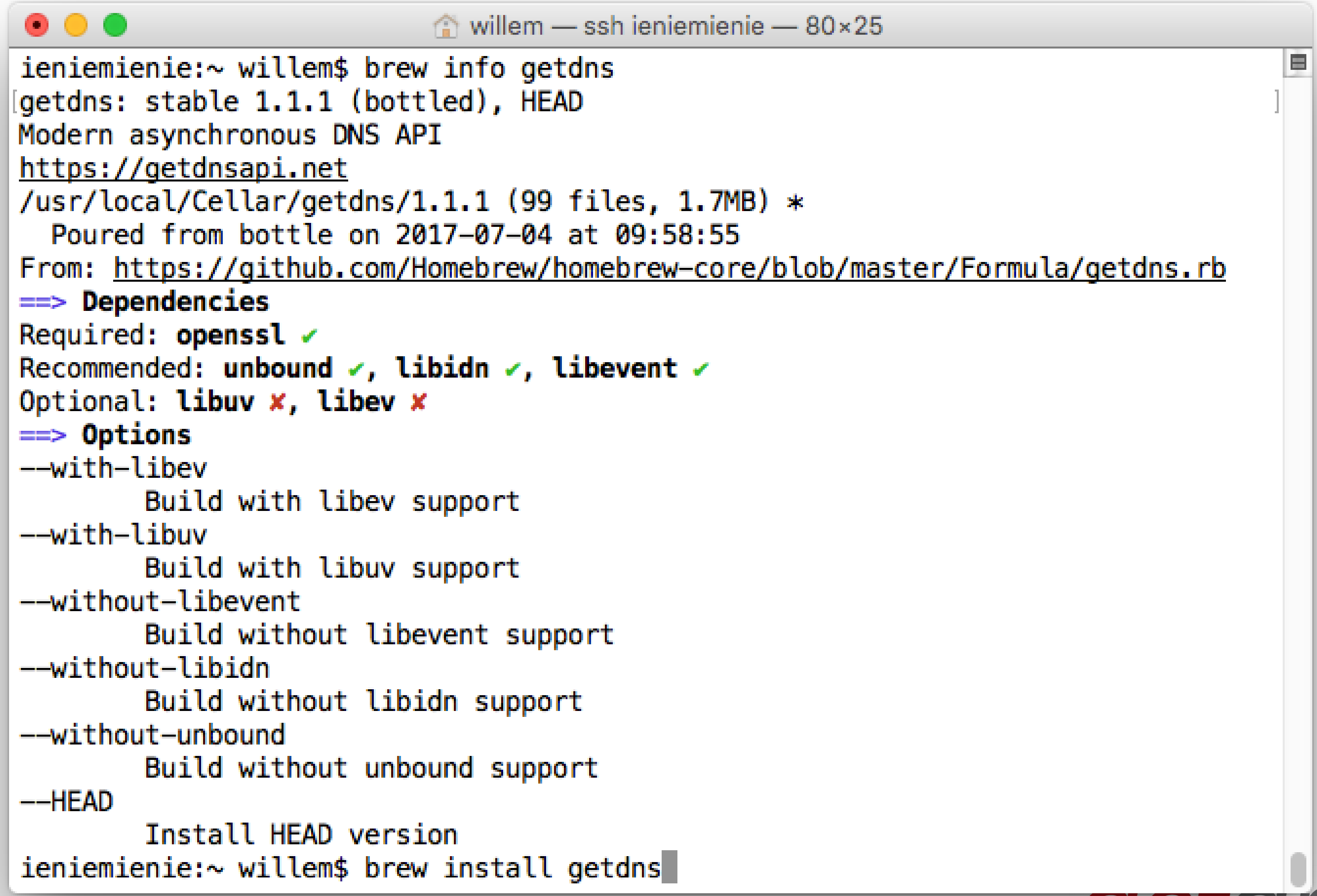
but first...

installation on ubuntu



```
willem@bonobo:~/afnic$ apt search getdns
Sorting... Done
Full Text Search... Done
getdns-utils/zesty 1.1.0~a2-1 amd64
  modern asynchronous DNS API (utils)

libgetdns-dev/zesty 1.1.0~a2-1 amd64
  modern asynchronous DNS API (development)

libgetdns1/zesty 1.1.0~a2-1 amd64
  modern asynchronous DNS API (shared library)

python-getdns/zesty 1.0.0~b1-1 amd64
  modern asynchronous DNS API (python bindings)

python-getdns-doc/zesty,zesty 1.0.0~b1-1 all
  modern asynchronous DNS API (documentation)

python3-getdns/zesty 1.0.0~b1-1 amd64
  modern asynchronous DNS API (python 3 bindings)

willem@bonobo:~/afnic$ sudo apt install getdns-utils python-getdns libgetdns-dev
```

getdns installation on MacOS



willem — ssh ieniemienie — 80×25

```
ieniemienie:~ willem$ brew info getdns
getdns: stable 1.1.1 (bottled), HEAD
Modern asynchronous DNS API
https://getdnsapi.net
/usr/local/Cellar/getdns/1.1.1 (99 files, 1.7MB) *
  Poured from bottle on 2017-07-04 at 09:58:55
From: https://github.com/Homebrew/homebrew-core/blob/master/Formula/getdns.rb
==> Dependencies
Required: openssl ✔
Recommended: unbound ✔, libidn ✔, libevent ✔
Optional: libuv ✘, libev ✘
==> Options
--with-libev
        Build with libev support
--with-libuv
        Build with libuv support
--without-libevent
        Build without libevent support
--without-libidn
        Build without libidn support
--without-unbound
        Build without unbound support
--HEAD
        Install HEAD version
ieniemienie:~ willem$ brew install getdns
```

getdns installation from tarball

```
$ wget https://getdnsapi.net/dist/getdns-1.1.2.tar.gz
--2017-07-04 10:20:20--  https://getdnsapi.net/dist/getdns-1.1.2.tar.gz
Resolving getdnsapi.net (getdnsapi.net)... 2a04:b900:0:100::37, 185.49.141.37
Connecting to getdnsapi.net (getdnsapi.net)|2a04:b900:0:100::37|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 948941 (927K) [application/x-gzip]
Saving to: 'getdns-1.1.2.tar.gz'
getdns-1.1.2.tar.gz       100%[===================>] 926.70K  --.-KB/s    in 0.08s
2017-07-04 10:20:20 (11.9 MB/s) - 'getdns-1.1.2.tar.gz' saved [948941/948941]

$ tar xzf getdns-1.1.2.tar.gz
$ cd getdns-1.1.2/
$ ./configure --enable-stub-only --without-libidn
checking for gcc... gcc
checking whether the C compiler works... yes
checking for C compiler default output file name... a.out
checking for suffix of executables...
checking whether we are cross compiling... no
$ make
$ sudo make install
```

getdns installation from repository

```
$ git clone https://github.com/getdnsapi/getdns
```

```
Cloning into 'getdns'...
remote: Counting objects: 13781, done.
remote: Compressing objects: 100% (165/165), done.
remote: Total 13781 (delta 167), reused 158 (delta 85), pack-reused 13531
Receiving objects: 100% (13781/13781), 8.86 MiB | 7.94 MiB/s, done.
Resolving deltas: 100% (10541/10541), done.
```

```
$ cd getdns
$ git checkout features/zeroconf-dnssec
```

```
Branch features/zeroconf-dnssec set up to track remote branch features/zeroconf-
dnssec from origin.
Switched to a new branch 'features/zeroconf-dnssec'
```

```
$ git submodule update --init
```

```
Submodule 'src/test/jsmn' (https://github.com/getdnsapi/jsmn.git) registered for
path 'src/jsmn'
Submodule 'src/yxml' (git://g.blicky.net/yxml.git) registered for path 'src/yxml'
Cloning into '/home/willem/getdns/getdns/src/jsmn'...
Cloning into '/home/willem/getdns/getdns/src/yxml'...
Submodule path 'src/jsmn': checked out '868c22e35ec223fc26ddefdb9ca83901dc6e2534'
Submodule path 'src/yxml': checked out '10f968b0e78b9aeee357d0de81a46b445c3fb27b'
```

getdns installation from repository

```
$ autoreconf -fi
```

```
libtoolize: putting auxiliary files in '.'.
libtoolize: copying file './ltmain.sh'
libtoolize: putting macros in AC_CONFIG_MACRO_DIRS, 'm4'.
libtoolize: copying file 'm4/libtool.m4'
libtoolize: copying file 'm4/ltoptions.m4'
libtoolize: copying file 'm4/ltsugar.m4'
libtoolize: copying file 'm4/ltversion.m4'
libtoolize: copying file 'm4/lt~obsolete.m4'
libtoolize: Consider adding '-I m4' to ACLOCAL_AMFLAGS in Makefile.am.
```

```
$ glibtoolize -ci
```

```
libtoolize: putting auxiliary files in '.'.
libtoolize: copying file './config.guess'
libtoolize: copying file './config.sub'
libtoolize: copying file './install-sh'
libtoolize: Consider adding '-I m4' to ACLOCAL_AMFLAGS in Makefile.am.
```

```
$ ./configure --enable-stub-only --without-libidn
$ make
$ sudo make install
```

installation
try out getdns_query

```
$ getdns_query -h
```

```
usage: getdns_query [<option> ...] \
[@<upstream> ...] [+<extension> ...] ['{ <settings> }'] [<name>] [<type>]

default mode: recursive, synchronous resolution of NS record
using UDP with TCP fallback

upstreams: @<ip>[%<scope_id>][@<port>][#<tls port>][~<tls name>][^<tsig spec>]
            <ip>@<port> may be given as <IPv4>:<port>
                  or '['<IPv6>[%<scope_id>]']':<port> too

tsig spec: [<algorithm>:]<name>:<secret in Base64>

extensions:
+add_warning_for_bad_dns               +edns_cookies
+dnssec_return_status                  +return_both_v4_and_v6
+dnssec_return_only_secure             +return_call_reporting
+dnssec_return_all_statuses            +sit=<cookie>         Send along cookie OPT
+dnssec_return_validation_chain                              with value <cookie>
+dnssec_return_full_validation_chain   +specify_class=<class>
+dnssec_roadblock_avoidance            +0           Clear all extensions
```

getdns installation
try out getdns_query

```
$ getdns_query -i


$ getdns_query -k
$ getdns_query -s . DNSKEY +dnssec_return_status
$ getdns_query -k
$ ls -l $HOME/.getdns


$ getdns_query -s @185.49.141.37~getdnsapi.net \
               -l LTU +return_call_reporting


$ getdns_query -s _443._tcp.www.afnic.fr TLSA \
                  +dnssec_return_validation_chain
```

The getdns API is:

- A *DNS API* specification (for resolving)
  by and for application developers (for application)

motivation

- `getaddrinfo()` does not fit standards* any more
  - Protocol signalling in non-address records:
    `SSHFP, TLSA, OPENPGPKEY, SMIMEA, URI, CAA, HIP, CDS, CDNSKEY, CSYNC`, etc.
  - Asynchronous standards (Happy Eyeballs)
  - App. level DNSSEC validation (for DANE)
  - DNS Privacy

The getdns API is:

- A *DNS API* specification (for resolving)
  by and for application developers (for application)

From API design considerations: **motivation**

… There are other DNS APIs available,
but there has been very little uptake …

… talking to application developers
… the APIs were developed by and for DNS people,
not application developers …

... create a natural follow-on to `gettadrinfo()` *...*

The getdns API is:

- A *DNS API* specification (for resolving)
  by and for application developers (for application)

- First edited by Paul Hoffman
- First published in April 2013
- Currently published at
  `https://getdnsapi.net/documentation/spec/`
- Maintained by *the getdns team*

The getdns library is:

- An implementation of the *getdns* API
- A *DNS API* specification (for resolving)
  by and for application developers (for application)

- First implementation initiative by Allison Mankin

- Initially a collaboration of VERISIGN™ LABS, NLnet Labs, Melinda Shore and sinodun

The getdns library is:

- 26 February 2014: getdns-0.1.0 release
- 23 July 2015: took over editor role
  of the API specification
- 22 October 2015: New API specification release
  introducing JSON-pointers
- 2016: 2 getdns-1.0.0 beta releases
  2 getdns-1.1.0 alpha releases
- 17 January 2017: getdns-1.0.0 released
  100% specification complete
- 3 July 2017: getdns-1.1.2 released (latest)
  many non-API functions

non-API doc: `https://getdnsapi.net/doxygen/modules.html`

The getdns library is:

- An implementation of the *getdns* API

  Claus Assman, Theogene Bucuti, Andrew Cathrow, Neil Cook, Saúl Ibarra Corretgé, Craig Despeaux, John Dickinson, **Sara Dickinson**, Robert Edmonds, Angelique Finan, Simson Garfinkel, Daniel Kahn Gillmor, Neel Goyal, Bryan Graham, Robert Groenenberg, Jim Hague, Paul Hoffman, Scott Hollenbeck, **Christian Huitema**, **Shumon Huque**, Jelte Janssen, Guillem Jover, Shane Kerr, Anthony Kirby, Olaf Kolkman, Sanjay Mahurpawar, **Allison Mankin**, Sai Mogali, Linus Nordberg, **Benno Overeinder**, **Joel Purra**, Tom Pusateri, Prithvi Ranganath, **Hoda Rohani**, Rushi Shah, Vinay Soni, **Melinda Shore**, Bob Steagall, Andrew Sullivan, Ondřej Surý, **Willem Toorop**, Gowri Visweswaran, **Wouter Wijngaards**, Glen Wiley, Paul Wouters

- Weekly meetings with the *getdns core team*

The getdns library

- Core team active in IETF and at IETF hackathons:
  - "Best in Show" prize at IETF93
    DNSSEC roadblock detection, start of DNS over TLS
  - "Best internet security" at IETF94
    edns0-client-subnet privacy election, start of padding
  - IETF95 – start of TLS DNSSEC auth. chain ext.
  - IETF96 – start of DNS64 work
  - IETF97 – Stubby interoperability testing
  - IETF98 – Start of Zero Configuration DNSSEC
    and...

The getdns library

- Core team active in IETF and at IETF hackathons:
  - IETF98 – DNS over TLS monitoring plugin by Stephane Bortzmeyer
  - Blog : `https://www.bortzmeyer.org/monitor-dns-over-tls.html`
  - Git : `https://github.com/bortzmeyer/monitor-dns-over-tls`
  - In use at dnsprivacy.org: `https://dnsprivacy.org/jenkins/job/dnsprivacy-monitoring/`

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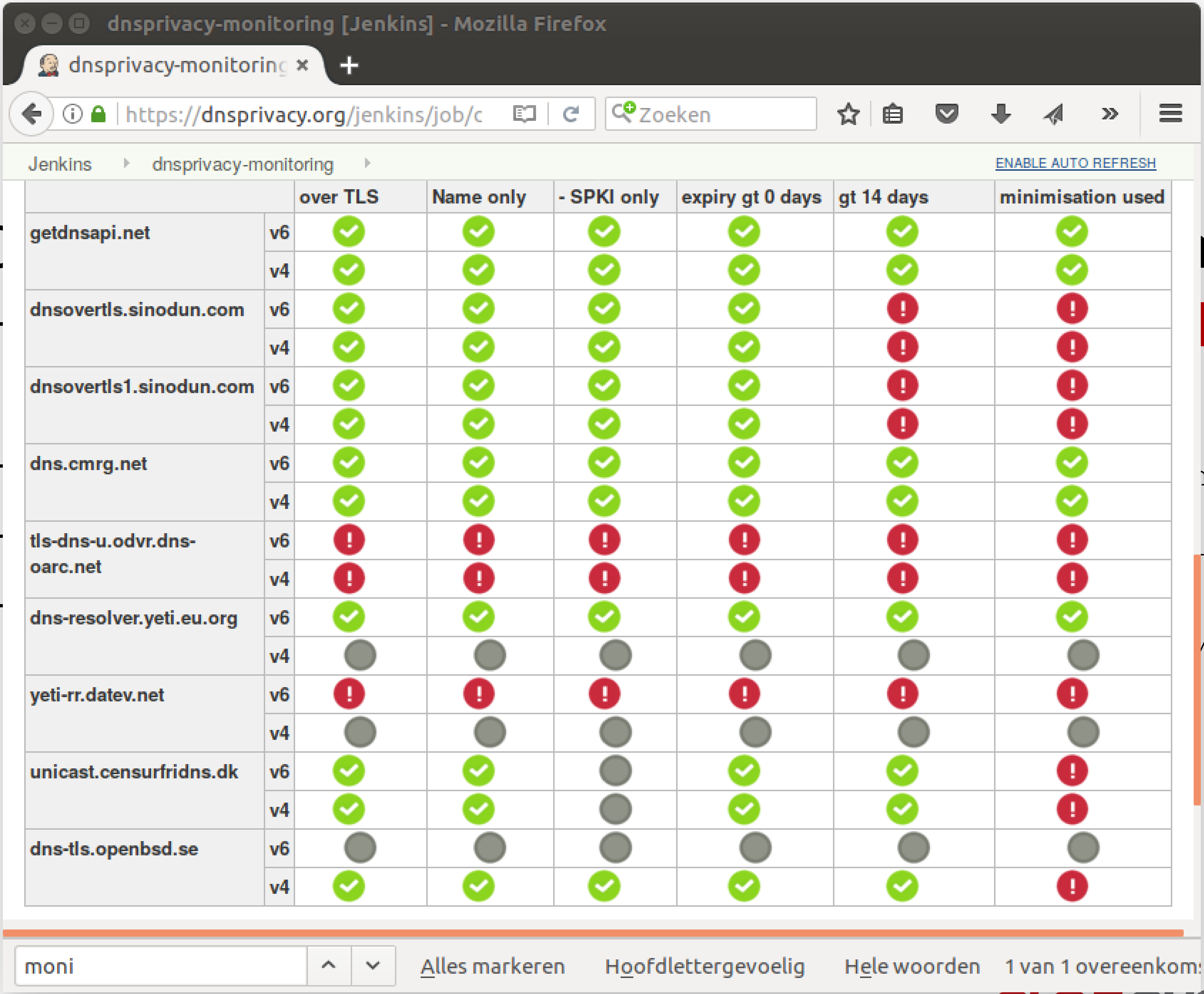


		over TLS	Name only	- SPKI only	expiry gt 0 days	gt 14 days	minimisation used
getdnsapi.net	v6	✓	✓	✓	✓	✓	✓
	v4	✓	✓	✓	✓	✓	✓
dnsovertls.sinodun.com	v6	✓	✓	✓	✓	!	!
	v4	✓	✓	✓	✓	!	!
dnsovertls1.sinodun.com	v6	✓	✓	✓	✓	!	!
	v4	✓	✓	✓	✓	!	!
dns.cmrg.net	v6	✓	✓	✓	✓	✓	✓
	v4	✓	✓	✓	✓	✓	✓
tls-dns-u.odvr.dns-oarc.net	v6	!	!	!	!	!	!
	v4	!	!	!	!	!	!
dns-resolver.yeti.eu.org	v6	✓	✓	✓	✓	✓	✓
	v4	●	●	●	●	●	●
yeti-rr.datev.net	v6	!	!	!	!	!	!
	v4	●	●	●	●	●	●
unicast.censurfridns.dk	v6	✓	✓	●	✓	✓	!
	v4	✓	✓	●	✓	✓	!
dns-tls.openbsd.se	v6	●	●	●	●	●	●
	v4	✓	✓	✓	✓	✓	!

The getdns library motivation

From the README.md:

… DNSSEC offers a unique global infrastructure for establishing cryptographic trust relations …

… offer application developers a modern and flexible way that enables end-to-end trust in the DNS architecture …

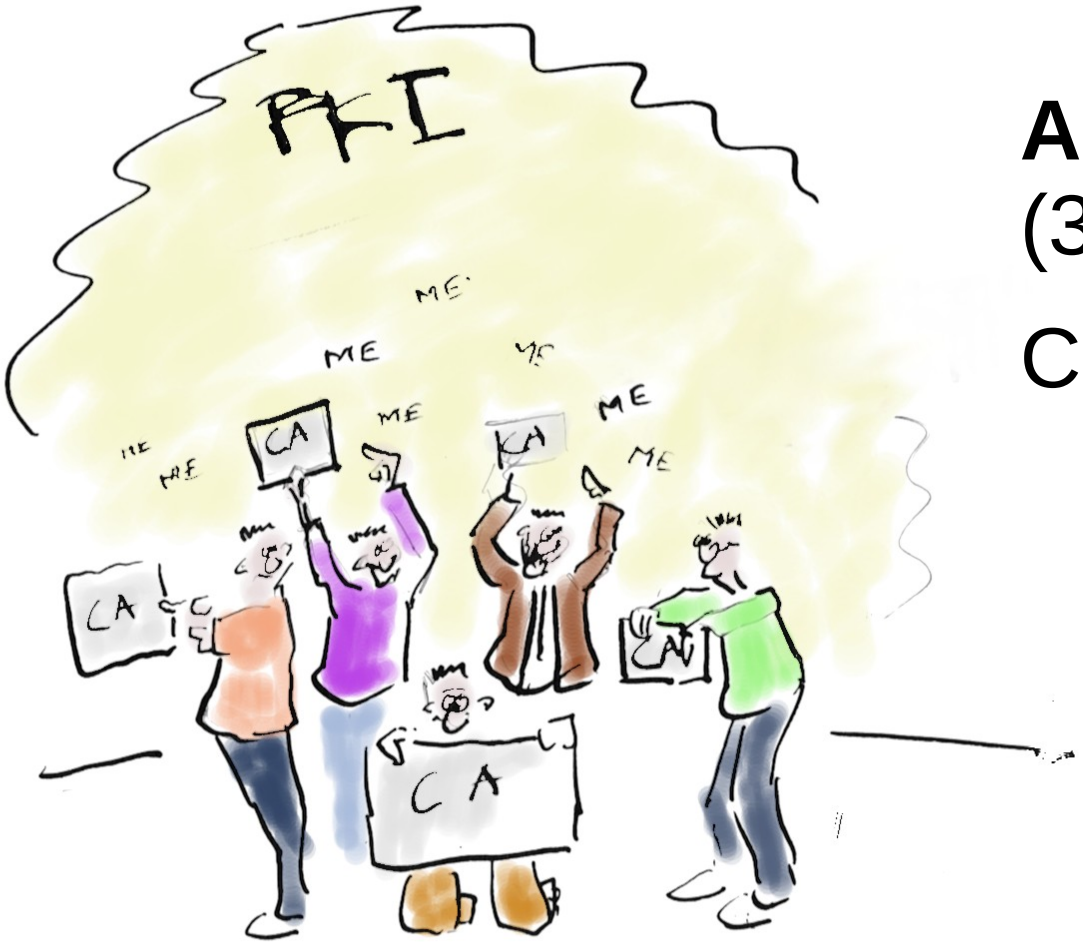
… inspire application developers towards innovative security solutions …

The getdns library motivation

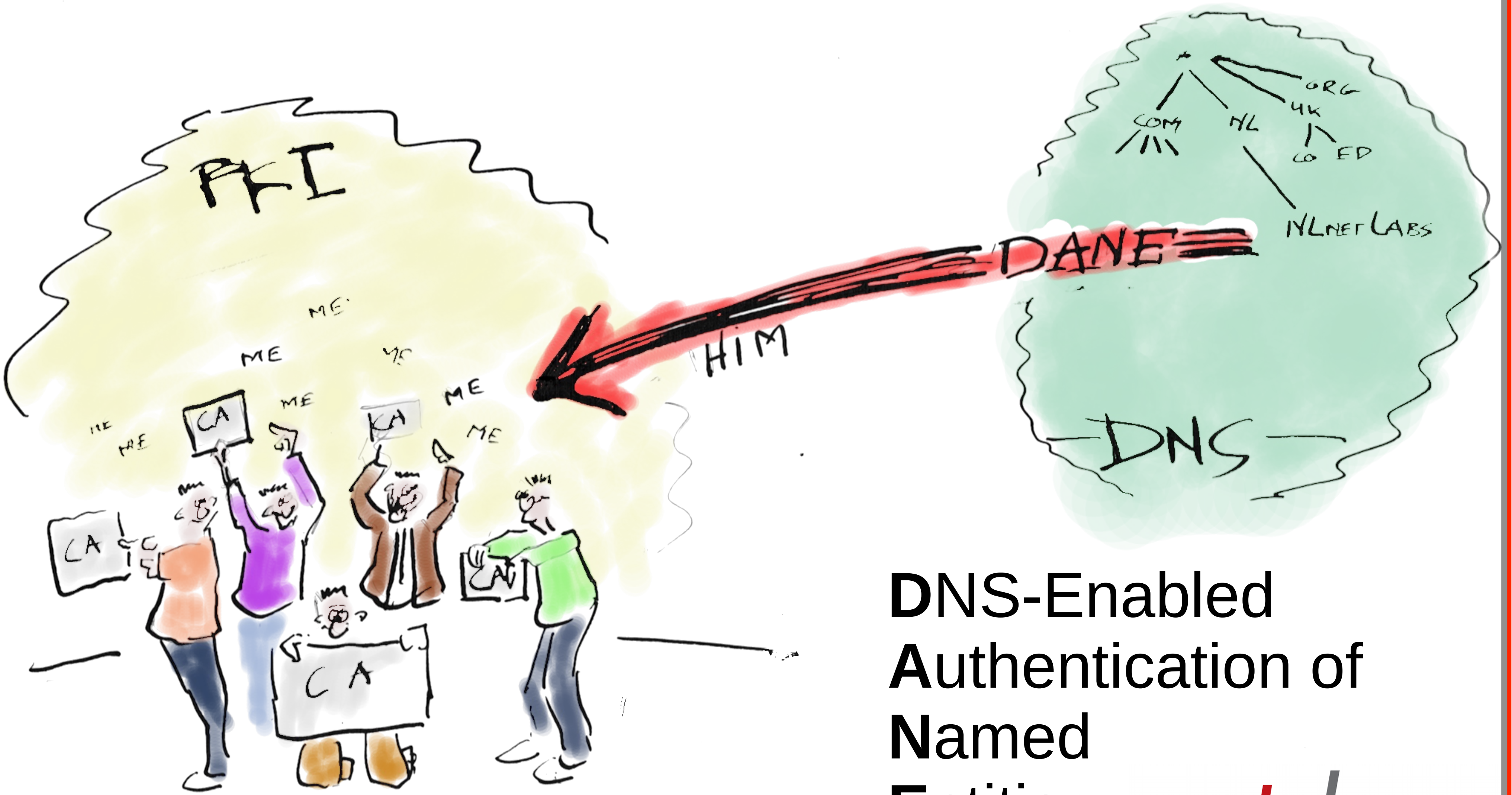
Regular PKI is flawed

Any Certificate Authority (3000+)

Can vouch for **any** name

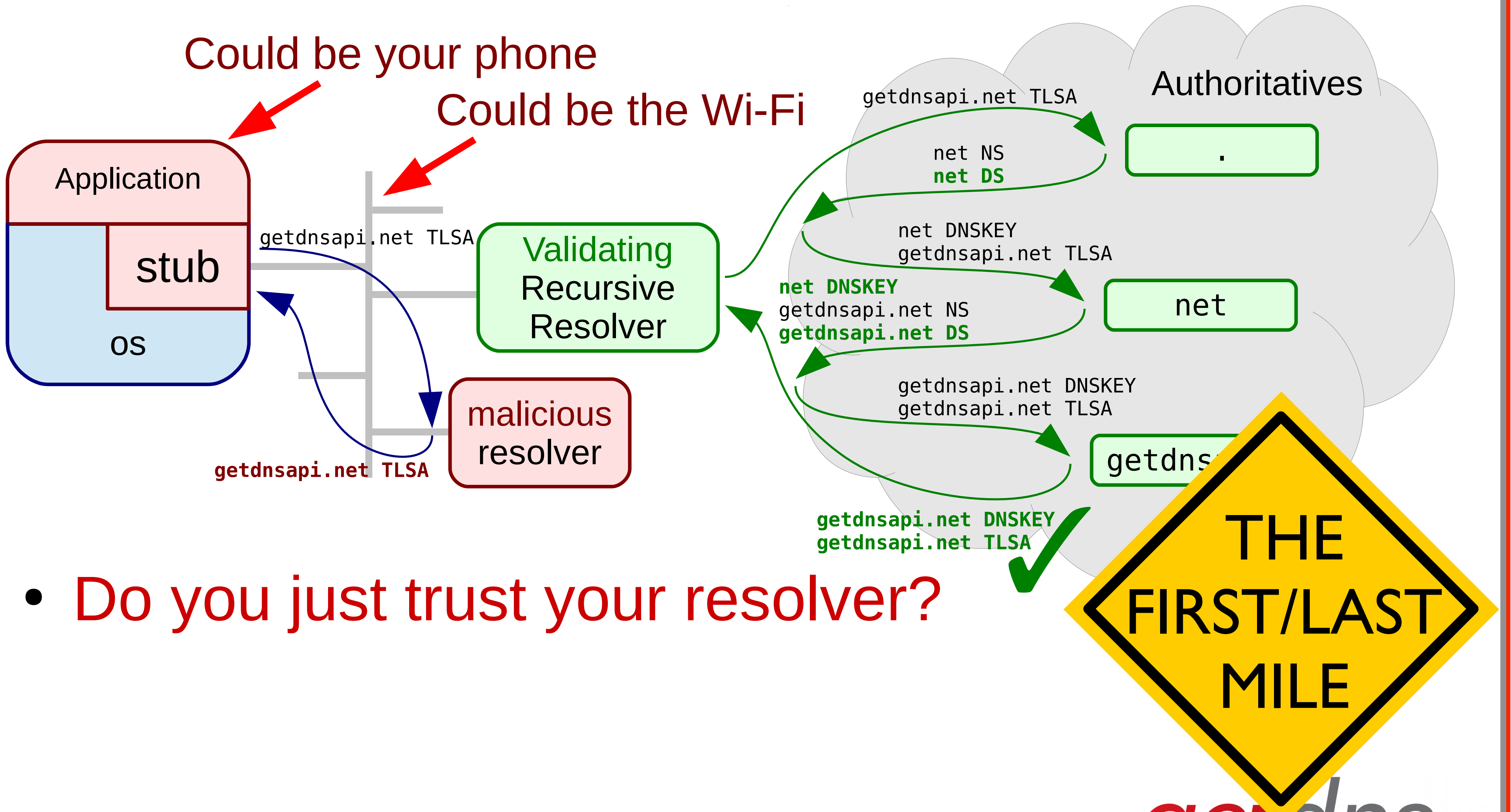


The getdns library motivation



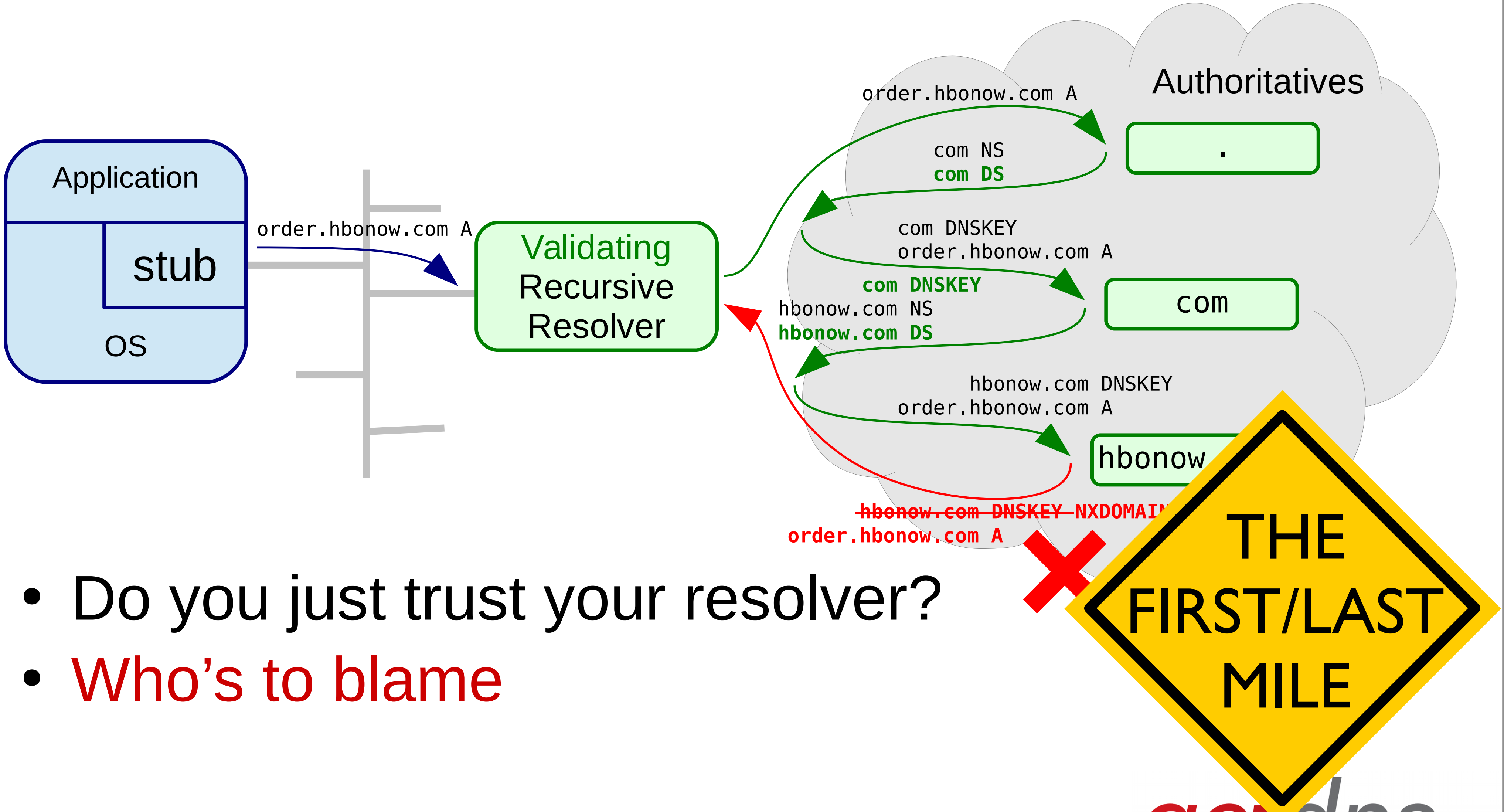
DNS-Enabled
Authentication of
Named
Entities

The getdns library motivation



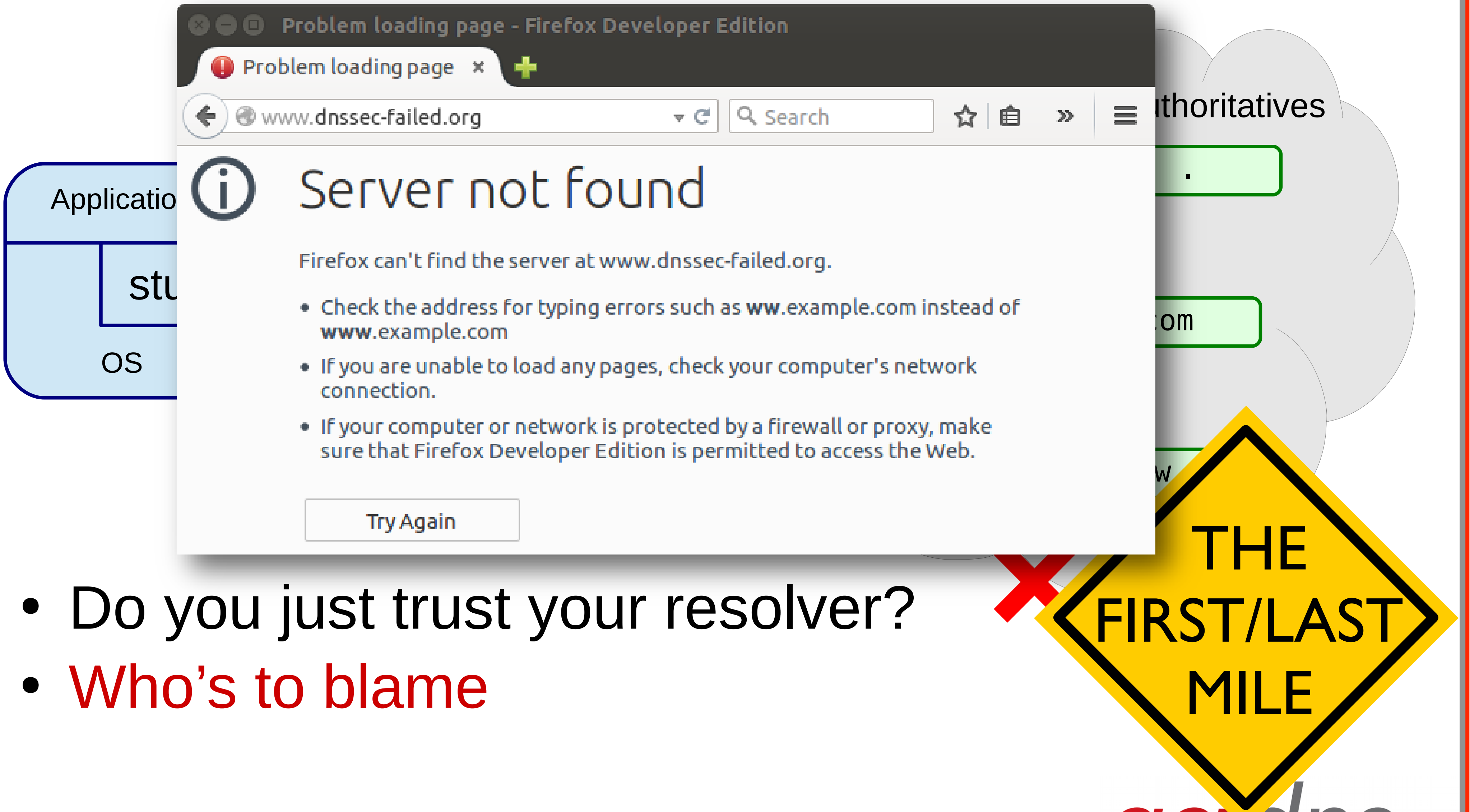
- Do you just trust your resolver?

The getdns library motivation



- Do you just trust your resolver?
- Who’s to blame

The getdns library motivation



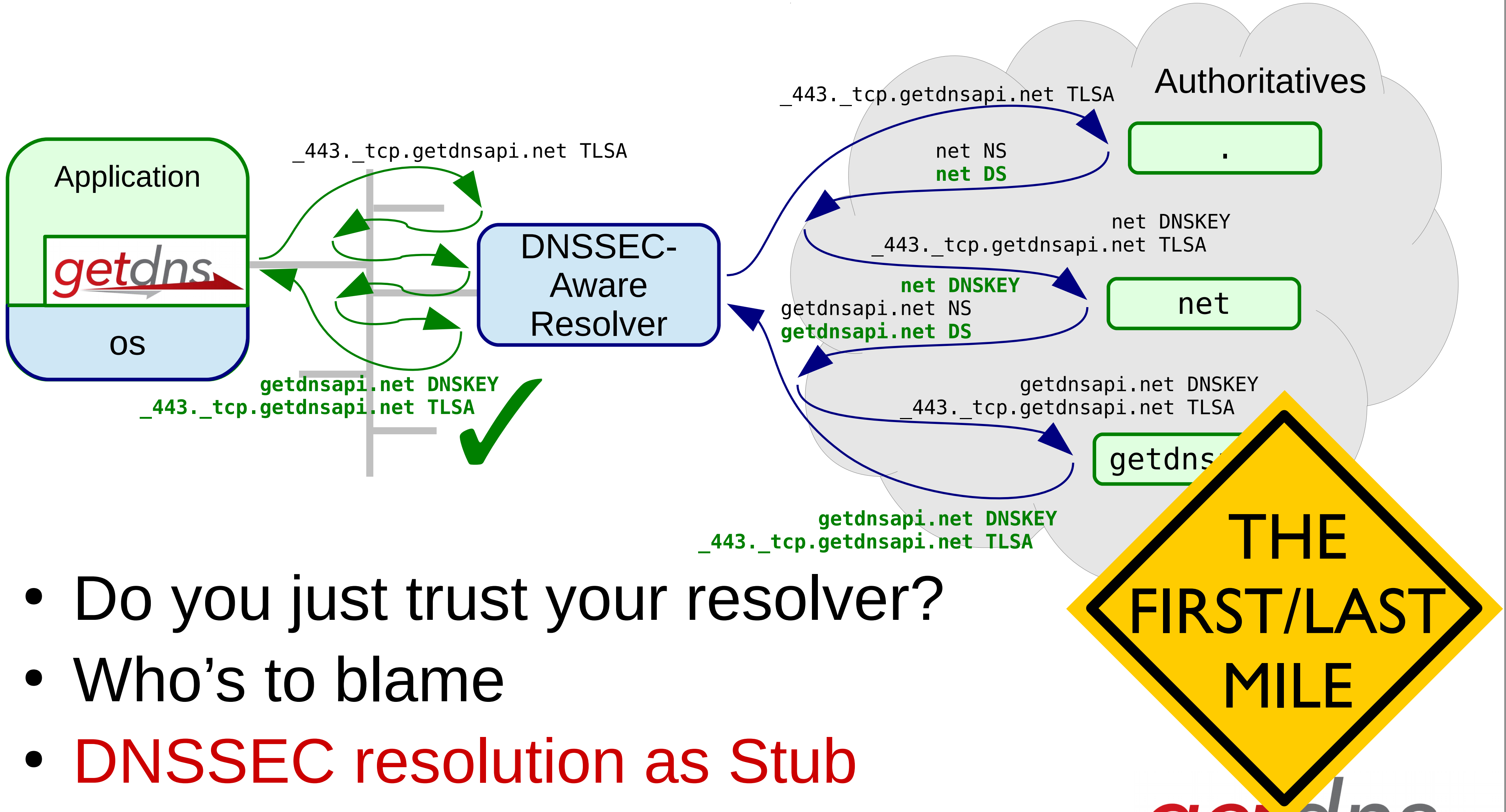
Server not found

Firefox can't find the server at www.dnssec-failed.org.

- Check the address for typing errors such as **ww**.example.com instead of **www**.example.com
- If you are unable to load any pages, check your computer's network connection.
- If your computer or network is protected by a firewall or proxy, make sure that Firefox Developer Edition is permitted to access the Web.

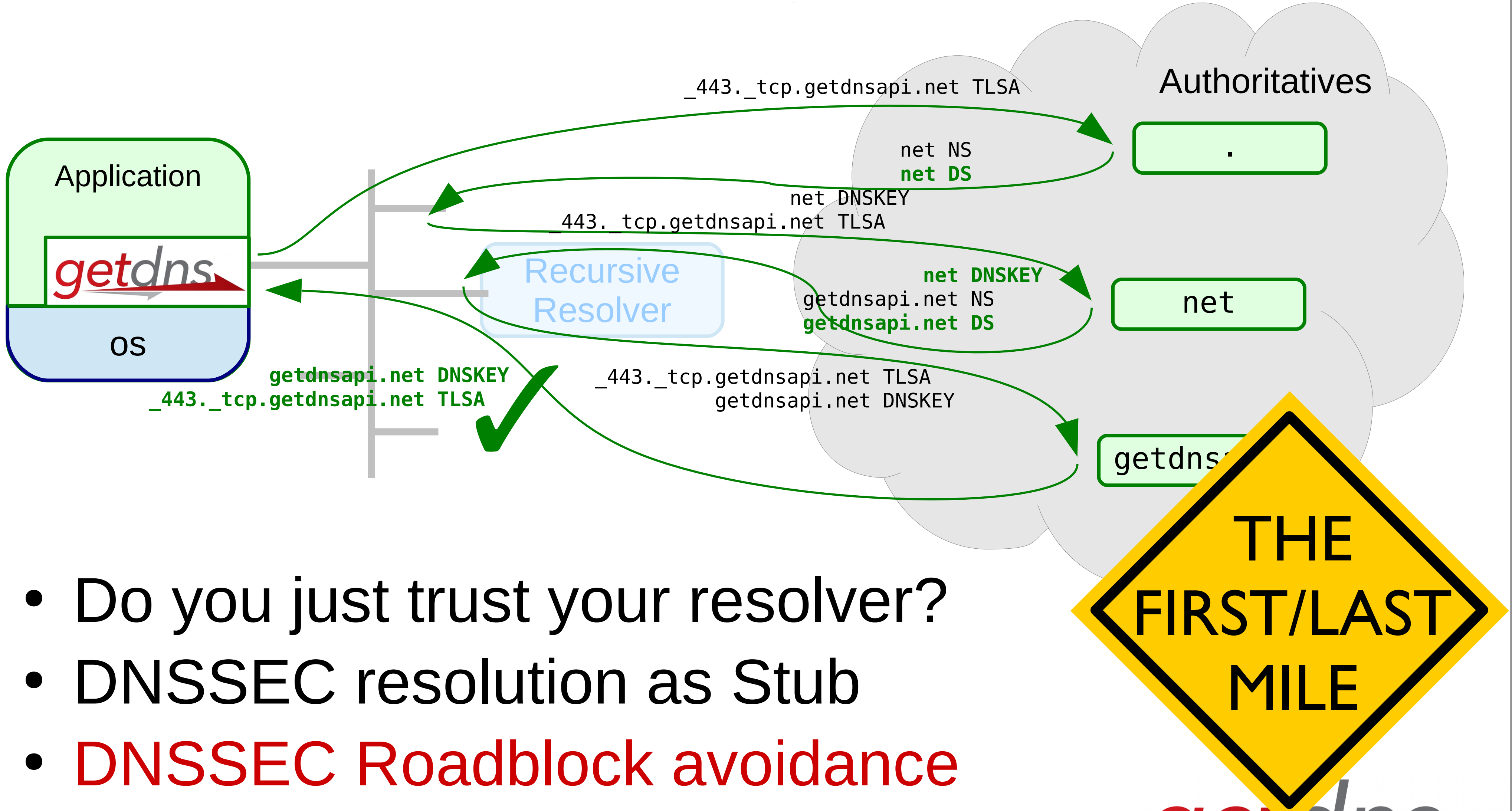
- Do you just trust your resolver?
- Who's to blame

The getdns library features



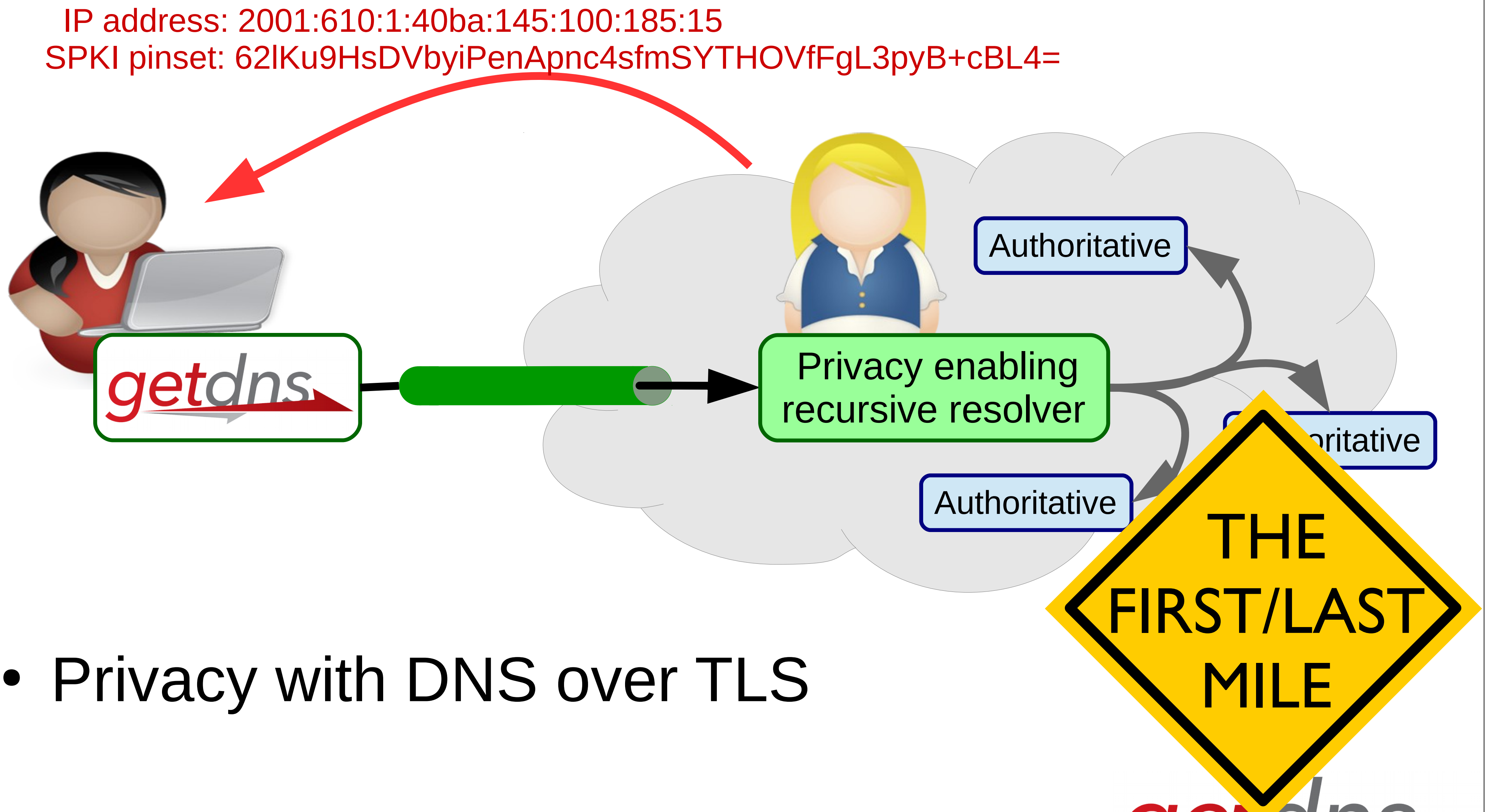
- Do you just trust your resolver?
- Who's to blame
- DNSSEC resolution as Stub

The getdns library features



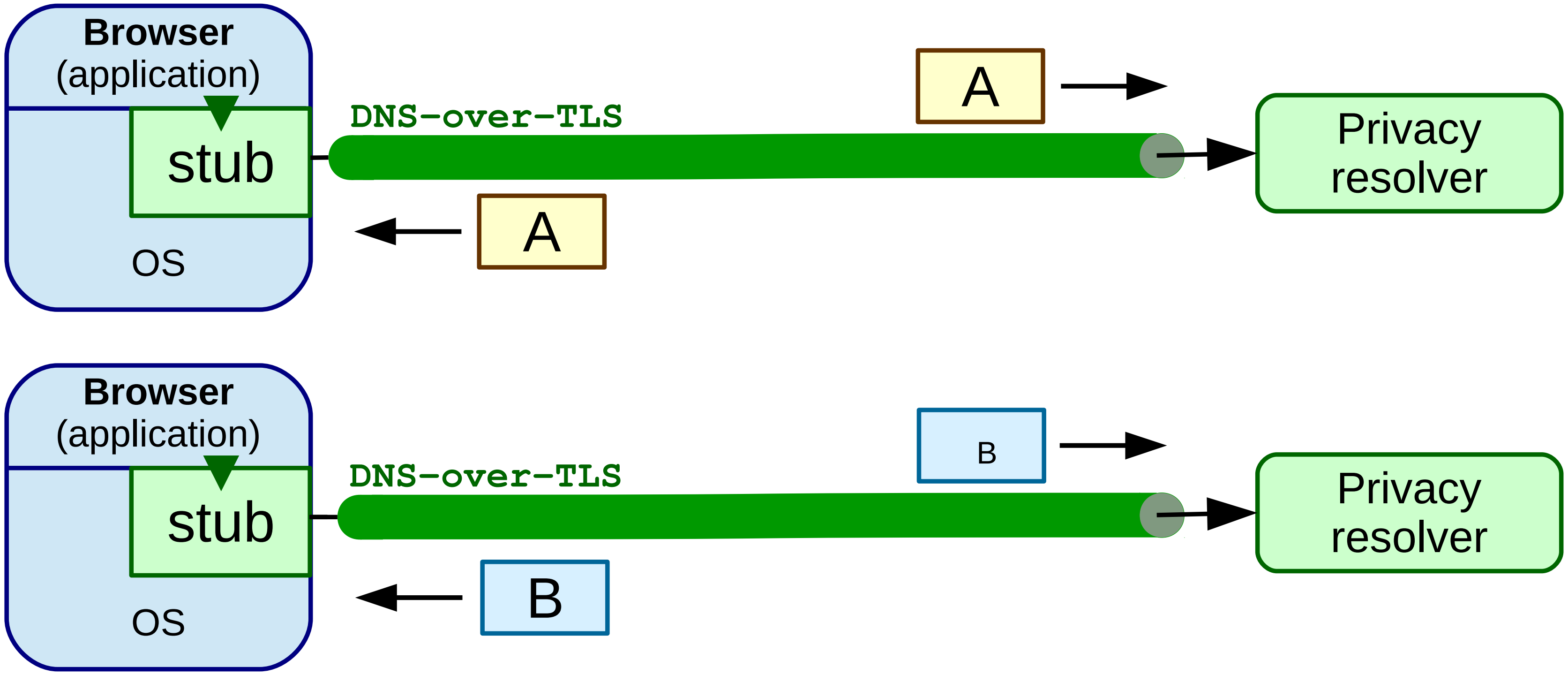
- Do you just trust your resolver?
- DNSSEC resolution as Stub
- DNSSEC Roadblock avoidance

The getdns library features


IP address: 2001:610:1:40ba:145:100:185:15
SPKI pinset: 62lKu9HsDVbyiPenApnc4sfmSYTHOVfFgL3pyB+cBL4=
getdns
Privacy enabling recursive resolver
Authoritative
Authoritative
Authoritative
THE FIRST/LAST MILE

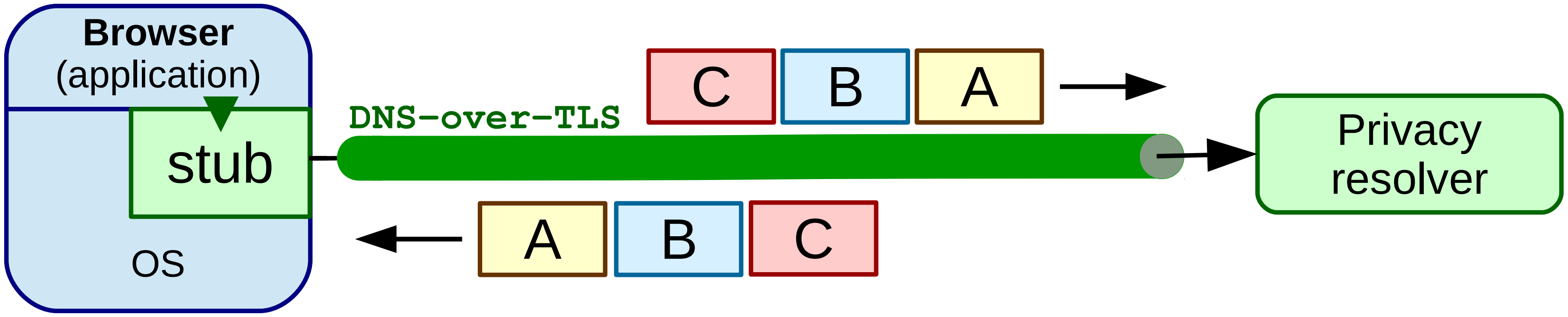
- Privacy with DNS over TLS

The getdns library features



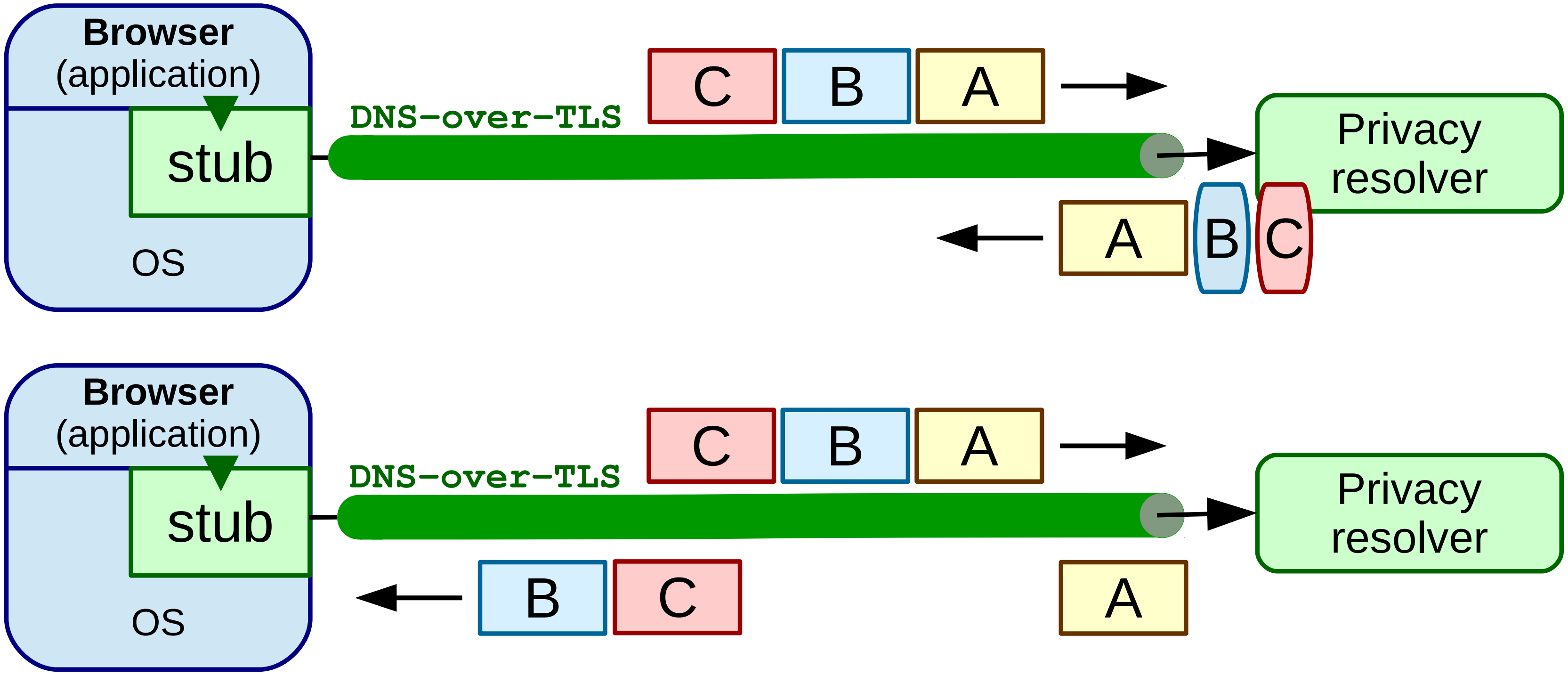
• TCP fastopen *(optional)*	RFC7413
• Connection reuse	RFC7766
• EDNS0 keepalive	RFC7828
• EDNS0 padding	RFC7830

The getdns library features



- Connection reuse $(A_Q/A_R, B_Q/B_R, C_Q/C_R)$
- Pipe-lining of queries $(A_Q,B_Q,C_Q,A_R,B_R,C_R)$

The getdns library features



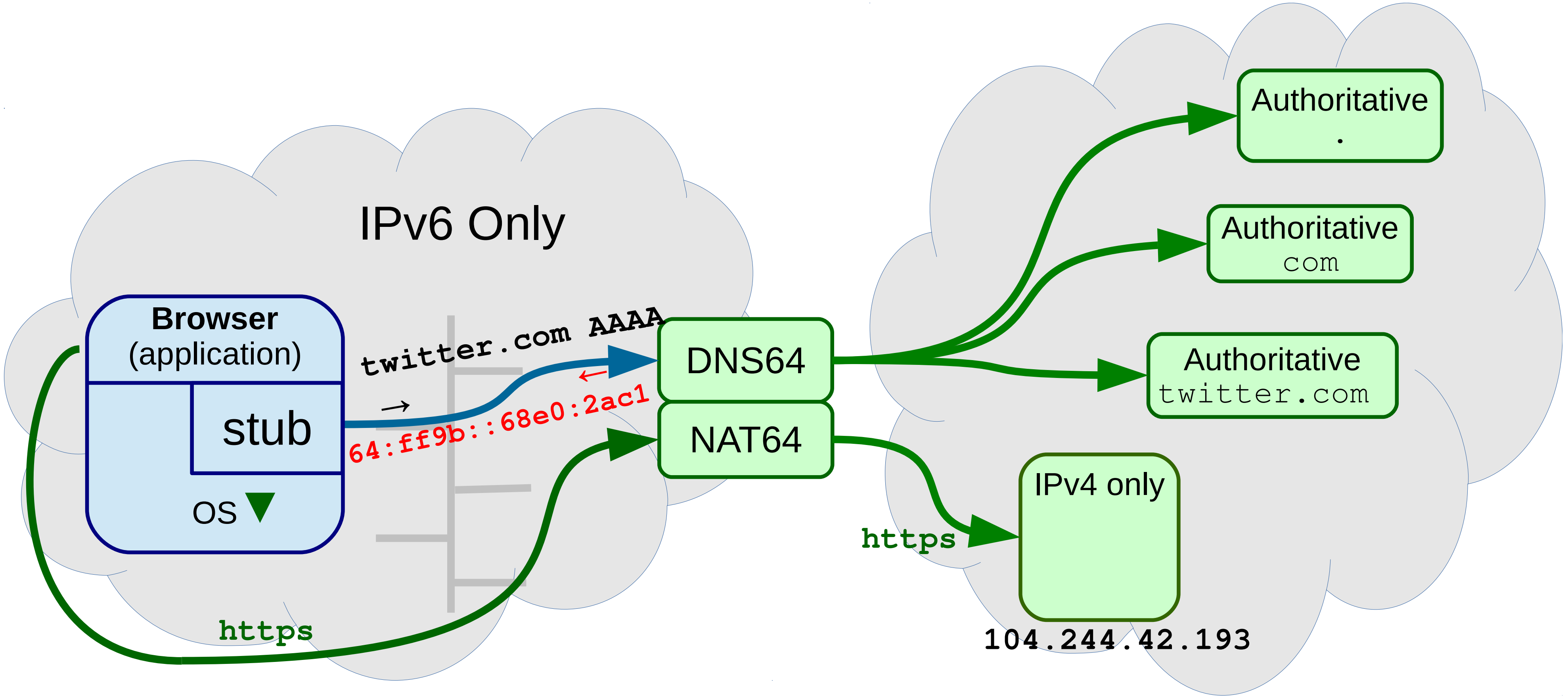
- Connection reuse $(A_Q/A_R, B_Q/B_R, C_Q/C_R)$
- Pipe-lining of queries $(A_Q,B_Q,C_Q,A_R,B_R,C_R)$
- Process Out-Of-Order-Responses $(A_Q,B_Q,C_Q,B_R,C_R,A_R)$

The getdns library on the roadmap

- For 1.2.0 (during IETF99)
- Zero configuration DNSSEC (built in unbound-anchor)
- KSK tracking (RFC5011 like)

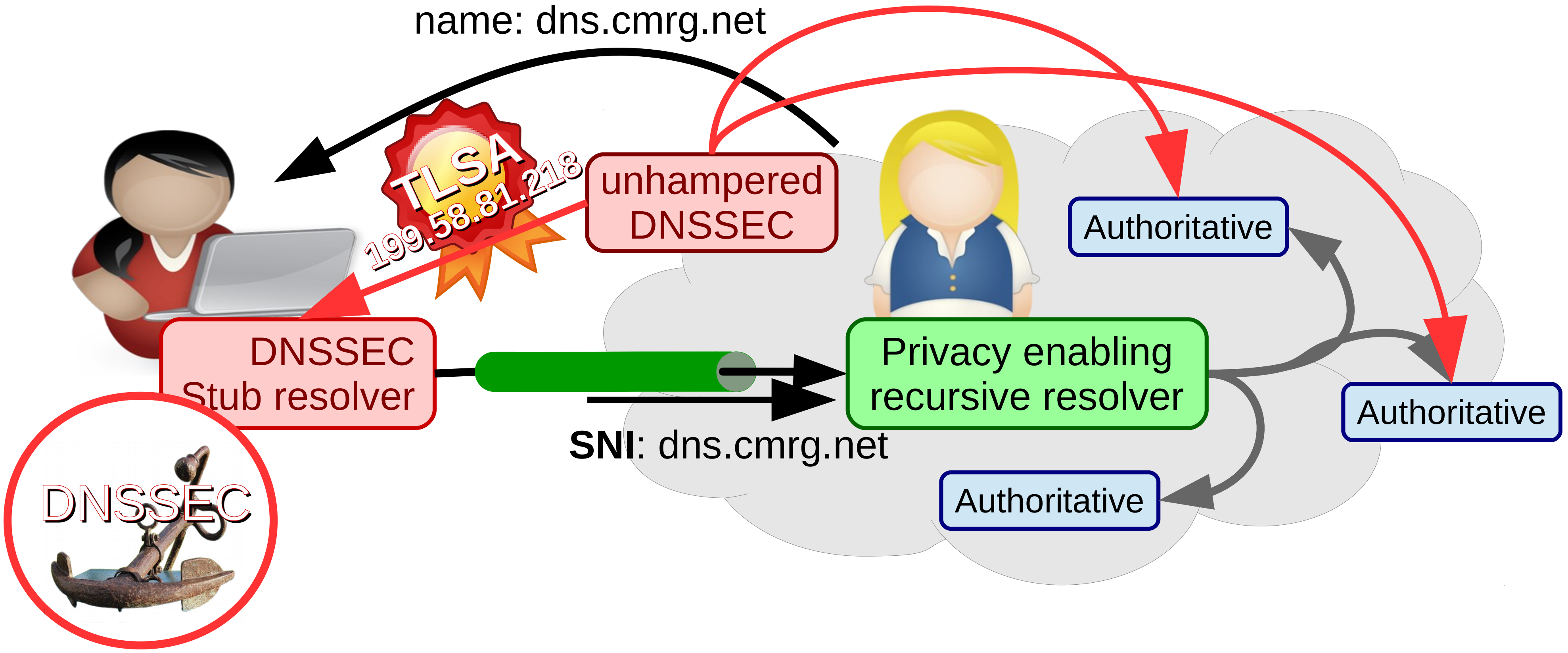
  Taking the "user space library" setting into account
  - Running with user permissions
  - Not running as a daemon

The getdns library on the roadmap



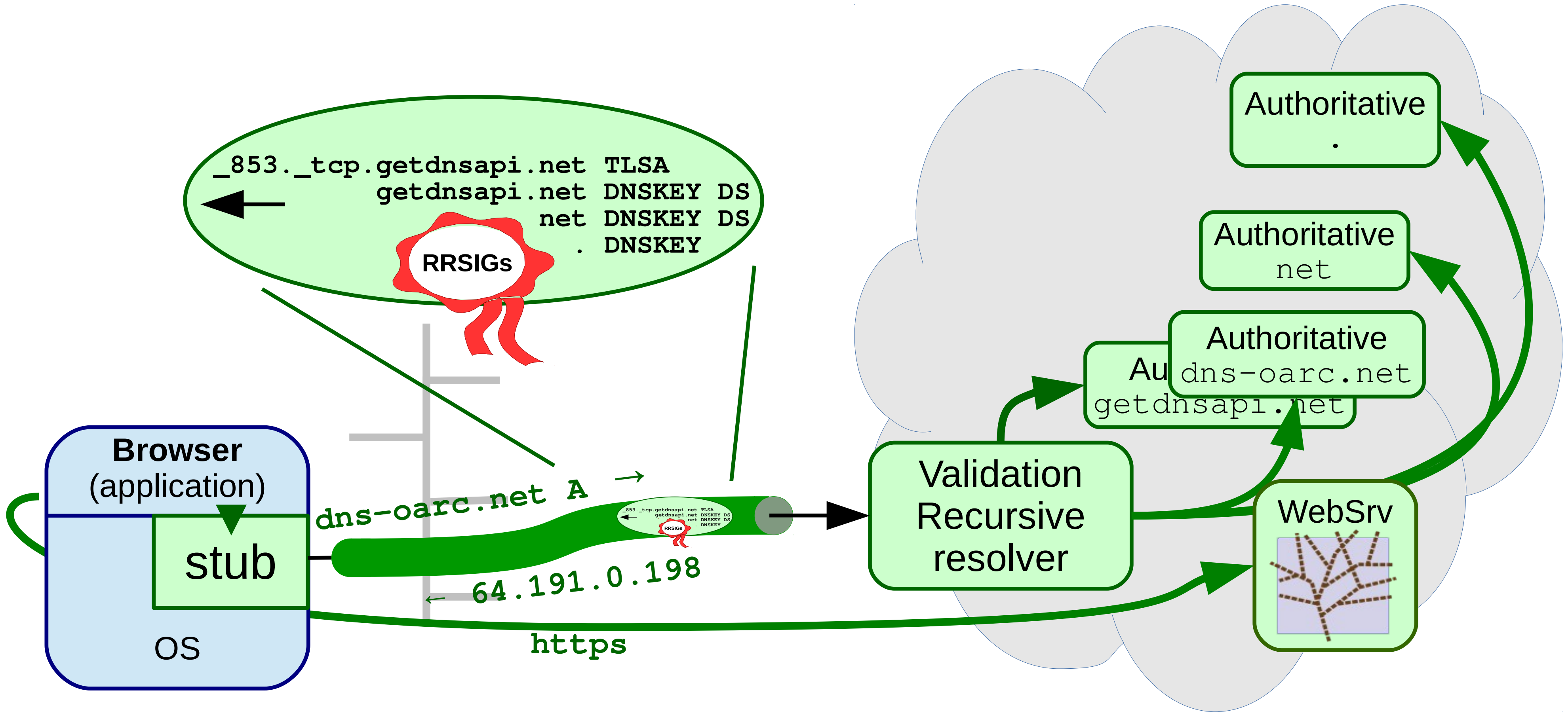
- DNS64 prefix discovery (RFC7050)

The getdns library on the roadmap



- DANE authenticated DNS over TLS

The getdns library on the roadmap



- DANE authenticated DNS over TLS
- DNSSEC authentication chain in TLS extension

getdns related research and projects

- The role of a versatile stub in *from the ground up* privacy (and security)
- DNSSEC for legacy applications
  (i.e. a dnssec-trigger follow up, with signalling)
- How can getdns benefit from a system component
  - i.e. share stateful connections to upstreams
  - have feedback on level of privacy

getdns related research and projects

Stubby

look & feel data structures

- *getdns* is not your typical C library

```
typedef struct getdns_dict getdns_dict;
typedef struct getdns_list getdns_list;
typedef struct getdns_bindata {  size_t  size;
                                 uint8_t *data; } getdns_bindata;
```

- Script like data structures are used to represent:
  - DNS responses
  - Resource Records
  - Rdata fields
- Formatted as JSON-like strings by

```
char *getdns_pretty_print_dict(getdns_dict *dict);
char *getdns_pretty_print_list(getdns_list *list);
```

look & feel data structures

- *getdns* is not your typical C library

response dict

```
{ "answer_type": GETDNS_NAMETYPE_DNS,
  "status": GETDNS_RESPSTATUS_GOOD
  "canonical_name": <bindata for afnic.fr.>,
  "just_address_answers": [
    { "address_data": <bindata for 192.134.5.25>,
      "address_type": <bindata of "IPv4"> },
    { "address_data": <bindata for 2001:67c:2218:30::5>,
      "address_type": <bindata of "IPv6"> }
  ],
  "replies_full": [
     <bindata of 0x7a2f81b00001000200040001056166e...>,
     <bindata of 0xa40581b00001000200040001056166e...>
  ],
  "replies_tree": [{ … first reply …  }, { … second reply …  }]
}
```

look & feel data structures

- *getdns* is not your typical C library

reply

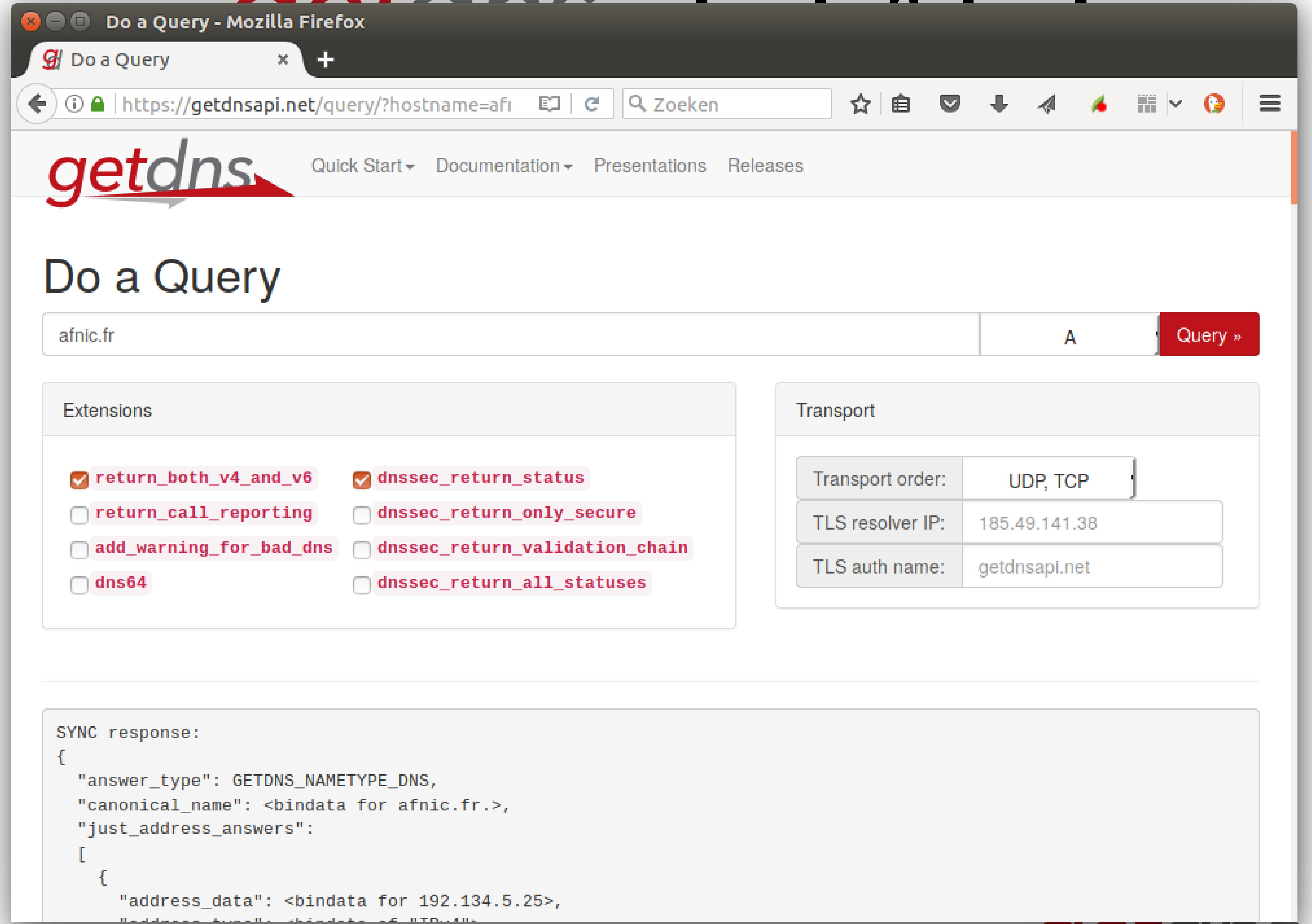
```
{ "answer_type": GETDNS_NAMETYPE_DNS,
  "canonical_name": <bindata for afnic.fr.>,
  "dnssec_status": GETDNS_DNSSEC_SECURE,
  "header": { "id": 50407,
              "qr": 1, "opcode": GETDNS_OPCODE_QUERY,
              "aa": 0, "tc": 0, "rd": 1, "ra": 1,
              "z" : 0, "ad": 1, "cd": 1,
              "rcode": GETDNS_RCODE_NOERROR,
              "qdcount": 1, "ancount": 2,
              "nscount": 4, "arcount": 1
  },
  "question": { "qclass": GETDNS_RRCLASS_IN,
                "qname" : <bindata for afnic.fr.>,
                "qtype" : GETDNS_RRTYPE_A
              },
```

look & feel
data structures

- *getdns* is not your typical C library

reply

```
"answer": [
  { "name"  : <bindata for afnic.fr.>,
    "type"  : GETDNS_RRTYPE_A,
    "class": GETDNS_RRCLASS_IN,
    "ttl"   : 31,
    "rdata": { "ipv4_address": <bindata for 192.134.5.25>,
               "rdata_raw": <bindata of 0xc0860519>
    }
  },
  { "name"  : <bindata for afnic.fr.>,
    "type"  : GETDNS_RRTYPE_RRSIG,
    "rdata": { "type_covered": GETDNS_RRTYPE_A,
               "algorithm": 8, "labels": 2,
               "original_ttl": 600,
               "signature_expiration": 1500960505,
               "signature_inception": 1498356836,
               "key_tag": 16774,
               "signers_name": <bindata for afnic.fr.>,
```


Do a Query - Mozilla Firefox

https://getdnsapi.net/query/?hostname=afı

Do a Query

afnic.fr | A | Query »

Extensions

- [✓] `return_both_v4_and_v6`
- [ ] `return_call_reporting`
- [ ] `add_warning_for_bad_dns`
- [ ] `dns64`
- [✓] `dnssec_return_status`
- [ ] `dnssec_return_only_secure`
- [ ] `dnssec_return_validation_chain`
- [ ] `dnssec_return_all_statuses`

Transport

Transport order:	UDP, TCP
TLS resolver IP:	185.49.141.38
TLS auth name:	getdnsapi.net

```
SYNC response:
{
  "answer_type": GETDNS_NAMETYPE_DNS,
  "canonical_name": <bindata for afnic.fr.>,
  "just_address_answers":
  [
    {
      "address_data": <bindata for 192.134.5.25>,
```

look & feel data structures

- reading getdns_dicts:

```
getdns_return_t getdns_dict_get_dict(
    const getdns_dict *dict, const char *name, getdns_dict **answer);

getdns_return_t getdns_dict_get_list(
    const getdns_dict *dict, const char *name, getdns_list **answer);

getdns_return_t getdns_dict_get_bindata(
    const getdns_dict *dict, const char *name, getdns_bindata **answer);

getdns_return_t getdns_dict_get_int(
    const getdns_dict *dict, const char *name, uint32_t *answer)


getdns_return_t getdns_dict_get_data_type(
    const getdns_dict *dict, const char *name, getdns_data_type *answer);

getdns_return_t getdns_dict_get_names(
    const getdns_dict *dict, getdns_list **answer);
```

getdns look & feel data structures

- reading getdns_lists:

```
getdns_return_t getdns_list_get_dict(
    const getdns_list *list, size_t index, getdns_dict **answer);

getdns_return_t getdns_list_get_list(
    const getdns_list *list, size_t index, getdns_list **answer);

getdns_return_t getdns_list_get_bindata(
    const getdns_list *list, size_t index, getdns_bindata **answer);

getdns_return_t getdns_list_get_int(
    const getdns_list *list, size_t index, uint32_t *answer);


getdns_return_t getdns_list_get_data_type(
    const getdns_list *list, size_t index, getdns_data_type *answer);

getdns_return_t getdns_list_get_length(
    const getdns_list *this_list, size_t *answer);
```

look & feel data structures

- Creating/writing to getdns_dicts:

```
getdns_dict * getdns_dict_create();

getdns_return_t getdns_dict_set_dict(
    getdns_dict *dict, const char *name, const getdns_dict *child_dict);

getdns_return_t getdns_dict_set_list(
    getdns_dict *dict, const char *name, const getdns_list *child_list);

getdns_return_t getdns_dict_set_bindata(
    getdns_dict *dict, const char *name, const getdns_bindata
*child_bindata);

getdns_return_t getdns_dict_set_int(
    getdns_dict *dict, const char *name, uint32_t child_uint32)

void getdns_dict_destroy(getdns_dict *dict);
```

look & feel data structures

Response object dict

```
{
  "answer_type": GETDNS_NAMETYPE_DNS,
  "status": GETDNS_RESPSTATUS_GOOD,
  "canonical_name": <bindata of "www.getdnsapi.net.">,
  "just_address_answers":
  [ { "address_data": <bindata for 185.49.141.37>,
      "address_type": <bindata of "IPv4">
    }
  ],
  "replies_full": [ <bindata of 0x00008180000100020004...> ],
  "replies_tree": [ { … first reply …  } ],
```

```
if ((r = getdns_address_sync(ctx, "getdnsapi.net", ext, &resp)))
        return r;
else if ((r = getdns_list_get_bindata(
    addr_dict, "/just_address_answers/0/address_data", &addr)))
        return r;
```

look & feel data structures

```
if ((r = getdns_address_sync(ctx, "getdnsapi.net", ext, &resp)))
        return r;
else if ((r = getdns_list_get_bindata(
    addr_dict, "/just_address_answers/0/address_data", &addr)))
        return r;
```

- Natural in script languages
- Python

```
resp = ctx.address('getdnsapi.net')
addr = resp.just_address_answers[0]['address_data']
```

- Nodejs

```
function callback(err, resp) {
    var addr = resp.just_address_answers[0].address_data;
}
ctx.getAddress('getdnsapi.net', callback);
```

getdns look & feel data structures

- The alternative would introduce a lot of new types:
  - Python:

```
addr = resp.replies_tree[0]['answer'][0]['rdata']['ipv6_address']
```

  - C now

```
r = getdns_dict_get_bindata(
        resp, "/replies_tree/0/answer/rdata/ipv6_address", &addr)))
```

  - C otherwise (ldns like)

```
getdns_response *resp;  getdns_reply    *reply;
getdns_rrs      *rrs;   getdns_rr       *rrs;
getdns_rdata    *rdata; struct sockaddr_storage addr;
if ((r = getdns_response_get_reply(resp, 0, &reply)))
        return r;
else if ((r = getdns_reply_get_answer_section(reply, &rrs)))
        return r;
else if ((r = getdns_rrs_get_rr(rrs, &rr)))
        return r;
else if ((r = getdns_rr_get_rdata(rr, &rdata)))
        return r;
else if ((r = getdns_rdata_get_rdatafield_address(rdata, 0, &addr)))
        return r;
```

getdns look & feel data structures

- *getdns* is not your typical C library
- Natural in script languages
- The alternative would introduce a lot of new types.
- With current approach, the library can easily grow
- New rdata fields or new extensions without a new API *(dns cookies, roadblock avoidance, client subnet, etc.)*
- Just in time parsing of wireformat data on the roadmap *(internally already iterator like accessor types for wireformat data)*
- Still… *“C bindings”* on the roadmap

look & feel lookup functions

```
getdns_return_t getdns_general(
    getdns_context         *context,
    const char             *name,
    uint16_t                request_type,
    getdns_dict            *extensions,
    void                   *userarg,
    getdns_transaction_t   *transaction_id,
    getdns_callback_t       callbackfn
);
```

- ***context*** contains configuration parameters
  - Stub or recursive modus operandi, timeout values, root-hints, forwarders, trust anchor, search path etc.)
- ***context*** contains the resolver cache

-
  ```
  getdns_return_t getdns_context_create(
      getdns_context **context, int set_from_os)
  ```

look & feel lookup functions

```
getdns_return_t getdns_general(
    getdns_context          *context,
    const char              *name,
    uint16_t                 request_type,
    getdns_dict             *extensions,
    void                    *userarg,
    getdns_transaction_t    *transaction_id,
    getdns_callback_t        callbackfn
);
```

- context contains configuration parameters
- ***name*** and ***request_type*** the name and type to lookup

look & feel lookup functions

```
getdns_return_t getdns_general(
    getdns_context          *context,
    const char              *name,
    uint16_t                 request_type,
    getdns_dict             *extensions,
    void                    *userarg,
    getdns_transaction_t    *transaction_id,
    getdns_callback_t        callbackfn
);
```

- context contains configuration parameters
- name and request_type the name and type to lookup
- ***extensions*** additional parameters specific for this lookup
  - `return_both_v4_and_v6`, `dnssec_return_status`, `specify_class`, `add_opt_parameter`

getdns look & feel extensions

- dnssec_return_validation_chain

```
– { # Response object
    "validation_chain":
    [ { "name" : <bindata for .>, "type": GETDNS_RRTYPE_DNSKEY, ... },
      { "name" : <bindata for .>, "type": GETDNS_RRTYPE_DNSKEY, ... },

      { "name" : <bindata for .>, "type": GETDNS_RRTYPE_RRSIG,
        "rdata": { "signers_name": <bindata for .>,
                   "type_covered": GETDNS_RRTYPE_DNSKEY, ... }, ... },

      { "name" : <bindata for net.>, "type": GETDNS_RRTYPE_DS, ... },
      { "name" : <bindata for net.>, "type": GETDNS_RRTYPE_RRSIG,
        "rdata": { "signers_name": <bindata for .>,
                   "type_covered": GETDNS_RRTYPE_DS, ... }, ... },
```

- Can be fed as `support_records` with companion function:

  -
    ```
    getdns_return_t
    getdns_validate_dnssec( getdns_list *to_validate
                          , getdns_list *support_records
                          , getdns_list *trust_anchors);
    ```

look & feel lookup functions

```
getdns_return_t getdns_general(
    getdns_context          *context,
    const char              *name,
    uint16_t                 request_type,
    getdns_dict             *extensions,
    void                    *userarg,
    getdns_transaction_t    *transaction_id,
    getdns_callback_t        callbackfn
);
```

- context contains configuration parameters
- name and request_type the name and type to lookup
- extensions additional parameters specific for this lookup
- ***userarg*** is passed in on the call to ***callbackfn***
- ***transaction_id*** is set to a unique value that is also passed in on the call to ***callbackfn***

look & feel lookup functions

```
getdns_return_t getdns_general(
    getdns_context          *context,
    const char              *name,
    uint16_t                 request_type,
    getdns_dict             *extensions,
    void                    *userarg,
    getdns_transaction_t    *transaction_id,
    getdns_callback_t        callbackfn
);

typedef void (*getdns_callback_t)(
    getdns_context          *context,
    getdns_callback_type_t   callback_type,
    getdns_dict             *response,
    void                    *userarg,
    getdns_transaction_t     transaction_id
);
// callback_type = complete, cancel, timeout or error
```

look & feel lookup functions

```
getdns_return_t getdns_general(
    getdns_context         *context,
    const char             *name,
    uint16_t                request_type,
    getdns_dict            *extensions,
    void                   *userarg,
    getdns_transaction_t   *transaction_id,
    getdns_callback_t       callbackfn
);

getdns_return_t getdns_general_sync(
    getdns_context         *context,
    const char             *name,
    uint16_t                request_type,
    getdns_dict            *extensions,
    getdns_dict           **response
);
```

look & feel lookup functions

```
getdns_return_t getdns_address(
    getdns_context         *context,
    const char             *name,
    getdns_dict            *extensions,
    void                   *userarg,
    getdns_transaction_t   *transaction_id,
    getdns_callback_t       callbackfn
);
```

- **getdns_address** also lookups in other name systems
  - local files, mDNS (not implemented yet)
- When name is found in the DNS, **getdns_address** returns both IPv4 and IPv6

look & feel lookup functions

```
getdns_return_t getdns_hostname(
    getdns_context          *context,
    getdns_dict             *address,
    getdns_dict             *extensions,
    void                    *userarg,
    getdns_transaction_t    *transaction_id,
    getdns_callback_t        callbackfn
);
```

- With **address**:

```
{ "address_type": <bindata of "IPv4">,
  "address_data": <bindata for 185.49.141.37>
}
```

will lookup `37.141.49.185.in-addr.arpa PTR`

look & feel lookup functions

```
getdns_return_t getdns_service(
    getdns_context            *context,
    getdns_dict               *name,
    getdns_dict               *extensions,
    void                      *userarg,
    getdns_transaction_t      *transaction_id,
    getdns_callback_t          callbackfn
);
```

- Provides a partly randomly sorted list (by weight and priority) of service addresses and ports (RFC2782)

```
"canonical_name": <bindata for _jabber._tcp.nlnetlabs.nl.>
"srv_addresses":
  [ { "address_data": <bindata for 2a04:b900::1:0:0:10>,
      "domain_name": <bindata for open.nlnetlabs.nl.>,
      "port": 5269 },
    { "address_data": <bindata for 185.49.140.10>,
      "domain_name": <bindata for open.nlnetlabs.nl.>,
      "port": 5269 }
  ],
```

look & feel event libraries

- `libevent`

```
Include : #include <getdns/getdns_ext_libevent.h>
Use     : getdns_extension_set_libevent_base(context, base);
Link    : -lgetdns -lgetdns_ext_event
```

- `libev`

```
Include : #include <getdns/getdns_ext_libev.h>
Use     : getdns_extension_set_libev_loop(context, loop);
Link    : -lgetdns -lgetdns_ext_ev
```

- `libuv`

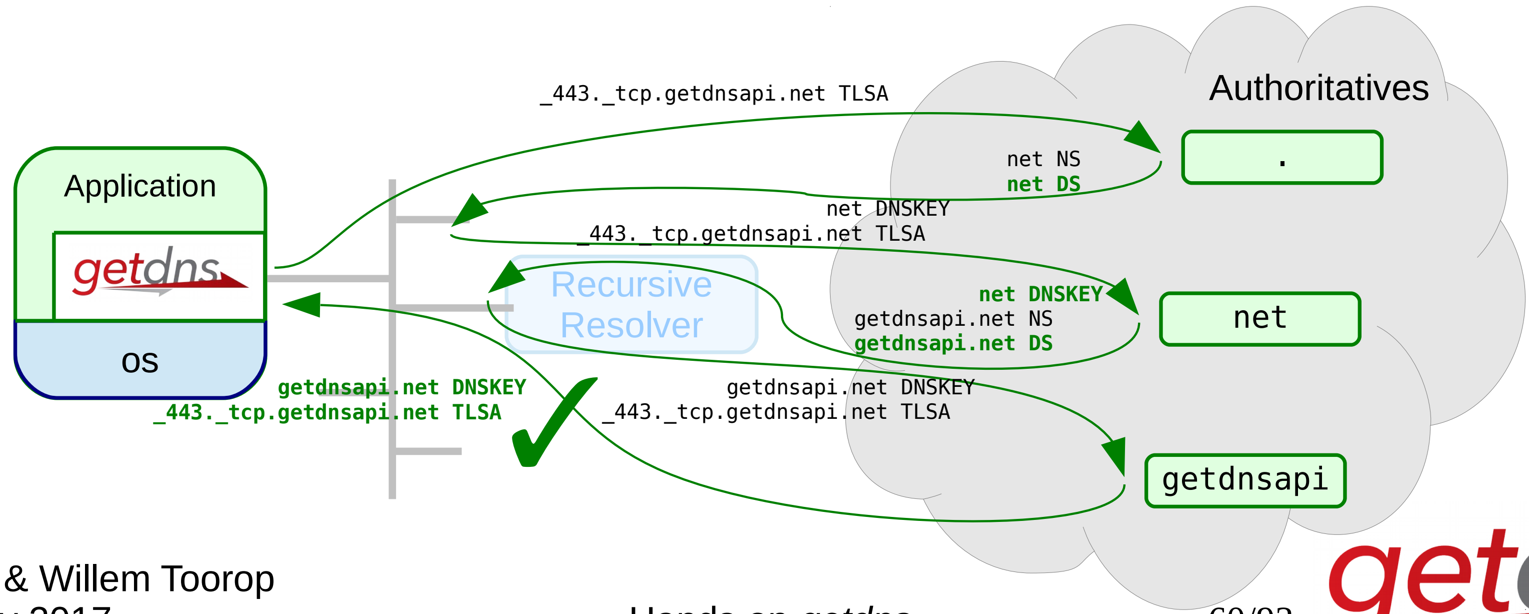
```
Include : #include <getdns/getdns_ext_libuv.h>
Use     : getdns_extension_set_libuv_loop(context, loop);
Link    : -lgetdns -lgetdns_ext_uv
```

look & feel example query

```
from getdns import *

ctx = Context()
ext = { "dnssec_return_only_secure": EXTENSION_TRUE }
res = ctx.general( '_443._tcp.getdnsapi.net', RRTYPE_TLSA, ext)

if res['status'] == RESPSTATUS_GOOD:
        # Process TLSA RRs
```



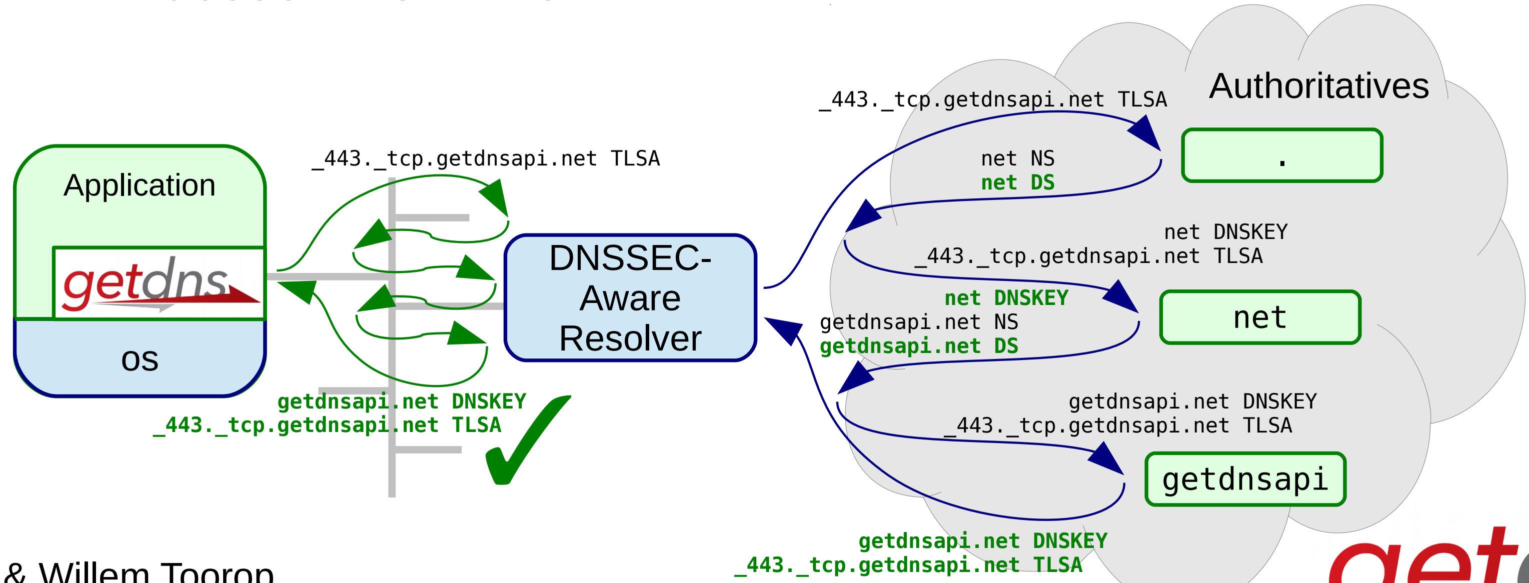
getdns look & feel example query

```
from getdns import *

ctx = Context()
ctx.resolution_type = RESOLUTION_STUB

ext = { "dnssec_return_only_secure": EXTENSION_TRUE }
res = ctx.general( '_443._tcp.getdnsapi.net', RRTYPE_TLSA, ext)

if res['status'] == RESPSTATUS_GOOD:
        # Process TLSA RRs
```



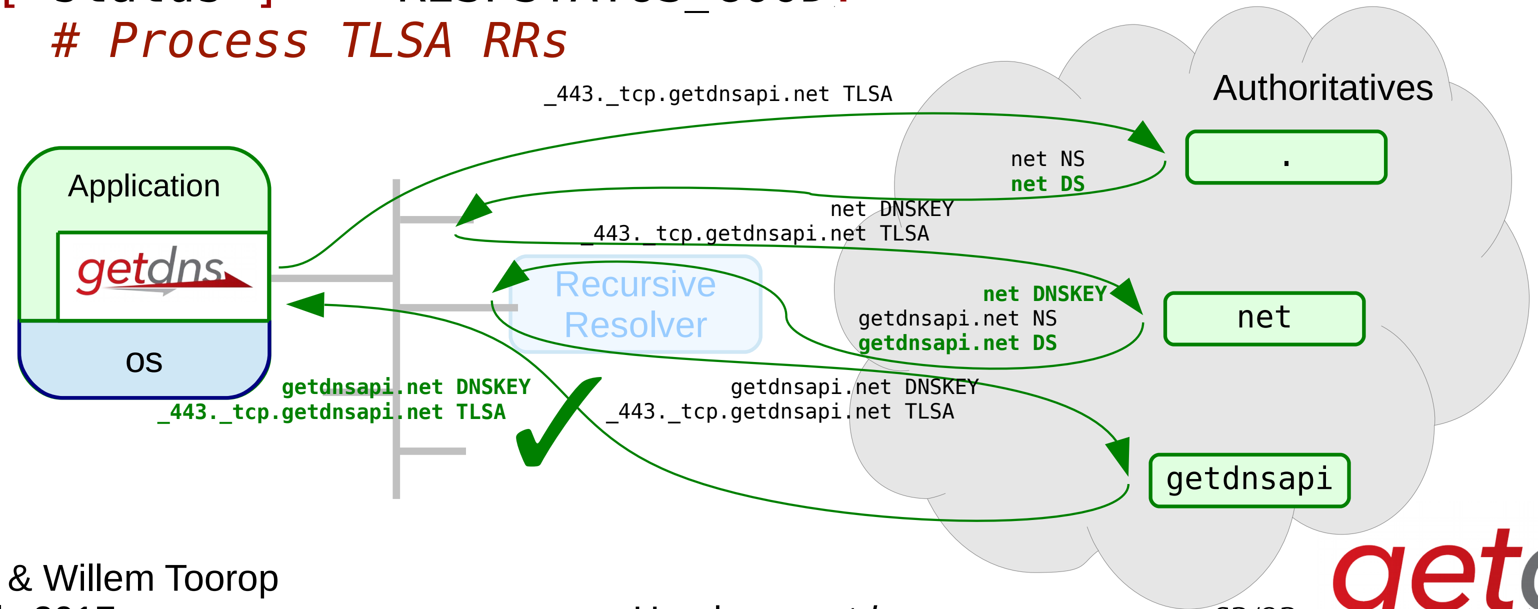
look & feel example query

```python
from getdns import *

ctx = Context()
ctx.resolution_type = RESOLUTION_STUB

ext = { "dnssec_return_only_secure" : EXTENSION_TRUE
      , "dnssec_roadblock_avoidance": EXTENSION_TRUE}
res = ctx.general( '_443._tcp.getdnsapi.net', RRTYPE_TLSA, ext)

if res['status'] == RESPSTATUS_GOOD:
        # Process TLSA RRs
```



look & feel example query

```python
from getdns import *

def process_tlsa_rrs( ttype, result, userarg, tid ):
        ctx = userarg
        if ttype == CALLBACK_COMPLETE:
                # Process TLSA RRs
                pass
        elif ttype == CALLBACK_TIMEOUT:
                # Handle timeout
                pass

ctx = Context()
ctx.resolution_type = RESOLUTION_STUB

ext = { "dnssec_return_only_secure" : EXTENSION_TRUE
      , "dnssec_roadblock_avoidance": EXTENSION_TRUE}
tid = ctx.general( '_443._tcp.getdnsapi.net', RRTYPE_TLSA, ext
                 , userarg = ctx, callback = process_tlsa_rrs )
ctx.run()
```

look & feel example query

```
var getdns = require('getdns');

function process_tlsa_rrs(err, res)
{
        if (err) {
                console.log( err )
        } else {
                // Process TLSA RRs
        }
}

ctx = getdns.createContext();
ctx.general( '_443._tcp.getdnsapi.net', getdns.RRTYPE_TLSA
           , { dnssec_return_only_secure : true
             , dnssec_roadblock_avoidance: true }
           , function(err, res) { process_tlsa_rrs(ctx, err, res); });
```

Hands on getdns DANE authenticated TLS connect *(python)*

```python
from getdns import *
from M2Crypto import SSL, X509
import sys
from socket import *
import hashlib

if len(sys.argv) > 1:
        hostname = sys.argv[1]
        port = int(sys.argv[2]) if len(sys.argv) > 2 else 443
else:
        print('%s <hostname> [ <port> ]' % sys.argv[0])
        sys.exit(0)

ctx = Context()
ctx.resolution_type = RESOLUTION_STUB
ext = { "dnssec_return_only_secure" : EXTENSION_TRUE }
#     , "dnssec_roadblock_avoidance": EXTENSION_TRUE }

# Correctly query and process DANE records
res = ctx.general('_%d._tcp.%s' % (port, hostname), RRTYPE_TLSA, ext)
```

Hands on getdns DANE authenticated TLS connect *(python)*

```
if res.status == RESPSTATUS_GOOD:
    # Process TLSA Rrs
    tlsas = [ answer for reply in res.replies_tree
                     for answer in reply['answer']
                      if answer['type'] == RRTYPE_TLSA ]

elif res.status == RESPSTATUS_ALL_TIMEOUT:
    print('Network error trying to get DANE records for %s' % hostname)
    sys.exit(-1);
elif res.status == RESPSTATUS_ALL_BOGUS_ANSWERS:
    print('DANE records for %s were BOGUS' % hostname)
    sys.exit(-1);
else:
    tlsas = None
    # Conventional PKIX without DANE processing
```

Hands on getdns DANE authenticated TLS connect *(python)*

- Find the CA vouching for the connection for PKIX-TA and DANE-TA usages.

```
ca_cert = None
def get_ca(ok, store):
    global ca_cert
    if store.get_current_cert().check_ca():
        ca_cert = store.get_current_cert()
    return ok

# Now TLS connect to each address  and verify the cert (or CA)
for address in ctx.address(hostname).just_address_answers:
    sock = socket(AF_INET if address['address_type'] == 'IPv4'
                  else AF_INET6, SOCK_STREAM)
    socket.setsockopt(sock, SOL_SOCKET, SO_REUSEADDR, 1)
    print('Connecting to %s' % address['address_data']);
    ssl_ctx = SSL.Context()
    ssl_ctx.load_verify_locations(capath = '/etc/ssl/certs')
    ssl_ctx.set_verify(SSL.verify_none, 10, get_ca)
    connection = SSL.Connection(ssl_ctx, sock=sock)
```

Hands on getdns DANE authenticated TLS connect *(python)*

- Just two more household affairs...

```
# set TLS SNI extension
connection.set_tlsext_host_name(hostname)

# Per RFC7671, for DANE-EE usage, certificate identity checks are
# based solely on the TLSA record, so we ignore name mismatch
# conditions in the certificate.
try:
    connection.connect((address['address_data'], port))

except SSL.Checker.WrongHost:
    pass
```

Hands on getdns DANE authenticated TLS connect *(python)*

- Without TLSA RRs, fall back to old fashioned PKIX

```
if not tlsas:
    print( 'No TLSAS. Regular PKIX validation '
         + ('succeeded' if connection.verify_ok() else 'failed'))
    continue # next address
```

- But with TLSA RRs, try each TLSA RR in turn.
  First one matching makes the day!
- Note that for PKIX-TA *(0)* and DANE-TA *(2)* we set cert to the CA.

```
cert = connection.get_peer_cert()
TLSA_matched = False
for tlsa in tlsas:
    rdata = tlsa['rdata']
    if rdata['certificate_usage'] in (0, 2):
        cert = ca_cert
```

Hands on getdns DANE authenticated TLS connect *(python)*

- Put certdata into selector and the matching_type shape

```
if rdata['selector'] == 0:
    certdata = cert.as_der()
elif rdata['selector'] == 1:
    certdata = cert.get_pubkey().as_der()
else:
    raise ValueError('Unkown selector')

if rdata['matching_type'] == 1:
    certdata = hashlib.sha256(certdata).digest()
elif rdata['matching_type'] == 2:
    certdata = hashlib.sha512(certdata).digest()
else:
    raise ValueError('Unkown matching type')
```

Hands on getdns DANE authenticated TLS connect *(python)*

- And see if certdata matches TLSA certificate association data
- With usages PKIX-TA *(0)* and PKIX-EE *(1)* we need to PKIX validate too (i.e. `connection.verify_ok()`)

```
    if str(certdata) == str(rdata['certificate_association_data'])\
    and (rdata['certificate_usage'] > 1 or connection.verify_ok()):
        TLSA_matched = True
        print('DANE validated successfully')
        break # from "for tlsa in tlsas:" (first one wins!)

if not TLSA_matched:
    print('DANE validation failed')
```

Hands on getdns DANE authenticated TLS connect *(python)*

- Our DANE example in action:

```
willem@bonobo:~/jcsa17$ ./dane-connect.py www.afnic.fr
Connecting to 2001:67c:2218:30::24
DANE validated successfully
Connecting to 192.134.5.24
DANE validated successfully

willem@bonobo:~/jcsa17$ ./dane-connect.py www.sidn.nl
Connecting to 2001:7b8:606:294::3
DANE validated successfully
Connecting to 212.114.98.233
DANE validated successfully

willem@bonobo:~/jcsa17$ ./dane-connect.py www.nominet.uk
Connecting to 2400:cb00:2048:1::6814:e3d
No TLSAS. Regular PKIX validation succeeded
Connecting to 104.20.14.61
No TLSAS. Regular PKIX validation succeeded
```

Hands on getdns C API – How to do a simple query

- Use API and non-API functions
- Do a synchronous request (one at a time).
- Extract data from the response dict
- Do asynchronously requests
- Use an event loop libraries
- Use extension dictionaries

- `https://getdnsapi.net/blog/simple-lookup/`
- `https://getdnsapi.net/static/getdns-jcsa17-examples-0.1.0.tar.gz`
- `https://github.com/getdnsapi/getdns-jcsa17`

Hands on getdns C API – How to do a simple query setup context

```
#include <getdns/getdns_extra.h>
#include <stdio.h>

int main()
{
    getdns_return_t r;
    getdns_context *ctxt = NULL;

    if ((r = getdns_context_create(&ctxt, 1)))
        fprintf( stderr, "Could not create context: %s\n"
               , getdns_get_errorstr_by_id(r));

    if (ctxt)
        getdns_context_destroy(ctxt);

    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

- `GETDNS_RETURN_SUCCESS == 0`
- `getdns_get_errorstr_by_id()` is a non-API function
- `getdns_conext_create()` does not touch `ctxt` on `failure`

Hands on getdns C API – How to do a simple query

do query

```
#include <getdns/getdns_extra.h>
#include <stdio.h>

int main()
{
    getdns_return_t r;
    getdns_context *ctxt = NULL;
    getdns_dict *resp = NULL;

    if ((r = getdns_context_create(&ctxt, 1)))
        fprintf( stderr, "Could not create context: %s\n"
               , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_address_sync(ctxt, "getdnsapi.net.", NULL, &resp)))
        fprintf( stderr, "Unable to do an address lookup: %s\n"
               , getdns_get_errorstr_by_id(r));

    if (resp)
        getdns_dict_destroy(resp);
    if (ctxt)
        getdns_context_destroy(ctxt);

    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

Hands on getdns C API – How to do a simple query

do query

```
#include <getdns/getdns_extra.h>
#include <stdio.h>

int main()
{
    getdns
    getdn
    getdn

    if ((
        f

    else                                                            sp)))
        f


    if (r
        g
    if (ct
        getd

    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

```
if (!(r = getdns_context_create(&ctxt))) {
    if (!(r = getdns_address_sync(ctxt, ..., &resp))) {

        getdns_dict_destroy(resp);
    }
    else
        ; /* error handling */

    getdns_context_destroy(ctxt);
} else
    ; /* error handling */
```

Hands on getdns C API – How to do a simple query

do query

```
#include <getdns/getdns_extra.h>
#include <std

int main
{
    get
    get
    get

    if


    els                                                          sp)))



    if

    if


    return
}
```

```
    if ((r = getdns_context_create(&ctxt, 1)))
        goto escape;

    if ((r = getdns_address_sync(ctxt, ..., &resp)))
        goto escape_destroy_context;

    if ((r = getdns_something(...)))
        goto escape_destroy_resp;

escape_destroy_resp:
    getdns_dict_destroy(resp);

escape_destroy_context:
    getdns_context_destroy(ctxt);

escape:
    return r ? EXIT_FAILURE : EXIT_SUCCESS;
```

Hands on getdns C API – How to do a simple query
do query

```
#include <getdns/getdns_extra.h>
#include <stdio.h>

int main()
{

    if (!(r = getdns_context_create(&ctxt, 1))
    &&  !(r = getdns_address_sync(ctxt, ..., &resp))
    &&  !(r = getdns_something(...))
    &&  !(r = getdns_something_else(...))) {

        /* The happy path */
    } else
        fprintf( stderr, "Something went wrong somewhere: %s\n"
               , getdns_get_errorstr_by_id(r));

    if (resp) getdns_dict_destroy(resp);
    if (ctxt) getdns_dict_destroy(ctxt);

    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

Hands on getdns C API – How to do a simple query get data

```
getdns_bindata *address;
char address_str[1024];

if ((r = getdns_context_create(&ctxt, 1)))
    fprintf( stderr, "Could not create context: %s\n"
           , getdns_get_errorstr_by_id(r));

else if ((r = getdns_address_sync(ctxt, "getdnsapi.net.", NULL, &resp)))
    fprintf( stderr, "Unable to do an address lookup: %s\n"
           , getdns_get_errorstr_by_id(r));

else if ((r = getdns_dict_get_bindata( resp,
    "/just_address_answers/0/address_data", &address)))
    fprintf( stderr, "Unable to get an address from the response: %s\n"
           , getdns_get_errorstr_by_id(r));

else if (address->size != 4 && address->size != 16)
    fprintf(stderr, "Unable to determine type of this address\n");

else if (! inet_ntop( address->size == 4 ? AF_INET : AF_INET6
                    , address->data, address_str, sizeof(address_str)))
    fprintf(stderr, "Could not convert address to string\n");
else
    printf("An address of getdnsapi.net is: %s\n", address_str);
```

Hands on getdns C API – How to do a simple query get data

```
getdns_bindata *address;
char address_str[1024];

if ((r = getdns_context_create(&ctxt, 1)))
    [illegible]
          , getdns_get_errorstr_by_id(r));

else if ((r = getdns_address_sync(ctxt, "getdnsapi.net.", NULL, &resp)))
    [illegible]
          , getdns_get_errorstr_by_id(r));
```

- JSON-pointer introduced into the API by us
- *getdns* returns "network" format IPv4 and IPv6 addresses
- No data is converted, response dicts brings you to the spot

```
else if ((r = getdns_dict_get_bindata( resp,
    "/just_address_answers/0/address_data", &address)))
    fprintf( stderr, "Unable to get an address from the response: %s\n"
           , getdns_get_errorstr_by_id(r));

else if (address->size != 4 && address->size != 16)
    fprintf(stderr, "Unable to determine type of this address\n");

else if (! inet_ntop( address->size == 4 ? AF_INET : AF_INET6
                    , address->data, address_str, sizeof(address_str)))
    fprintf(stderr, "Could not convert address to string\n");
else
    printf("An address of getdnsapi.net is: %s\n", address_str);
```

Hands on getdns C API – How to do a simple query asynchronous

```
#include <getdns/getdns_extra.h>
#include <stdio.h>

void callback(getdns_context *ctxt, getdns_callback_type_t cb_type,
    getdns_dict *resp, void *userarg, getdns_transaction_t trans_id) {}

int main()
{
    getdns_return_t r;
    getdns_context *ctxt = NULL;

    if ((r = getdns_context_create(&ctxt, 1)))
        fprintf( stderr, "Could not create context: %s\n"
               , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_address(ctxt, "getdnsapi.net.", 0, 0, 0, callback)))
        fprintf( stderr, "Unable to schedule an address lookup: %s\n"
               , getdns_get_errorstr_by_id(r));
    else
        getdns_context_run(ctxt);

    if (ctxt)
        getdns_context_destroy(ctxt);
    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

Hands on getdns C API – How to do a simple query asynchronous

```
#include <getdns/getdns_extra.h>
#include <stdio.h>

void callback(getdns_context *ctxt, getdns_callback_type_t cb_type,
    getdns_dict *resp, void *userarg, getdns_transaction_t trans_id) {}

int main()
{
    getdns_return_t r;
    getdns_context *ctxt = NULL;

    if ((r = getdns_context_create(&ctxt, 1)))
        fprintf( stderr, "Could not create context: %s\n"
               , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_address(ctxt, "getdnsapi.net.", 0, 0, 0, callback)))
        fprintf( stderr, "Unable to schedule an address lookup: %s\n"
               , getdns_get_errorstr_by_id(r));
    else
        getdns_context_run(ctxt);

    if (ctxt)
        getdns_context_destroy(ctxt);
    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

- A request is ***scheduled***
- A callback function is ***registered***
- `getdns_context_run()` is **not** an API function

Hands on getdns C API – How to do a simple query async libuv

```
int main() {
    getdns_return_t r;
    getdns_context *ctxt = NULL;
    uv_loop_t loop;

    if (uv_loop_init(&loop)) {
        fprintf( stderr, "Could not initialize event loop\n");
        return EXIT_FAILURE;
    }
    else if ((r = getdns_context_create(&ctxt, 1)))
        fprintf( stderr, "Could not create context: %s\n"
                   , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_extension_set_libuv_loop(ctxt, &loop)))
        fprintf( stderr, "Unable to set the event loop: %s\n"
                   , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_address(ctxt, "getdnsapi.net.", 0, 0, 0, callback)))
        fprintf( stderr, "Unable to schedule an address lookup: %s\n"
                   , getdns_get_errorstr_by_id(r));
    else
        uv_run(&loop, UV_RUN_DEFAULT);

    if (ctxt) getdns_context_destroy(ctxt);
    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

- #include <uv.h>
- cc -o 05-libuv-query -lgetdns -lgetdns_ext_libuv -luv

```
int
    uv_loop_t loop;

    if (uv_loop_init(&loop)) {
        fprintf( stderr, "Could not initialize event loop\n");
        return EXIT_FAILURE;
    }
    else if ((r = getdns_context_create(&ctxt, 1)))
        fprintf( stderr, "Could not create context: %s\n"
                   , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_extension_set_libuv_loop(ctxt, &loop)))
        fprintf( stderr, "Unable to set the event loop: %s\n"
                   , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_address(ctxt, "getdnsapi.net.", 0, 0, 0, callback)))
        fprintf( stderr, "Unable to schedule an address lookup: %s\n"
                   , getdns_get_errorstr_by_id(r));
    else
        uv_run(&loop, UV_RUN_DEFAULT);

    if (ctxt) getdns_context_destroy(ctxt);
    return r ? EXIT_FAILURE : EXIT_SUCCESS;
}
```

Hands on getdns C API – How to do a simple query get data 2

```
void callback(getdns_context *ctxt, getdns_callback_type_t cb_type,
    getdns_dict *resp, void *userarg, getdns_transaction_t trans_id)
{
    getdns_return_t r;
    getdns_list    *jaa;     /* The just_address_answers list */
    size_t          i;       /* Variable to iterate over the jaa list */
    getdns_dict    *ad;      /* A dictionary containing an address */

    if (cb_type != GETDNS_CALLBACK_COMPLETE)
        fprintf( stderr, "Something went wrong with this query: %s\n"
               , getdns_get_errorstr_by_id(cb_type));

    else if ((r = getdns_dict_get_list(resp, "just_address_answers", &jaa)))
        fprintf( stderr, "No addresses in the response dict: %s\n"
               , getdns_get_errorstr_by_id(r));

    else for (i = 0; !getdns_list_get_dict(jaa, i, &ad); i++) {

        getdns_bindata *address;
        char            address_str[1024];

        if ((r = getdns_dict_get_bindata(ad, "address_data", &address)))
            fprintf( stderr, "Could not get address_data: %s\n"
                   , getdns_get_errorstr_by_id(r));
```

Hands on getdns C API – How to do a simple query get data 2

```c
void callback(getdns_context *ctxt, getdns_callback_type_t cb_type
    getdns_dict *resp, void *userarg, getdns_transaction_t tra
{
    getdns_return_t r;
    getdns_list    *jaa;     /* The just_address_answers list */
    size_t          i;       /* Variable to iterate over the jaa list */
    getdns_dict    *ad;      /* A dictionary containing an address */

    if (cb_type != GETDNS_CALLBACK_COMPLETE)
        fprintf( stderr, "Something went wrong with this query: %s\n"
               , getdns_get_errorstr_by_id(cb_type));

    else if ((r = getdns_dict_get_list(resp, "just_address_answers", &jaa)))
        fprintf( stderr, "No addresses in the response dict: %s\n"
               , getdns_get_errorstr_by_id(r));

    else for (i = 0; !getdns_list_get_dict(jaa, i, &ad); i++) {

        getdns_bindata *address;
        char            address_str[1024];

        if ((r = getdns_dict_get_bindata(ad, "address_data", &address)))
            fprintf( stderr, "Could not get address_data: %s\n"
                   , getdns_get_errorstr_by_id(r));
```

works with all constants

stop *for* when != 0

Hands on getdns C API – How to do a simple query get data 2

```
    size_t               i;        /* Variable to iterate over the jaa list */
    getdns_dict         *ad;       /* dictionary containing an address */

    if (cb_type != GETDNS_CALLBACK_COMPLETE)
        fprintf( stderr, "Something went wrong with this query: %s\n"
               , getdns_get_errorstr_by_id(cb_type));

    else if ((r = getdns_dict_get_list(resp, "just_address_answers", &jaa)))
        fprintf( stderr, "No addresses in the response dict: %s\n"
               , getdns_get_errorstr_by_id(r));

    else for (i = 0; !getdns_list_get_dict(jaa, i, &ad); i++) {

        getdns_bindata *address;
        char            address_str[1024];

        if ((r = getdns_dict_get_bindata(ad, "address_data", &address)))
            fprintf( stderr, "Could not get address_data: %s\n"
                   , getdns_get_errorstr_by_id(r));

        else if (address->size != 4 && address->size != 16)
            fprintf(stderr, "Unable to determine address type\n");

        else if (! inet_ntop( address->size == 4 ? AF_INET : AF_INET6,
            address->data, address_str, sizeof(address_str)))
            fprintf(stderr, "Could not convert address to string\n");
        else
            printf("An address of getdnsapi.net is: %s\n", address_str);
    }
    getdns_dict_destroy(resp); /* Safe, because resp is NULL on error */
}
```

Hands on getdns C API – How to do a simple query multiple queries

```
struct dane_query_st {
    getdns_dict            *addrs_response;
    getdns_transaction_t    addrs_transaction_id;
    getdns_dict            *tlsas_response;
    getdns_transaction_t    tlsas_transaction_id;
};
int main()
{
    getdns_return_t r;
    getdns_context *ctxt = NULL;
    uv_loop_t loop;
    getdns_dict *ext;
    struct dane_query_st state = { NULL, 0, NULL, 0 };
-------------------------------------------//-----------------------

    else if ((r = getdns_context_set_resolution_type(
                      ctxt, GETDNS_RESOLUTION_STUB)))
        fprintf( stderr, "Could not set stub resolution modus: %s\n"
               , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_address( ctxt, "getdnsapi.net.", NULL
                                 , &state
                                 , &state.addrs_transaction_id
                                 , addresses_callback)))
        fprintf( stderr, "Unable to schedule an address lookup: %s\n"
               , getdns_get_errorstr_by_id(r));
```

void * userarg

Hands on getdns C API – How to do a simple query multiple queries

```
else if (!(ext = getdns_dict_create())) {
    fprintf( stderr, "Could not allocate extensions dict\n");
    r = GETDNS_RETURN_MEMORY_ERROR;
}
else if ((r = getdns_dict_set_int(ext, "dnssec_return_only_secure"
                                 , GETDNS_EXTENSION_TRUE))
      ||  (r = getdns_dict_set_int(ext, "dnssec_roadblock_avoidance"
                                 , GETDNS_EXTENSION_TRUE)))
    fprintf( stderr, "Could not populate extensions dict: %s\n"
           , getdns_get_errorstr_by_id(r));

else if ((r = getdns_general( ctxt, "_443._tcp.getdnsapi.net."
                            , GETDNS_RRTYPE_TLSA, ext
                            , &state
                            , &state.tlsas_transaction_id
                            , tlsas_callback)))
    fprintf( stderr, "Unable to schedule a TLSA lookup: %s\n"
           , getdns_get_errorstr_by_id(r));
else
    uv_run(&loop, UV_RUN_DEFAULT);
```

void *
userarg

- Create & populate extensions the API way

Hands on getdns C API – How to do a simple query multiple queries

```
    else if ((r = getdns_str2dict(
                "{ dnssec_return_only_secure : GETDNS_EXTENSION_TRUE "
                ", dnssec_roadblock_avoidance: GETDNS_EXTENSION_TRUE }", &ext)))

        fprintf( stderr, "Could not create/populate extensions dict: %s\n"
               , getdns_get_errorstr_by_id(r));

    else if ((r = getdns_general( ctxt, "_443._tcp.getdnsapi.net."
                                , GETDNS_RRTYPE_TLSA, ext
                                , &state
                                , &state.tlsas_transaction_id
                                , tlsas_callback)))
        fprintf( stderr, "Unable to schedule a TLSA lookup: %s\n"
               , getdns_get_errorstr_by_id(r));
    else
        uv_run(&loop, UV_RUN_DEFAULT);
```

void * userarg

- Create & populate extensions the unofficial non-API way

Hands on getdns C API – How to do ~~a simple query~~ multiple queries

```
void addresses_callback(getdns_context *ctxt, getdns_callback_type_t cb_type,
    getdns_dict *resp, void *userarg, getdns_transaction_t trans_id)
{
    struct dane_query_st *state = (struct dane_query_st *)userarg;

    if (cb_type != GETDNS_CALLBACK_COMPLETE) {
        /* Something went wrong,
         * Cancel the TLSA query if it hasn't finished yet.
         * Then abort the connection.
         */
        if (! state->tlsas_response)
            (void) getdns_cancel_callback(
                ctxt, state->tlsas_transaction_id);

        abort_connection(state);
        return;
    }
    state->addrs_response = resp;
    if (state->tlsas_response)
        setup_connection(state);
    else
        ; /* Wait for TLSA lookup to complete */
}
```

Hands on getdns C API – How to do a simple query multiple queries

```
void tlsas_callback(getdns_context *ctxt, getdns_callback_type_t cb_type,
    getdns_dict *resp, void *userarg, getdns_transaction_t trans_id)
{
    struct dane_query_st *state = (struct dane_query_st *)userarg;

    if (cb_type != GETDNS_CALLBACK_COMPLETE) {
        /* Something went wrong,
         * Cancel the TLSA query if it hasn't finished yet.
         * Then abort the connection.
         */
        if (! state->addrs_response)
            (void) getdns_cancel_callback(
                ctxt, state->addrs_transaction_id);

        abort_connection(state);
        return;
    }
    state->tlsas_response = resp;
    if (state->addrs_response)
        setup_connection(state);
    else
        ; /* Wait for address lookup to complete */
}
```

Hands on getdns C API – How to do a simple query multiple queries

```c
void abort_connection(struct dane_query_st *state)
{
    getdns_dict_destroy(state->addrs_response);
    getdns_dict_destroy(state->tlsas_response);
    fprintf(stderr, "DNS failure\n");
}

void setup_connection(struct dane_query_st *state)
{
    uint32_t status;

    if (getdns_dict_get_int(state->tlsas_response, "status", &status)
    ||  status == GETDNS_RESPSTATUS_ALL_BOGUS_ANSWERS) {

        abort_connection(state);
        return;
    }
    printf("DNS lookups were successful!\n");

    /* Schedule opening the TLS connection to the addresses (if any)
     * and verification with the received TLSAs (if any)
     * i.e. uv_tcp_connect(connect, socket, dest, callback);
     */
}
```