DNSSEC for legacy applications

`libnss_getdns`, a getdns nsswitch module

*as an alternative for the system **stub***

Willem Toorop

19 November 2015

DNS-WG @ RIPE71

NLnet Labs

Genesis getdns API is

Unbound security

- A *DNS API* specification (for resolving)
  by and for application developers (for application)
- First implementation by VERISIGN™LABS and NLnet Labs

From Verisign:

Theogene Bucuti, Craig Despeaux,
Angelique Finan, Neel Goyal,
Scott Hollenbeck, Shumon Huque,
Sanjay Mahurpawar, Allison Mankin,
Sai Mogali, Prithvi Ranganath,
Rushi Shah, Vinay Soni, Bob Steagall,
Gowri Visweswaran, Glen Wiley

From NLnet Labs:

Olaf Kolkman, Benno Overeinder,
Willem Toorop, Wouter Wijngaards

From Sinodun:

Sara and John Dickinson

From No Mountain Software:

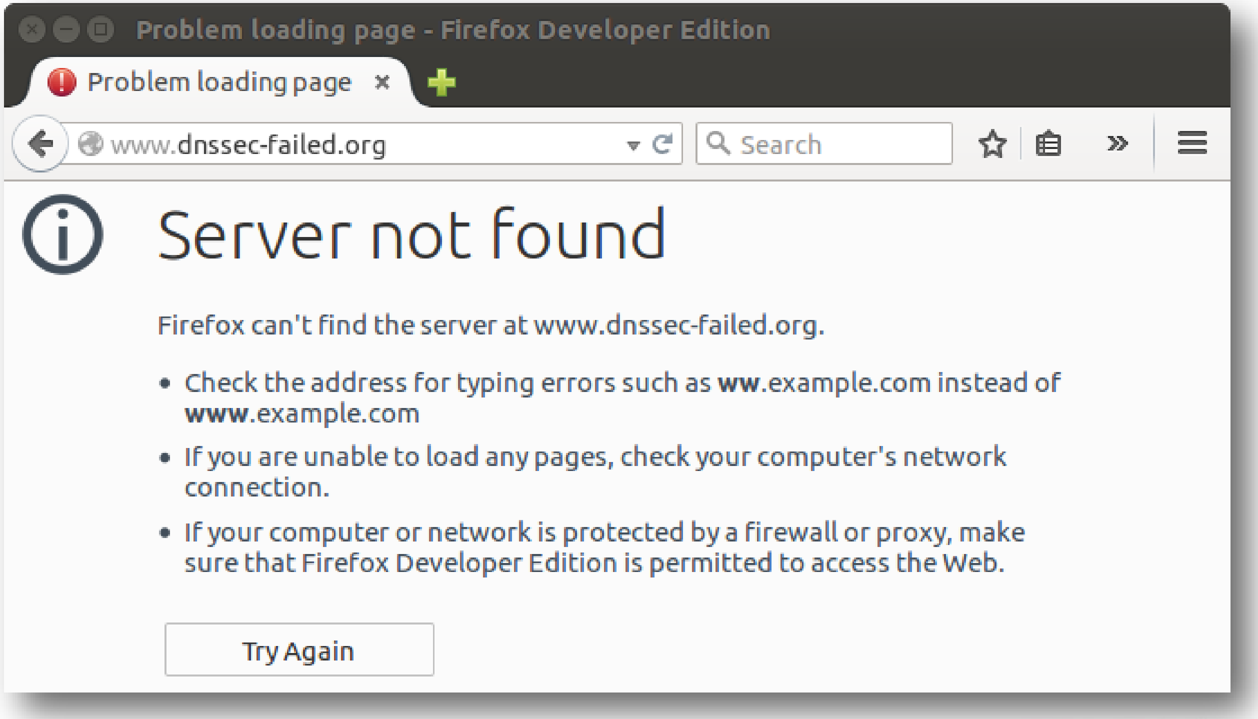
Melinda Shore

Genesis

- Give *applications* a better handle on DNS, ie:
  - Asynchronous
  - Get resource records other then `A` and `AAAA`
  - Get DNSSEC status for DANE

Genesis

- Give *applications* a better handle on DNS, ie:
  - Asynchronous
  - Get resource records other then `A` and `AAAA`
  - Get DNSSEC status for DANE, *but also signalling!*



Server not found

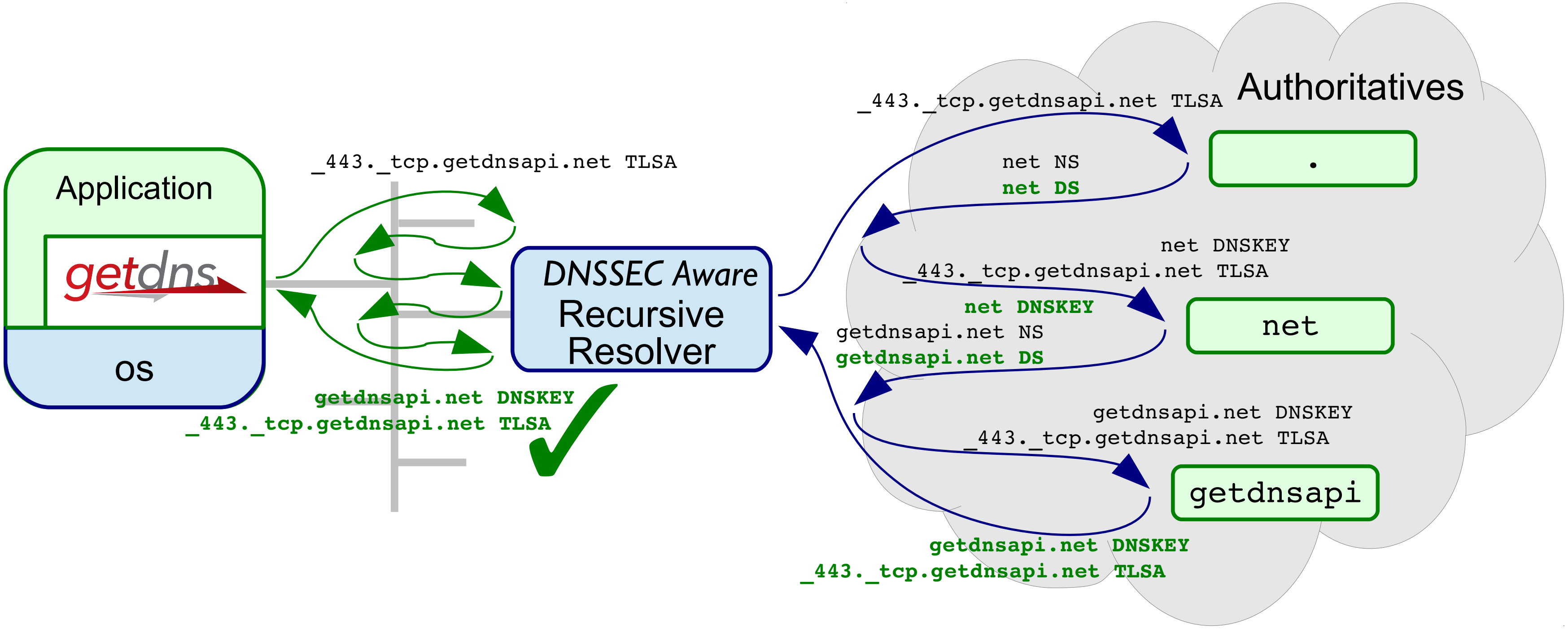
Firefox can't find the server at www.dnssec-failed.org.

- 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.

Genesis

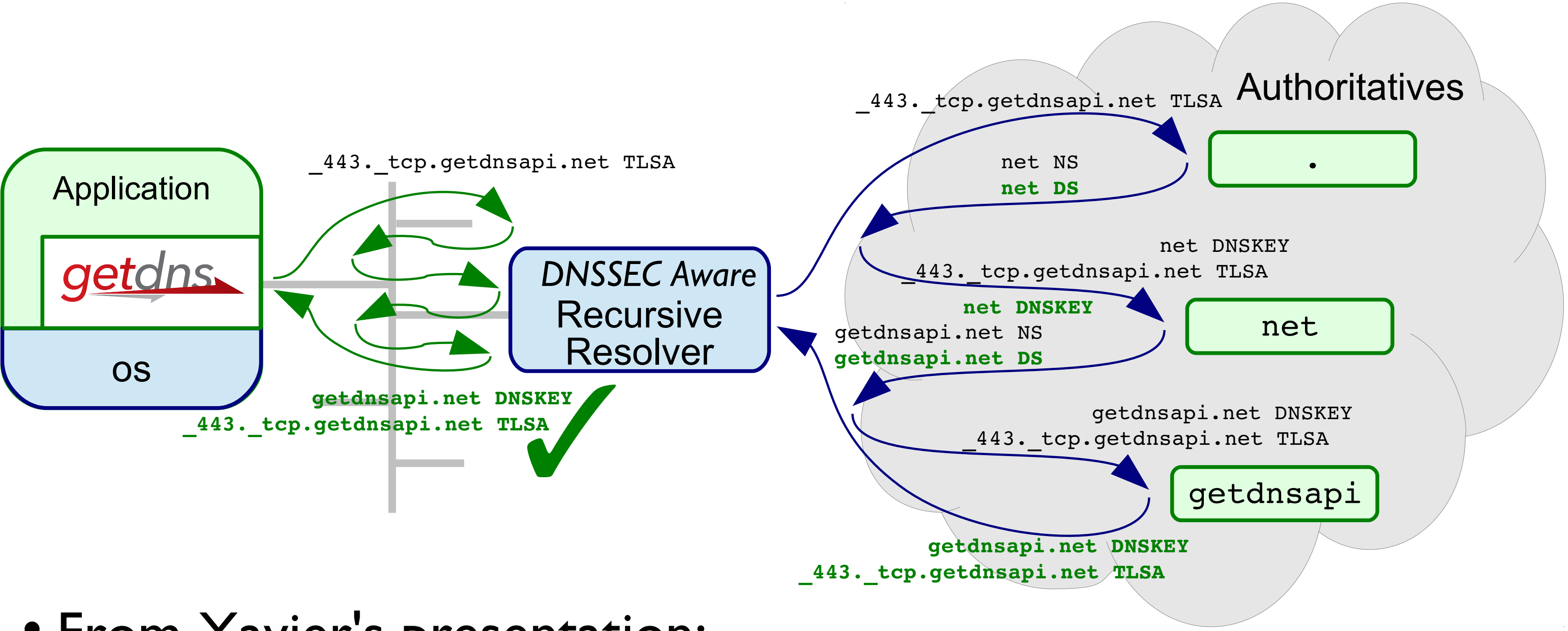
- Give *applications* a better handle on DNS, ie:
  - Asynchronous
  - Get resource records other then `A` and `AAAA`
  - Get DNSSEC status for DANE, *but also signalling!*

- Many *features* don't need *application interface*
  - TCP Pipelining, Keep connections open, TCP Fast Open
  - DNS over TLS


Application
getdns
OS
_443._tcp.getdnsapi.net TLSA
DNSSEC Aware Recursive Resolver
getdnsapi.net DNSKEY
_443._tcp.getdnsapi.net TLSA
✓
Authoritatives
_443._tcp.getdnsapi.net TLSA
.
net NS
net DS
net DNSKEY
_443._tcp.getdnsapi.net TLSA
net DNSKEY
net
getdnsapi.net NS
getdnsapi.net DS
getdnsapi.net DNSKEY
_443._tcp.getdnsapi.net TLSA
getdnsapi
getdnsapi.net DNSKEY
_443._tcp.getdnsapi.net TLSA

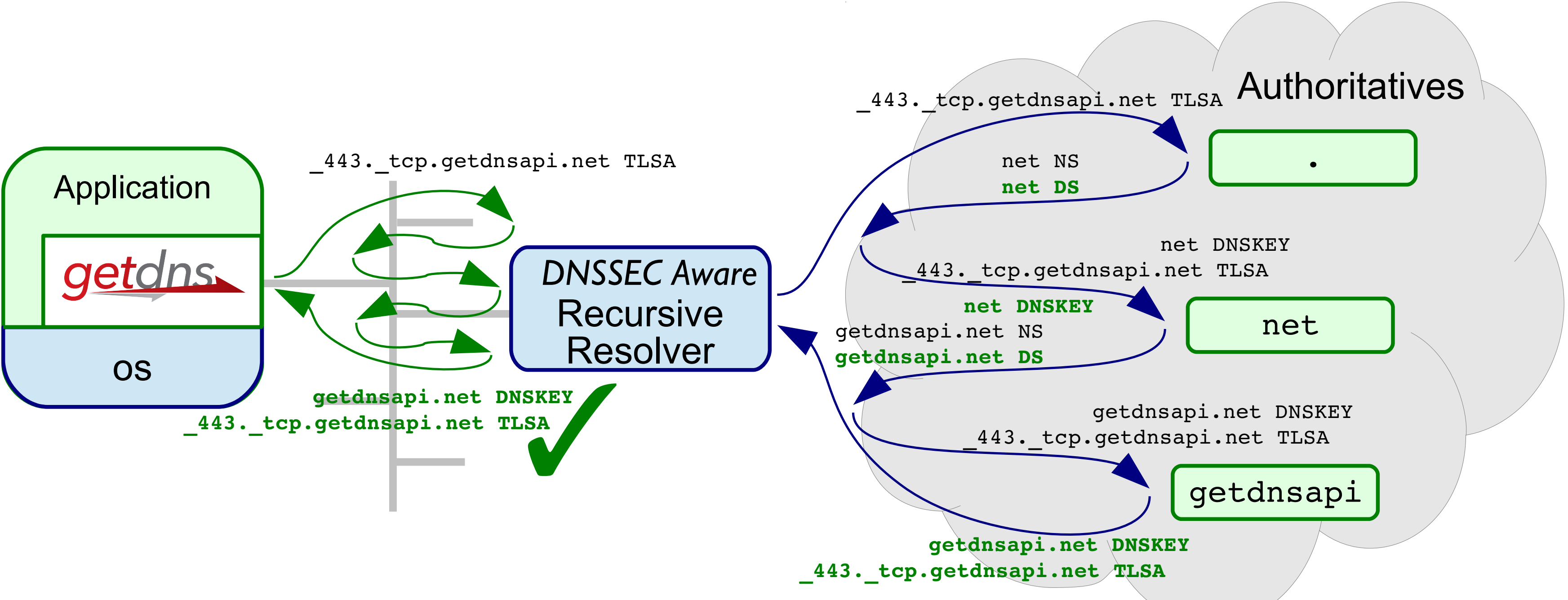
- Many *features* don't need *application interface*
  - TCP Pipelining, Keep connections open, TCP Fast Open
  - DNS over TLS
  - DNSSEC iteration as STUB

– Since version 0.5.1, Roadblock Avoidance



- From Xavier's presentation:
  - 64% provide DNSSEC for existing things
  - 56% provide DNSSEC proof for Denial of Existance
  - 40% provide DNSSEC for wildcards

– Since version 0.5.1, Roadblock Avoidance



Application

getdns

OS

_443._tcp.getdnsapi.net TLSA

DNSSEC Aware Recursive Resolver

getdnsapi.net DNSKEY
_443._tcp.getdnsapi.net TLSA

✓

Authoritatives

_443._tcp.getdnsapi.net TLSA

.

net NS
net DS

net DNSKEY
_443._tcp.getdnsapi.net TLSA

net

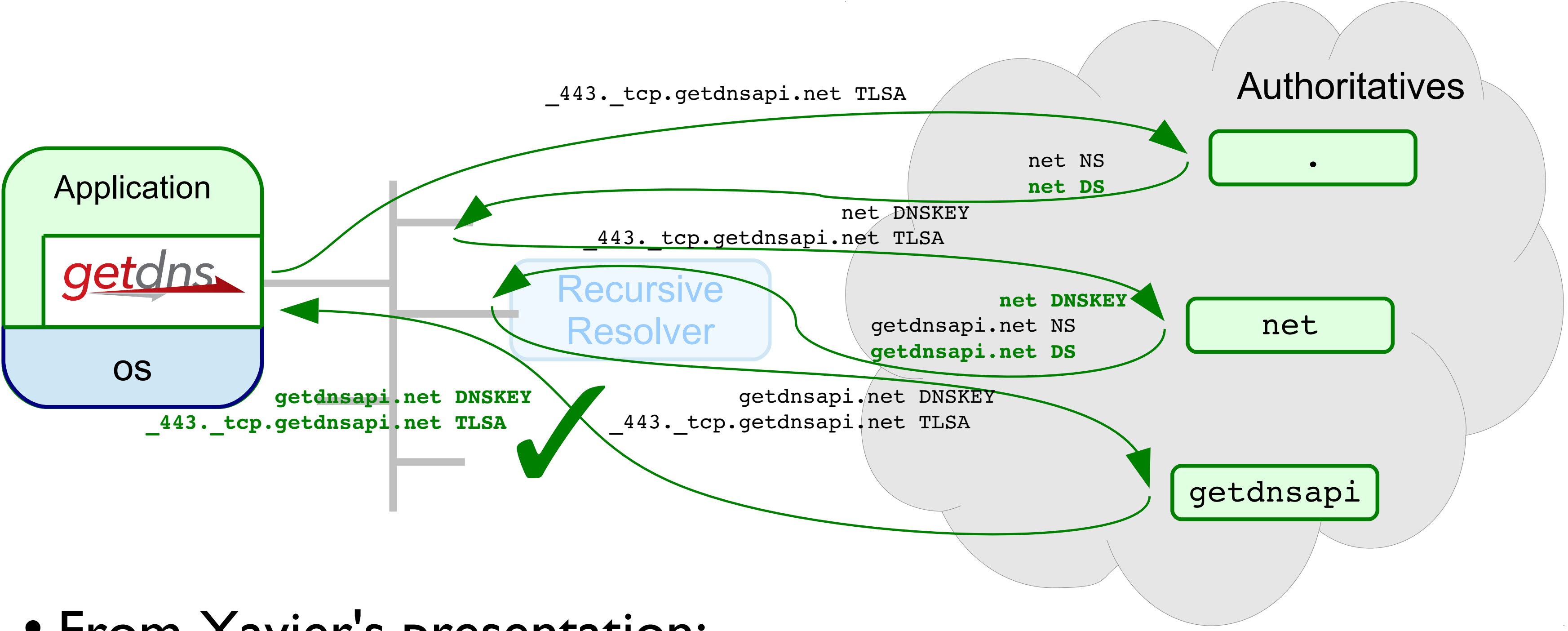
net DNSKEY
getdnsapi.net NS
getdnsapi.net DS

getdnsapi.net DNSKEY
_443._tcp.getdnsapi.net TLSA

getdnsapi

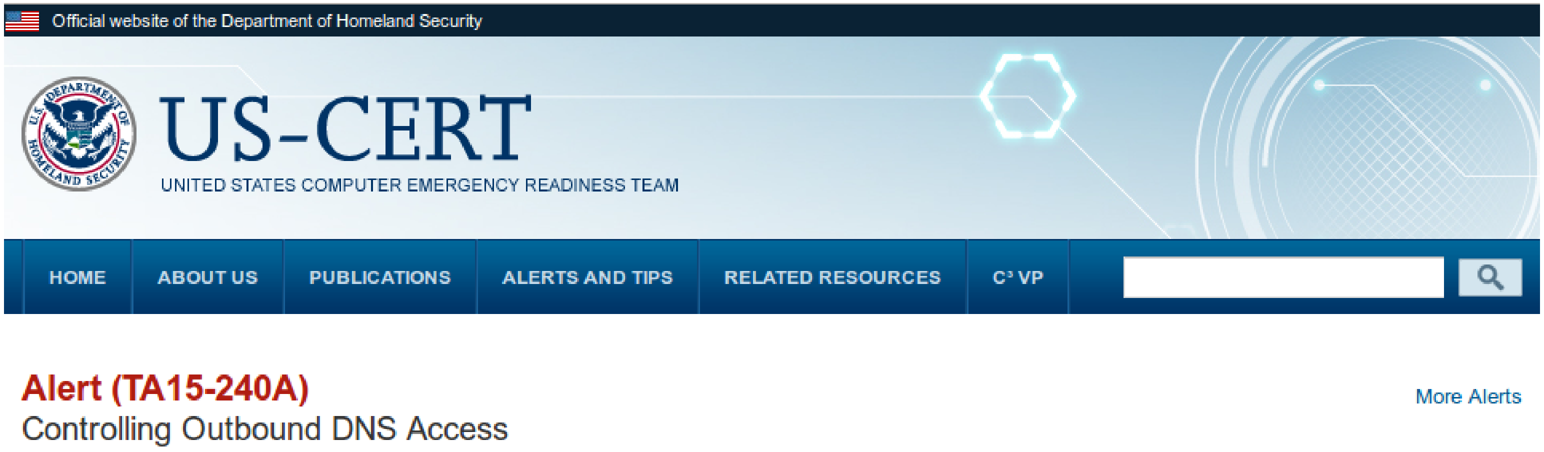
getdnsapi.net DNSKEY
_443._tcp.getdnsapi.net TLSA

- From Xavier's presentation:
  - 64% provide DNSSEC for existing things
  - 56% provide DNSSEC proof for Denial of Existance
  - 40% provide DNSSEC for wildcards
- `draft-ietf-dnsop-dnssec-roadblock-avoidance`
- Minimal passive implementation: *on BOGUS, retry with full recursion*
  - Since version 0.5.1, Roadblock Avoidance



- From Xavier's presentation:
  - 64% provide DNSSEC for existing things
  - 56% provide DNSSEC proof for Denial of Existance
  - 40% provide DNSSEC for wildcards
- `draft-ietf-dnsop-dnssec-roadblock-avoidance`
- Minimal passive implementation: *on BOGUS, retry with full recursion*
  - Since version 0.5.1, Roadblock Avoidance

- https://www.us-cert.gov/ncas/alerts/TA15-240A


Official website of the Department of Homeland Security

US-CERT

UNITED STATES COMPUTER EMERGENCY READINESS TEAM

Alert (TA15-240A)

Controlling Outbound DNS Access

More Alerts

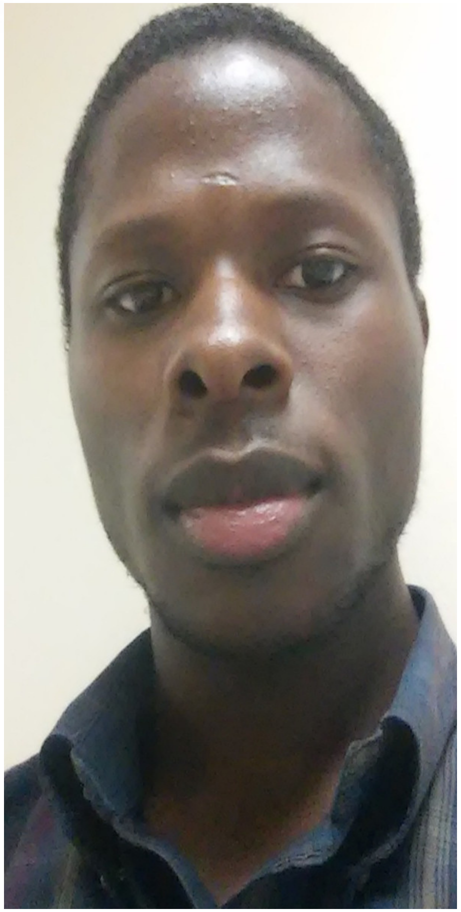
Configure enterprise perimeter network devices to block all outbound User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) traffic to destination port 53, except from specific, authorized DNS servers (including both authoritative and caching/forwarding name servers).

- `draft-ietf-dnsop-dnssec-roadblock-avoidance`
- Minimal passive implementation: *on BOGUS, retry with full recursion*
  - Since version 0.5.1, Roadblock Avoidance

Genesis

- Many *features* don't need *application interface*
- Linux and Unix systems provide a default DNS resolver library
  - Applications perform name resolution via `getaddrinfo()`, `getnameinfo()`, etc.
- Current library implementations do not support DNSSEC nor other modern DNS capabilities

Enhanced system wide lookup using getdns



A summer student project

executed at VERISIGN™ LABS, by

Theogene H. Bucuti, *University of North Texas*

Supervised by: Gowri Visweswaran
and Allison Mankin

Explore the ways to provide an alternative for the system's stub resolver, adding modern DNS capabilities such as security and privacy, and compare the usability, possibilities and impossibilities of the different options.

Enhanced system wide lookup using getdns

- **libnss_getdns**
  - *Open Source module that provides DNSSEC validation for legacy systems through the Linux/Unix name resolution framework (nsswitch) using the getdns library*

- `https://github.com/getdnsapi/libnss_getdns`
- Works for: Firefox, Opera, Links2, Epiphany, lynx, curl, wget, ssh, ping, telnet, etc.
- Does not work for Google Chrome & Chromium
- Also `LD_PRELOAD` based version. Not recommended

libnss_getdns Configuration

- In /etc/nsswitch.conf replace dns with getdns

```
# /etc/nsswitch.conf
#
# Example configuration of GNU Name Service Switch functionality.

hosts:          files mdns4_minimal [NOTFOUND=return] getdns mdns4
networks:       files
```

`libnss_getdns` Configuration

- In `/etc/nsswitch.conf` replace `dns` with `getdns`

```
# /etc/nsswitch.conf
#
# Example configuration of GNU Name Service Switch functionality.

hosts:          files mdns4_minimal [NOTFOUND=return] getdns mdns4
networks:       files
```

- **Issue**: Many of the modern DNS capabilities have *state*:
  - State full transports (TCP & TLS)
  - The cache with full recursion
  - Upstream capability tagging etc.

all contained in a `getdns_context`

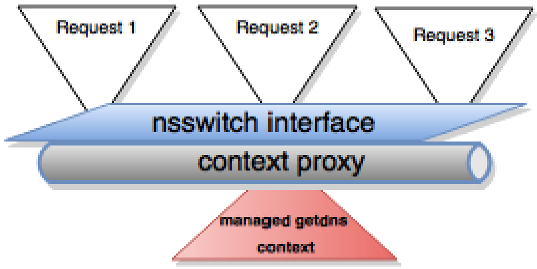
libnss_getdns Configuration

- In /etc/nsswitch.conf replace dns with getdns

```
# /etc/nsswitch.conf
#
# Example configuration of GNU Name Service Switch functionality.

hosts:          files mdns4_minimal [NOTFOUND=return] getdns mdns4
networks:       files
```

- **Issue**: Many of the modern DNS capabilities have *state* all contained in a getdns_context
- $ ./getdns_daemon



requests channelled to a context manager through a proxy

libnss_getdns Configuration

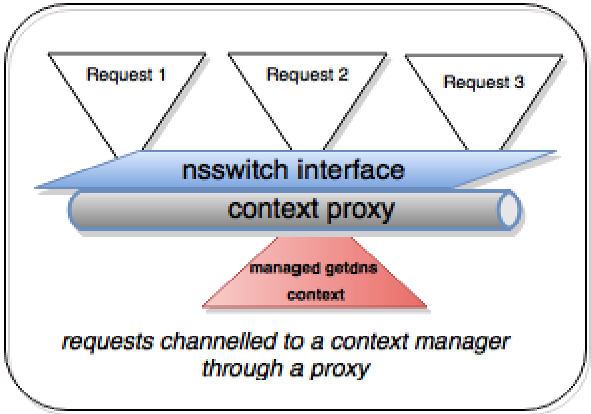
- In `/etc/nsswitch.conf` replace `dns` with `getdns`

```
# /etc/nsswitch.conf
#
# Example configuration of GNU Name Service Switch functionality.

hosts:          files mdns4_minimal [NOTFOUND=return] getdns mdns4
networks:       files
```

- **Issue**: Many of the modern DNS capabilities have *state* all contained in a `getdns_context`
- `$ ./getdns_daemon`

-
  ```
  configure --disable-daemon-only-mode
  configure --without-context-proxy
  configure --with-context-proxy=dbus
  ```
  Not recommended



requests channelled to a context manager through a proxy

libnss_getdns Configuration

- User level config:

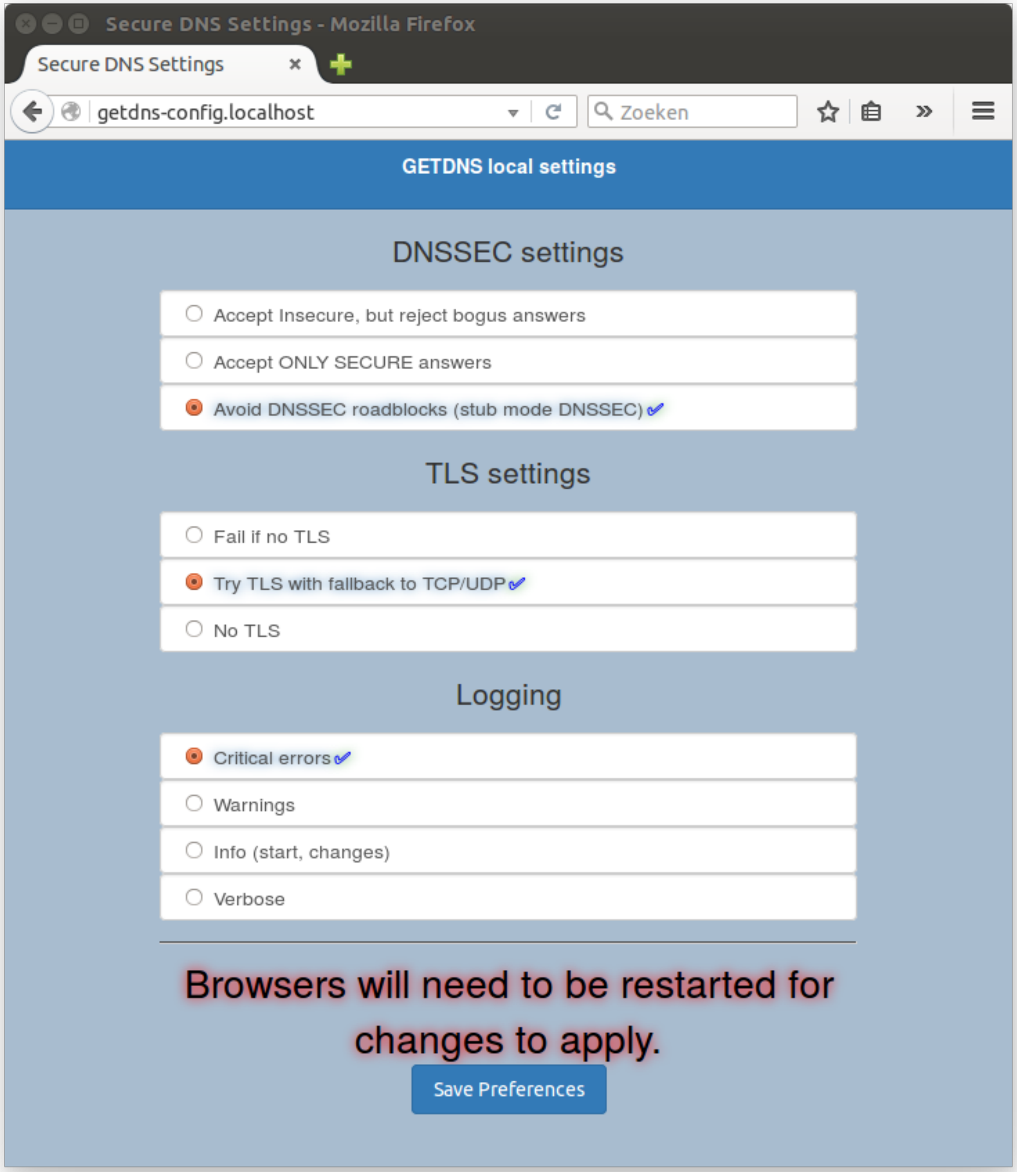
`~/.getdns/preferences.conf`

- Global level config:

`/etc/getdns.conf`

```
# /etc/getdns.conf

dnssec: roadblock_avoidance
tls: prefer_tls
logging: critical
```



GETDNS local settings

DNSSEC settings

○ Accept Insecure, but reject bogus answers
○ Accept ONLY SECURE answers
● Avoid DNSSEC roadblocks (stub mode DNSSEC) ✓

TLS settings

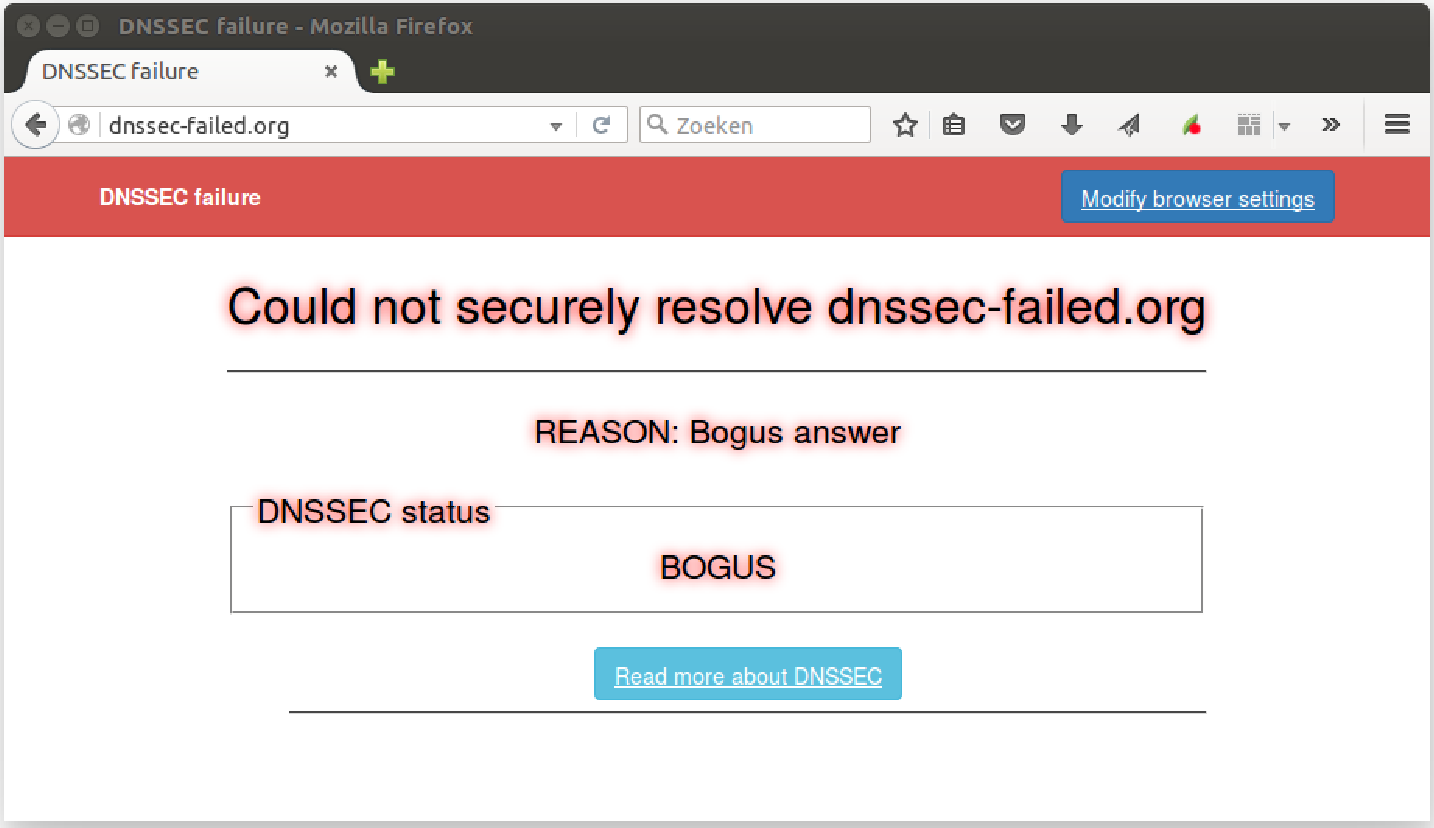
○ Fail if no TLS
● Try TLS with fallback to TCP/UDP ✓
○ No TLS

Logging

● Critical errors ✓
○ Warnings
○ Info (start, changes)
○ Verbose

Browsers will need to be restarted for changes to apply.

libnss_getdns
In path signalling



DNSSEC failure

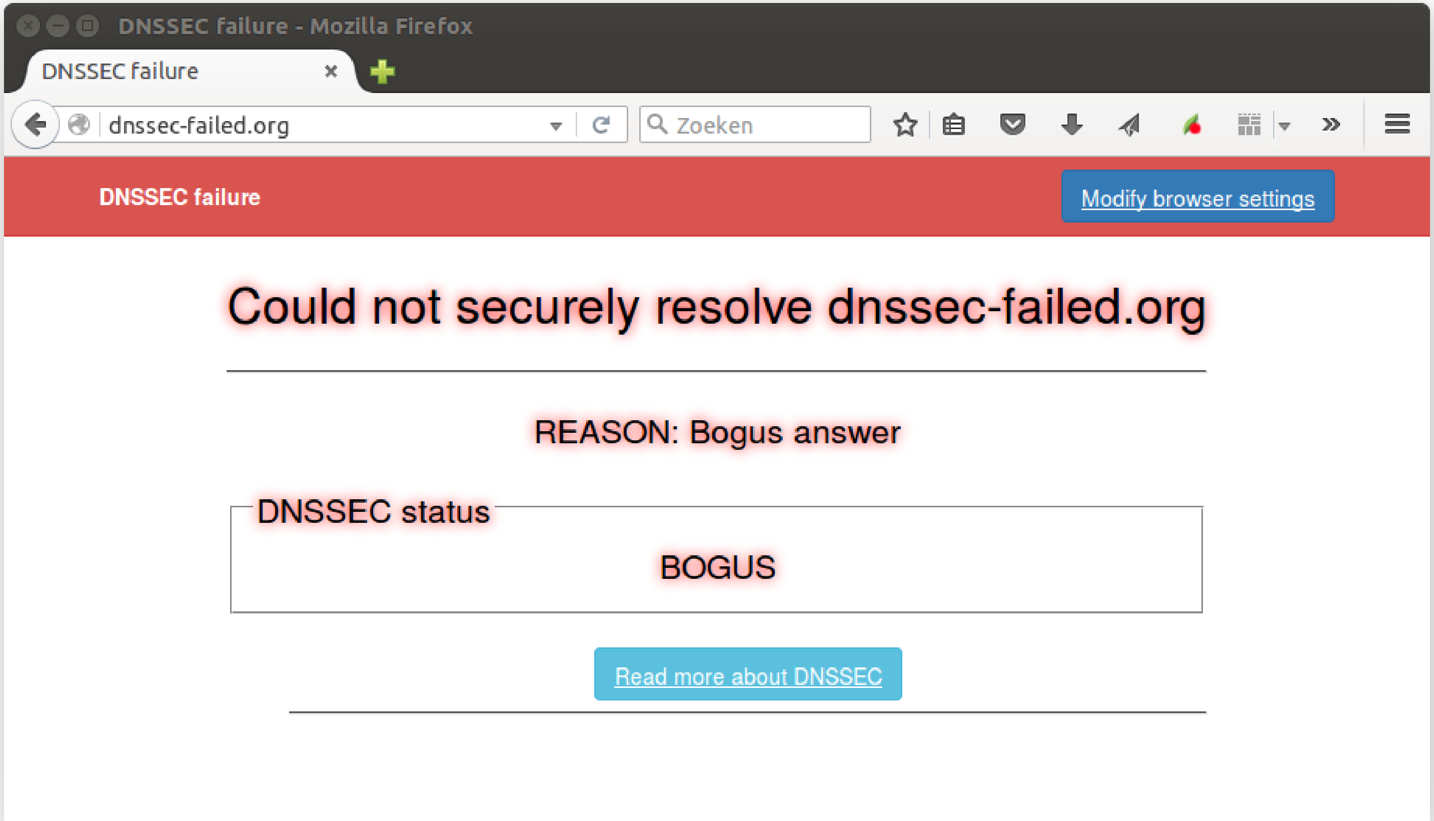
Could not securely resolve dnssec-failed.org

REASON: Bogus answer

DNSSEC status

BOGUS

libnss_getdns
In path signalling



Could not securely resolve dnssec-failed.org

REASON: Bogus answer

DNSSEC status

BOGUS

- Better approach: Desktop notifications
- Offer to add negative trust anchor

Summary

- *DNSSEC-capable* alternative to the system's stub resolver
- *Seamlessly* enforce *secure* and *private* name resolution
- Avoid *DNSSEC roadblocks*
- *Customisable* at system and user level
- *DNSSEC failure signalling* (http only)

Warning!

An exploring study. Code is a collection of many different try outs. Use for experimentation only. Do **not** use in production!

roadblock_avoidance extension needs much more work too

github repo https://github.com/getdnsapi/libnss_getdns

me Willem Toorop <willem@nlnetlabs.nl>