DNSSEC:
Rollin', Rollin', Rollin'

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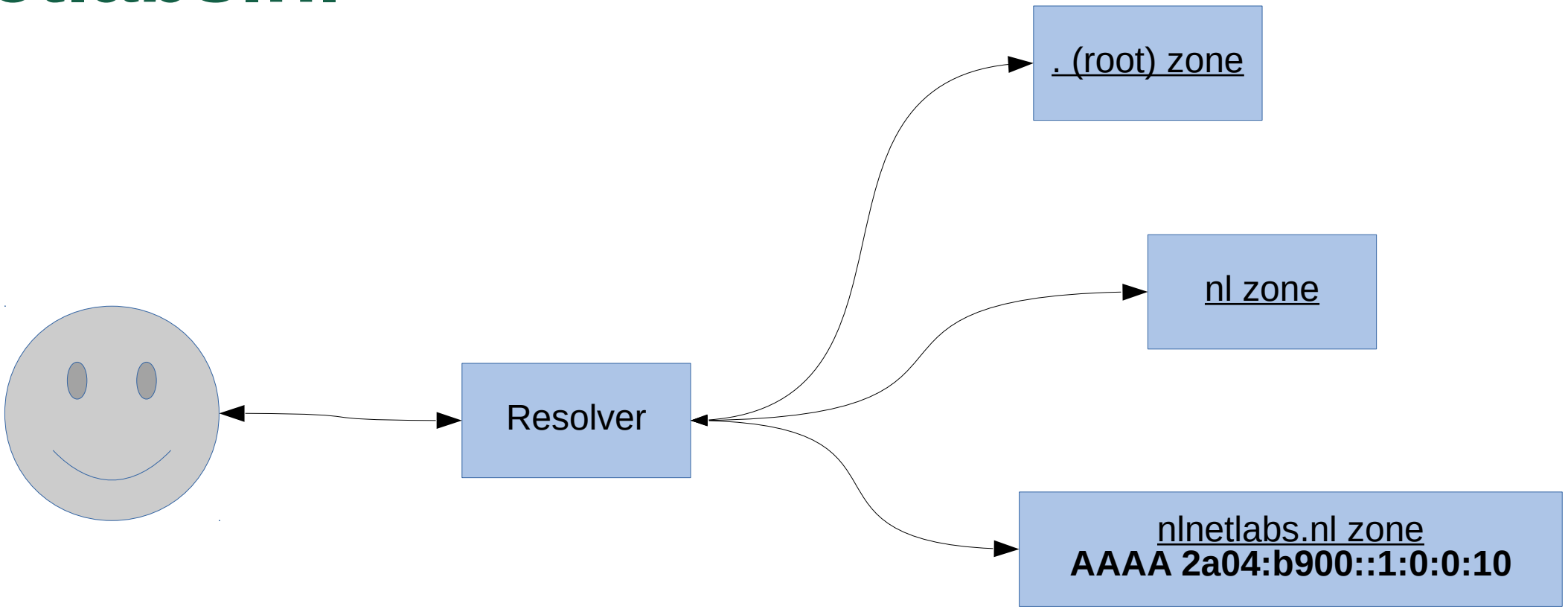
DNS – resolving IPv6 address for nlnetlabs.nl



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Answer with DNSSEC signature

;; QUESTION SECTION:

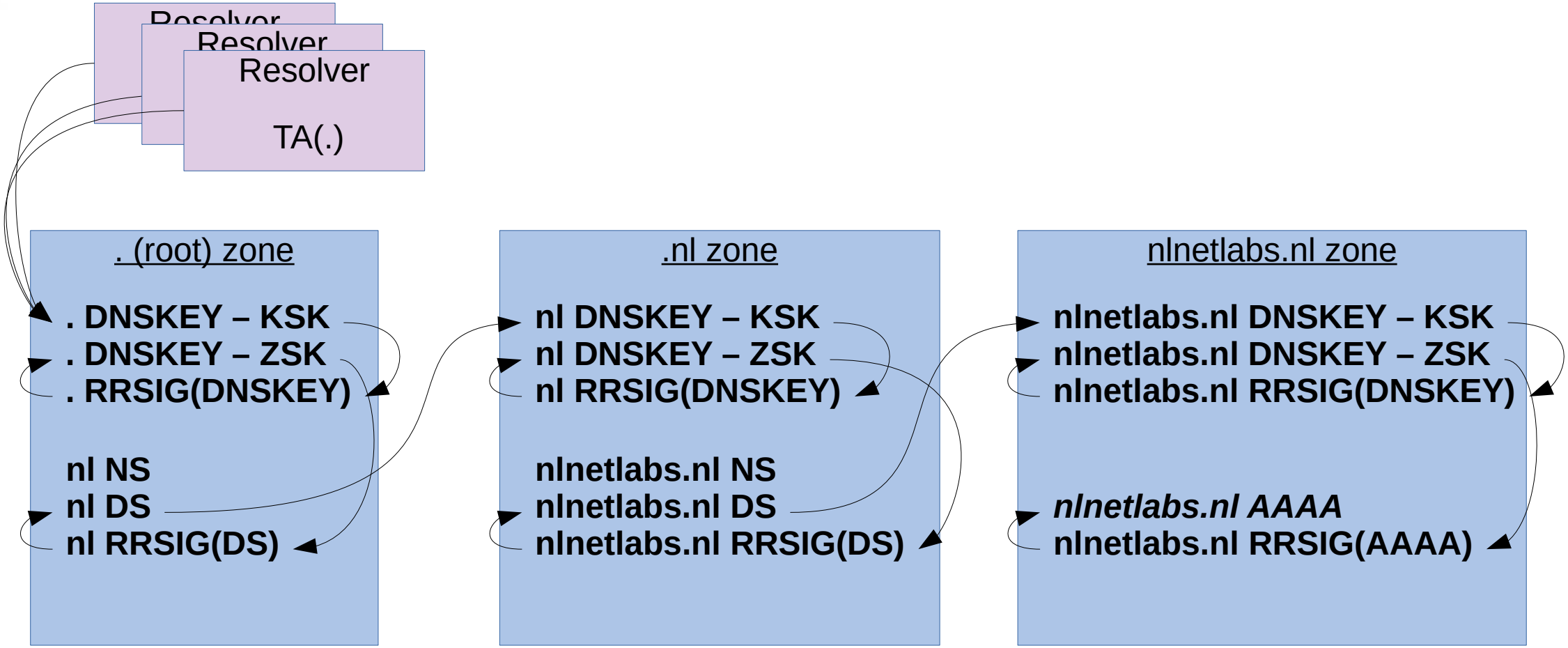
;nlnetlabs.nl. IN AAAA

;; ANSWER SECTION:

nlnetlabs.nl. 10200 IN **AAAA** 2a04:b900::1:0:0:10

nlnetlabs.nl. 10200 IN **RRSIG** **AAAA** 8 2 10200 20180529005003 20180501005003 42393 nlnetlabs.nl. HcAuIC0d5eCYZYwsoEDymzQOBRR5SmhJUZwv6n[...]

DNSSEC authentication chain



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Root KSK roll

- Original timeline:
  - 26th October 2016 – new key created
    - Keytag 20326
  - 11th July 2017 – new key published in root zone
    - Start in-band update mechanism
  - 11th October 2017 – use new key to sign root DNSKEY rrset
    - Validation will fail for users that only have KSK2010 as TA

Root KSK roll

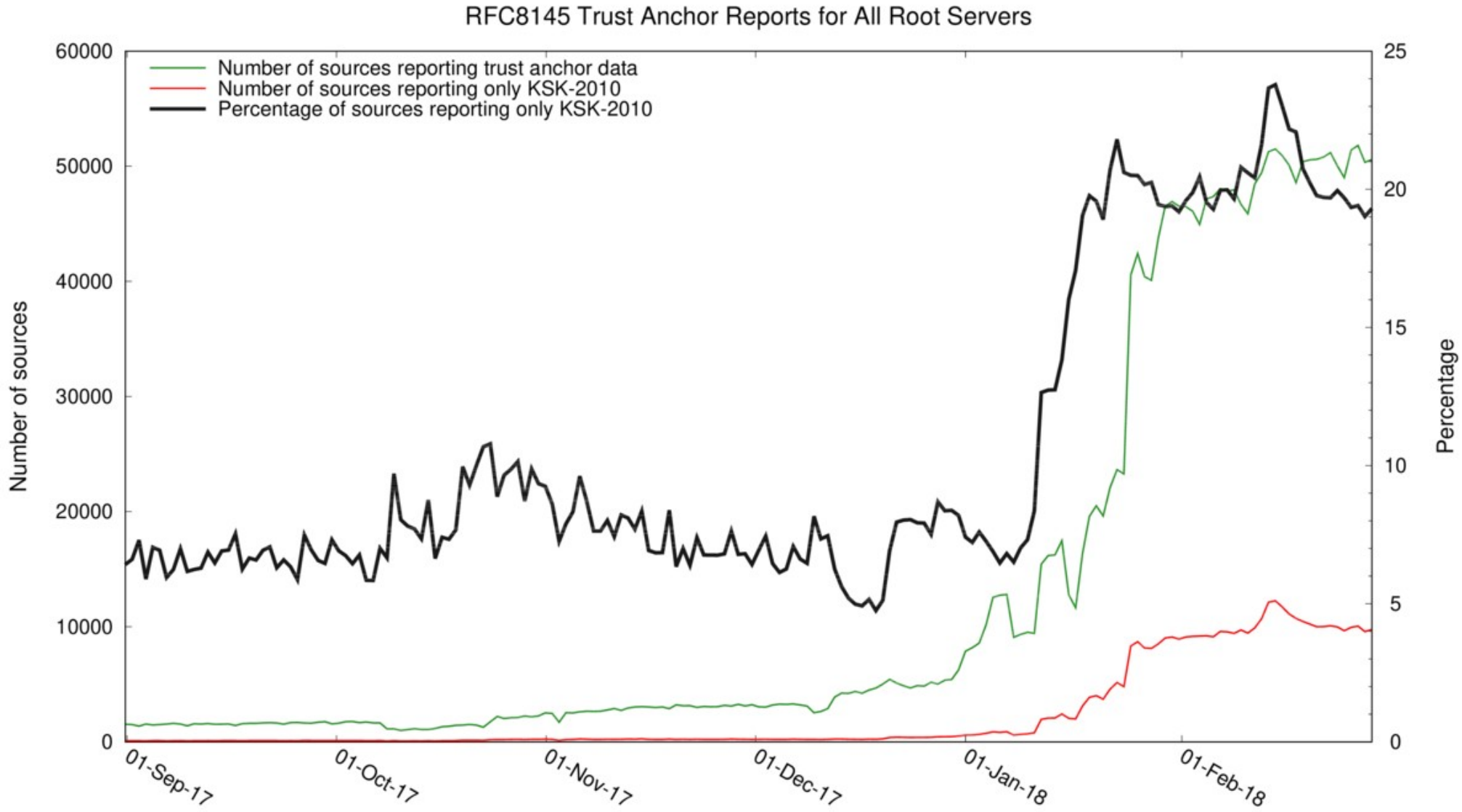
- O

. 172800 IN DNSKEY 257 3 8 (
AwEAAaz/tAm8yTn4Mfeh5eyI96WSVexTBAvkMgJzkKTO
iW1vkIbzxeF3+/4RgWOq7HrxRixHlFlExOLAJr5emLvN
7SWXgnLh4+B5xQlNVz8Og8kvArMtNROxVQuCaSnIDdD5
LKyWbRd2n9WGe2R8PzgCmr3EgVLrjyBxWezF0jLHwVN8
efS3rCj/EWgvIWgb9tarpVUDK/b58Da+sqqls3eNbuv7
pr+eoZG+SrDK6nWeL3c6H5Apxz7LjVc1uTIdsIXxuOLY
A4/ilBmSVIzuDWfdRUfhHdY6+cn8HFRm+2hM8AnXGXws
9555KrUB5qihylGa8subX2Nn6UwNR1AkUTV74bU=
) ; KSK; alg = RSASHA256; key id = **20326**

Updating DNSSEC Trust Anchors

- Manually
- Outside DNS protocol (e.g. software update)
- In DNS protocol → RFC5011 (“Automated Updates of DNS Security (DNSSEC) Trust Anchors”)
  - Using trust in existing TA to start trusting another key
  - New root TA in resolvers on 11th August 2017

http://root-trust-anchor-reports.research.icann.org/rfc8145-by-day-all.png



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Root key sentinel (draft-ietf-dnsop-kskroll-sentinel)

- User impact on root key roll
  - root-key-sentinel-is-ta-20326
  - root-key-sentinel-not-ta-20326
  - Some bogus domain
- In Unbound, BIND and Knot resolver
- No results available yet

RFC 5011 in Open Source Resolvers

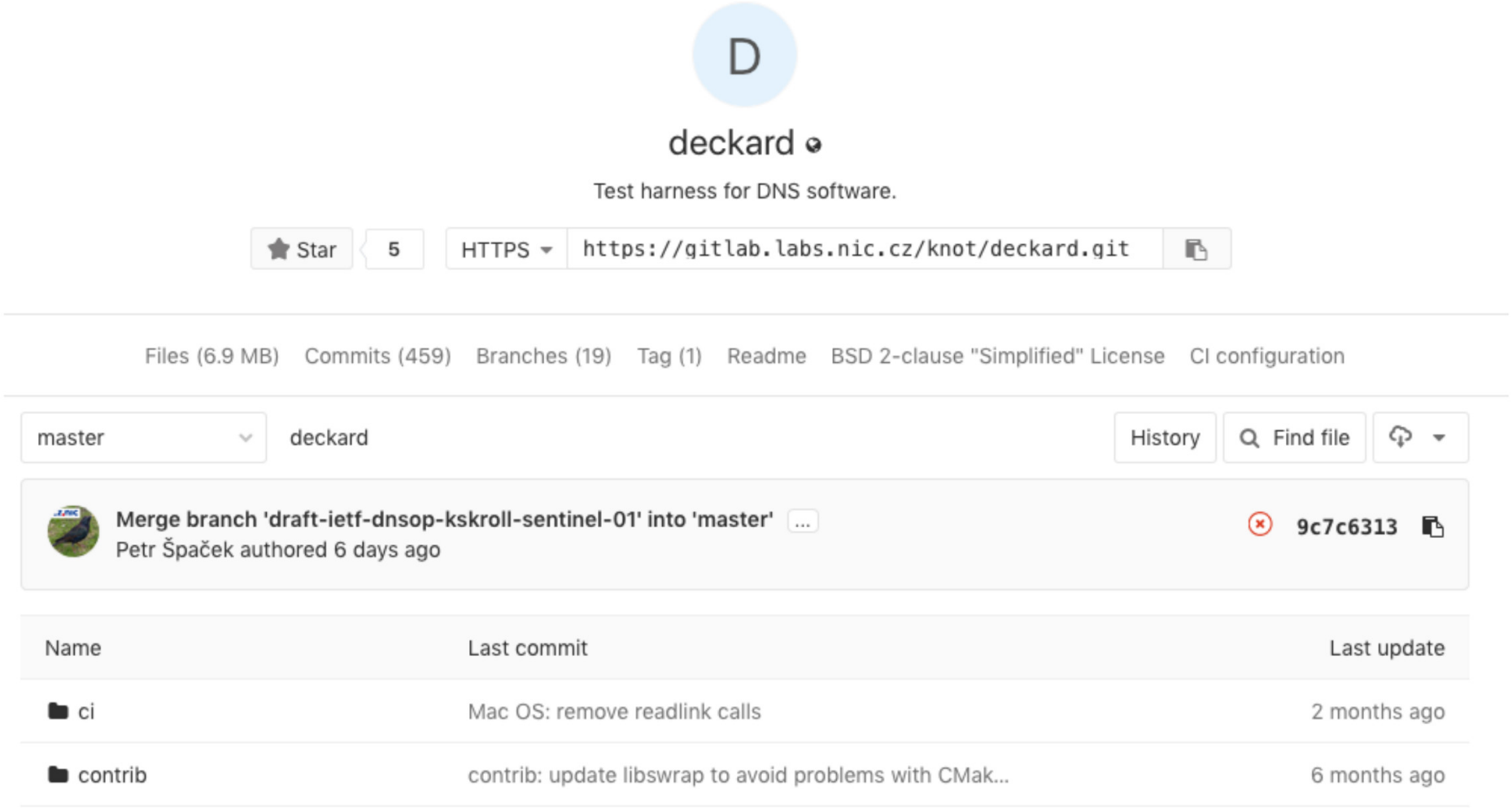
Yes

- Unbound
- Bind
- Knot Resolver

No

- PowerDNS Recursor
- Dnsmasq
- systemd-resolved

RFC 5011 Compliance Test



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Test Scenarios

- Happy Path
- Un-publish before signing
- Roll-back after signing
- Revocation of old key
- Early re-introduction of old key
- Un-revoked old key
- Late re-introduction of old key
- Missing new key
- Non-writeable state directory
- Resolver restarts
- Restarts with non-writable state directory
- Late installation with old key only
- Late installation with both keys
- Post-roll installation with old key only
- Post-roll installation with new key only
- Happy path with forwarding to a non-validating resolver
- Happy path while forwarding to a non-DNSSEC resolver

Unbound

Versions

First production release	1.0.0	2008-05-20
RFC 5011 since	1.4.0	2009-11-26
Latest release	1.7.1	2018-05-03
Current Debian stable	1.6.0	2016-12-15

Unbound

Findings

Late Installation

- Only trusts the new trust anchor after the 30 days' hold down.
- Even if the new trust anchor is provided on installation.
- Fixed in 1.6.5 (2017-08-21).

Re-introduction of Old Key

- accepts the old key after remove and add hold-downs.

Unbound

Operational

RFC 5011 needs to be explicitly enabled

- *trust-anchor-file* v. *auto-trust-anchor-file*

Non-writable state directory

- initially: logs error and carries on until next restart
- 1.5.4 (2015-07-09): logs error and stops

Unbound

Do I have the new KSK?

auto-trust-anchor-file

```
# cat /var/lib/unbound/root.key
; autotrust trust anchor file
;;id: . 1
;;last_queried: 1525860779 ;;Wed May  9 12:12:59 2018
;;last_success: 1525860779 ;;Wed May  9 12:12:59 2018
;;next_probe_time: 1525901662 ;;Wed May  9 23:34:22 2018
;;query_failed: 0
;;query_interval: 43200
;;retry_time: 8640
.    172800   IN   DNSKEY   257 3 8
AwEAAaz/tAm8yTn4Mfeh5eyI96WSVexTBAvkMgJzkKTOiW1vkIbzxeF3+/4RgWOq7HrxRixHlFlExOLAJr[illegible]mLvN7SWXgnLh4+B5xQ
lNVz8Og8kvArMtNROxVQuCaSnIDdD5LKyWbRd2n9WGe2R8PzgCmr3EgVLrjyBxWezF0jLHwVN8efS3rCj/Ew[illegible]vIWgb9tarpVUDK/
b58Da+sqqls3eNbuv7pr+eoZG+SrDK6nWeL3c6H5Apxz7LjVc1uTIdsIXxuOLYA4/
ilBmSVIzuDWfdRUfhHdY6+cn8HFRm+2hM8AnXGXws9555KrUB5qihylGa8subX2Nn6UwNR1AkUTV74bU= ;{id = 20326 (ksk),
size = 2048b} ;;state=2 [  VALID  ] ;;count=0 ;;lastchange=1525860756 ;;Wed May  9 12:12:36 2018
.    172800   IN   DNSKEY   257 3 8
AwEAAagAIKlVZrpC6Ia7gEzahOR+9W29euxhJhVVLOyQbSEW0O8gcCjFFVQUTf6v58fLjwBd0YI0EzrAcQqBGCzh/
RStIoO8g0NfnfL2MTJRkxoXbfDaUeVPQuYEhg37NZWAJQ9VnMVDxP/VHL496M/QZxkjf5/
Efucp2gaDX6RS6CXpoY68LsvPVjR0ZSwzz1apAzvN9dlzEheX7ICJBBtuA6G3LQpzW5hOA2hzCTMjJPJ8LbqF6dsV6DoBQzgul0sGI
cGOYl7OyQdXfZ57relSQageu+ipAdTTJ25AsRTAoub8ONGcLmqrAmRLKBP1dfwhYB4N7knNnulgQxA+Uk1ihz0= ;{id = 19036
(ksk), size = 2048b} ;;state=2 [  VALID  ] ;;count=0 ;;lastchange=1525860756 ;;Wed May  9 12:12:36
2018
```

new KSK

old KSK

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Bind 9

Versions

First production release	9.0.0	2000-09-16	
First still usable release*	9.6.2	2010-03-01	*supporting RSASHA256
RFC 5011 since	9.7.0	2010-02-16	
RFC 5011 working since*	9.7.1	2010-06-17	*according to our test
Latest release	9.12.1	2018-03-14	
Current Debian stable	9.10.3	2015-09-16	

Bind 9

Findings

Re-introduction of Old Key

- initially: accepts the old key even before the hold-downs have passed.
- 9.10.2 (2015-02-25): never accepts revoked keys again

Post-roll Installation with Old Key

- initially: resolver goes insecure instead of bogus
- 9.10.4 (2016-04-28): fixed

Bind 9

Operational

RFC 5011 needs to be explicitly enabled

- *trusted-keys* v. *managed-keys*

Non-writable state directory

- initially: repeatedly logs and carries on; upon restart goes insecure
- 9.8.1 (2011-08-31): logs error once and carries on; upon restart goes bogus

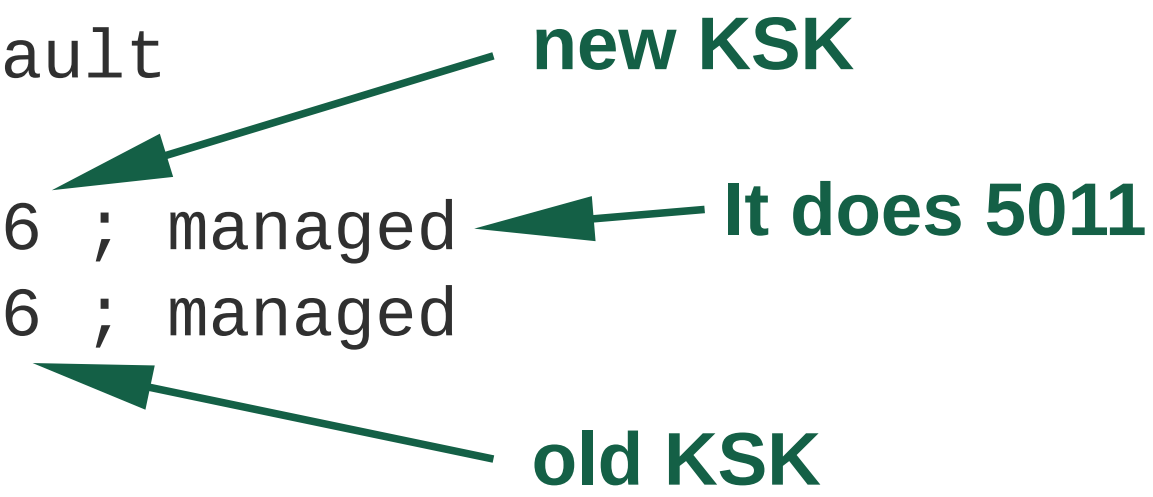
Bind 9

Do I have the new KSK?

```
# rndc secroots
# cat /var/cache/bind/named.secroots
09-May-2018 11:01:55.792

 Start view _default

./RSASHA256/20326 ; managed
./RSASHA256/19036 ; managed
```



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Knot Resolver

Versions

First production release	1.0.0	2016-06-21
RFC 5011 since	1.0.0	*
Latest release	2.3.0	2018-04-23
Current Debian stable	1.2.0	2017-01-25

* in our tests first working in 1.2.0, faulty in 1.2.2, then working again in 1.5.0

Knot Resolver

Findings*

Re-introduction of old key

- accepts the old key after remove and add hold-downs

Late installation with old key only

- 1.2.0: accepts the new key during the add hold-down but not after
- 1.2.5: accepts the new key for one day only

Revocation of old key

- 1.5.0: accepts the old key for only day after removal from DNSKEY record.

* last test was on 1.2.0

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Knot Resolver

Operational

Trust anchors are always update via RFC 5011. \o/

Non-writable state directory

- initially: stops at start with *permission* denied
- 1.5.1: same message but keeps running and goes bogus one day late
- 2.0.0: stops at start again.

- Resolver restarts
  - 1.2.0: add hold-down restart with every restart if trust anchor is kept but config directory recreated, otherwise bogus three days after key roll.
  - 2.0.0: fixed

Knot Resolver

Do I have the new KSK?

```
# cat /etc/knot-resolver/root.key
.                       172800 DNSKEY 257 3 8
AwEAAagAIKlVZrpC6Ia7gEzahOR+9W29euxhJhVVLOyQbSEW0O8gcCjFFVQUTf6v58f
LjwBd0YI0EzrAcQqBGCzh/
RStIoO8g0NfnfL2MTJRkxoXbfDaUeVPQuYEhg37NZWAJQ9VnMVDxP/VHL496M/
QZxkjf57/
EfucP2gaDX6RS6CXpoY68LsvPVjR0ZSwzz1apAzvN9dlzEheX7ICJBBtuA6G3LQpzW5
hOA2hzCTMjJPJ8LbqF6dsV6DoBQzgul0sGIcGOYl7OyQdXfZ57relSQageu+ipAdTTJ
25AsRTAoub8ONGcLmqrAmRLKBP1dfwhYB4N7knNnulqQxA+Uk1ihz0= ; Valid: ;
KeyTag:19036
.                       172800 DNSKEY 257 3 8
AwEAAaz/tAm8yTn4Mfeh5eyI96WSVexTBAvkMgJzkKTOiW1vkIbzxeF3+/4RgWOq7Hr
xRixHlFlExOLAJr5emLvN7SWXgnLh4+B5xQlNVz8Og8kvArMtNROxVQuCaSnIDdD5LK
yWbRd2n9WGe2R8PzgCmr3EgVLrjyBxWezF0jLHwVN8efS3rCj/
EWgvIWgb9tarpVUDK/
b58Da+sqqls3eNbuv7pr+eoZG+SrDK6nWeL3c6H5Apxz7LjVc1uTIdsIXxuOLYA4/
ilBmSVIzuDWfdRUfhHdY6+cn8HFRm+2hM8AnXGXws9555KrUB5qihylGa8subX2Nn6U
wNR1AkUTV74bU= ; Valid: ; KeyTag:20326
```


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PowerDNS Recursor

Do I have the new KSK?

```
# rec_constrol get-tas
Configured Trust Anchors:
.
  19036 8 2 49aac11d7b6f6446702e54a1607371607a1a41855200fd2ce1
cdde32f24e8fb5
  20326 8 2 e06d44b80b8f1d39a95c0b0d7c65d08458e880409bbc683457
104237c7f8ec8d
```

20326 missing?

- upgrade to at least 4.0.5
- https://doc.powerdns.com/recursor/dnssec.html#trust-anchors

Dnsmasq

Do I have the new KSK?

- Configuration includes somewhere:

```
dnssec
trust-anchor=.,19036,8,2,49AAC1...
trust-anchor=.,20326,8,2,E06D44...
```

systemd-resolved

Do I have the new KSK?

- Root trust anchors are baked into the source.
- New KSK added in version 233 (2017-03-12), probably backported in various stable distributions.
- src/resolve/resolved-dns-trust-anchor.c

```
static int dns_trust_anchor_add_builtin_positive(DnsTrustAnchor *d) {
    /* … */
    r = add_root_ksk(answer, key, 20326, /* … */);
    /* … */
}
```

What happens next?

ICANN proposed to proceed to roll on October 11 this year.

- Public comment period ended April 1.
- 20 comments, mostly in favor of going ahead.
- Final plan should be published any day now.