Our work on post-quantum DNSSEC

Caspar Schutijser | *Preparing the DNS for the Post-Quantum Cryptography transition* webinar

18 maart 2026

SIDN LABS

Empirically investigating impact of PQC on DNSSEC

DNS' stringent requirements

- Signature size
- Public key size
- Validation speed
- Signing speed

Agenda

1. Past study: Evaluating PQC (Falcon and Mayo) in DNSSEC Signing for TLD Operators

2. Current study: impact of PQ DNSSEC on DNS resolvers

Evaluating PQC (Falcon and Mayo) in DNSSEC Signing for TLD Operators

Caspar Schutijser, Elmer Lastdrager, Ralph Koning, and Cristian Hesselman

24 July 2025

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Hardware support (AVX2)	Proof of nonexistence
4 algorithms	3 zone files

Algorithm	Public key size	Signature size
RSA-1280	162*	160
ECDSA-P256	64	64
Falcon-512	897	666
MAYO-2 (R1)	5488	180

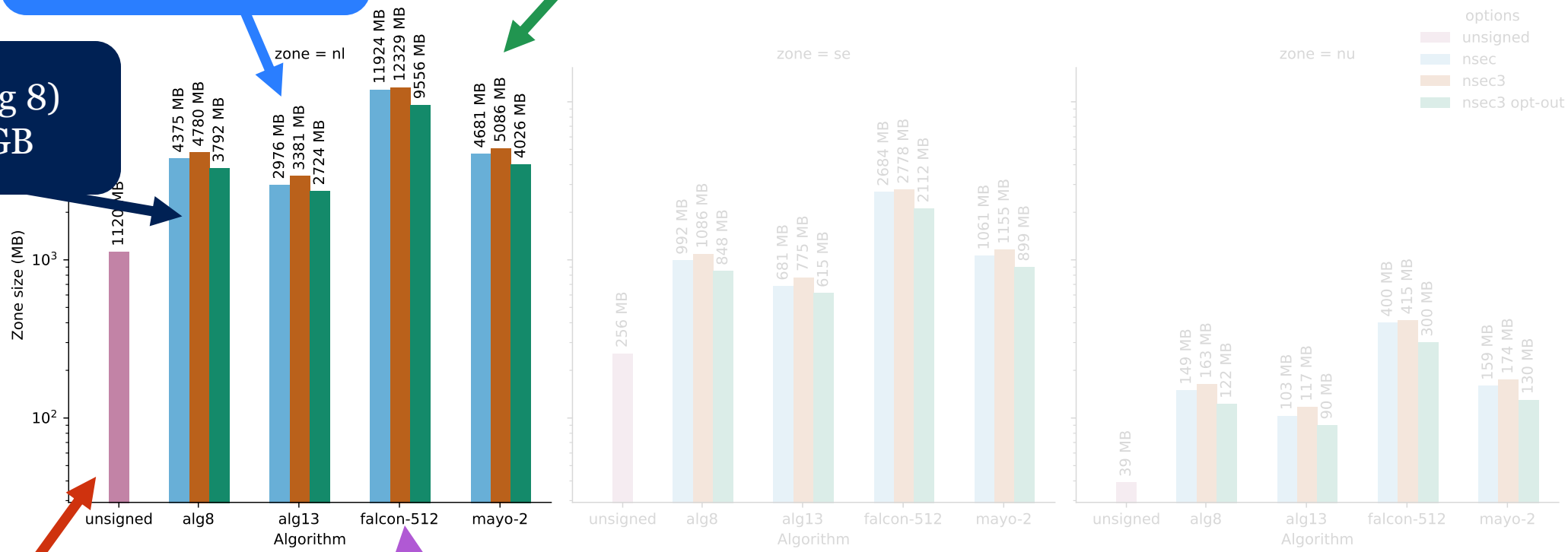
all numbers are in bytes

Zone sizes

ECC (alg 13)
~3 GB

Mayo ~5 GB

RSA (alg 8)
~4.5 GB



Unsigned ~1 GB

Falcon ~12 GB

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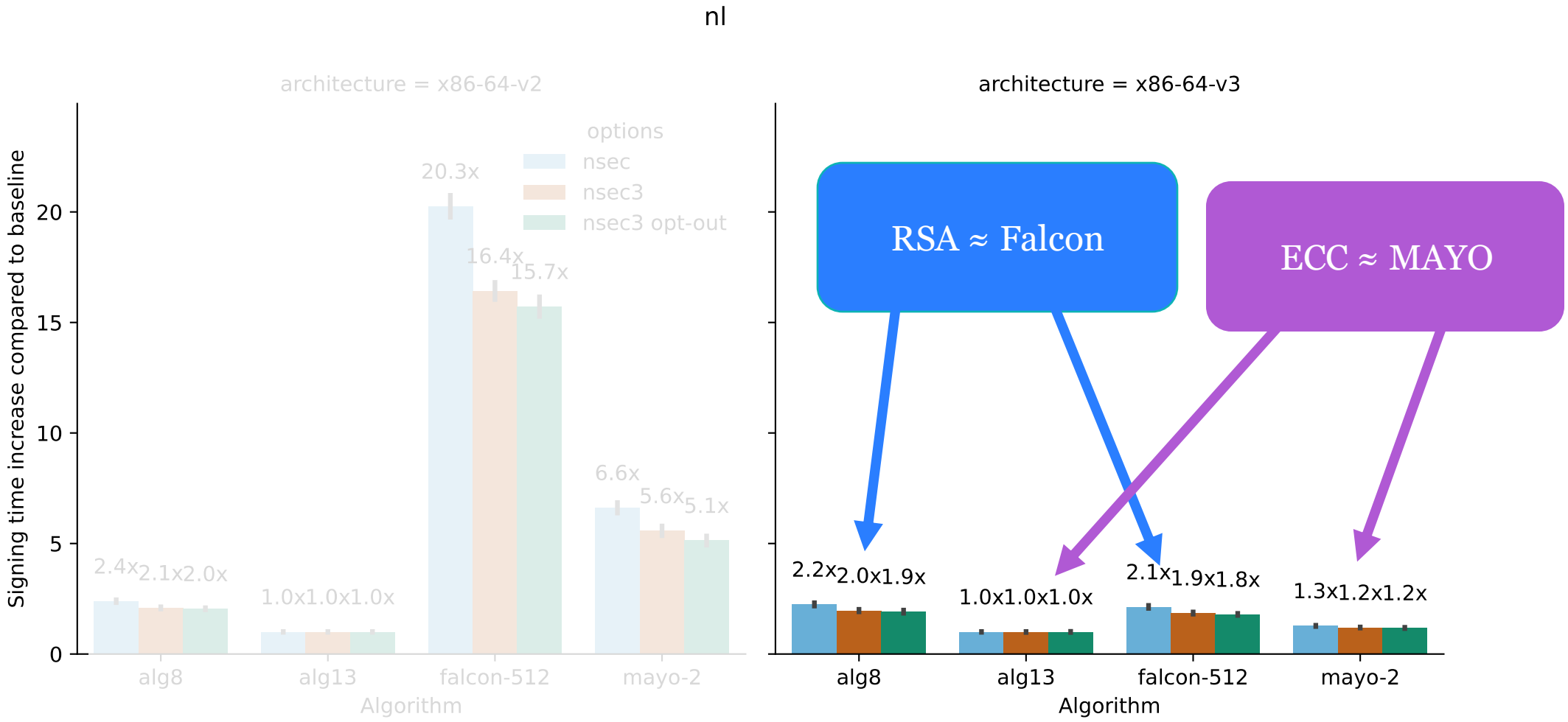
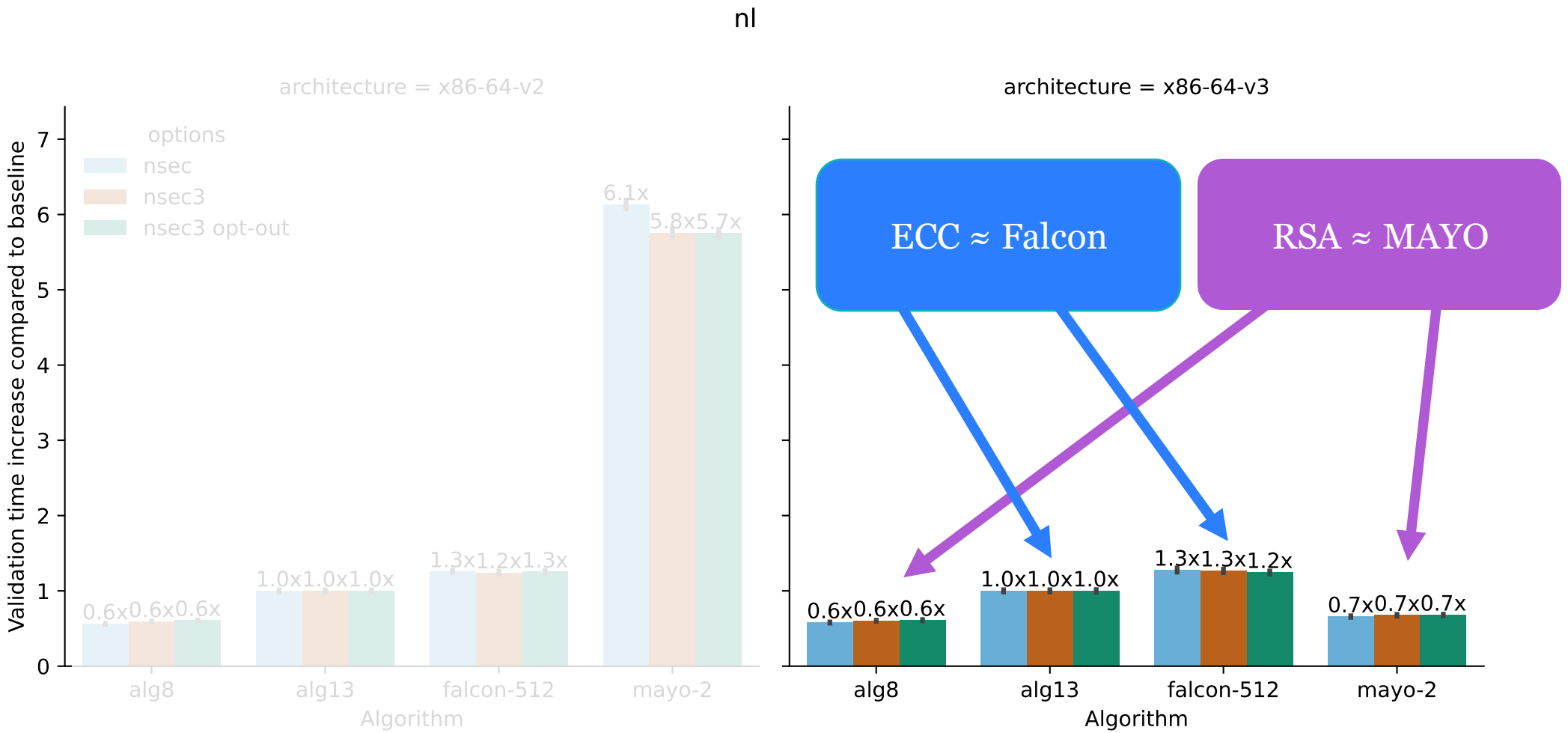
Signing time of entire .nl zone



Validating the entire .nl zone



Conclusions

Impact on computation time looks comparable to what we have experience with*†‡

Signed zonefiles can become quite a bit bigger, will also affect size of DNS answers

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Download our paper

"*Evaluating Post-Quantum Cryptography in DNSSEC Signing for Top-Level Domain Operators*" in Network Traffic Measurement and Analysis Conference (TMA2025)

https://tma.ifip.org/2025/wp-content/uploads/sites/14/2025/06/tma2025_paper4.pdf

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1. Past study: Evaluating PQC (Falcon and Mayo) in DNSSEC Signing for TLD Operators

2. Current study: impact of PQ DNSSEC on DNS resolvers

Impact on DNS resolvers matters

DNS resolvers have to do a lot of work

Resource exhaustion attacks

Bigger DNS answers implies more use of TCP

What is the impact of PQC?

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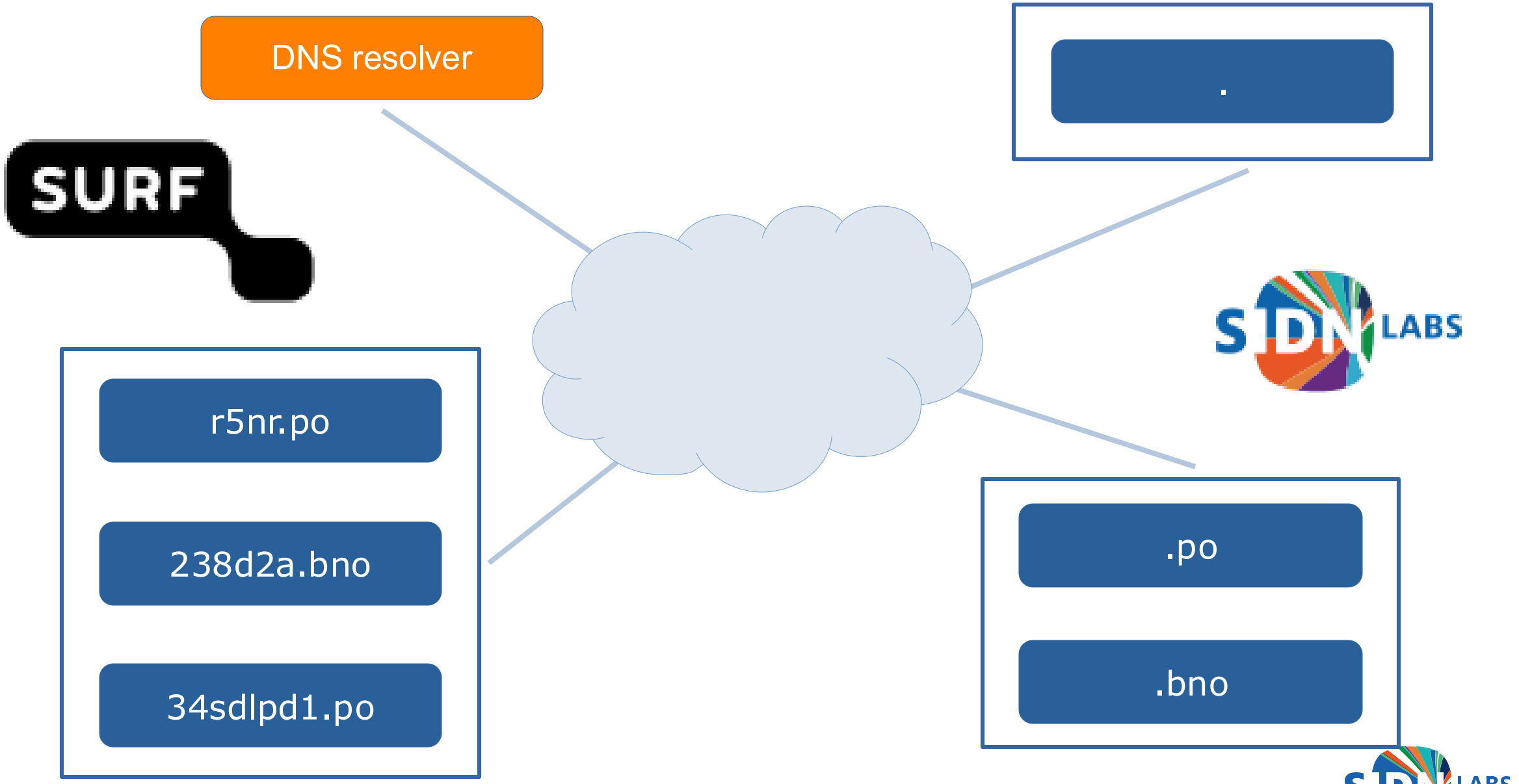
Testbed with replica of "DNS world"

- Authoritative name servers (root, TLDs, regular DNS zones)
- Resolver
- Client (to perform resolver measurements with)

Support for PQC algorithms


DNS resolver
SURF
.
r5nr.po
238d2a.bno
34sdlpd1.po
.po
.bno

Replaying realistic traffic

Step 1: collect data from DNS resolver (in anonymized form)

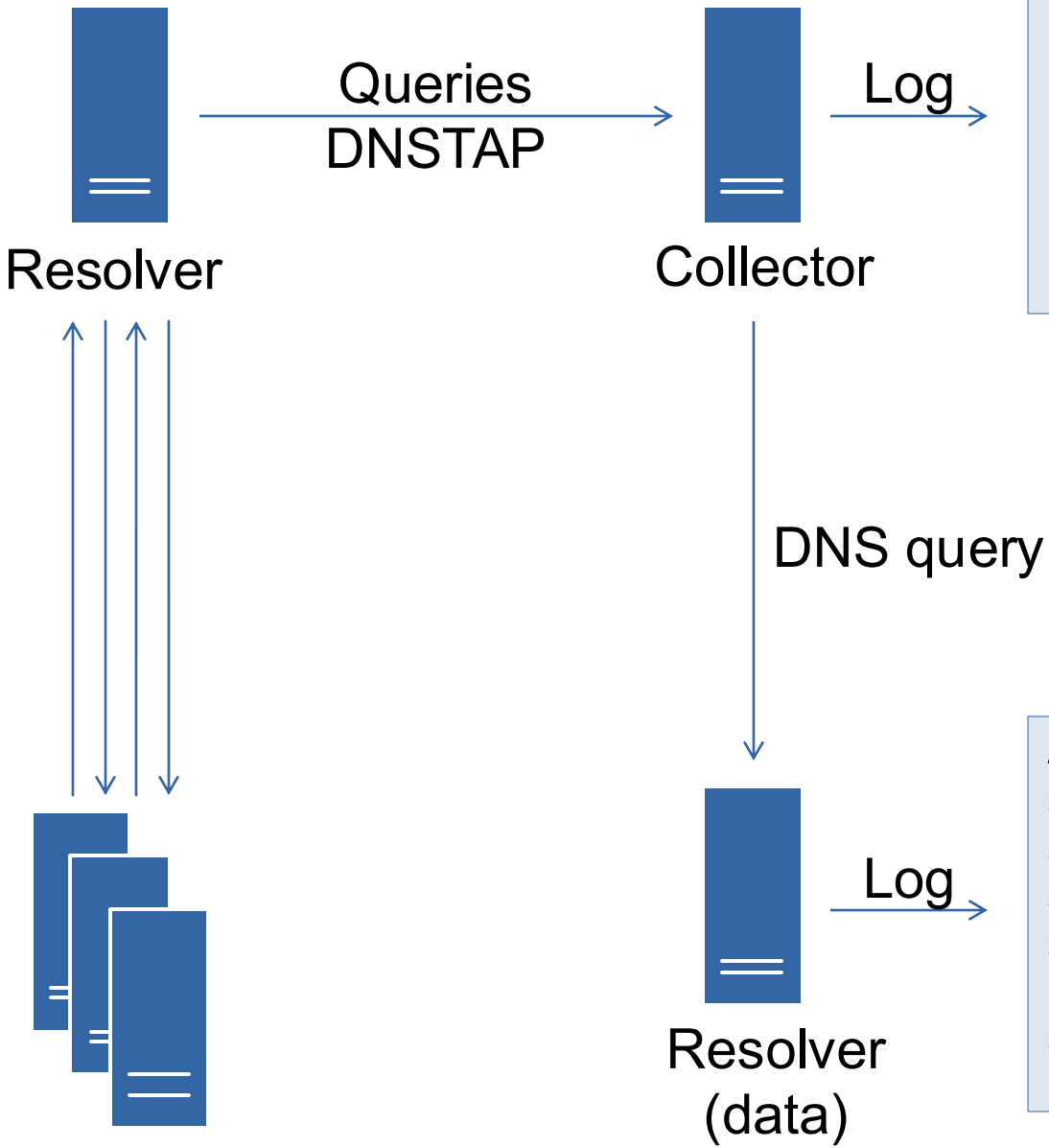
Step 2: rebuild DNS zones based on DNS answers

Step 3: sign zones using PQC algorithms

Step 4: replay queries

Important: data is anonymized

- Exact contents of DNS records are not important
- But format and amounts are

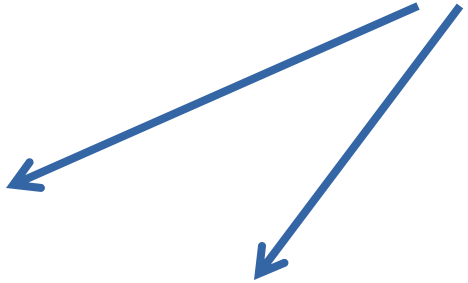


Queries
12:04 surf.nl A UDP
12:07 sidn.nl MX TCP

Answers
surf.nl NS ns1.surfnet.nl.
surf.nl NS ns2.surfnet.nl.
surf.nl A 145.100.190.243
sidn.nl NS ns5.sidn.nl.
ns5.sidn.nl A 145.40.68.55
sidn.nl MX 0 sidn-nl.v-v1.mx.microsoft.

Answers
surf.nl NS ns1.surfnet.nl.
surf.nl NS ns2.surfnet.nl.
surf.nl A 145.100.190.243
sidn.nl NS ns5.sidn.nl.
ns5.sidn.nl A 145.40.68.55
sidn.nl MX 0 sidn-nl.v-v1.mx.microsoft.

Answers
r5nr.po NS mq8.ql9c1h8.po.
r5nr.po NS loq.ql9c1h8.po.
r5nr.po A 48.194.99.216
4itd.po NS ecr.4itd.po.
ecr.4itd.po A 166.246.223.124
4itd.po MX 5 r9p1jlg.8xrl.ym.1qz1utjhe.



$ORIGIN r5nr.po.
r5nr.po. 3600 SOA ...
@ NS mq8.ql9c1h8.po
@ NS loq.ql9c1h8.po
@ A 48.194.99.216

$ORIGIN 4itd.po.
4itd.po. 3600 SOA ...
@ NS ecr.4itd.po.
ecr A 166.246.223.124
@ MX 5 r9p1jlg.8xrl.ym.1qz1utjhe.

Measurements to determine impact

- Various scenarios and algorithms
- Impact on resolver
  - CPU
  - Memory
  - TCP fallbacks
  - Network traffic
  - Latency
  - …

Goal: input for DNS community

Thank you

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