Rolling with Confidence:
Managing the Complexity of DNSSEC Operations

Moritz Müller[1,2], Taejoong Chung[3], Roland van Rijswijk-Deij[2], Alan Mislove[3]

[1]SIDN, [2]University of Twente, [3]Northeastern University

RIPE 76 | 2018-05-16

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UNIVERSITY OF TWENTE.

About SIDN

- Registry of the Dutch ccTLD *.nl*
- More than 5,8 million registered domains
- More than 3 million signed with DNSSEC
- SIDN Labs is its research department
  - Goal: increase the security and stability of *.nl* and the Internet overall
  - 7 team members + interns

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“key rollovers are a fact of life when using DNSSEC”

from RFC 6781

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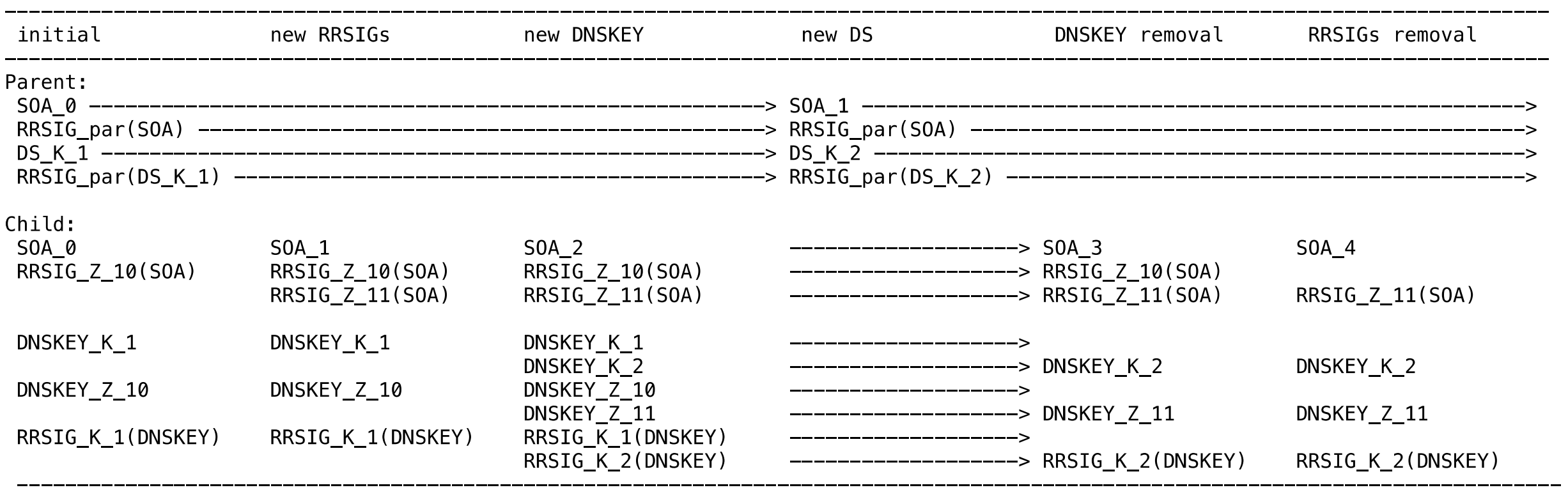
- ZSK Rollovers
- KSK Rollovers
- Algorithm Rollovers

Algorithm Rollover Stages



from RFC 6781, Figure 8

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Rollovers can be risky

[Unbound-users] DNSSEC validation failure of .nl TLD

Marco Davids (SIDN)
Wed Oct 31 12:29:20 CET 2012

```
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA1

Hi,

On 10/29/12 20:14, Casey Deccio wrote:

> Looks like perhaps the new ZSK wasn't pre-published long enough.

As promised a brief (informal) follow-up on what happened.

Indeed the new ZSK wasn't pre-published long enough. After OpenDNSSEC
generated it and just prior to publishing it in the DNS, the software
encountered a problem. As a result of that, the zonefile was never
published. In fact, we missed two zonefileupdates before we got all
the right people mobilised and where ready to restart the process.

When we published the new zonefile, OpenDNSSEC figured that the
pre-publication time was long enough and started to include new
RRSIg's, made by the new ZSK. This resulted in validation errors.

So, the observation of Casey was just right.

We will maintain to look into this issue further and we will implement
protective measures to prevent this from happening again.

Regards,

- --
Marco
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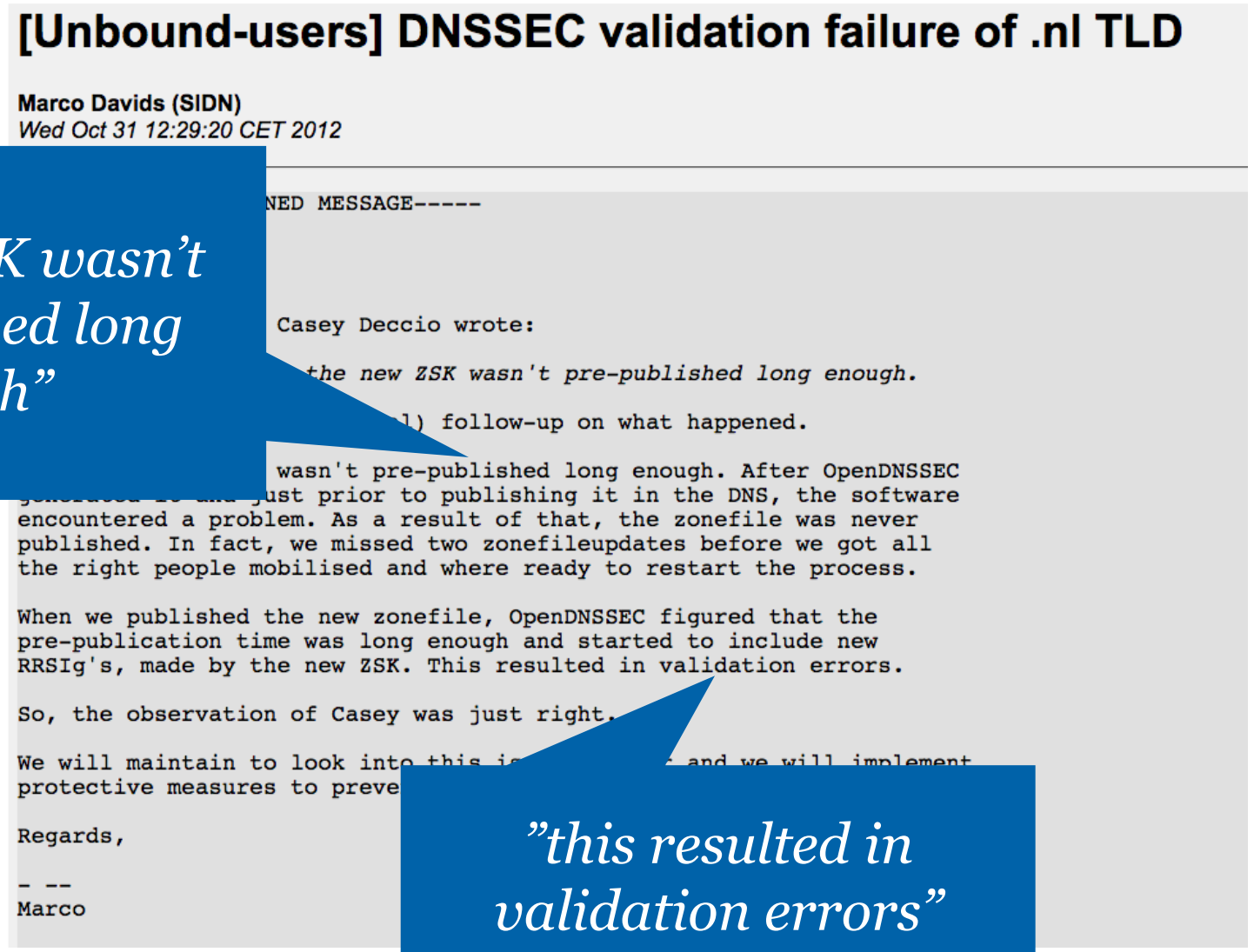

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It’s all about the right timing

Timing of Rollovers

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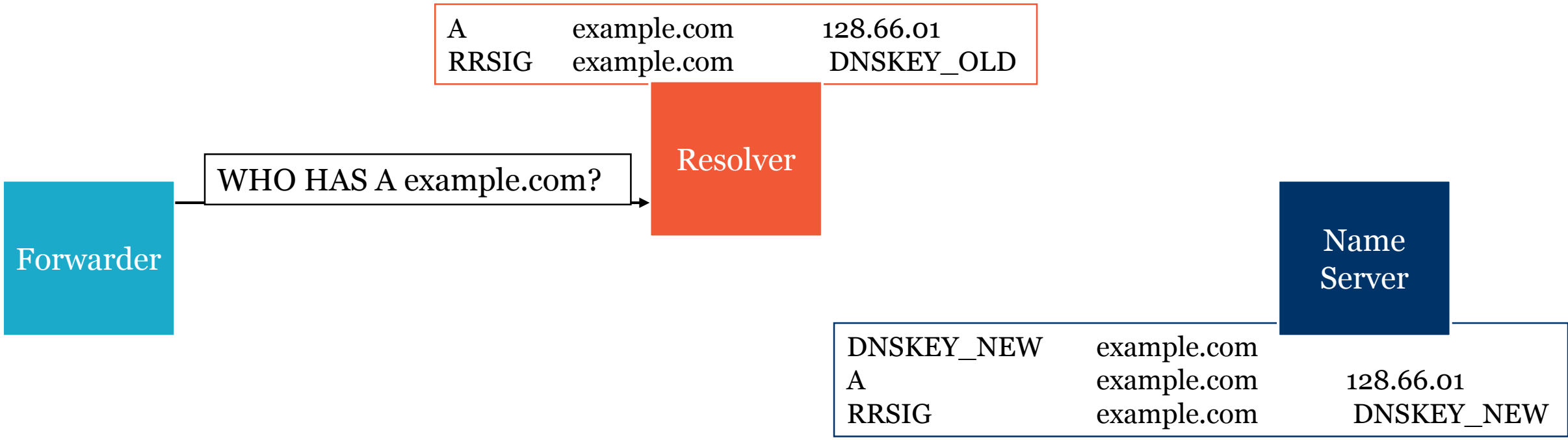

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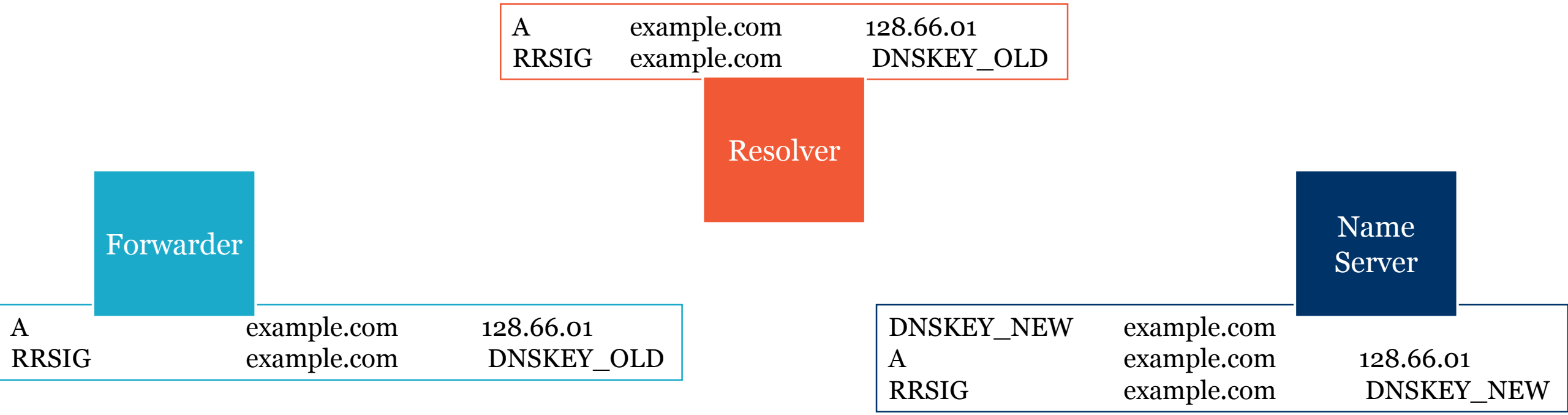

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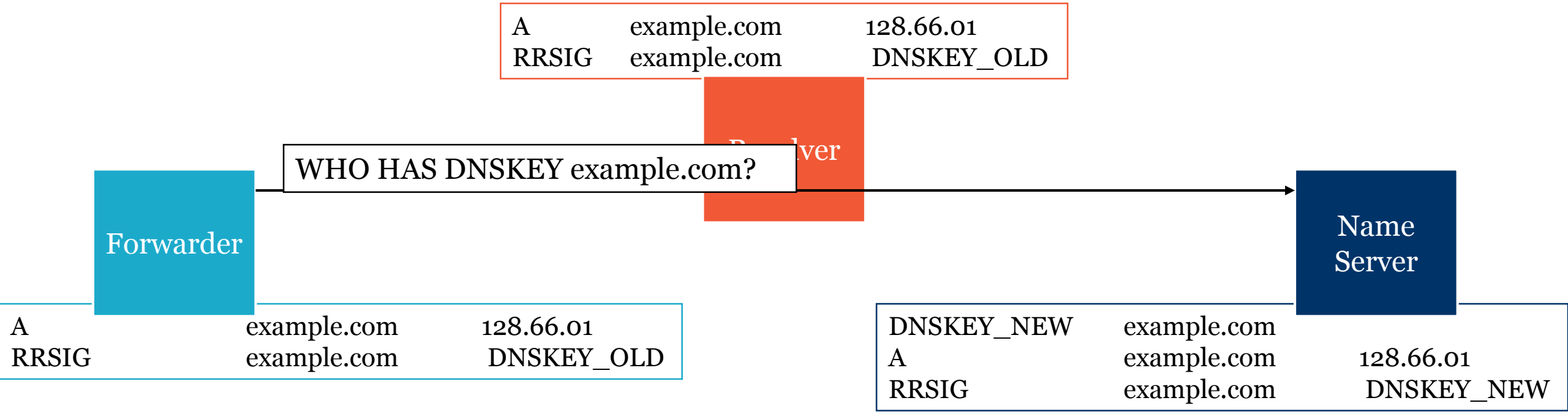

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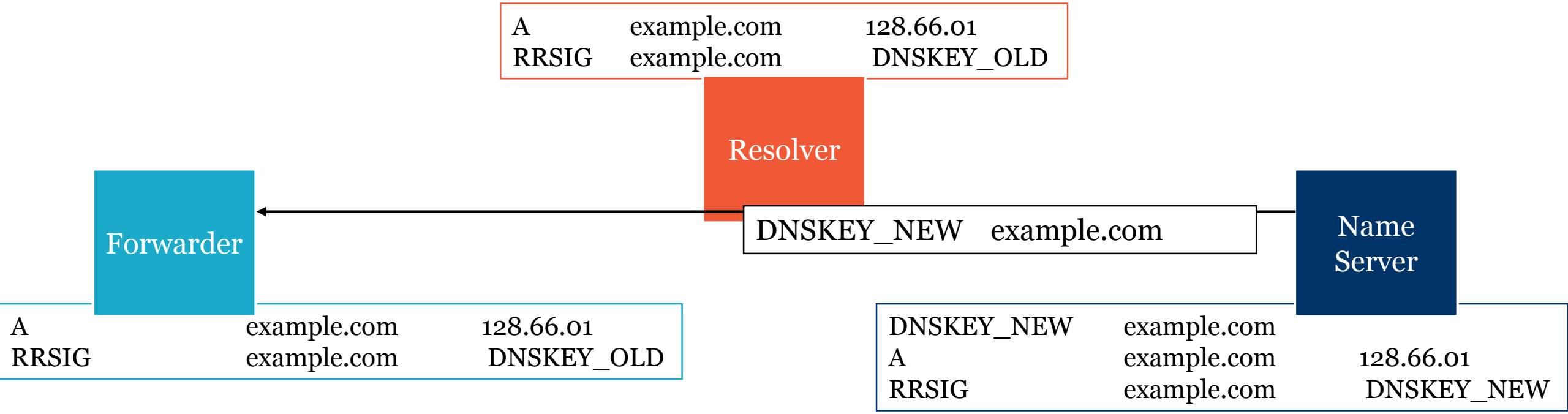

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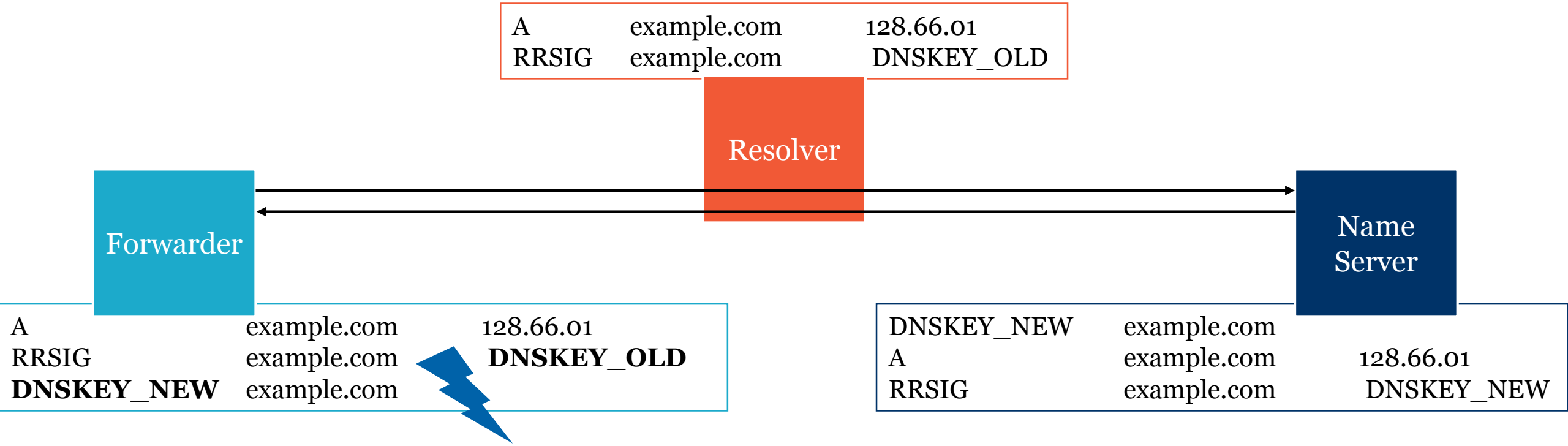

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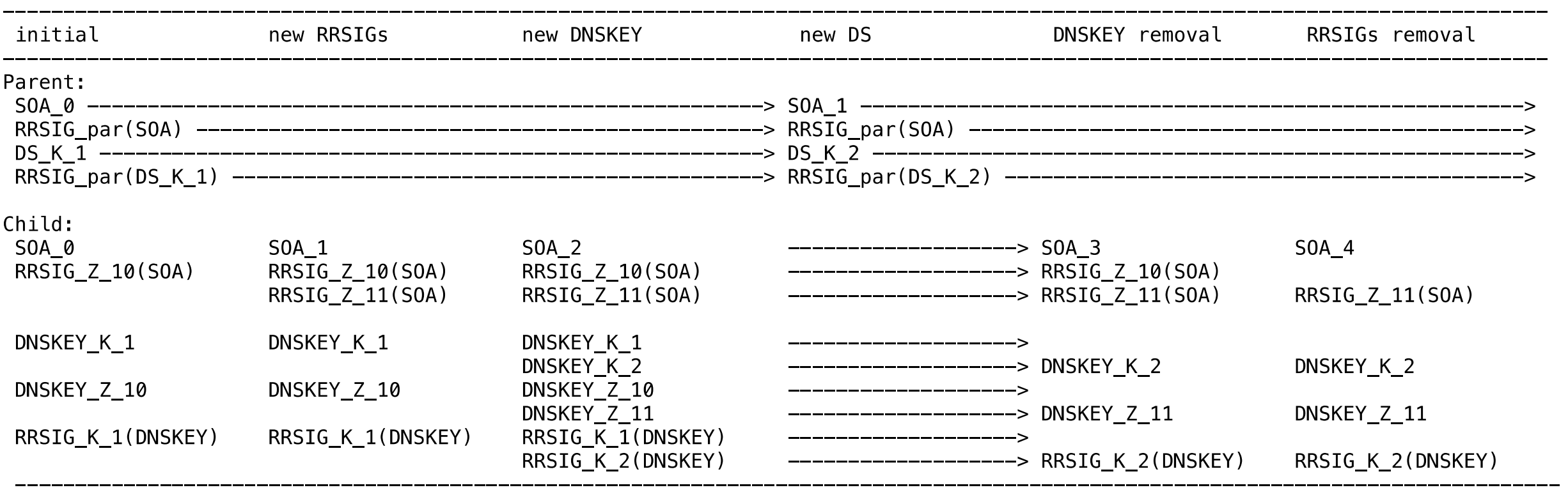
Timing of Rollovers

	Publication Delay	Propagation Delay
Description	Time it takes until every name server is in sync	Time it takes until resolvers have picked up the new state
Period	Seconds to minutes	Minutes, hours, or even days

Algorithm Rollover Stages



from RFC 6781, Figure 8

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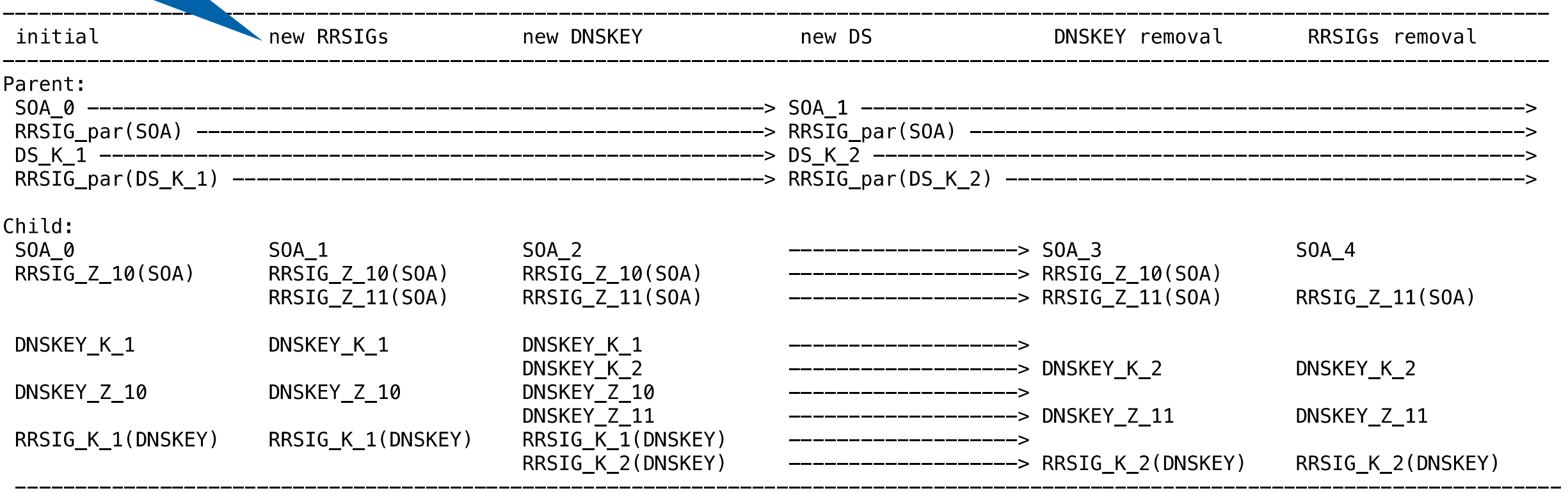
Algorithm Rollover Stages

5 Stages



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Algorithm Rollover Stages

5 Stages

initial	new RRSIGs	new DNSKEY	new DS	DNSKEY removal	RRSIGs removal
Parent:					
SOA_0			----------> SOA_1		
RRSIG_par(SOA)			----------> RRSIG_par(SOA)		
DS_K_1			----------> DS_K_2		
RRSIG_par(DS_K_1)			----------> RRSIG_par(DS_K_2)		
Child:					
SOA_0	SOA_1	SOA_2	----------> SOA_3		SOA_4
RRSIG_Z_10(SOA)	RRSIG_Z_10(SOA)	RRSIG_Z_10(SOA)	----------> RRSIG_Z_10(SOA)		
	RRSIG_Z_11(SOA)	RRSIG_Z_11(SOA)	----------> RRSIG_Z_11(SOA)		RRSIG_Z_11(SOA)
DNSKEY_K_1	DNSKEY_K_1	DNSKEY_K_1	---------->		
		DNSKEY_K_2	----------> DNSKEY_K_2		DNSKEY_K_2
DNSKEY_Z_10	DNSKEY_Z_10	DNSKEY_Z_10	---------->		
		DNSKEY_Z_11	----------> DNSKEY_Z_11		DNSKEY_Z_11
RRSIG_K_1(DNSKEY)	RRSIG_K_1(DNSKEY)	RRSIG_K_1(DNSKEY)	---------->		
		RRSIG_K_2(DNSKEY)	----------> RRSIG_K_2(DNSKEY)		RRSIG_K_2(DNSKEY)

Wait for delays

from RFC 6781, Figure 8

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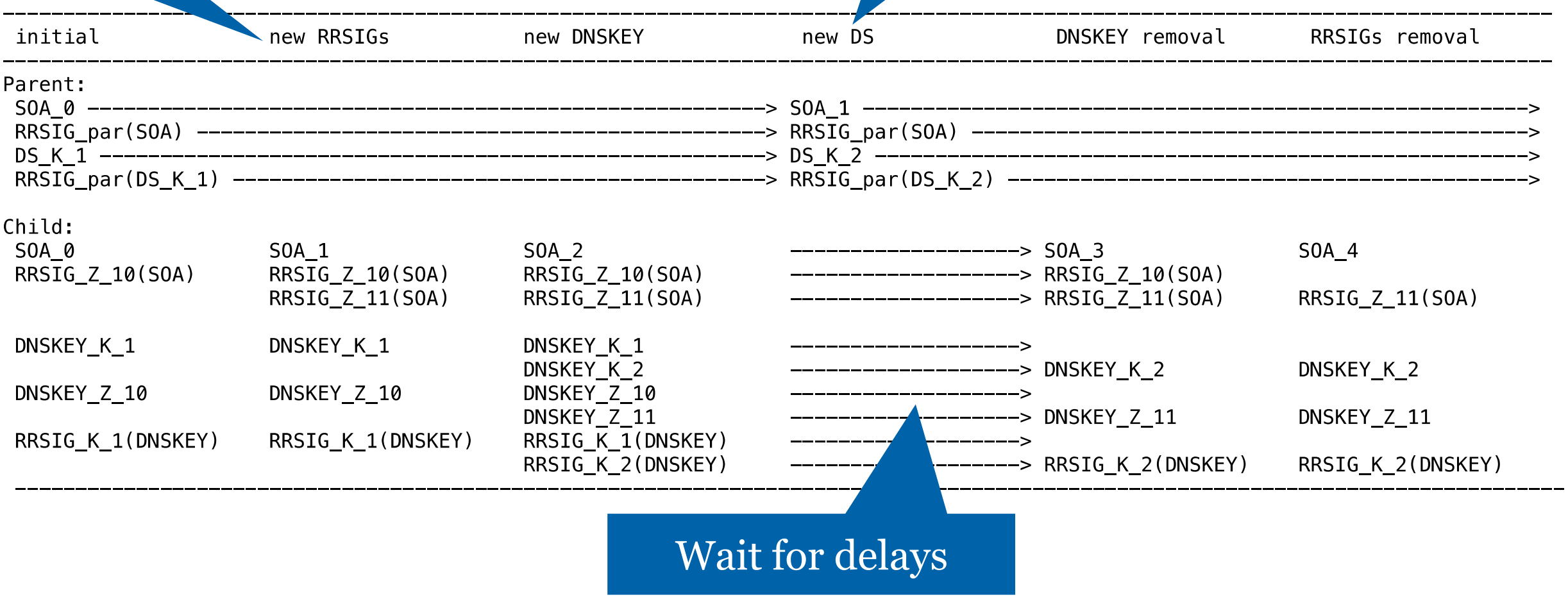
Algorithm Rollover Stages

5 Stages

Interaction with parent



Wait for delays

from RFC 6781, Figure 8

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The Conservative Algorithm Rollover

- Some old Unbound resolvers expect one signature for each algorithm in the zone apex
- If not, they suspect a downgrade attack
- and fail validation :-(

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- If not, they suspect a downgrade attack
- and fail validation :-(

- We've tested this:
  - Out of 10.000 RIPE Atlas probes only 6 failed :-)

The .se Algorithm Rollover

- .se has 1.4 Million registered domains
- > 50% signed with DNSSEC
- ~ 70% of Swedish users rely on validating resolvers
- First algorithm rollover ever:
  - From RSA/SHA-1 to RSA/SHA-256

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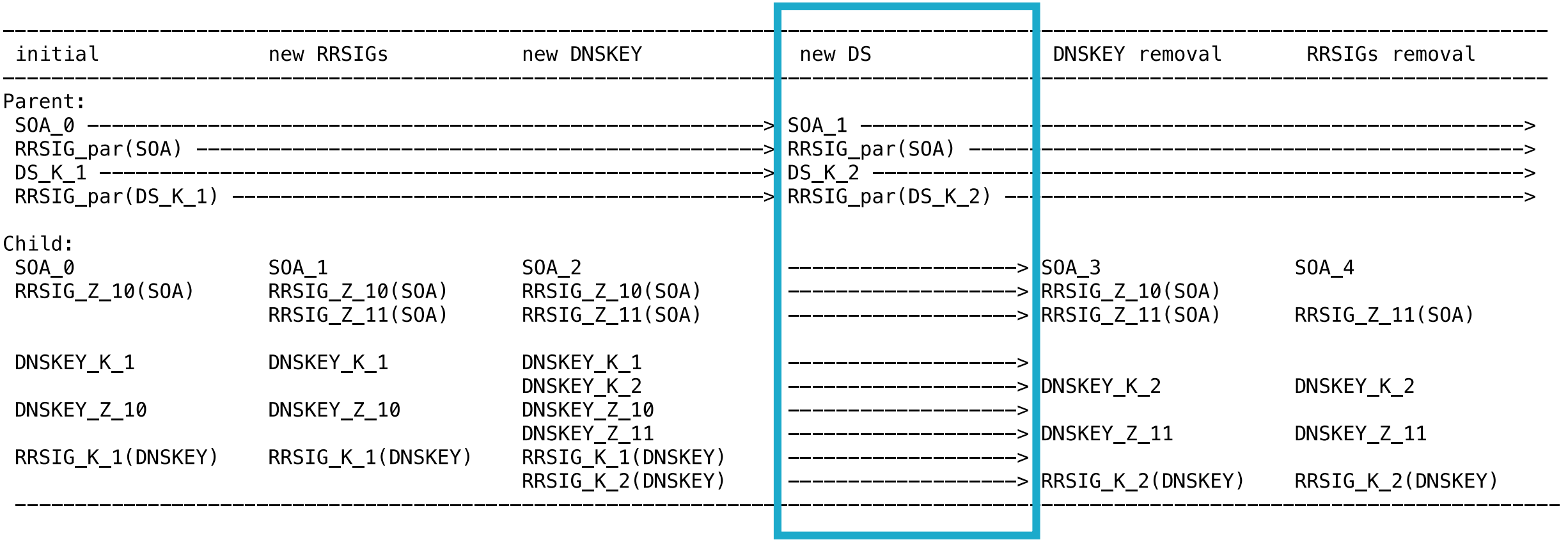
3 Measurement Types

- Monitor publication delay
- Monitor propagation delay
- Monitor the trust chain

Algorithm Rollover Stages



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Publication Delay

- Using 10.000 RIPE Atlas probes
- Query the authoritative NSes directly

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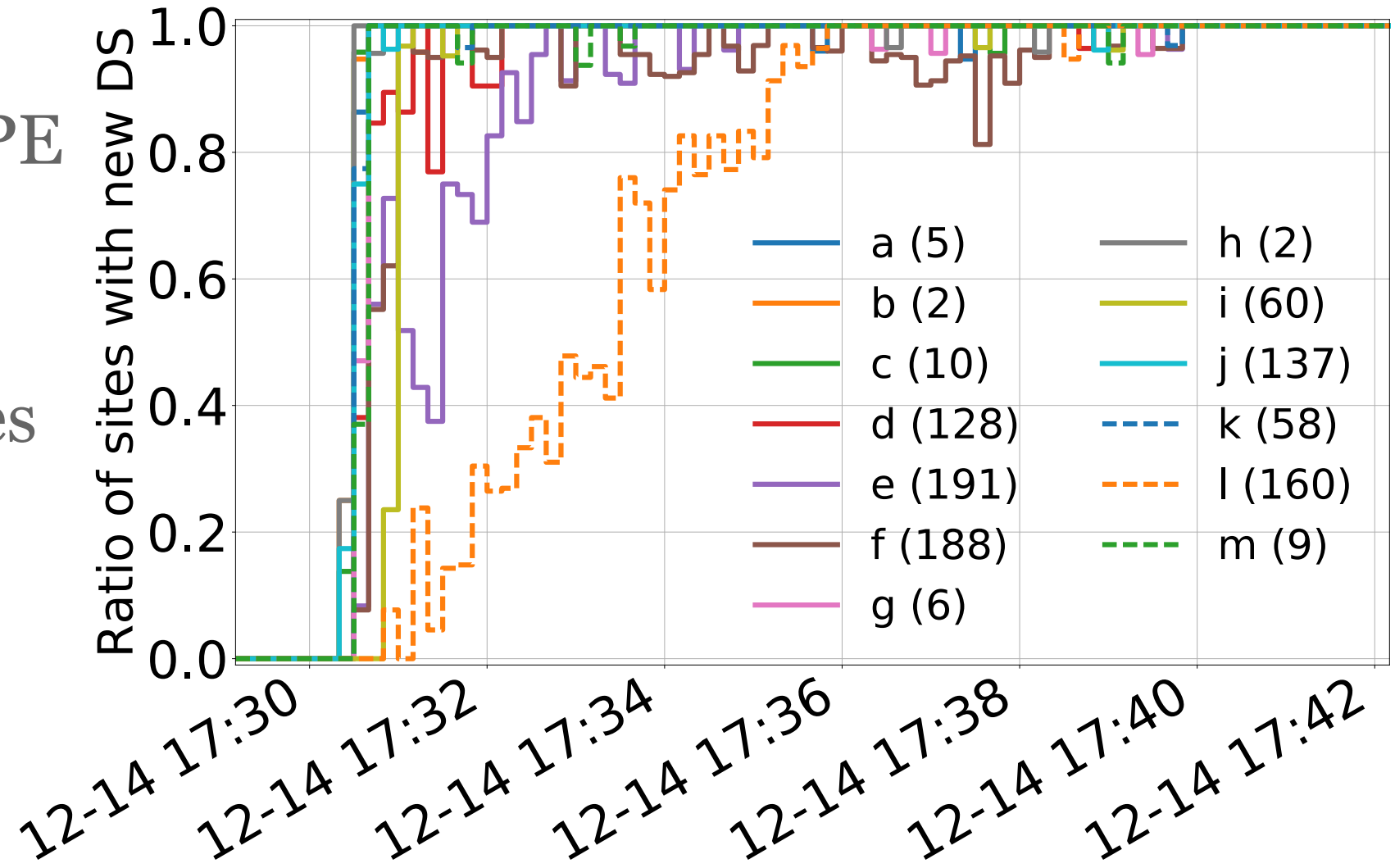

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Propagation Delay

- Using 10.000 RIPE Atlas probes
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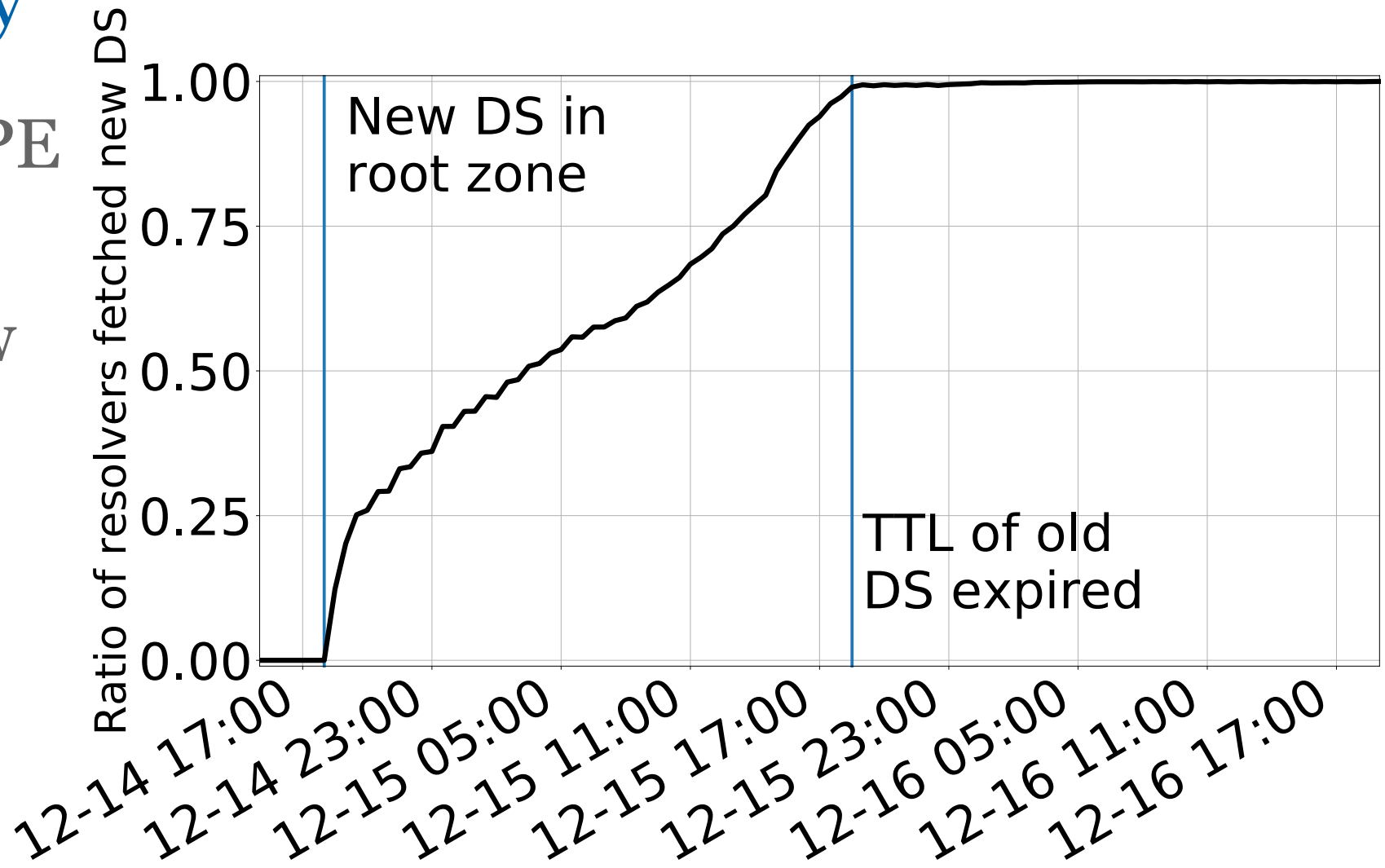

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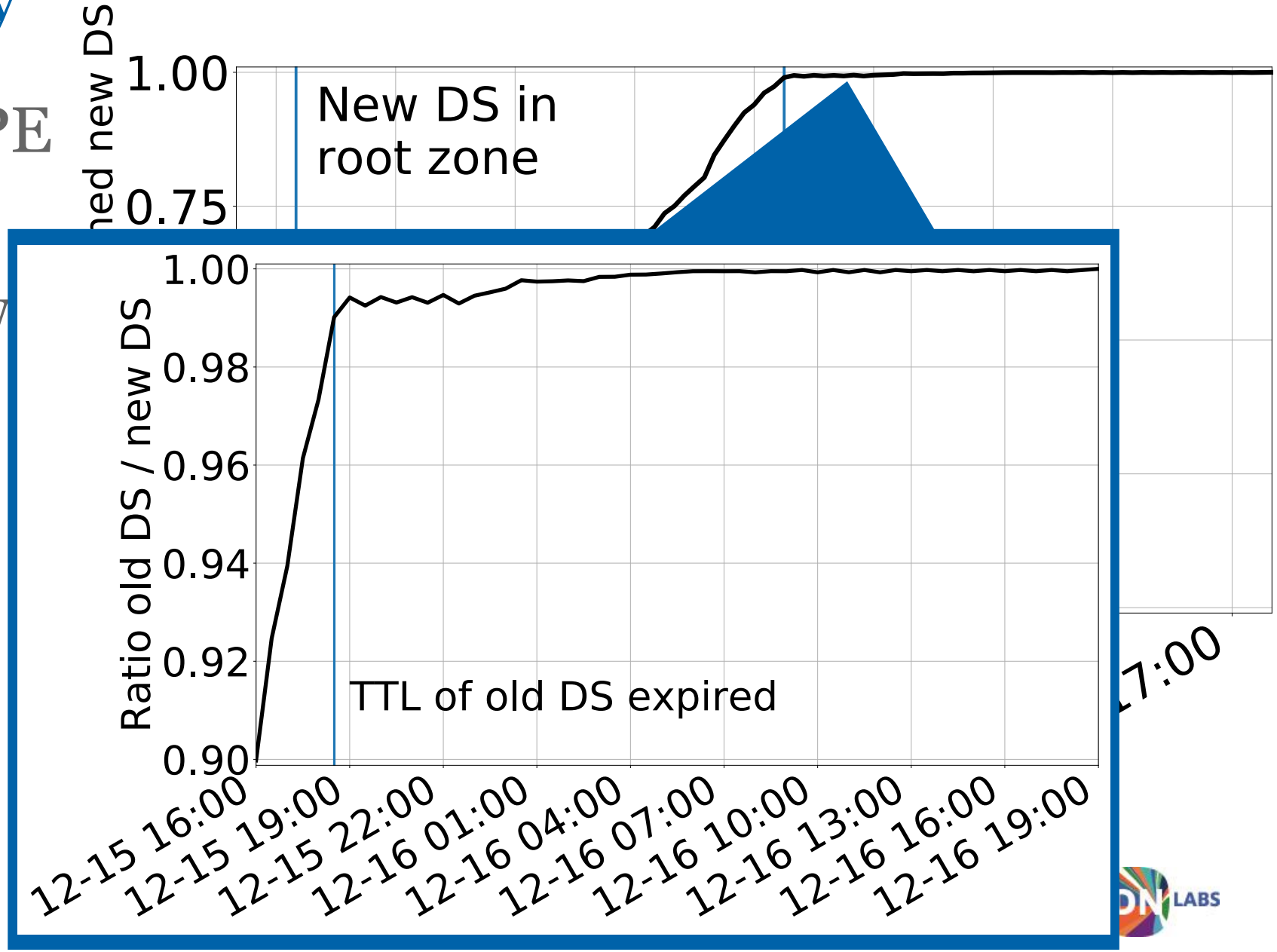


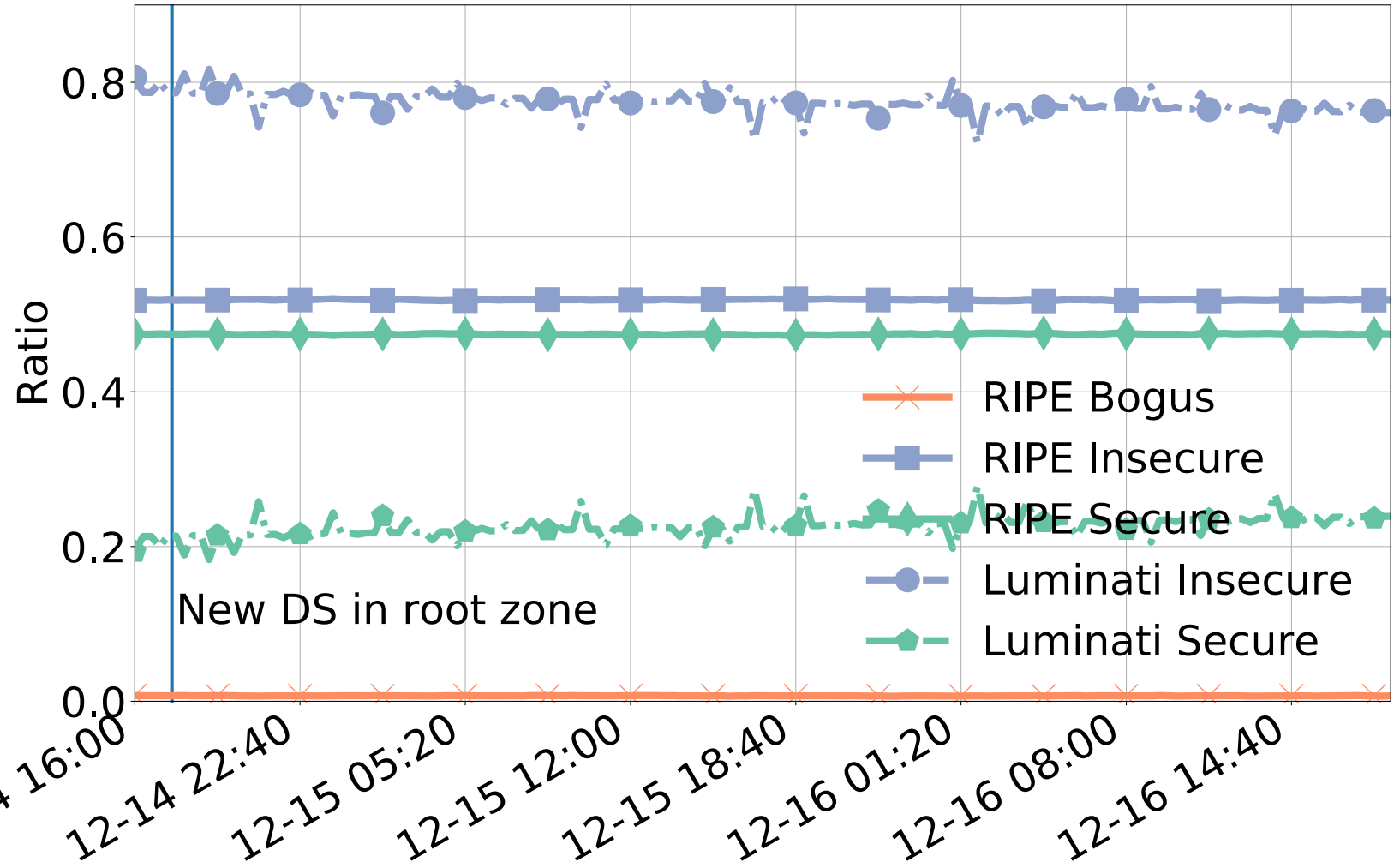
Timing of the Stage

- Publication delay: ~ 10 minutes
- Propagation delay: ~ 48 hours
- Move to next stage after: ~ 48 hours, 10 minutes

Monitor the Trust Chain

- Using 10.000 RIPE Atlas probes
- Luminati Network
- >46.000 VPs, > 8.000 behind validating resolvers
- Test-domains with valid and bogus records
- Which gives us three resolver states:
  - Validating, non-validating and bogus

Monitor the Trust Chain



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Summary

- .se rollover was successful
- Conservative algorithm rollover not necessary
- Take your time

Monitor your own Rollover

- Measurements described at sidnlabs.nl
- Tool to automate the rollover available soon
- Detailed paper available soon (if it gets accepted)
- More information about the .se rollover:
  - Preparation
  - Lessons learned

Thanks

- to IIS, the operators of .se
- to RIPE

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Questions?

Moritz Müller

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@moritzcm_