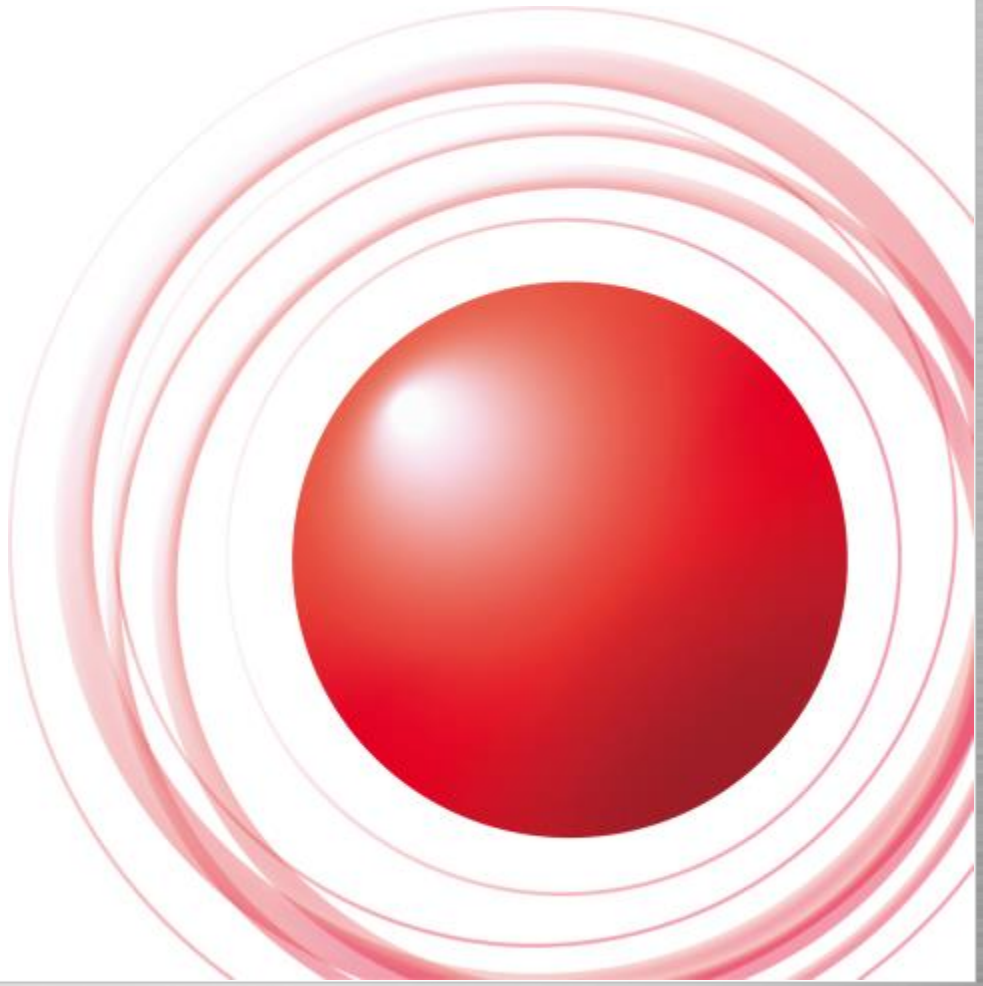
RPKI: Latest Research and Operational Insights in Japan

- Romain Fontugne (IIJ): Overview of RPKI research at IIJ.
- Keisuke Ishibashi (ICU): Social Dilemma in the Adoption of RPKI and its Possible Resolution through Altruism and Bounded Rationality.
- Wataru Ohgai (JPNIC): What matters to your life? - from RPKI point of view.

Overview of RPKI research at IIJ

Romain Fontugne

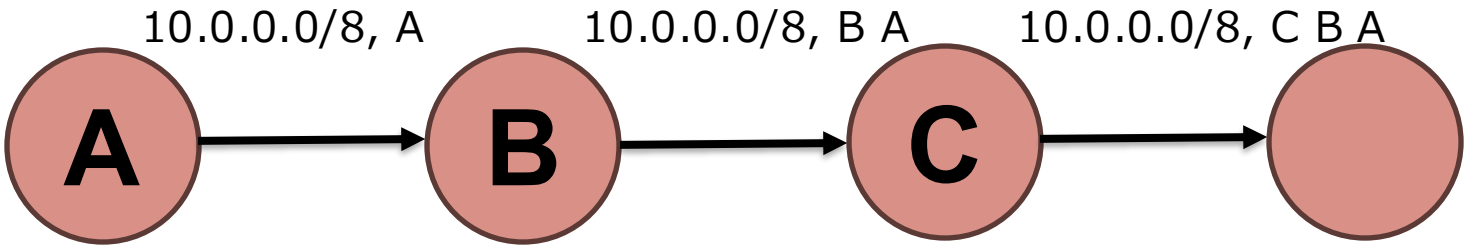


iijlab seminar
2025/04/15

Ongoing Innovation

Why RPKI?

- BGP route propagation is based on trust



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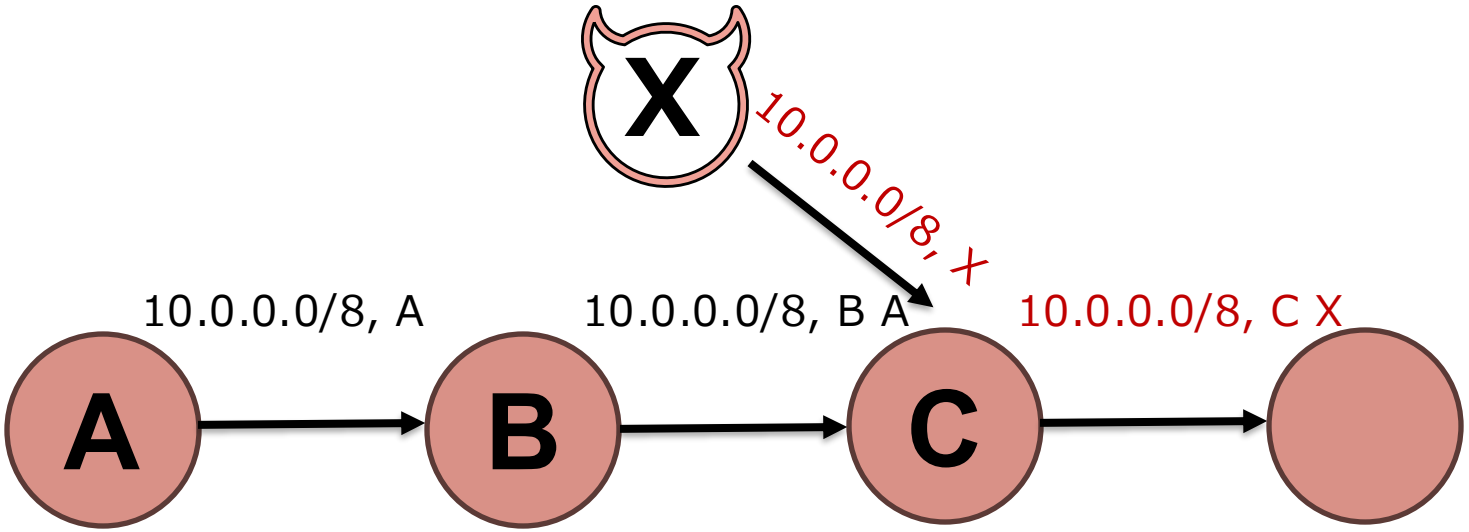
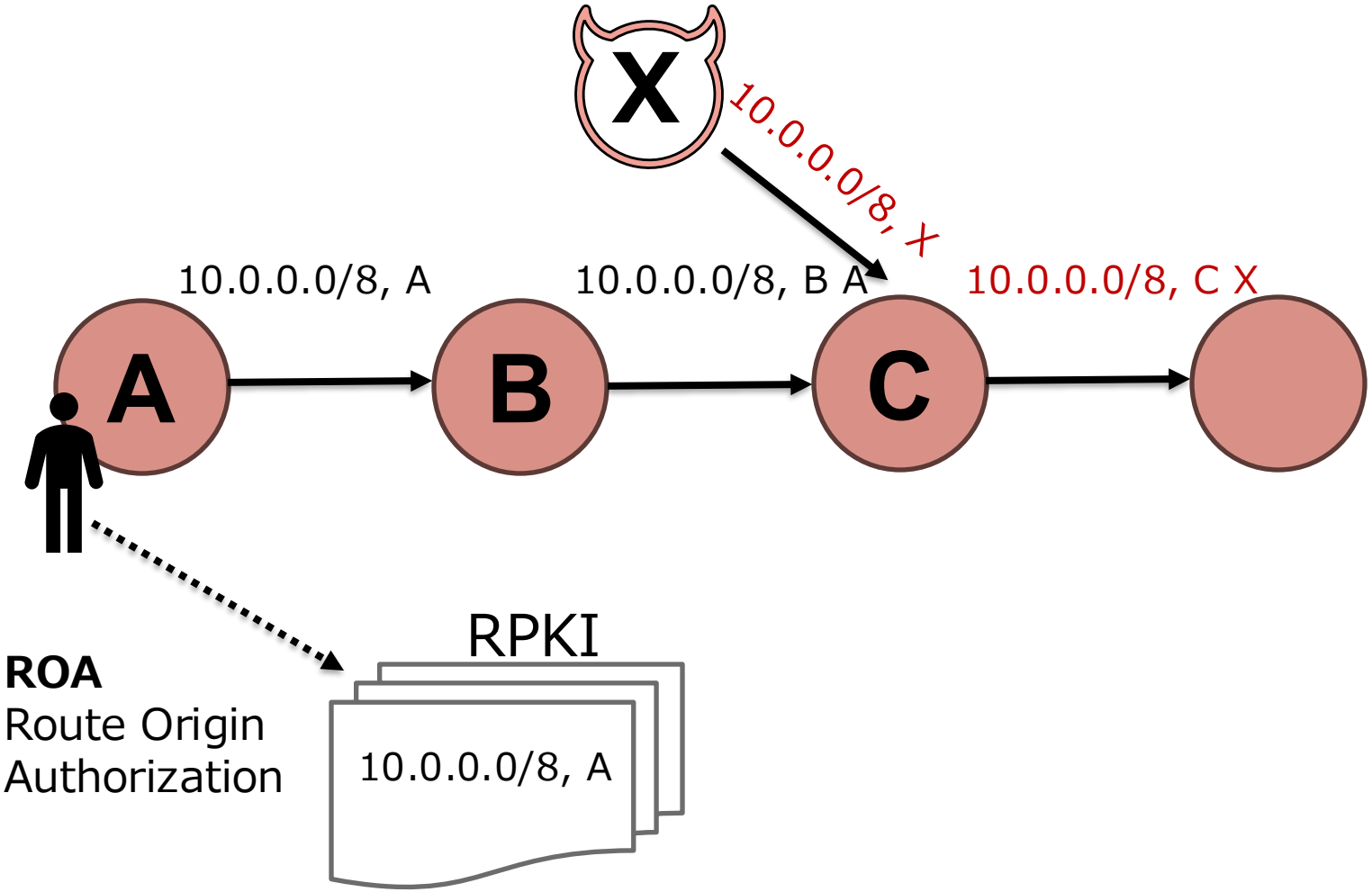


Why RPKI?

- BGP route propagation is based on trust
- RPKI uses digital certificate to add cryptographic validation



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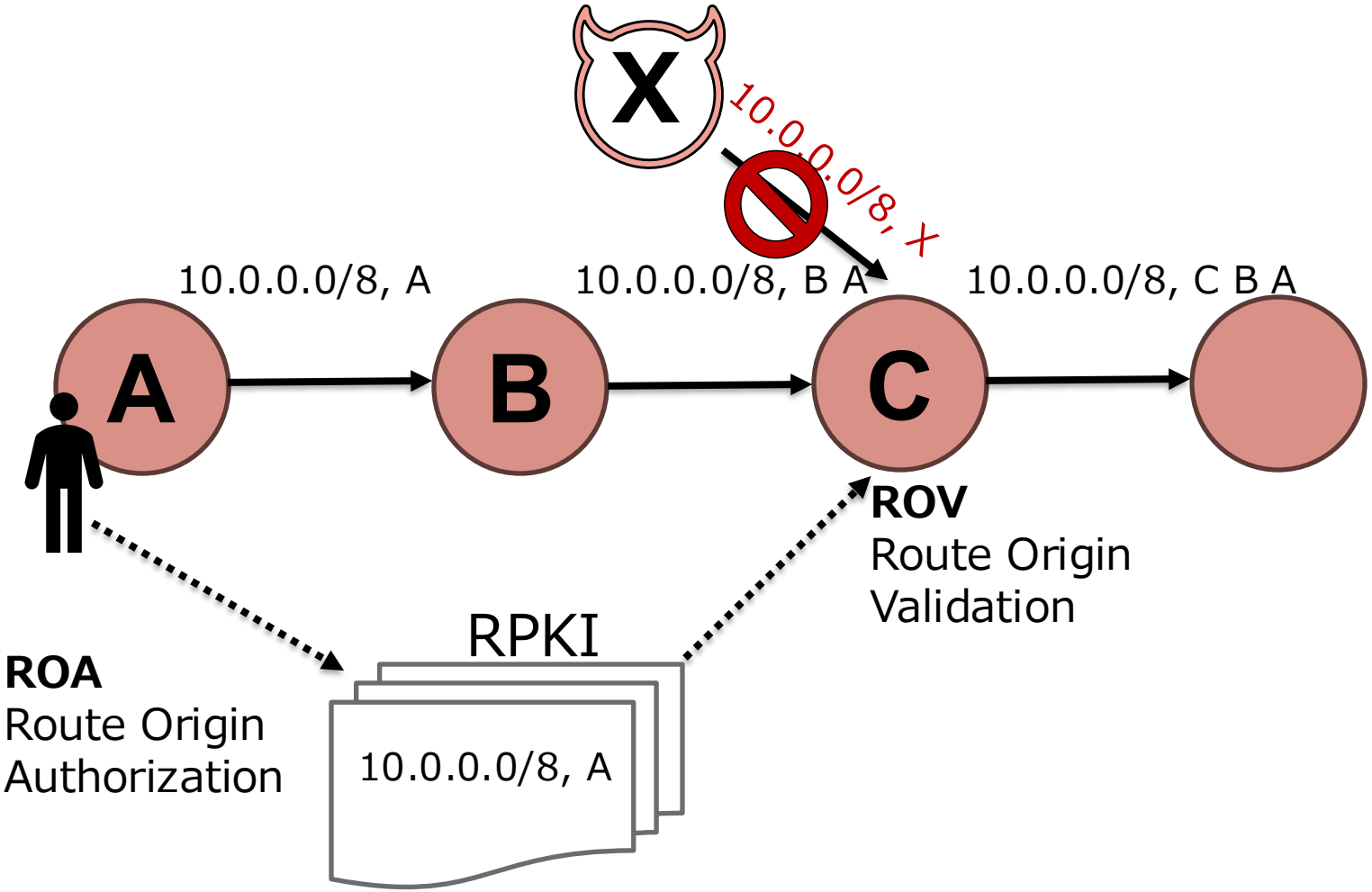


RPKI research at IIJ

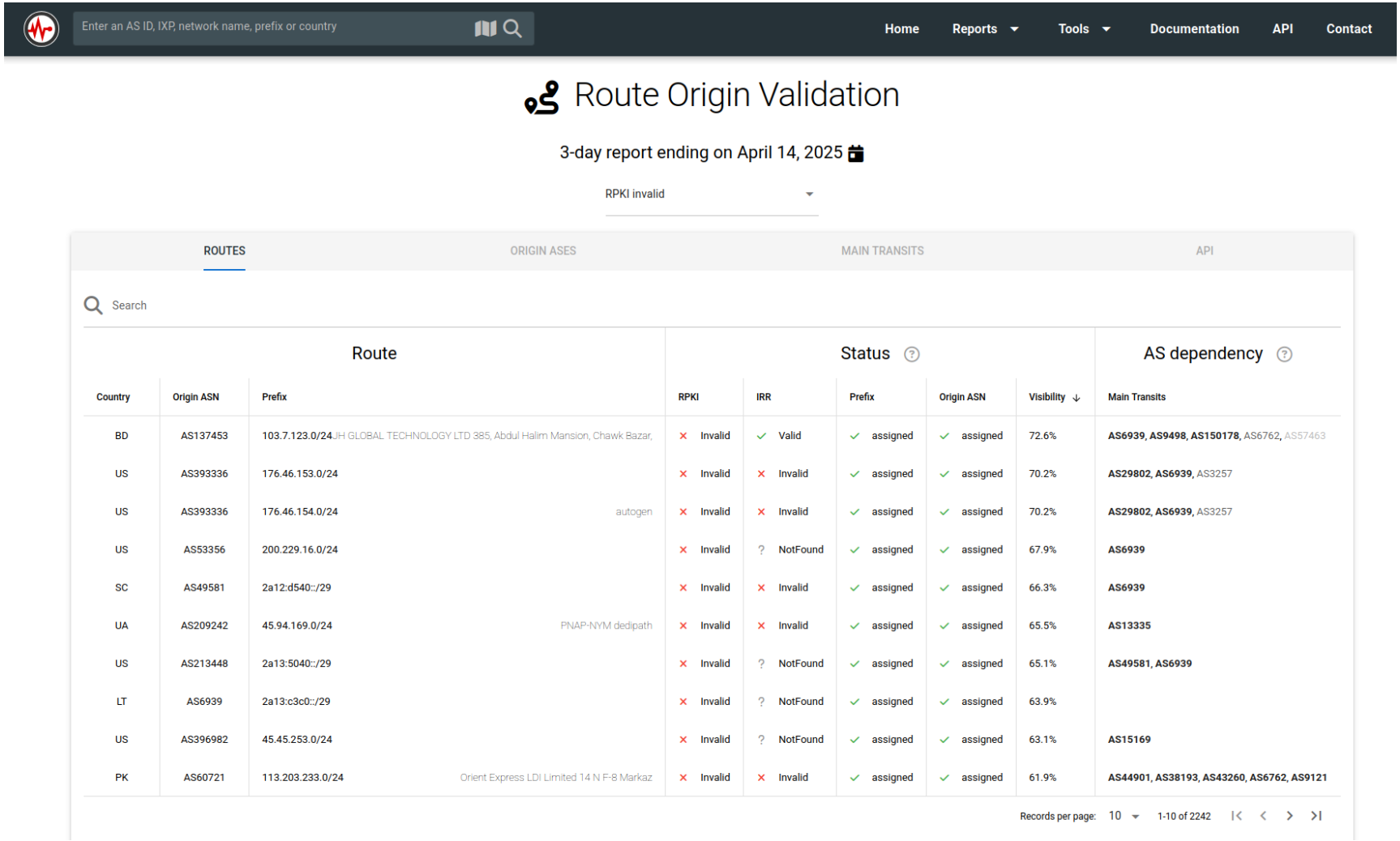
Objectives

- Explore and understand the RPKI ecosystem
  - **Deployment:** How fast is the deployment of RPKI? Who is using RPKI?
  - **Impact:** How RPKI impacts the Internet? Operations?
- Make recommendations to RIR, software developers, and operators

IHR RPKI Dashboard

- Which prefixes are in RPKI? Invalid? How they propagate?

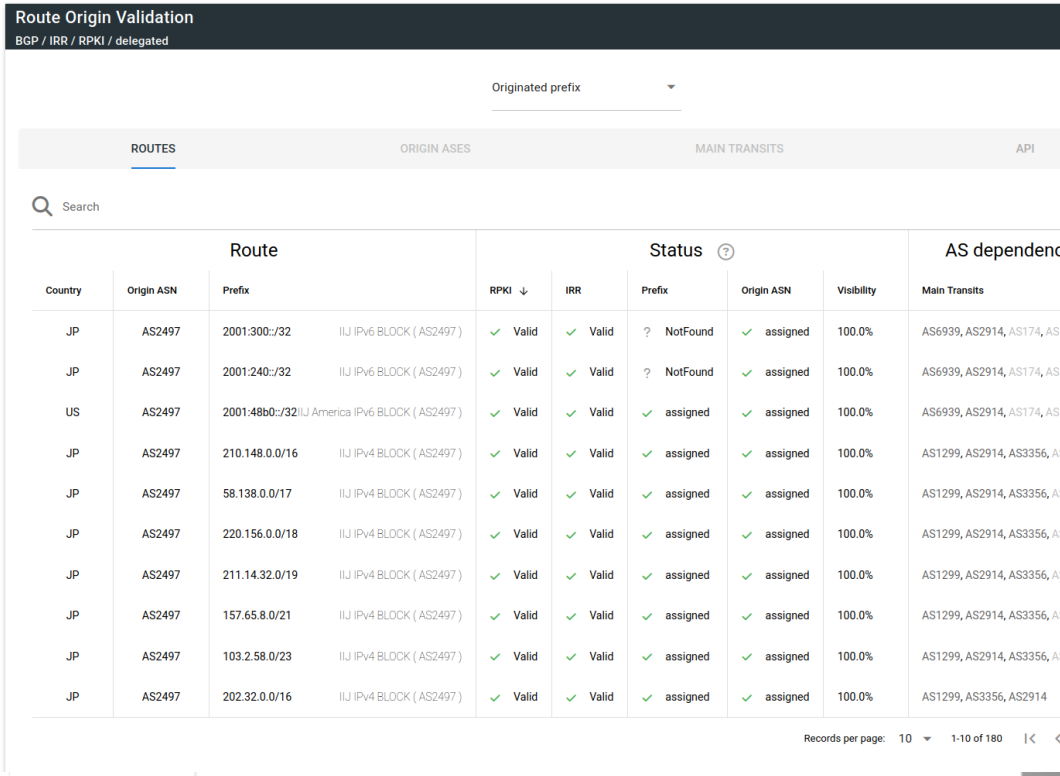
IHR website (https://www.ihr.live/en/rov)



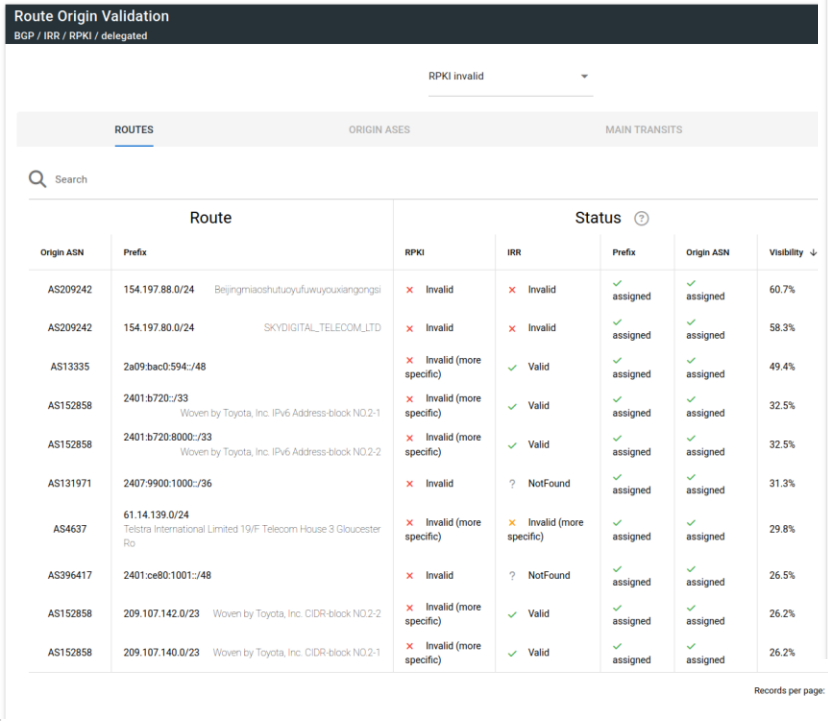
IHR RPKI Dashboard (https://www.ihr.live)

- Global, Country, and AS views
- Updated daily
- Data available via API / downloads

Prefixes originated by IIJ

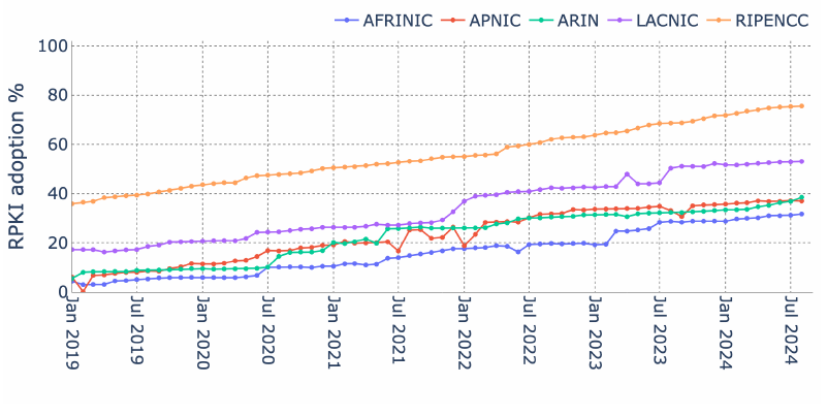


Invalid Prefixes in Japan

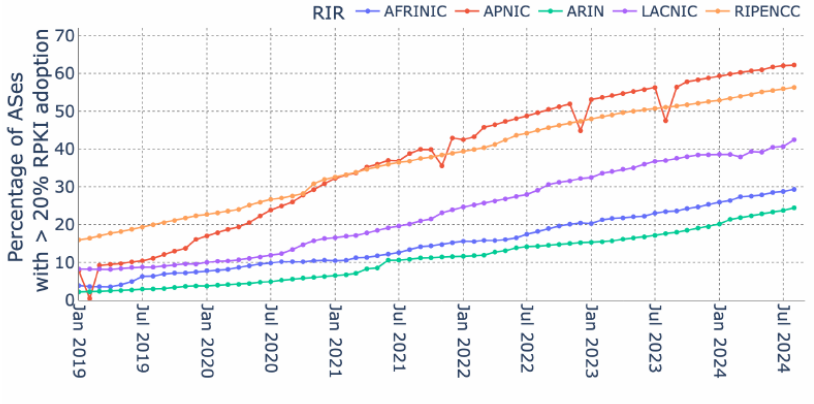


Identifying Current Barriers in RPKI Adoption

- **What drives the deployment of RPKI? Why NOT using RPKI?**



(a) RPKI adoption by address space.



(b) RPKI adoption by networks

AS Rank	ASN	Org. Name	# Prefixes	Addr Size in /24	RPKI coverage %
1	3356	Lumen	938	116,864	0.10
2	1299	Arelion	86	872	95.18
3	174	Cogent	4136	106,561	0.55
4	2914	NTT	261	26,819	95.04
5	6762	Telecom Italia	161	412	46.12
6	6939	Hurican Electric	225	2236	68.83
7	3257	GTT	913	26,146	11.23
8	6453	Tata	96	2242	86.89
9	6461	Zayo	198	6194	3.76
10	3491	PCCW Global	449	3951	97.37

Table 4: Characteristics of the 10 top ranked networks using RPKI

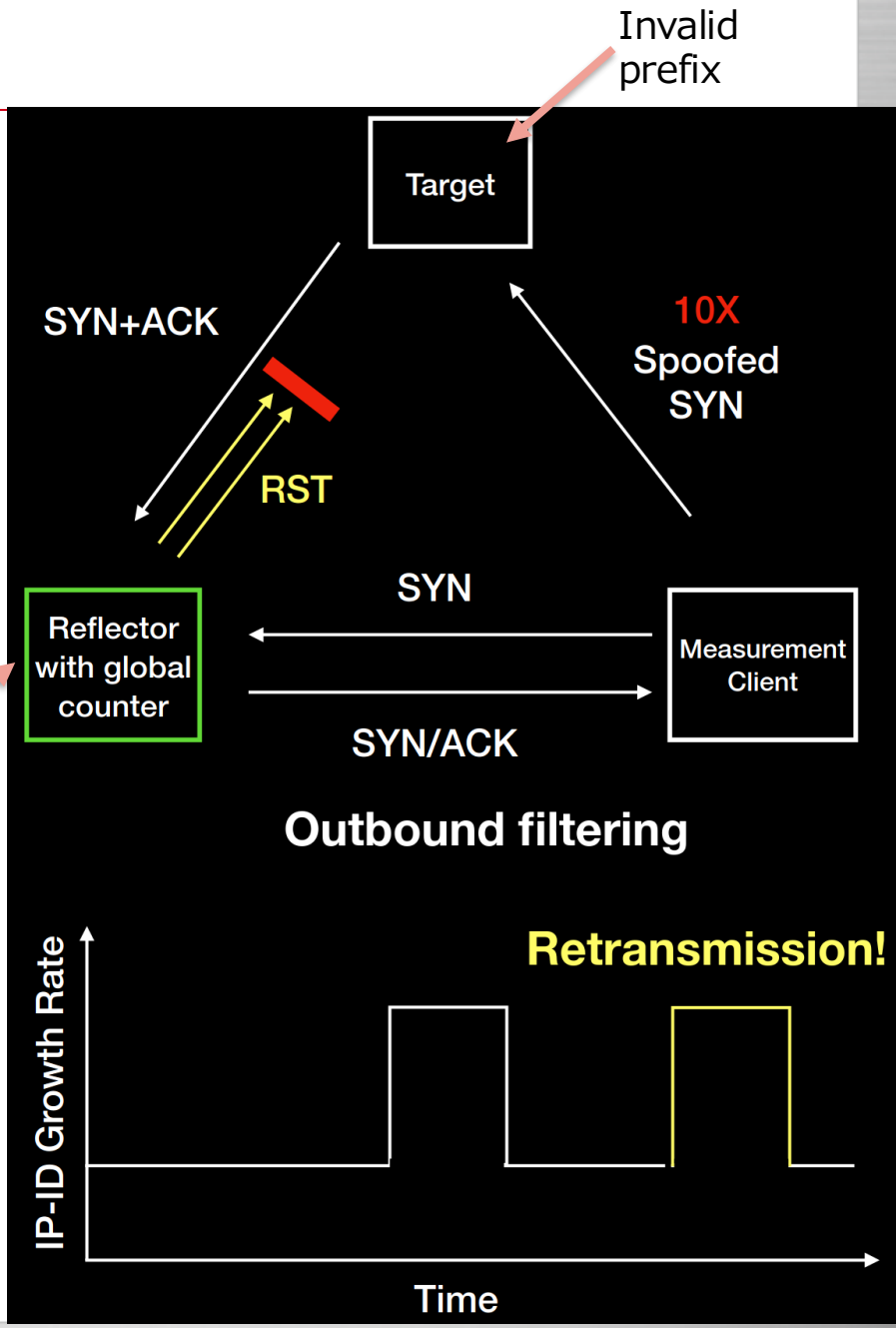
→ Good steady deployment until 50% but probably it's the easiest part

Testart et al. "Identifying Current Barriers in RPKI Adoption", TPRC'24

RoVista

- **Who is implementing ROV?**

- Measurement technique based on:
  - IP-ID
  - IP spoofing



RoVista: Results

- ~3 years of results: https://rovista.netsecurelab.org
- 32k ASes

Search By ASN | Search

Rank	ASN	Country	Organization	ROV-Score	Last updated on
1	3356	United States	Level 3 Parent, LLC	100.0%	2025-04-10
2	1299	Sweden	Arelion Sweden AB	100.0%	2025-04-10
3	174	United States	Cogent Communications	100.0%	2025-04-10
4	3257	United States	GTT Communications Inc.	100.0%	2025-04-10
5	2914	United States	NTT America, Inc.	100.0%	2025-04-10
6	6939	United States	Hurricane Electric LLC	100.0%	2025-04-10
7	6453	United States	TATA COMMUNICATIONS (AMERICA) INC	100.0%	2025-04-10
8	6762	Italy	Telecom Italia S.p.A.	0.0%	2025-04-10
9	6461	United States	Zayo Bandwidth	100.0%	2025-04-10
10	3491	United States	PCCW Global, Inc.	100.0%	2025-04-10

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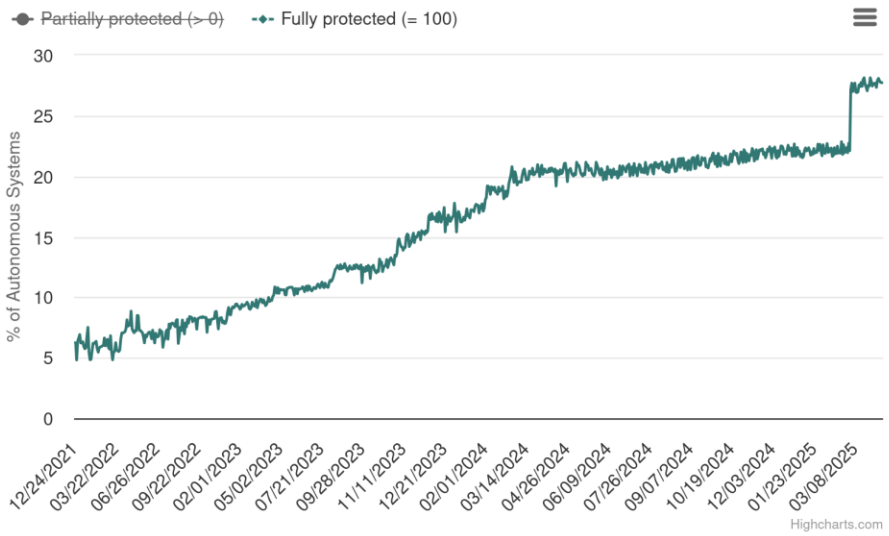
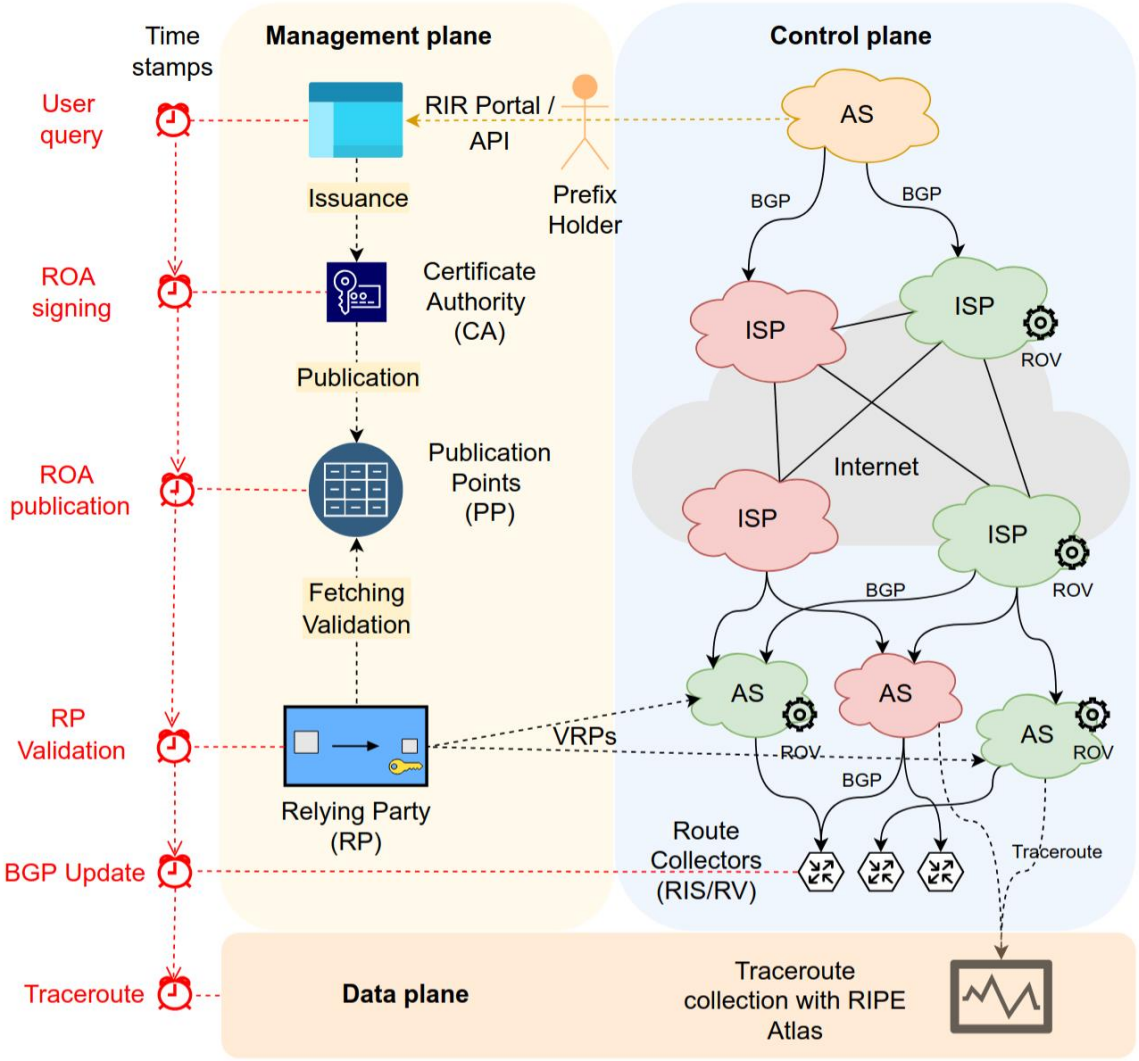


→ Difficult to measure, still in early deployment stage(?)

Li et al. RoVista: "Measuring and Analyzing the Route Origin Validation (ROV) in RPKI"

RPKI time-of-flight

- **Is RPKI slow? Does it bother BGP operations/automation?**



RPKI time-of-flight (Cont.)

- **ROA creation, median delay in minutes:**

	Sign*	NotBefore*	Publication†	Relying Party†	BGP‡
AFRINIC	0 (0)	0 (0)	3 (2)	14 (13)	15 (16)
APNIC	10 (13)	10 (13)	14 (16)	34 (38)	26 (28)
ARIN	- (-)	- (-)	69 (97)	81 (109)	95 (143)
LACNIC	0 (0)	- (-)	54 (32)	66 (42)	51 (34)
RIPE	0 (0)	0 (0)	4 (4)	14 (13)	18 (18)
After fix:					
ARIN	- (-)	- (-)	8 (9)	21 (22)	28 (23)

→ **Good understanding of BGP reactivity to RPKI changes**

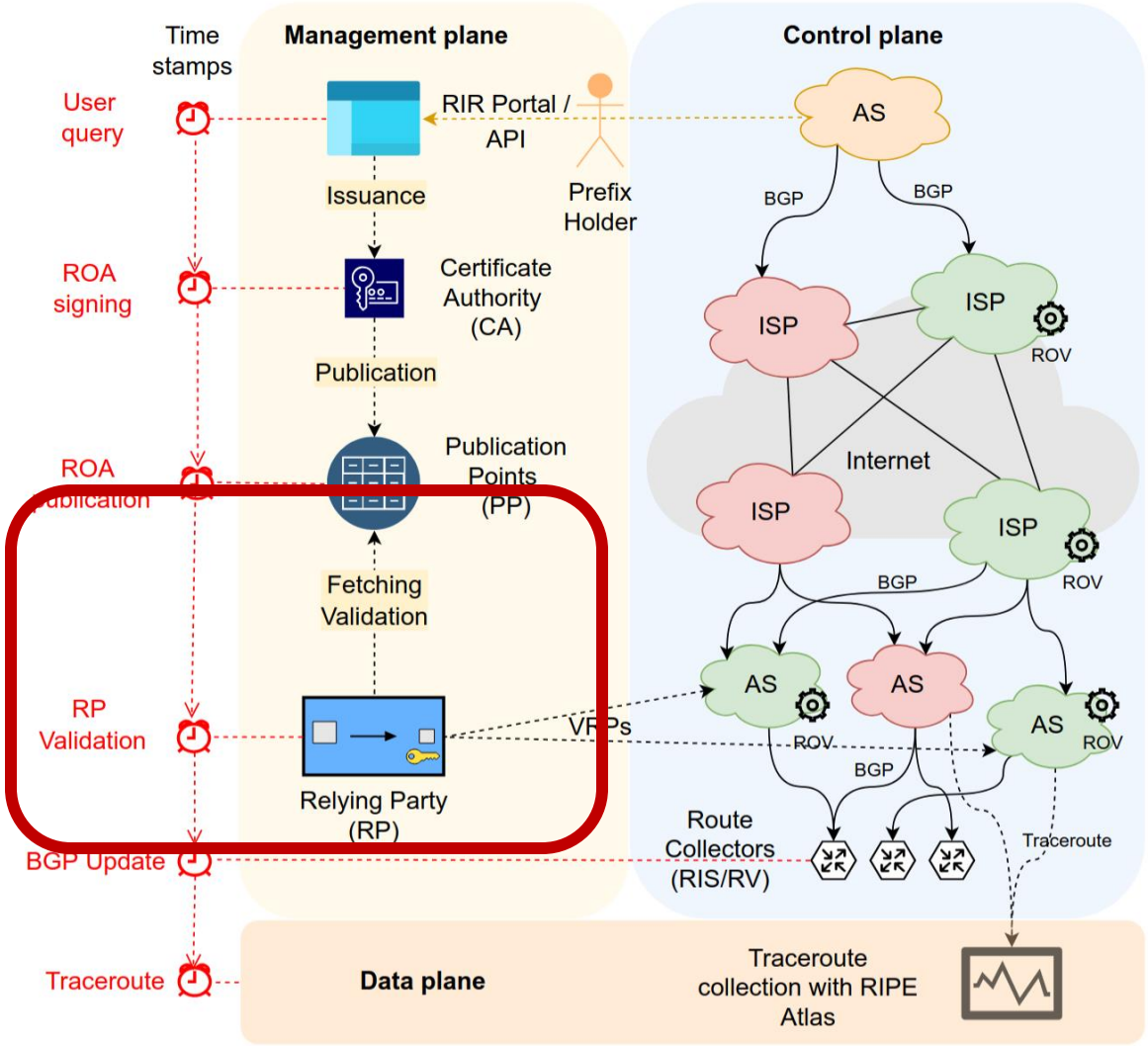
→ **ARIN, APNIC, RIPE updated their software based on this study**

Fontugne et al. "RPKI Time-of-Flight: Tracking Delays in the Management, Control, and Data Planes", PAM'23

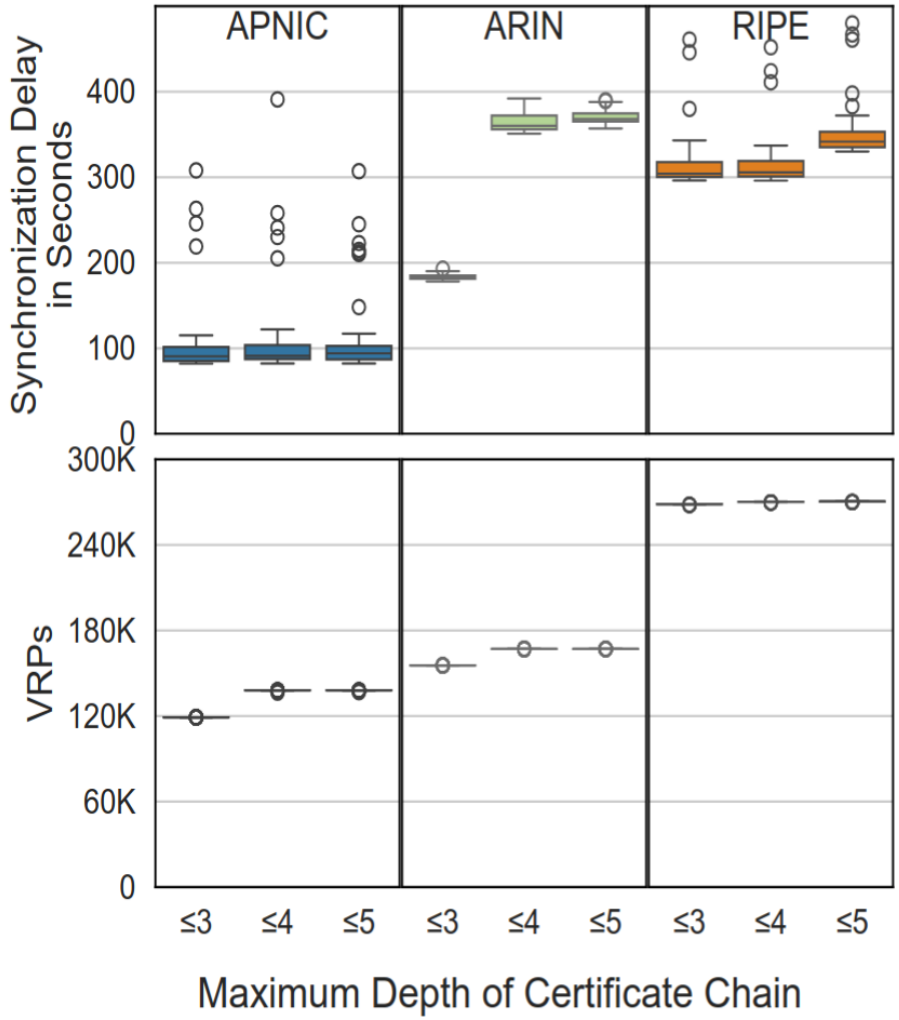
Relying Party delay

RP delay

1. Fetch data from **all** publication points
2. Validate data
3. Push new data to routers



Relying Party synchronization delay (cont.)



→ **ARIN Delegated PP: double delay for only 7% more VRPs**

→ **Bundling speed up processing (APNIC & RIPE)**

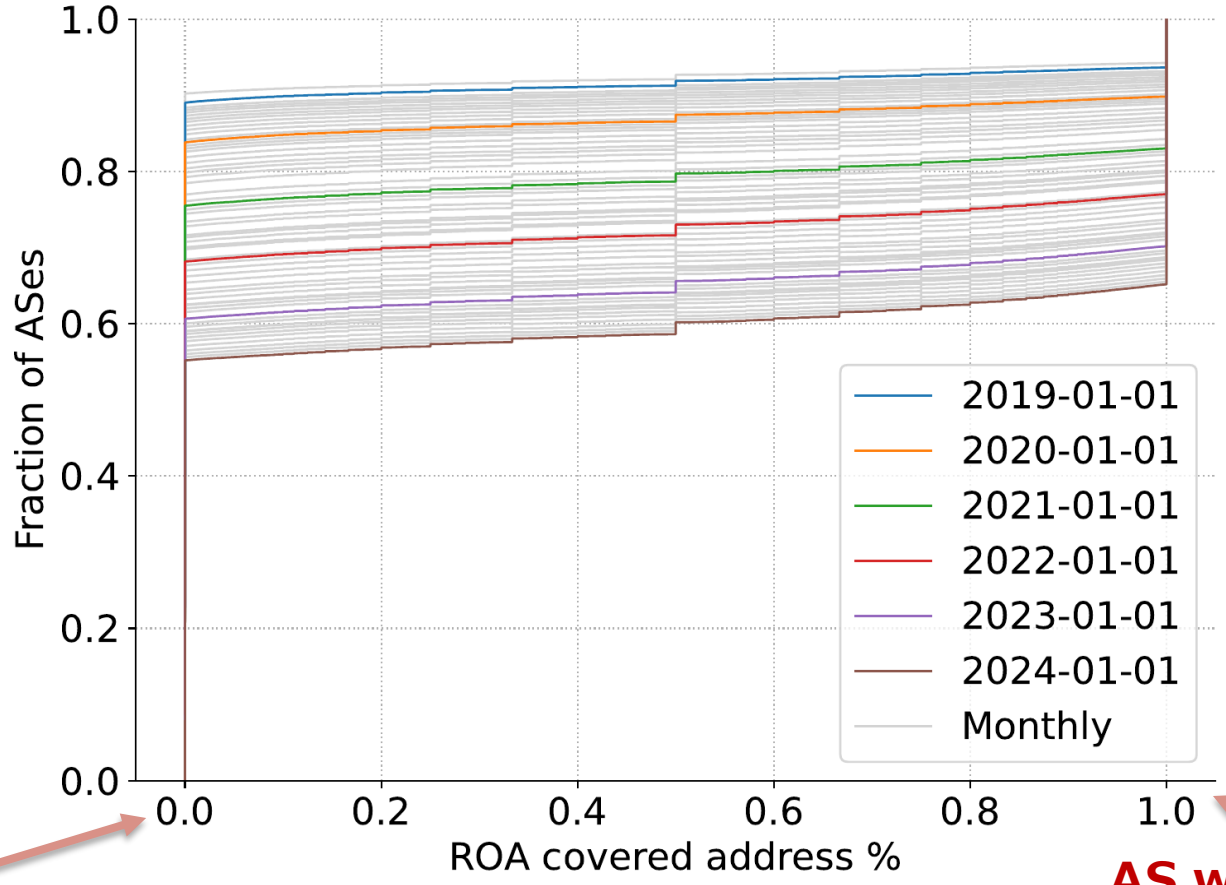
Ongoing work

- **Barriers in RPKI adoption**
  - How much adoption do we need?
  - How hard would it be to get to max adoption?

- **Optimal ROV deployment**
  - Deploying ROV everywhere is not needed
  - But where is the most effective places to deploy ROV?

Questions?

Identifying Current Barriers in RPKI Adoption



AS not at all using RPKI

AS with all its prefixes in RPKI

Testart et al. "Identifying Current Barriers in RPKI Adoption", TPRC'24