The IRR Landscape and its Implications on Global Internet Traffic

Daniel Wagner | DE-CIX R&D // joint work with AMS-IX

nog.fi2026.06

BGP Filter Generation

➔Lots of networks deploy BGP import/export filters

- Security reasons
- Policy enforcement

➔The filter generation relies on external IRR data

- From an IXP handbook: "The route server pulls in multiple *external* databases and checks each announcement per origin AS [...] and delegation [...]"

➔Main IRR data (RPSL objects) relied on:

- AS-SET
- ROUTE(6)
- AUT-NUM

But what if the data in the external source is…

→… inaccurate?

→… outdated?

→… orphaned?

→… even compromised?

But what if the data in the external source is…

➔… inaccurate? … Incorrect filters

➔… outdated? … Unintended blackholes

➔… orphaned? … Redundant filters

➔… even compromised? … Traffic highjacks

A First Glance at the IRR System

➔Lot's of different IRR databases around

➔Some are "authoritative"

- Operated by the official RIRs and their delegates

➔Some are "third party"

- From a time when whois was operated, but the existence of the whois data was the source for ground truth itself

Proposal for a BCOP (RIPE90, 2025)

- ➔IXP operator must use *only RIR* IRR databases (or their official delegates) for Route Server filter generation
- ➔The adoption of this policy will probably result in a massive transfer of RPSL objects (and a traffic shift until then)
  - Grace period of 12 months is introduced in which the list of allowed databases is supplemented by IRRs with more than 1% of global route objects
    - RADB
    - RIPE-NONAUTH
    - NTT
    - LEVEL3

Community Reaction (summarized)

➔Do authoritative IRRs represent operators better than third-party IRRs?

➔Is the juice worth the squeeze?

- Can’t we wait for RPKI to take over?

➔What about legacy space?

- It can’t be transferred

Method

→ We correlate and analyze a large number of data sources

- WHOIS dumps from all 5 RIRs and 14 third-party IRRs
- BGP data
  - Route server dumps from AMS-IX and DE-CIX
  - MRT dumps from RIPE RIS collectors
- RPKI ROA repository data
- RIR specific sources on legacy data
- NRO delegation files

→ We talked a lot to RIRs about their databases and processes for IRR and legacy space

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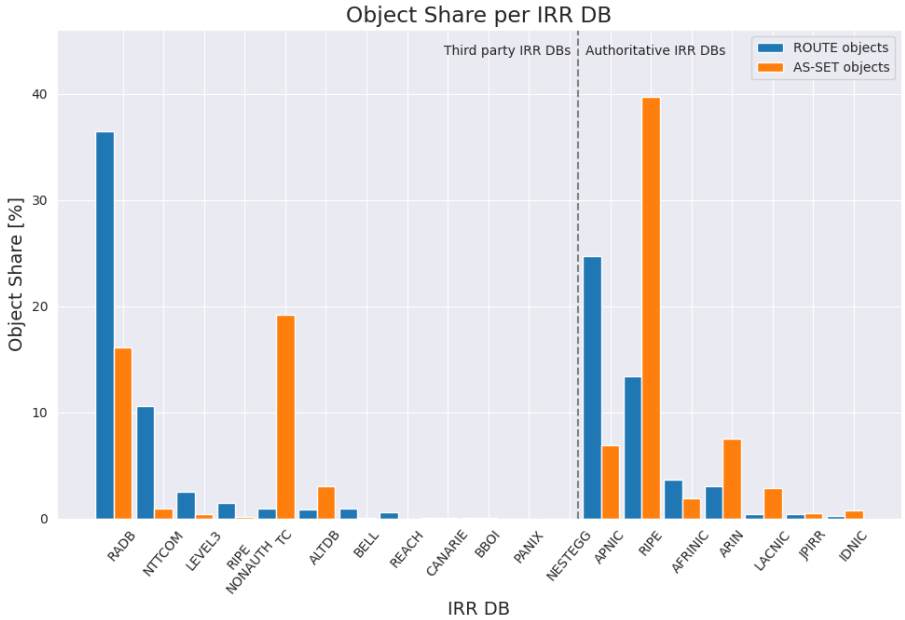
Where are the objects stored?

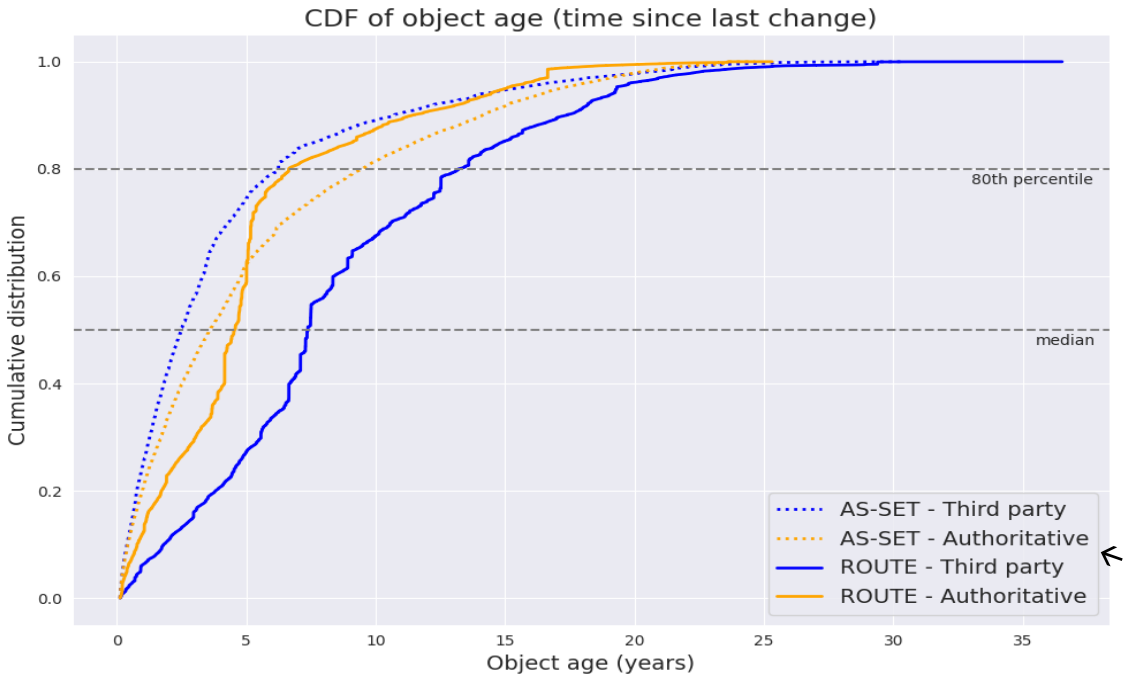


Object	Authoritative IRRs	Third-party IRRs
ROUTE objects	46%	54%
AS-SET objects	60%	40%
AUT-NUM objects	79%	21%

Source: NIST RPKI monitor - https://rpki-monitor.antd.nist.gov/

How Often are Objects Updated?

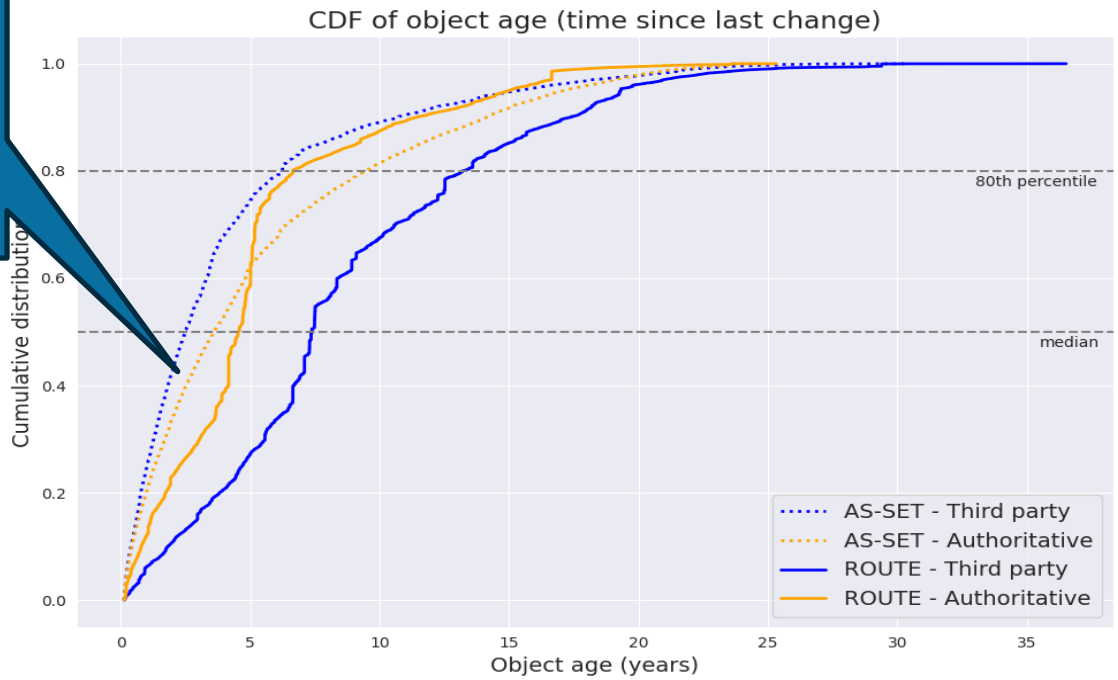
Good performance



bad performance

How Often are Objects Updated?

AS-SET updates look a bit better for third-party IRRs. *This is caused by TC!*



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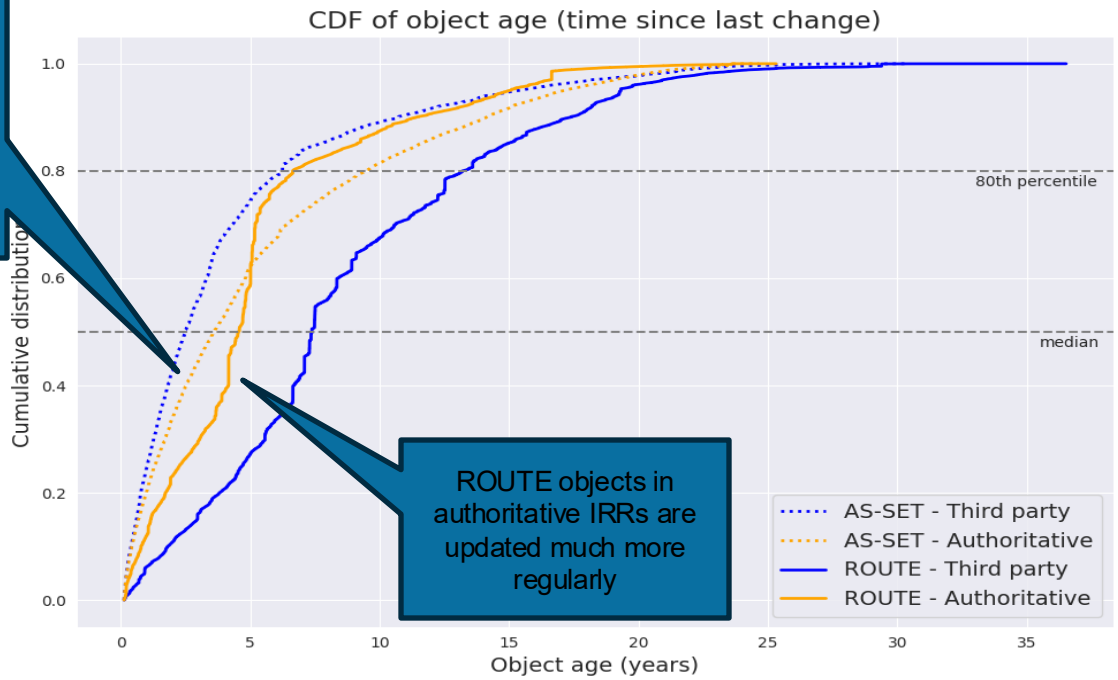

ROUTE objects in authoritative IRRs are updated much more regularly

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Do Objects Align with the DFZ?

← bad performance

Good performance →

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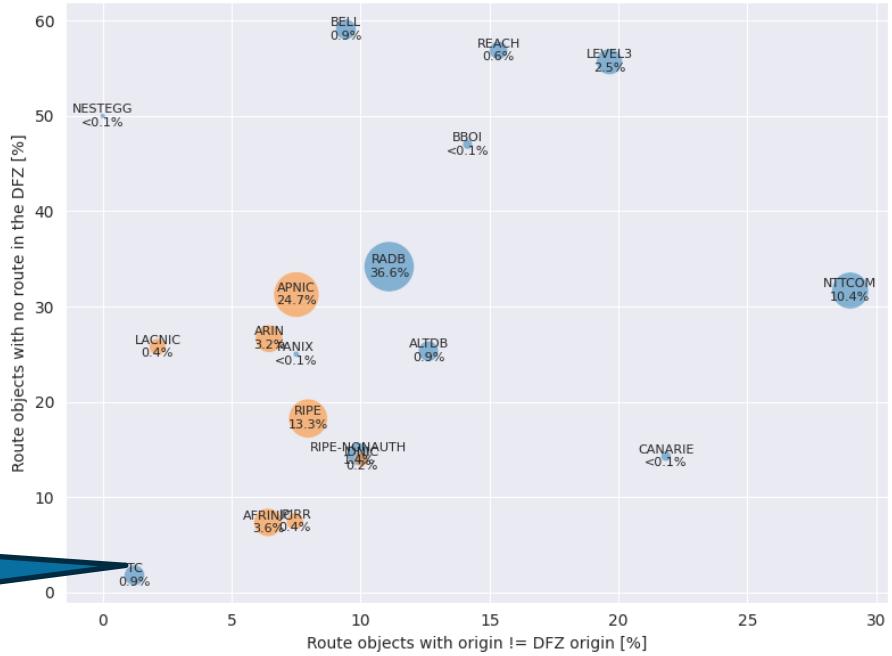
Where networks meet

www.de-cix.net

Do Objects Align with the DFZ?

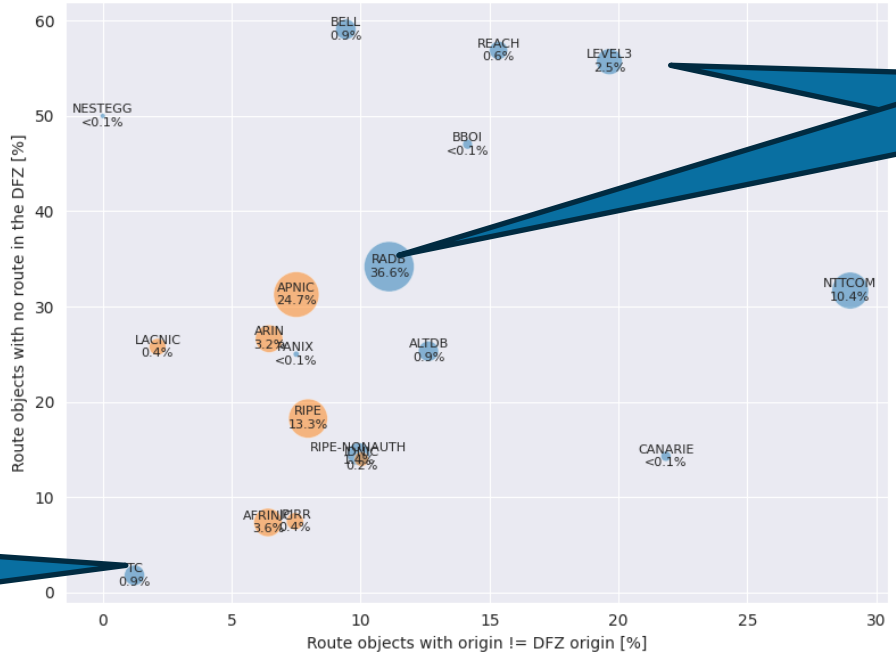


TC is the unlikely winner. We asked them: they enforce strict rules.

→ The size of the bubbles indicates the share of overall route objects the respective database holds.

→ The more on the bottom left a database is, the more relevant information it contains and the more accurately it reflects the information reflects the situation in the DFZ.

Do Objects Align with the DFZ?



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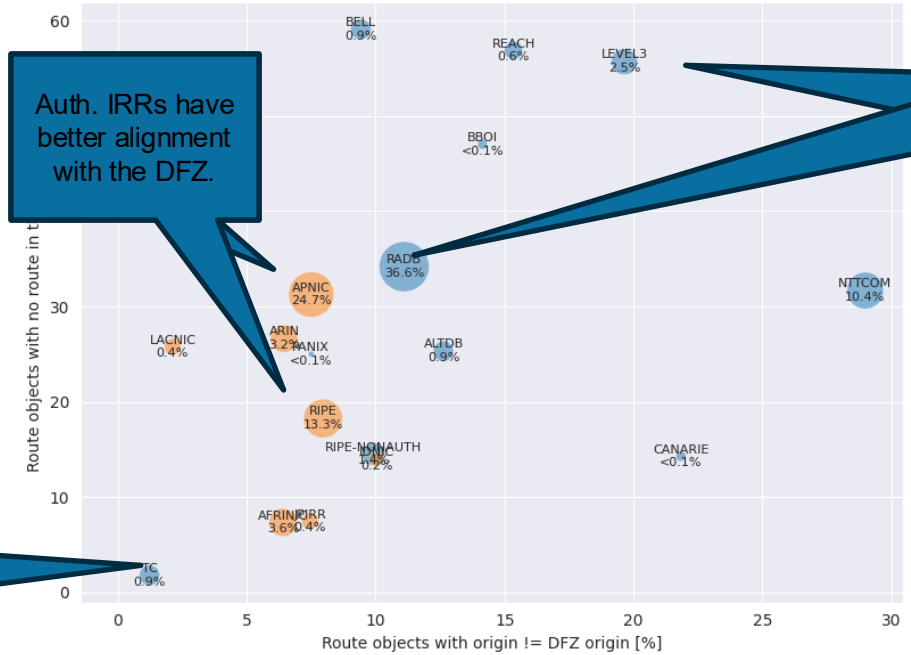

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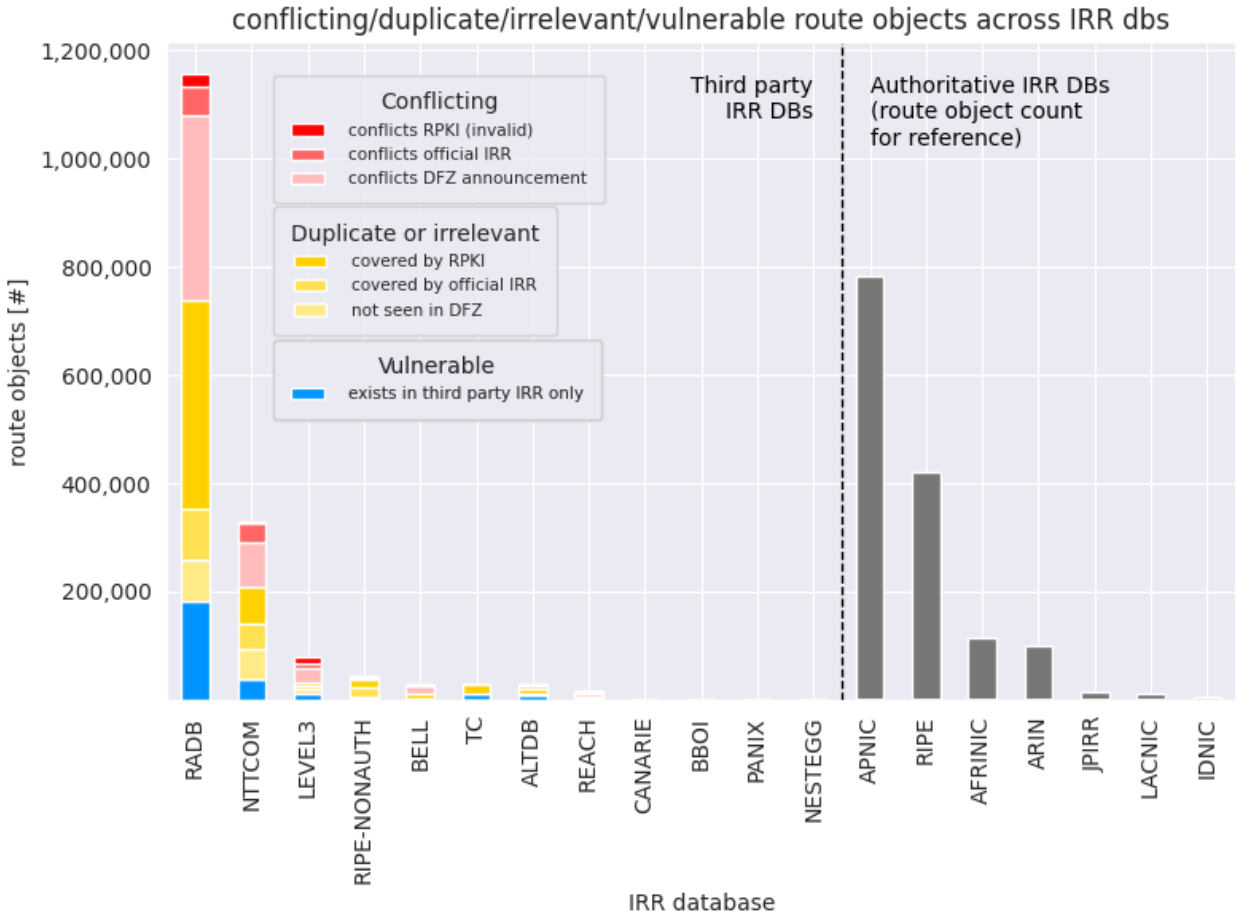
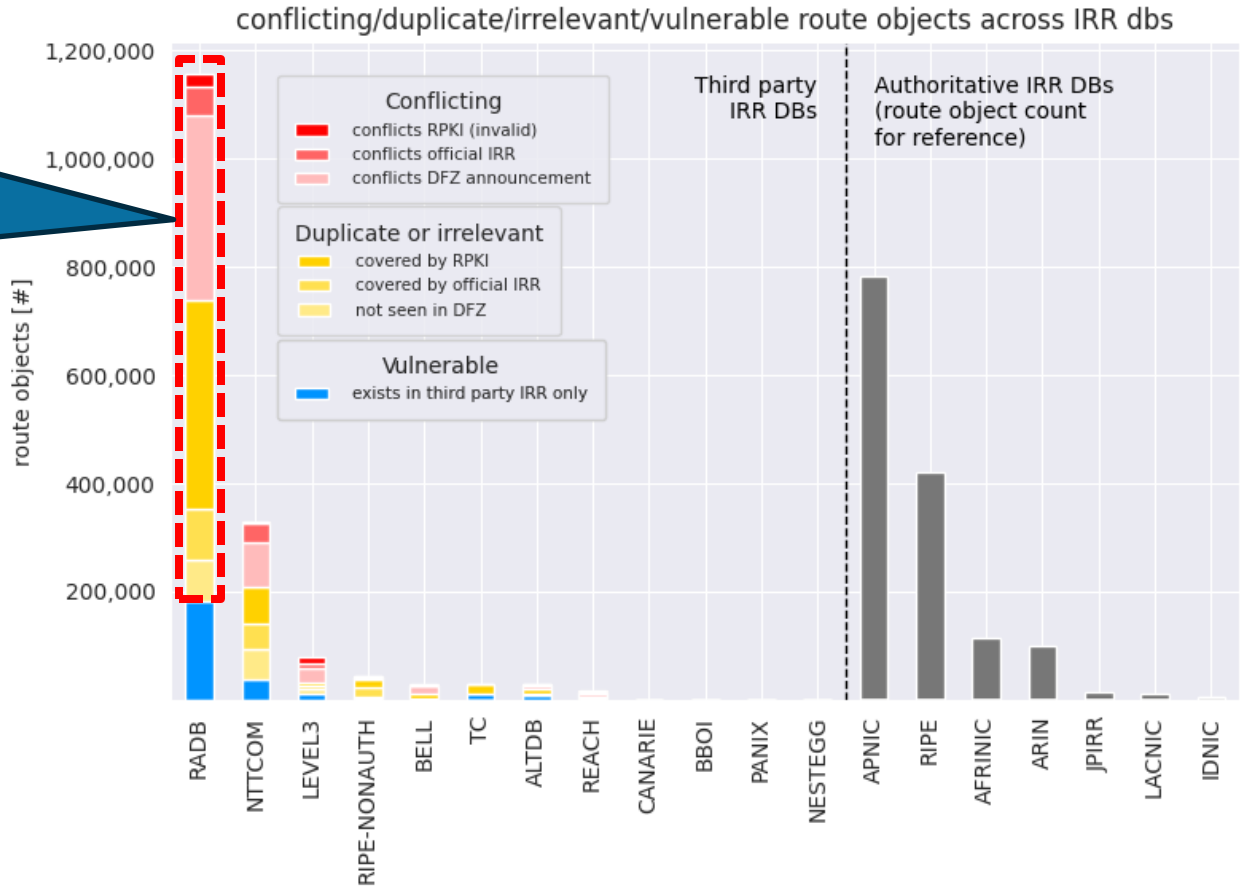


How about Data Quality of Route Objects?

1M route objects (84%) in RADB are conflicting or irrelevant.



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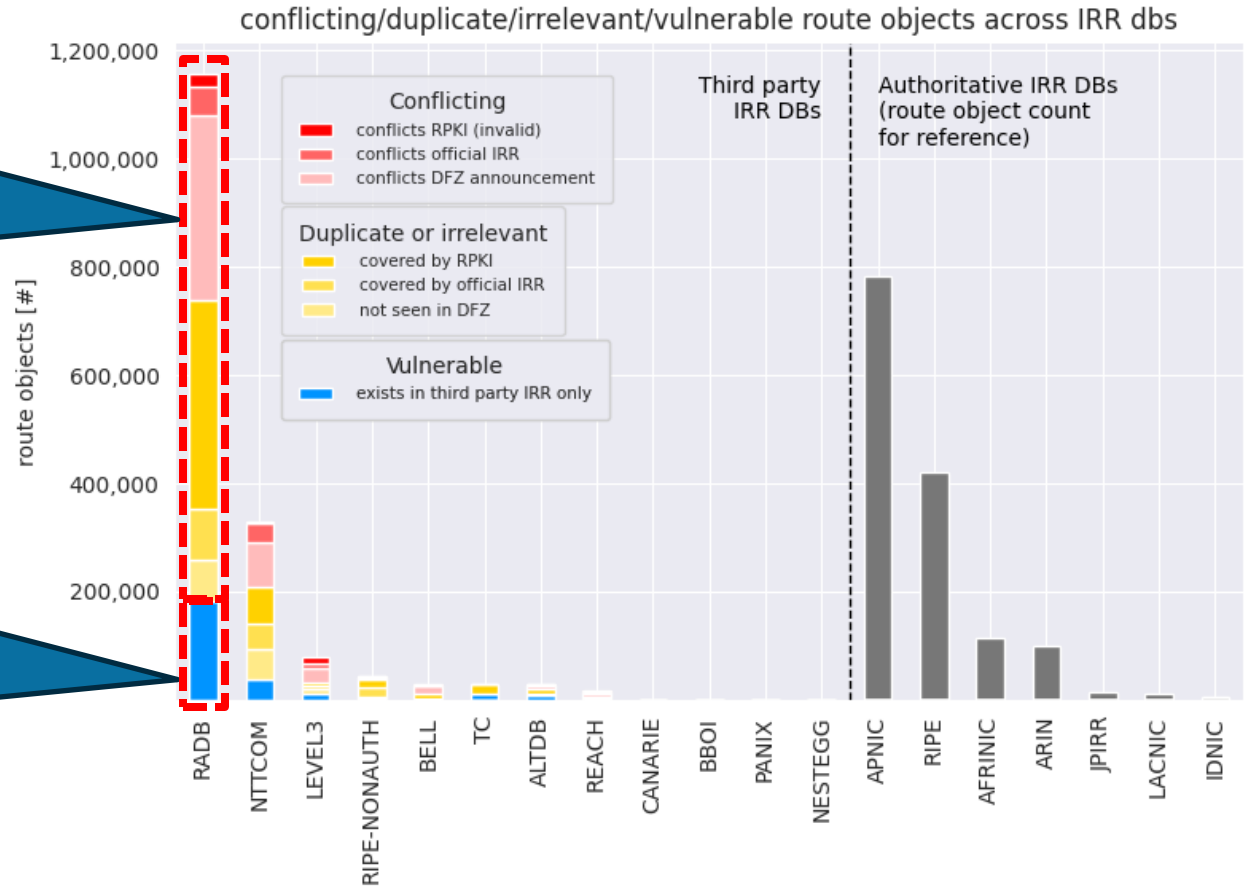

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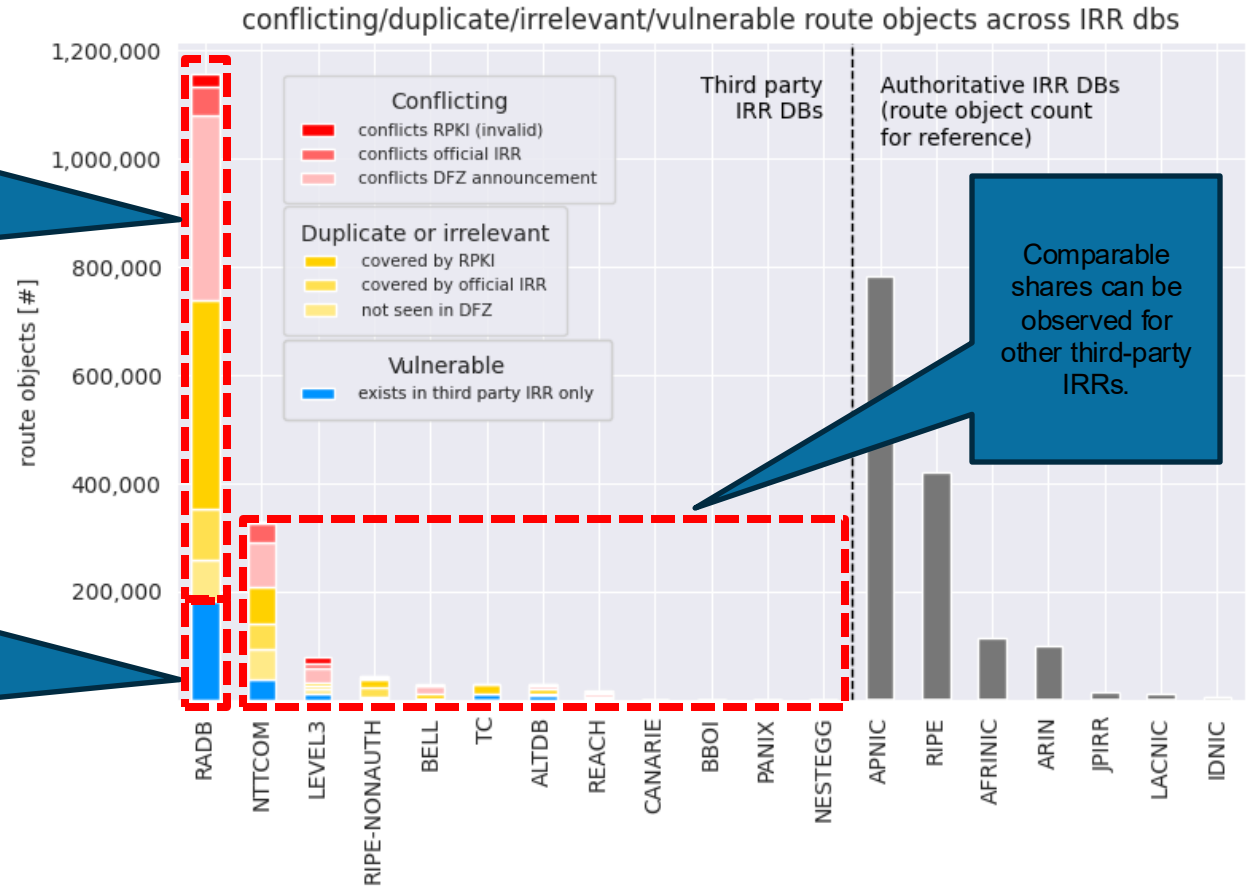

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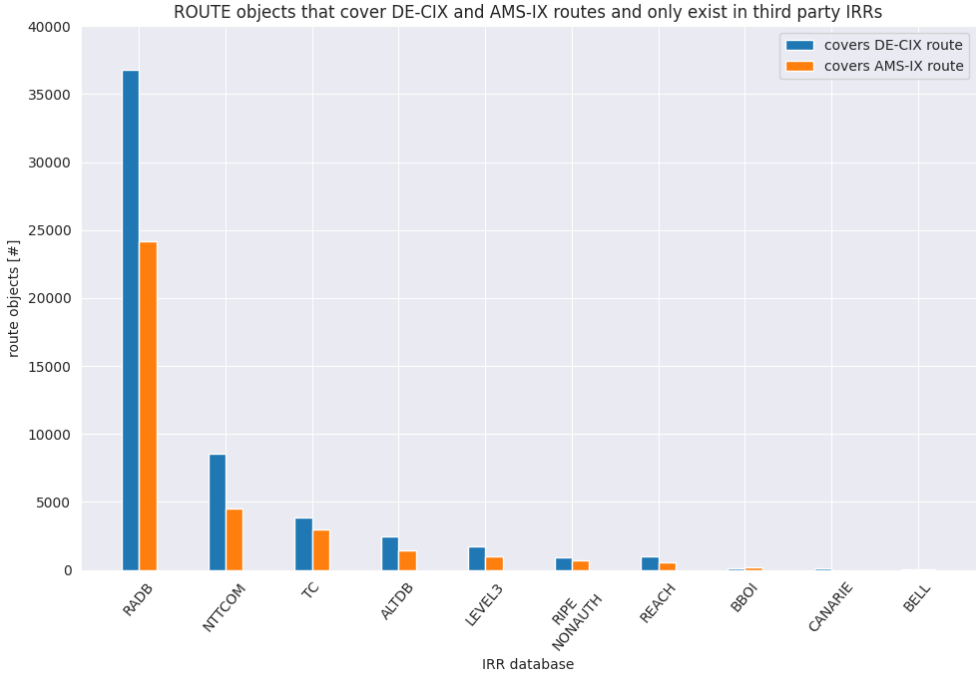
Comparable shares can be observed for other third-party IRRs.

Vulnerable Route Objects covering Production Announcements



In total, we identified 36k/56k vulnerable route objects relevant for AMS-IX/DE-CIX routes. >50% of them are in RADB.

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- We found more than 230k injectable/vulnerable route objects

➔What about legacy space?

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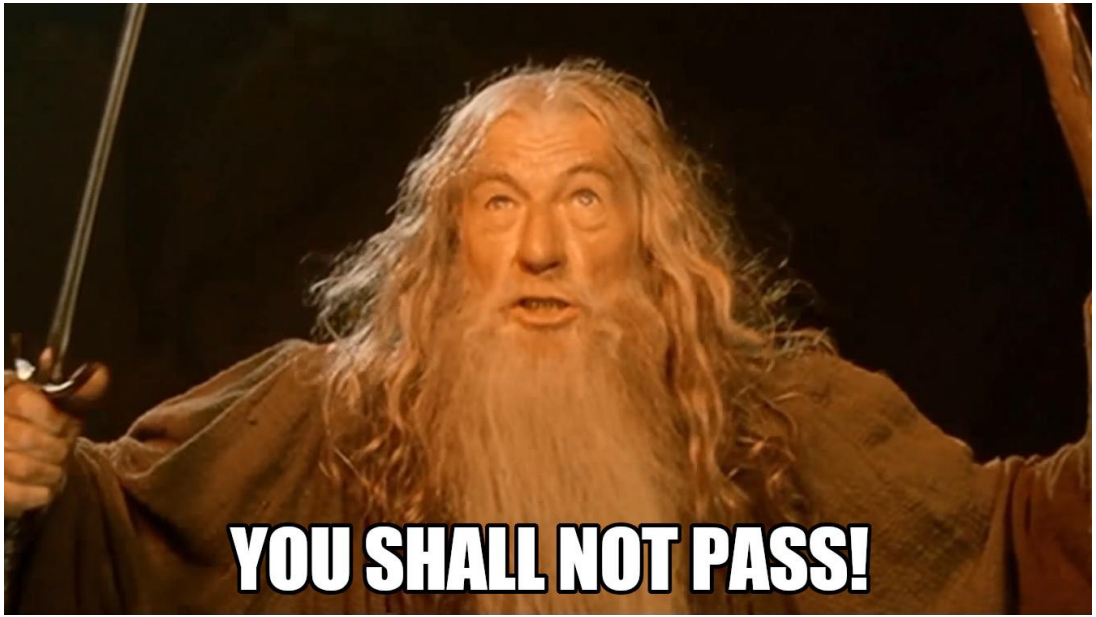

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Legacy Space ….

➔In general, Legacy space is the space allocated to Organizations before the 5 RIRs where established

- But not all RIRs were established at the same time
- Oldest: RIPE NCC, founded in April 1992
  Youngest: AFRINIC, established in October 2004

➔Different ways of handling their corresponding Legacy space

Different RIR, Different Legacy Space Rules

RIR	IRR access	RPKI access	Due diligence process
AFRINIC	no service agreement	service agreement	Yes*
APNIC	All APNIC legacy space is under contract or was returned to IANA.		
ARIN	service agreement	service agreement	Yes*
LACNIC	no service agreement	no service agreement	Yes*
RIPE NCC	no service agreement	service agreement	Yes*

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ARIN legacy remains the main obstacle.

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Where networks meet

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ARIN legacy remains the main obstacle.

All RIRs require due diligence for service agreement.

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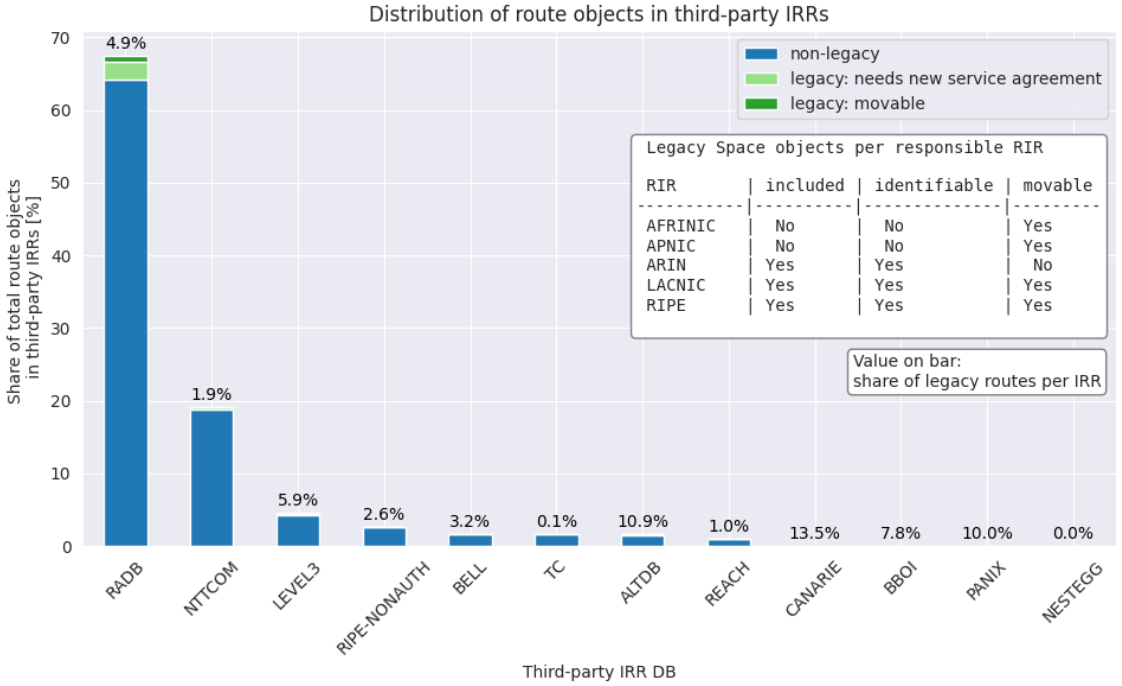
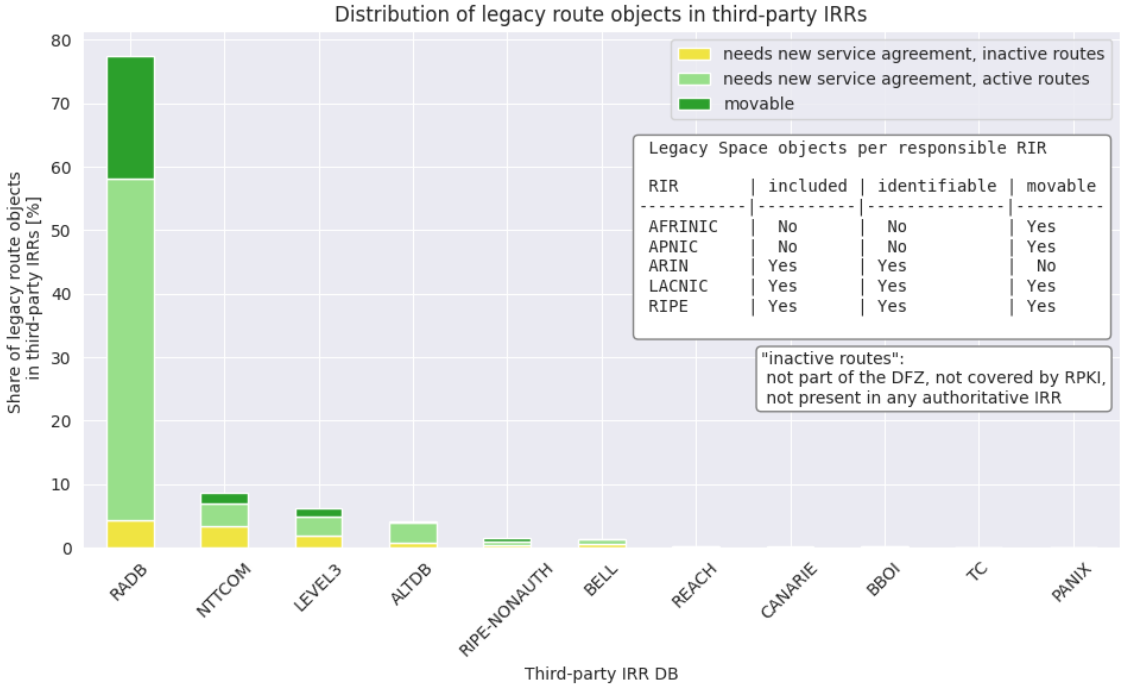
Where networks meet

* for service agreement

Where does Legacy Space "live"?



Global Share per Third-Party IRR



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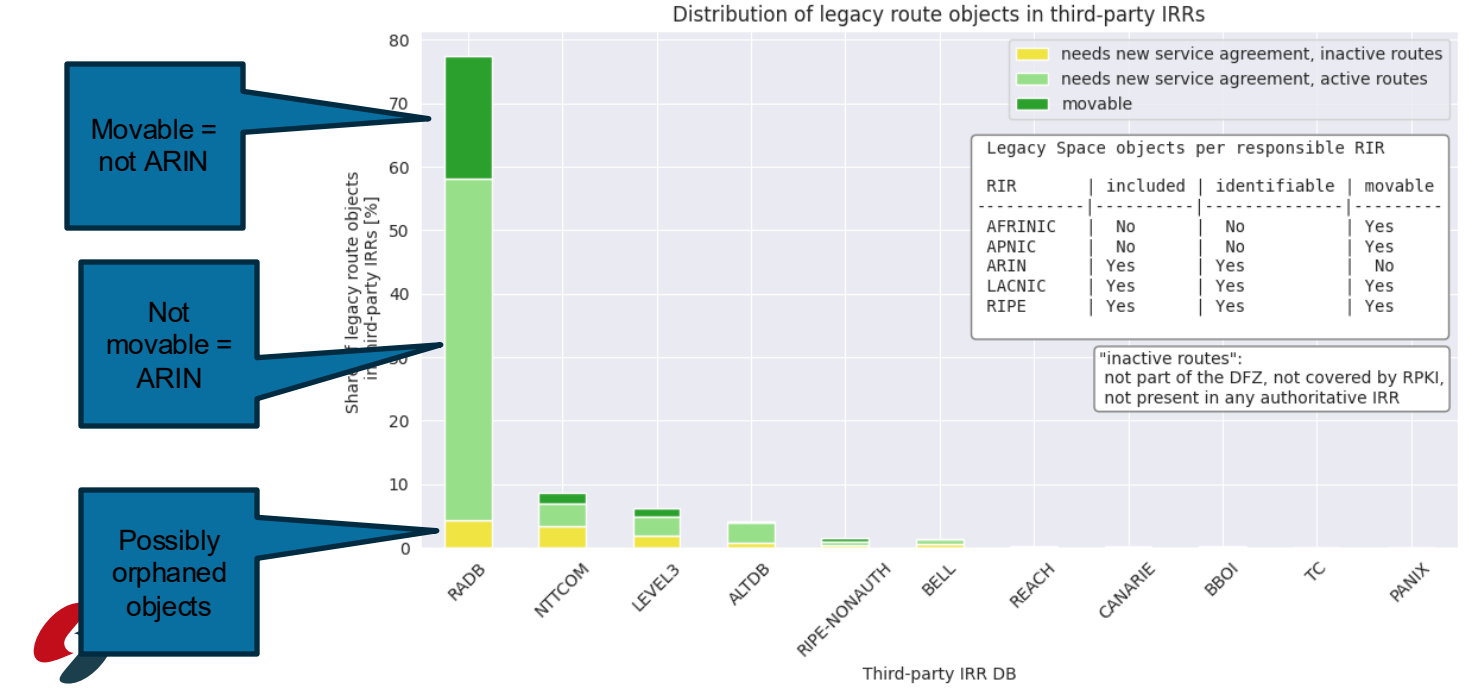

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➔What about legacy space?

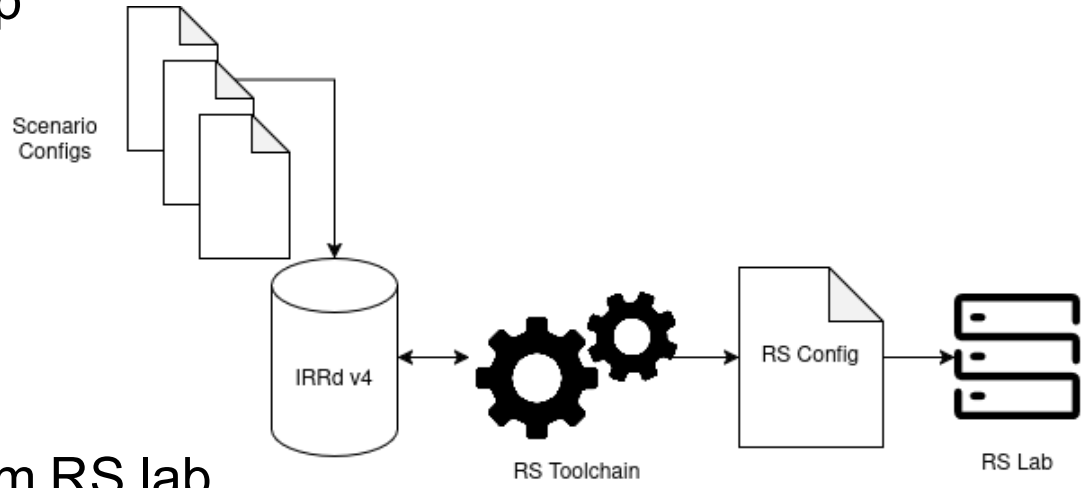
- ARIN remains problematic, for other RIRs non-member IRR services exists
- We found 3.27% ARIN legacy route objects in third-party IRRs, mostly in RADB

Spoiler: RIPE Labs Article (3)

- ➔Investigate Impact of
  - Third-party AS-SET deprecation
  - Third-party ROUTE(6) deprecation
  - Allowing ROA-derived fake ROUTE(6) objects
- ➔Breakdown of lost prefixes
- ➔Measure actual traffic loss

Experiment Setup

- Replicate production setup as close as possible
- Plug scenario-configs into IRRd v4
- Get list of lost prefixes from RS lab



Next Steps

- Publish third part of RIPE Labs article series
- Measure actual traffic loss
- 3 different scenarios
  - Combination of IRR DBs and RPKI inclusion

- Spoiler:
  - RPKI seems to be promising to replace lots of problematic & legacy-derived IRR problems
  - AS-SET resolution based on RIR IRR data causes significant traffic loss, ASPA would help to solve this problem