RIPE NCC
RIPE NETWORK COORDINATION CENTER

ASPA in the RPKI Dashboard

Tim Bruijnzeels | APNIC 61 | 10 February 2026

What is ASPA?

AS Provider Authorisations (ASPA)

ASPA Object Structure (simplified)

- Like a ROA
- Signed by the holder of one Customer AS
- Authorising one or more Provider ASes

The holder of the Customer AS Number declares which AS Numbers may appear as their Providers in BGP paths

Plausible Paths from Customer to Provider

Plausible, well… *Not Implausible* Paths

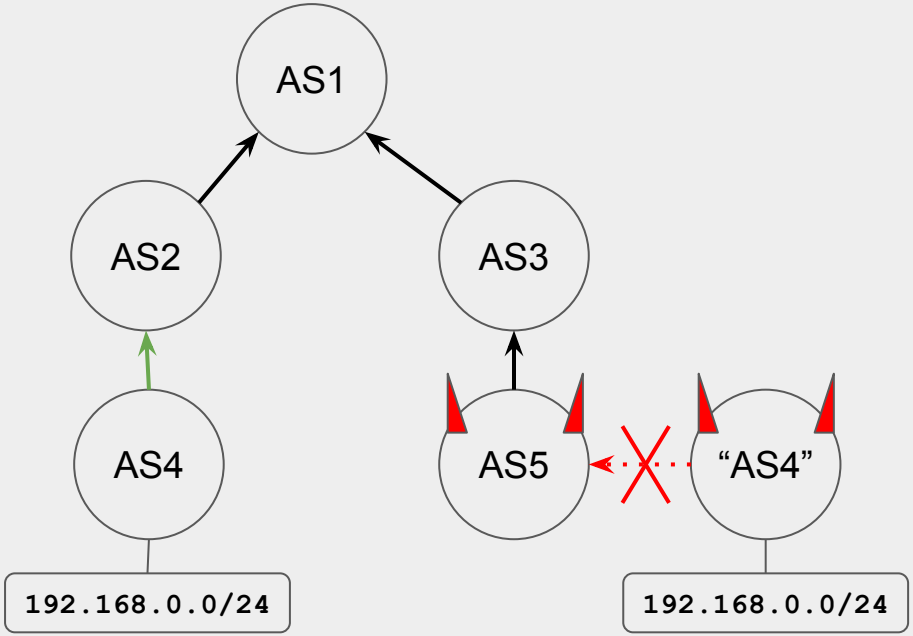
- Each AS-to-AS hop is *verified* as:
  - Provider
  - Not Provider
  - No Attestation
    (no ASPA exist for customer AS)

- A path received from a customer is **invalid** if "Not Provider" encountered:
  - Proven unexpected hop
  - Support partial deployment (no attestation is okay)
  - Fail open in case of an issue with RPKI *validation* itself

Routes learned from Customer AS networks MUST NOT have "Not Provider"

ASPA Verification - Routes from Customers

Spoofed origin AS



Given:
192.168.0.0/24 => AS4
AS4 => [AS2]

AS1 sees 1 3 5 4 192.168.0.0/24

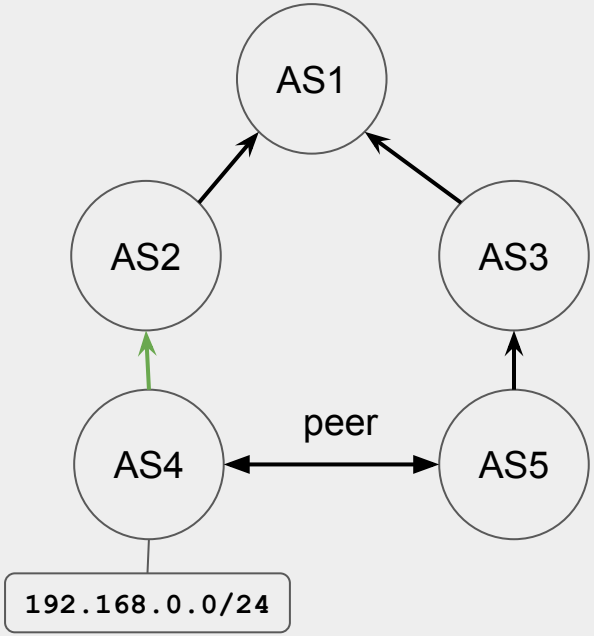
AS1 knows:

- AS3 is a customer session
- AS5 is “Not Provider” for AS4

Therefore this is **invalid**.

ASPA Verification - Routes from Customers

Or.. perhaps just a leak?



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AS1 sees 1 3 5 4 192.168.0.0/24

AS1 knows:

- AS3 is a customer session
- AS5 is "Not Provider" for AS4

Therefore this is **invalid**.

Note: it does not matter if it's an accidental leak, or malicious spoofing.

Other Routes? Valley Free Routing!

Announcements go **up ramp** from customers to providers to a **single peak** consisting of a shared provider or two adjacent peers and then **down ramp** from providers to customers.

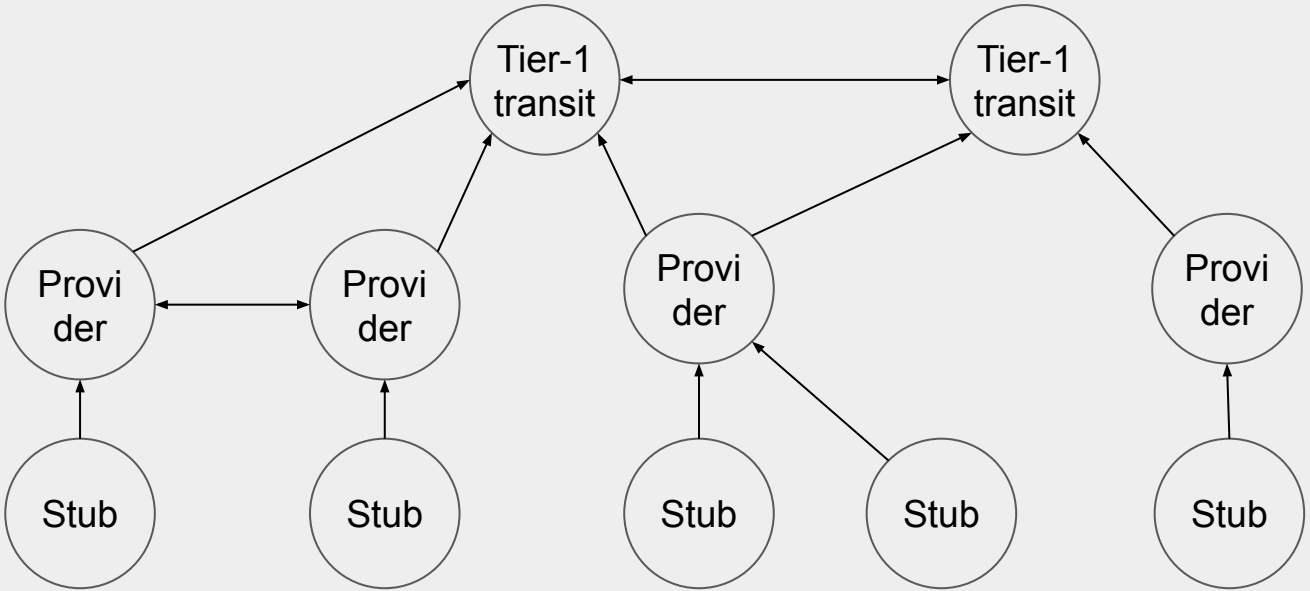
Announcements that go **up**, then **down** and then **up** (and likely **down**) again have a **valley**.

Valleys are considered harmful route leaks because:

- Latency
- Congestion
- Cost
- Data security

Valley Free Routing

Topology and Relations



Spoiler:

ASPA objects provide information about the relations needed to detect valleys

How ASPA Finds Valleys

Take the longest possible

- Customer to Provider path from the origin as “UP” ramp
- Provider to Customer path from the reverse end as “DOWN” ramp

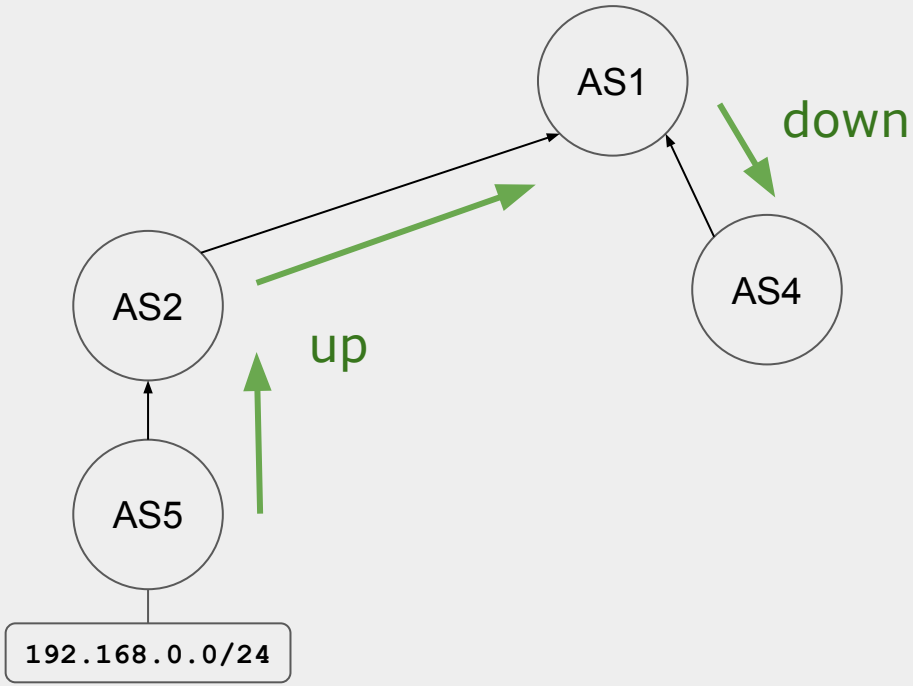
Then UP and DOWN must either

- meet at adjacent peers
- meet in a shared Provider
- overlap with multiple hops (partial adoption or complex relations)

A gap between UP and DOWN means there is a valley: mark **invalid**

Valley Free Routing

Valley Free - Common Provider




```
Given:
192.168.0.0/24 => AS5

AS1 => [ AS6 ]
AS2 => [ AS1 ]
AS3 => [ AS1 ]
```

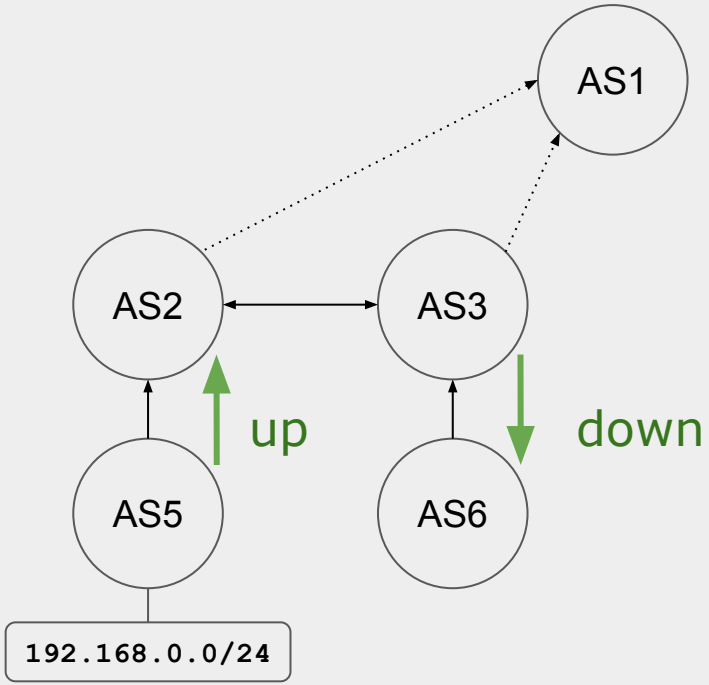
```
AS4 sees 4 1 2 5 192.168.0.0/24
```

- AS4 is "Not Provider" for AS1
  UP: 1 2 5
- AS2 is "Not Provider" for AS1
  DOWN: 4 1

Meet in shared provider AS1 => **valid**

Valley Free Routing

Valley Free - Peer




```
Given:
192.168.0.0/24 => AS5

AS1 => [ AS0 ] # provider free
AS2 => [ AS1 ]
AS3 => [ AS1 ]
```

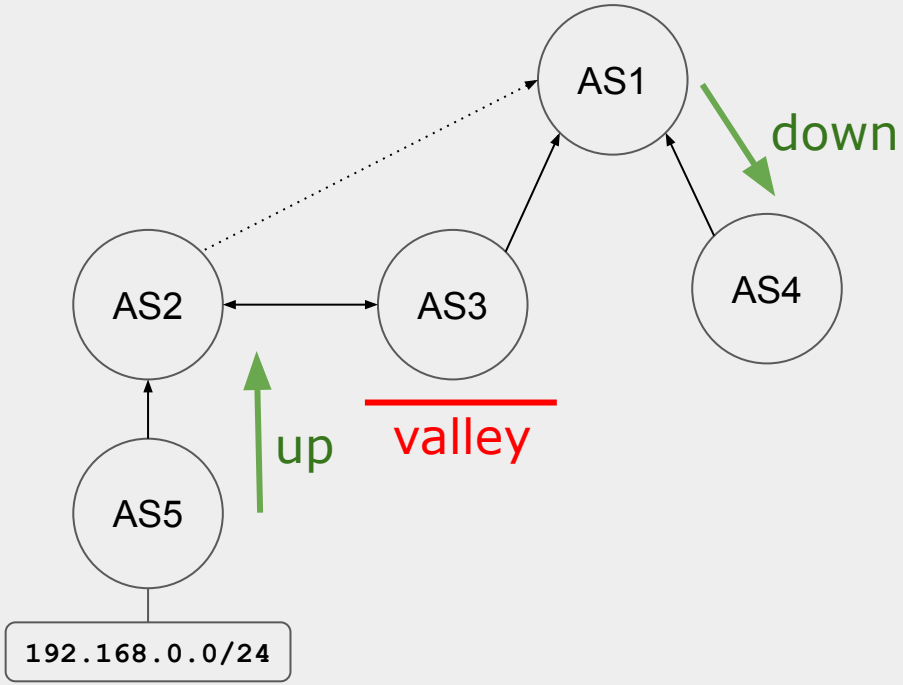
AS6 sees 6 3 2 5 192.168.0.0/24

- AS3 is "Not Provider" for AS2
  UP: 2 5
- AS2 is "Not Provider" for AS3
  DOWN: 6 3

Ramps meet at peers 2-3 => **valid**

Valley Free Routing

Not Valley Free - Leak by adjacent peer




```
Given:
192.168.0.0/24 => AS5

AS1 => [ AS99 ]
AS2 => [ AS1 ]
AS3 => [ AS1 ]
```

```
AS4 sees 4 1 3 2 5 192.168.0.0/24
```

- AS3 is "Not Provider" for AS2
  UP: 2 5
- AS3 is "Not Provider" for AS1
  DOWN: 4 1

AS3 is a valley, therefore this is **invalid**.

The Curious Case of AS 0

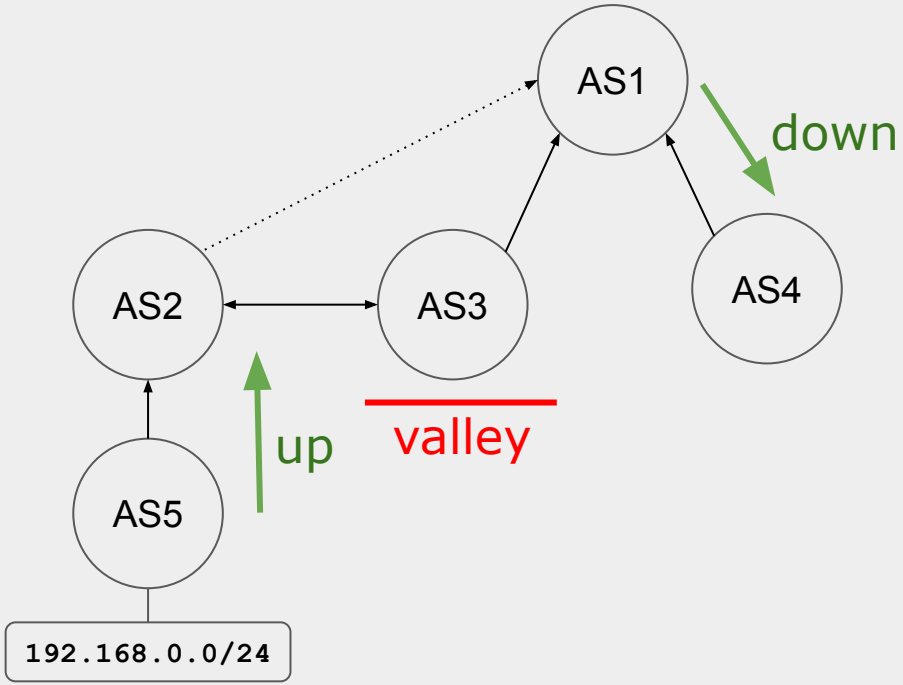
The Curious Case of AS 0

AS 0 is used in ASPA objects to indicate that the **customer AS** has no providers.

- AS 0 is reserved and cannot be on the path
- So every next AS gets “No Provider”
- Used by
  - Tier-1/Transit-free Networks
  - Transparent Route Servers
  - Route Collectors

Valley Free Routing

Leak by adjacent peer - Through TIER-1




```
Given:
192.168.0.0/24 => AS5

AS1 => [ AS0 ] # NO PROVIDER
AS2 => [ AS1 ]
AS3 => [ AS1 ]
```

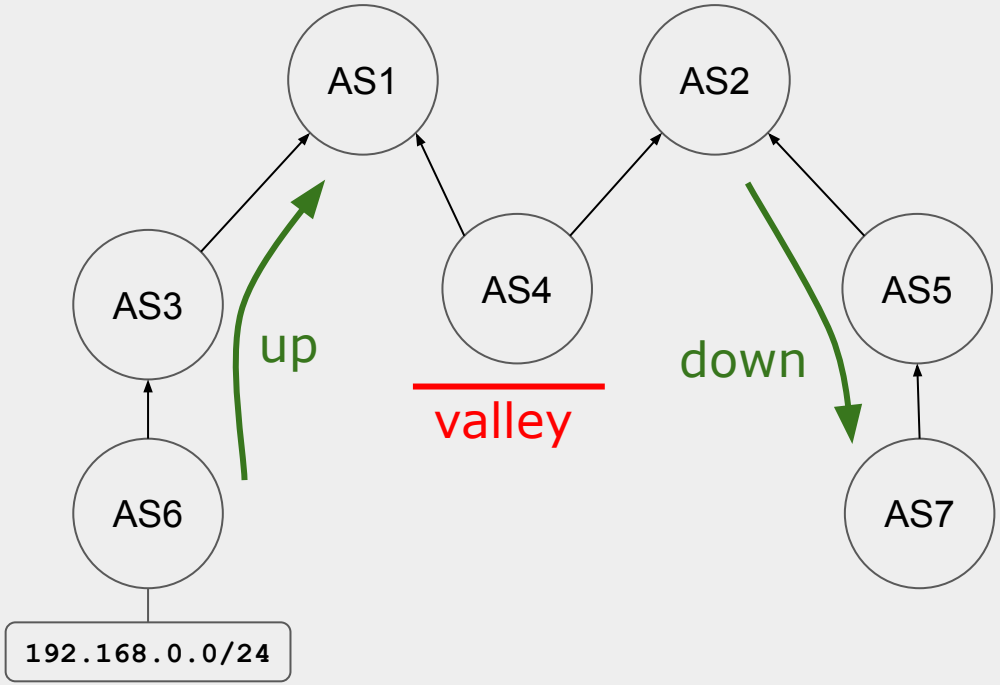
AS4 sees 4 1 3 2 5 192.168.0.0/24

- AS3 is "Not Provider" for AS2
  UP: 2 5
- AS3 is "Not Provider" for AS1
  DOWN: 4 1

AS3 is a valley, therefore this is **invalid**.

Valley Free Routing

Not Valley Free - Leak to second Tier-1



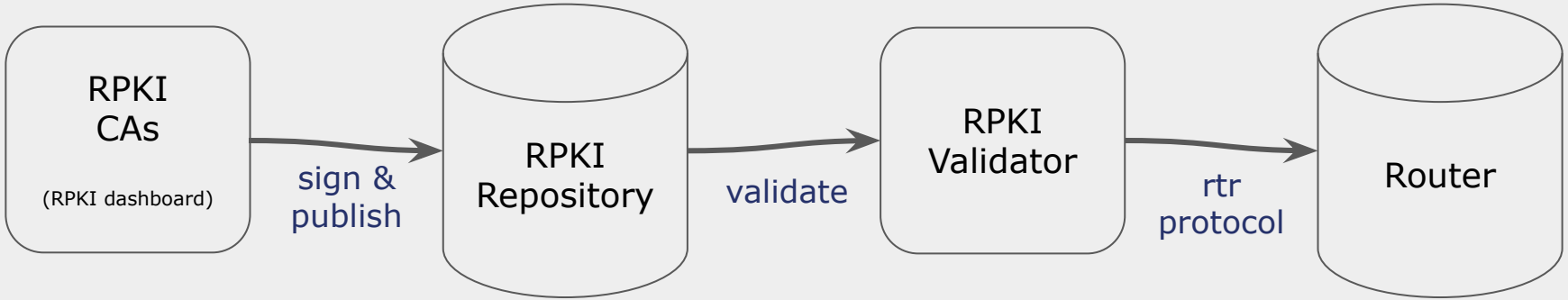

```
Given:
192.168.0.0/24 => AS6

AS1 => [ AS0 ] # provider free
AS2 => [ AS0 ] # provider free


AS5 sees 2 4 1 3 6 192.168.0.0/24
```

- AS4 is "Not Provider" for AS1
  UP: 1 3 6
- AS4 is "Not Provider" for AS2
  DOWN: 5 2

AS4 is a valley, therefore this is **invalid**.

ASPA in the Router!

From Signing to Router



- ➔ Same deployment model as ROAs
- ➔ No crypto in the router (could run on modest hardware)
- ➔ Should allow simple config in routers

ASPA Validation Deployment

It’s a sharp tool

- As with Route Origin Validation: reject invalid (i.e. do not downpref)

But it’s early days

- Not yet available on many routers, talk to your vendor!
  (Supported on: Bird, OpenBGPd, NIST-BGP-SR. Test phase: Cisco IOS-XR)

- Probably wise to start by logging
- Warn customers if they did not include you as a provider

ASPA Deployment

Which Providers should go on your ASPA objects?

- **All** your IP Transit Providers (your upstreams)!
- **Not** your lateral peers
- Unless those peers that *can* act as your Provider
- Also include non-transparent route servers (very rare)

Why would you create ASPA objects?

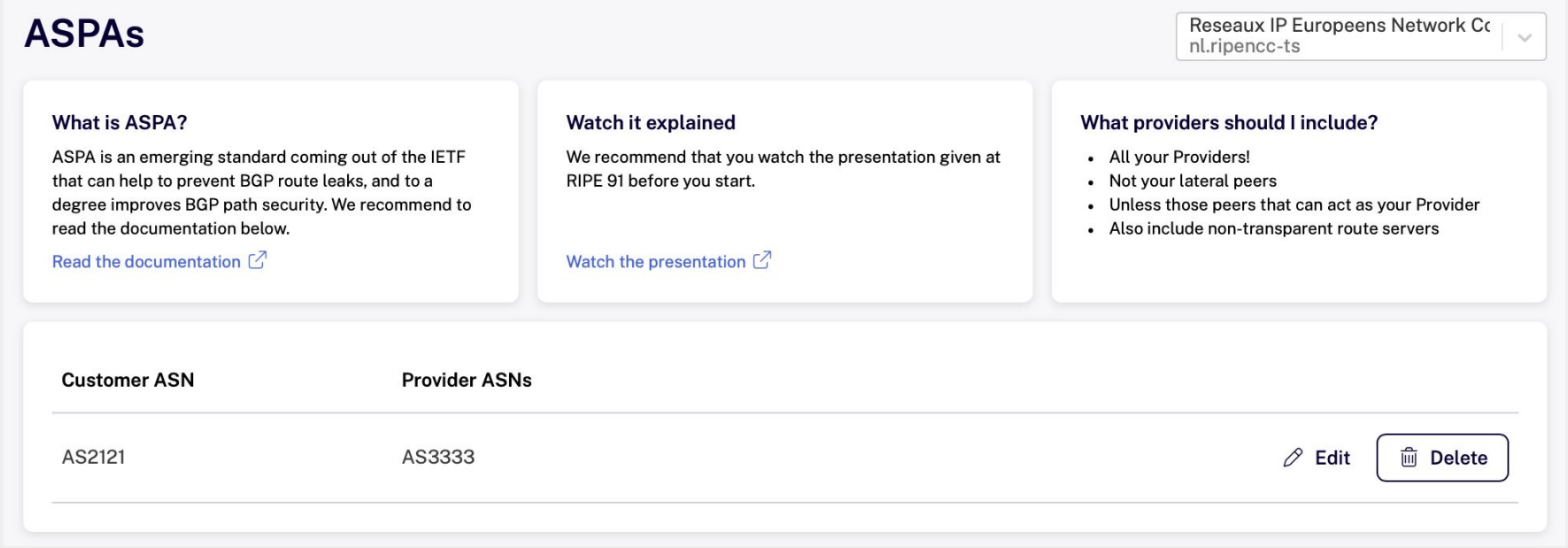
- Protect your network against leaks and easy path spoofing
- Help other networks (more deployment makes validation better)

When should you NOT create ASPA objects?

- If you are unsure about who your Providers are
- If you cannot keep them in sync with your operations!

ASPA in the RIPE NCC Dashboard!

RIPE NCC RPKI Dashboard

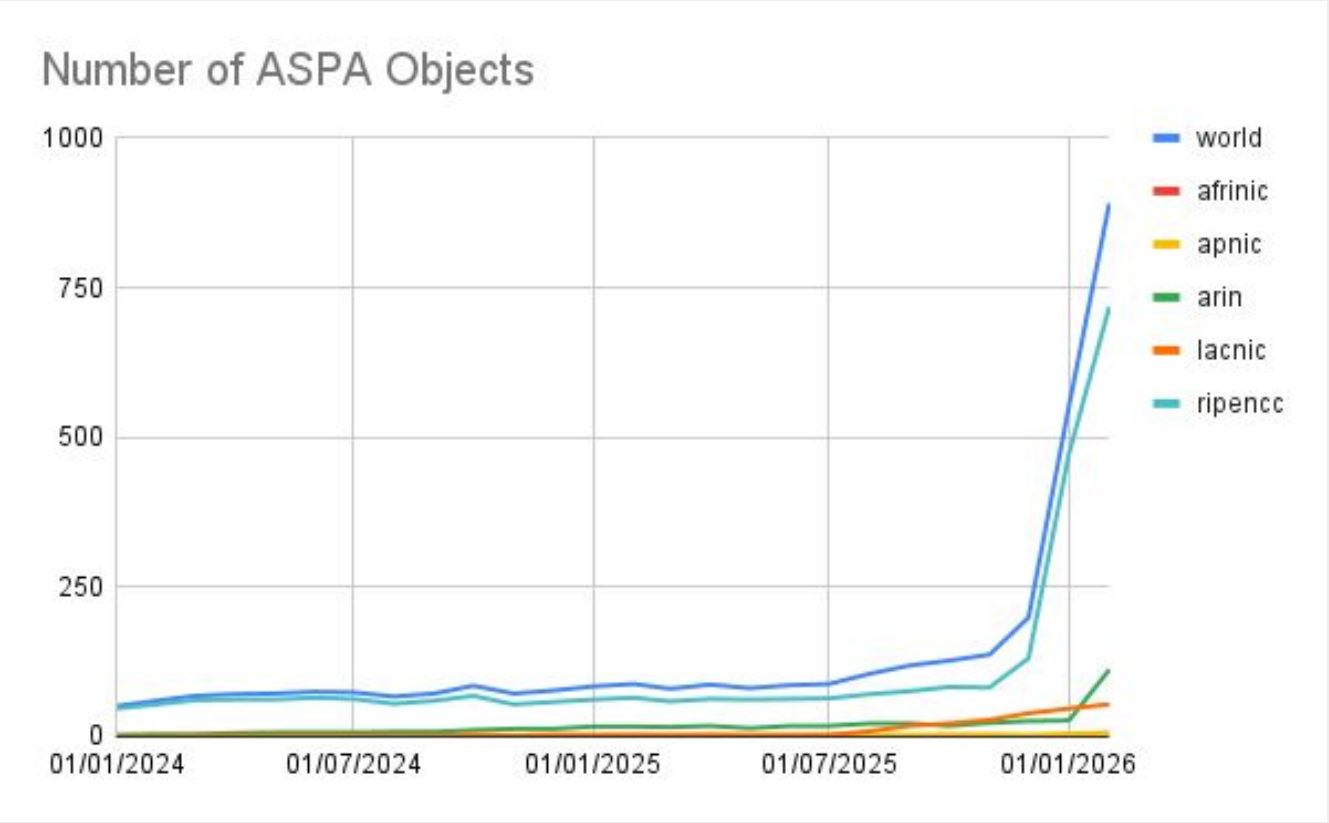


Suggest Providers based on RIS?

- NO!
  - It will include false positives
  - It will not include providers not seen by RIS
- YES!
  - People will forget networks
  - This becomes problematic when people start validating
- The middle?
  - Suggest possible forgotten providers, carefully
  - Avoid click-all-and-save
  - Plan to look at this later this year

ASPA Uptake

ASPA Objects by RIR



Before July 2025

- Krill CLI

July 2025

- Krill UI

Nov 2025

- RIPE NCC UI

Jan 2026

- ARIN UI

ASPA Objects by Country Code

ISO 3166	% Registered
GD	36.4
KN	25.0
SY	9.1
BH	8.3
SM	7.7
GR	6.6
MO	6.3
PT	6.2
DK	4.7
AL	4.6
LV	4.5
DE	4.2
AE	3.9
GI	3.8
LU	3.8

ISO 3166	number
DE	132
US	127
GB	77
BR	55
FR	52
NL	49
IT	32
DK	22
SE	22
RU	20
CN	19
CZ	18
CA	18
GR	17
CH	17

AS0 ASPA Objects

25

(6 Feb 2026)

Next Steps?

More ASPA Signing

- Number Resource Organisation (NRO) RPKI program
  - Coordinates RPKI efforts between RIRs
  - Goal: ASPA support at each RIR in 2026
  - Helps to secure funding and priority

More Reading

- RIPE NCC ASPA Documentation
  https://www.ripe.net/manage-ips-and-asns/resource-management/rpki/aspa/
- ASPA Verification Draft:
  https://datatracker.ietf.org/doc/html/draft-ietf-sidrops-aspa-verification
- ASPA Examples:
  https://github.com/ksriram25/IETF/blob/main/ASPA_path_verification_examples.pdf
- Formal Proof:
  https://datatracker.ietf.org/meeting/110/materials/slides-110-sidrops-sriram-aspa-alg-accuracy-01

Questions & Comments

tbruijnzeels@ripe.net