An opinionated review of RPKI validators

and the state of their Debian packaging

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What is RPKI?

RPKI is the system used to cryptographically validate BGP announcements.

The data components of RPKI:

- Route Origin Authorizations (ROA): the certificates stating which ASN is authorized to announce certain IP networks. A bit like RPSL route objects.
- Autonomous System Provider Authorizations (ASPA): the certificates stating which upstreams are authorized for an ASN.

The software components of RPKI:

- Distribution infrastructure by RIRs and networks.
- Validation infrastructure by each network.

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RPKI in practice

Networks use RPKI to verify that the routes received from BGP peers, transits and customers are not spoofed.

BGP routers check if the state of a route is valid, invalid or unknown.

The software used by ISPs:

- Validators: collect the ROAs and ASPAs and verifies them.
- RPKI-to-Router (RTR) servers: make the result of validation available to the routers.

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The software (1)

Validators

- Routinator 3000
- OpenBSD's rpki-client
- ~~RIPE NCC RPKI Validator~~ (discontinued)
- ~~OctoRPKI~~ (discontinued)
- FORT Validator (development restarted in mid-2023)
- rpki-prover (niche software)
- ~~Dragon Research Labs RPKI toolkit~~ (not developed since 2018)

The software (2)

OctoRPKI and rpki-client do not implement the RPKI-to-router (RTR) protocol themselves, but use an external daemon.

RTR servers

- ~~gortr~~ (abandoned)
- stayrtr

stayrtr is an actively maintained fork of gortr and has replaced it.

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Usage of validation software

	Oct 2021	May 2022	Apr 2023	Nov 2023	Dec 2024
Routinator	79%	69.9%	78.9%	79.2%	79.5%
rpki-client	8%	19.3%	9.3%	10.4%	10.1%
OctoRPKI	6%	3.5%	6.1%	4.5%	4.4%
FORT Validator	3%	3.2%	4.2%	3.9%	3.8%
RIPE NCC Validator	4%	4.4%	1.3%	1.9%	1.9%
rpki-prover	0%	0.5%	0.1%	0.1%	0.1%

This is dangerously close to becoming a *software monoculture*.

This data was gathered by NLNet Labs by counting the unique IPs accessing a RRDP web server.

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Routinator

Pros
- Actively developed, support contracts available.
- Well documented.

Cons
- Difficult to package by distributions.
- Too high adoption causes a lack of software diversity.

Developed in Rust by NLnet Labs.

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rpki-client

Pros

- Actively developed by network operators, support contracts available.
- Simple and essential.
- Separation of privileges in multiple processes.
- Quickly implements new protocol features.

Cons

- Needs a third party RTR daemon.

Developed in C by the OpenBSD project.

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RIPE NCC Validator

Pros

- Nothing else was available at the time?

Cons

- Written in Java.
- RIPE NCC stopped development.
- End of support in June 2021: **nobody should use it anymore!**

Developed in Java by RIPE NCC.

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OctoRPKI

Pros

- Simple and essential.

Cons

- Feels like a Cloudflare-specific project, the development roadmap is unclear.
- Needs a third party RTR daemon.
- Officially discontinued in March 2024: **nobody should use it anymore!**

Developed in Go by Cloudflare.

FORT Validator

Pros

- Used to be actively developed.
- Well documented.
- Good middle ground of features and complexity.

Cons

- After a long pause development resumed in mid-2023, but it is still slow.

Developed in C by LACNIC and NIC.MX.

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rpki-prover

Pros
- Software diversity is good.

Cons
- Niche programming language.
- ~~Very~~ ~~low~~ No adoption.

Developed in Haskell by Mikhail Puzanov.

Should I package it?

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My suggestions

Use two of:

- Routinator
- FORT Validator (?)
- rpki-client + stayrtr

They are all good and have different tradeoffs.

Using software packaged by a Linux distribution significantly reduces the system administration effort and allows to adopt diverse implementations.

Software diversity is important and needs to be encouraged!

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Features

	BGPSec	ASPA	RSC	signed TALs
Routinator	✓	✓		
rpki-client	✓	✓	✓	✓
FORT Validator				
rpki-prover	✓	✓	✓	

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Why use packaged software

The great debate: packages from distributions[1] or the developers?

Why use distribution packages?

- Integration with the OS and high attention to details.
- Ready to use after the installation.
- Automatic security updates[2].
- Maintained by system administrators, not software developers.

Why use vendor packages?

- Freshness.

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[1] Full disclosure: I develop a Linux distribution (Debian).
[2] Job Snijders estimated in 2022 that over 70% of the clients currently in use are insecure.

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Debian for network operators

Debian GNU/Linux is the one stop shop for all your RPKI validation needs.

My goals

- Packages with sane defaults which just work after being installed.
- Common management of TALs in the `rpki-trust-anchors` package.
- State of the art security with systemd sandboxing.

Issues

- The RPKI ecosystem is still young and fast-moving for a stable distribution.
- Routinator cannot be packaged (yet?).

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The issue with Routinator

The Rust development ecosystem is broken and hostile to distributions

- APIs are not stable (and there is no dynamic linking).
- Hence it is common for Rust software to depend on specific versions of libraries.
- General *vendoring* of dependencies is not acceptable to the Debian security team.
- Maintaining multiple versions of libraries in the distribution is too much time consuming (and not appreciated either...).
- Different Rust programs depend on different versions of the same library.
- **Packaging complex Rust projects is difficult.**

The Routinator developers publish a Debian package which is good enough, but it does not use `rpki-trust-anchors`.

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The state of Debian RPKI packages

Package	Debian 11	Debian 12
`routinator`	✗	✗
`rpki-client`	✗	(✓)
~~`octorpki`~~	✗	✗
`fort-validator`	(✓)	(✓)
~~`gortr`~~	✓	✓
`stayrtr`	(✓)	(✓)
`rpki-trust-anchors`	✓	✓
`OpenBGPD (bonus!)`	✗	(✓)

I removed `gortr` from Debian 12, in favour of `stayrtr`.

All packages in Ubuntu 22.04 LTS are not up to date at this point and I do not recommend to use them for RPKI validation.

At this point I will not further update Debian 11.

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Backports to Debian/stable

Backported packages of RPKI-related software and OpenBGPD will be maintained in the official Debian backports archive at least until the release of Debian 13.

```
echo 'deb http://deb.debian.org/debian bookworm-backports main' \
  > /etc/apt/sources.list.d/bookworm-backports.list
apt update
apt install rpki-client/bookworm-backports stayrtr/bookworm-backports
```

I will do the same for Debian 13 after it will be released.

Any questions?

`https://www.linux.it/~md/text/rpki-validators-anix2024.pdf`
(Google … Marco d'Itri … I'm feeling lucky)