

Routing Security Roadmap

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Why are we doing any of this?

- Creating filters based on public data, forces malicious actors to leave a trail in IRR, WHOIS or other data sources: **auditability**
- **Bugs happen!** – your router may suddenly ignore parts of your configuration, you'll then rely on your EBGP peer's filters
- **Everyone makes mistakes** – a typo is easily made

Average view on routing security



Perception: it is hopeless, too many holes...



But really, there is only a **finite** amount of hurdles...



Exhaustive list of issues in the current ecosystem

- IRRdb / database inaccuracy (stale, autopiloted, non-validated)
- IXPs not filtering
- Lack of Path Validation
- Lack of sufficient and good enough software

IRR – what is broken what can be fixed?

- Some IRRdbs do not perform validation
 - Meaning that virtually anyone can create virtually any route/route6 object and sneak those into the prefix-filters
- Eleven relevant IRRs not validating: RIPE, NTTCOM, RADB, ALTDB, ARIN IRR, BBOI, BELL, LEVEL3, RGNET, TC, CANARIE
- Two solutions:
 - Lock the database down (RIPE / RIPE-NONAUTH)
 - Filter on the mirror level

RIPE NWI-5 proposal & implementation

- RIPE NCC's IRR previously allowed anyone to register any non-RIPE-managed space if it had not yet been registered. *DANGER*
- The “RPSL” password & maintainer was used for this

SOLVED

Three steps were taken:

- Cannot register non-RIPE-managed space any more
- All non-RIPE space moved to separate “RIPE-NONAUTH” database
- Route/route6 ASN authorization rules have been improved

More info: <https://www.ripe.net/manage-ips-and-asns/db/impact-analysis-for-nwi-5-implementation>

OK – so current status

- Ten relevant IRRs not validating: NTTCOM, RADB, ALTDB, ARIN IRR, BBOI, BELL, LEVEL3, RGNET, TC, CANARIE
- Done: ~~RIPE~~

ARIN IRR allows anyone to register anything

```
hanna:~ job$ whois -h rr.arin.net 2001:67c:208c::
% This is the ARIN Routing Registry.
% Note: this output has been filtered.
%       To receive output for a database update, use the "-B" flag.

% Information related to '2001:67c:208c::/48AS15562'

route6:      2001:67c:208c::/48
descr:       2001:67c:208c::/48 - Job's net
remarks:     Job asked me to steal his net.  Honest!
origin:      AS15562
mnt-by:      MNT-ATTW-Z
source:      ARIN # Filtered
```

ARIN community also recognized this is an issue

- Consultation at [NANOG](#) and through [ARIN-Consult](#) mailing list
- https://www.arin.net/vault/resources/routing/2018_roadmap.html
- <https://teamarin.net/2018/07/12/the-path-forward/>

“Improve, or kill it”

ALMOST SOLVED

OK – so current status

- Nine relevant IRRs not validating: NTTCOM, RADB, ALTDB, BBOI, BELL, LEVEL3, RGNET, TC, CANARIE
- Done: ~~RIPE, ARIN IRR~~
- How to deal with the remaining nine ?
- Not all of these are so easily communicated with, not all are really actively managed

How are IRR and RPKI different?

- IRR route/route6 objects are statements:
 - About what Prefix/Origin ASN combinations can exist
 - Not necessarily made by the owner of the resource
 - Doesn't tell us anything about the validity of other route objects, or other non-matching BGP announcements
 - Unsuitable for filtering your upstream, OK-ish for peers and downstreams
 - **Not exclusive**
- RPKI on the other hand:
 - Objects are only created by resource holders
 - RFC 6811 is game changer – RPKI based BGP Origin Validation allows for non-authorized BGP announcements to be rejected
 - **Exclusive**

The “IRR” system access

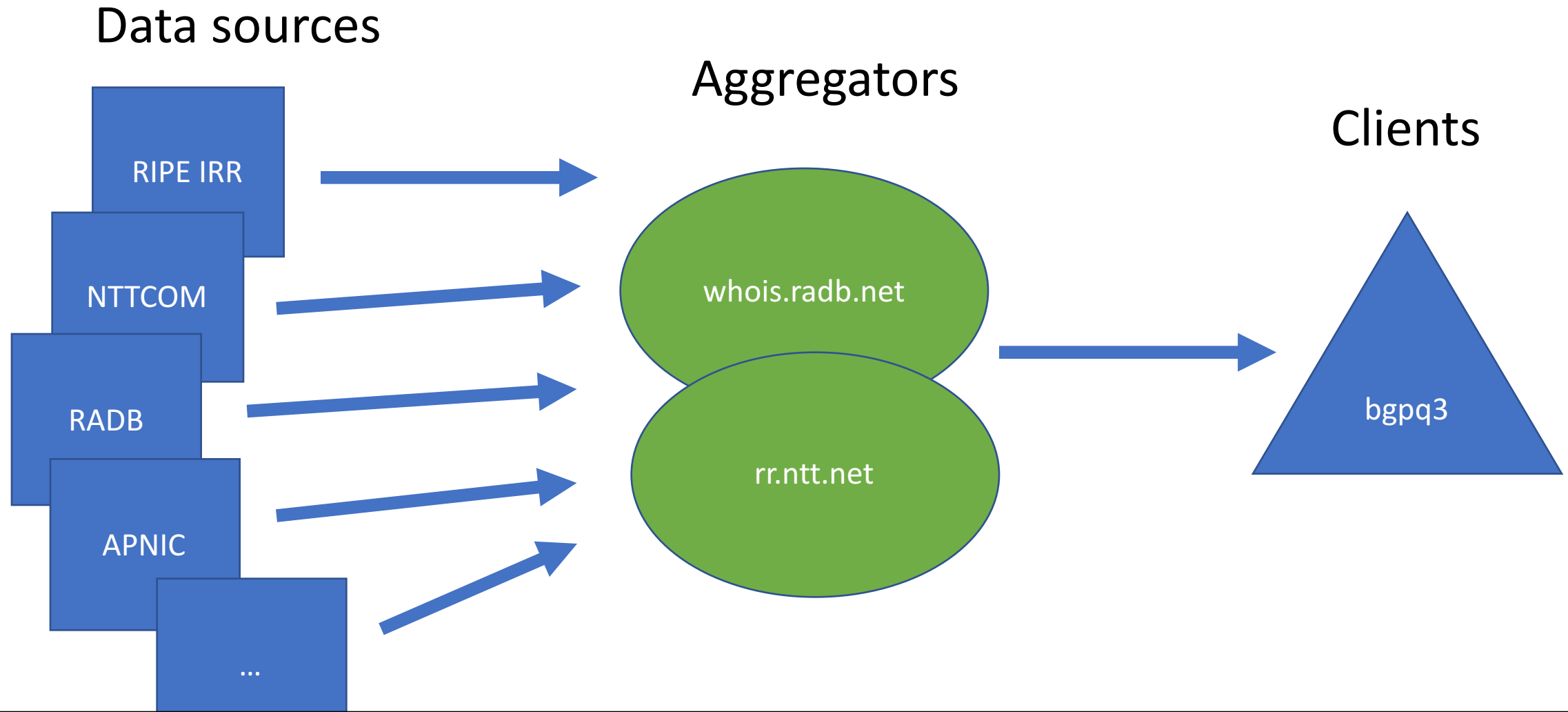
- The IRR is access through predominantly two “gateways”
 - **whois.radb.net** (the bgpq3 and peval default)
 - **rr.ntt.net**
- All mirroring is essentially done with one software: [IRRd](#)

Solution: Let’s use the hegemonic duopoly for good!

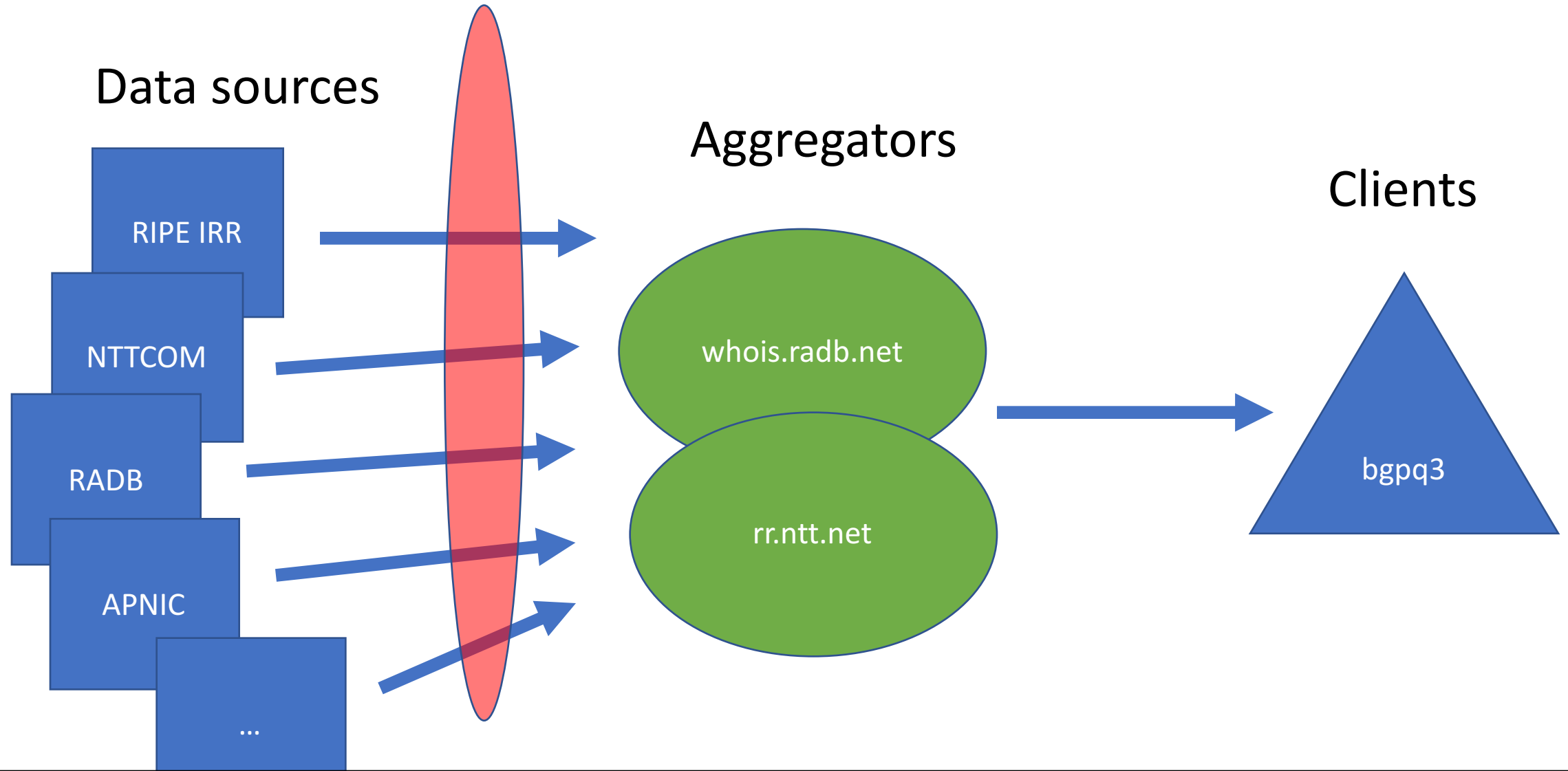
Proposal: Let RPKI “drown out” conflicting IRR

- RPKI can be used for *BGP Origin Validation* – but also for other things!
- A RPKI ROA is sort of a route-object
 - It has a “prefix”, “origin” and “source” (the root)
 - We can [use RPKI ROAs for provisioning BGP prefix-filters](#)
- Extend IRRd so that when IRR information is in direct conflict with a RPKI ROA – the conflicting information is suppressed ([Github](#))

Improving security at the “aggregator”?



RPKI filter at the aggregators



RPKI suppressing conflicting IRR advantages

- Industry-wide common method to get rid of stale proxy route objects – by creating a ROA you hide old garbage in IRRs
- By creating a ROA – you will significantly decrease the chances of people being able to use IRR to hijack your resource

OK – so current status

SOLVED

- IRRs not validating: no longer relevant
- Done: ~~RIPE, ARIN IRR, NTTCOM, RADB, ALTDB, BBOI, BELL, LEVEL3, RGNET, TC, CANARIE~~

NTT & Dashcare have started a full rewrite of IRRd to make this possible:
<https://github.com/irrdnet/irrd4>

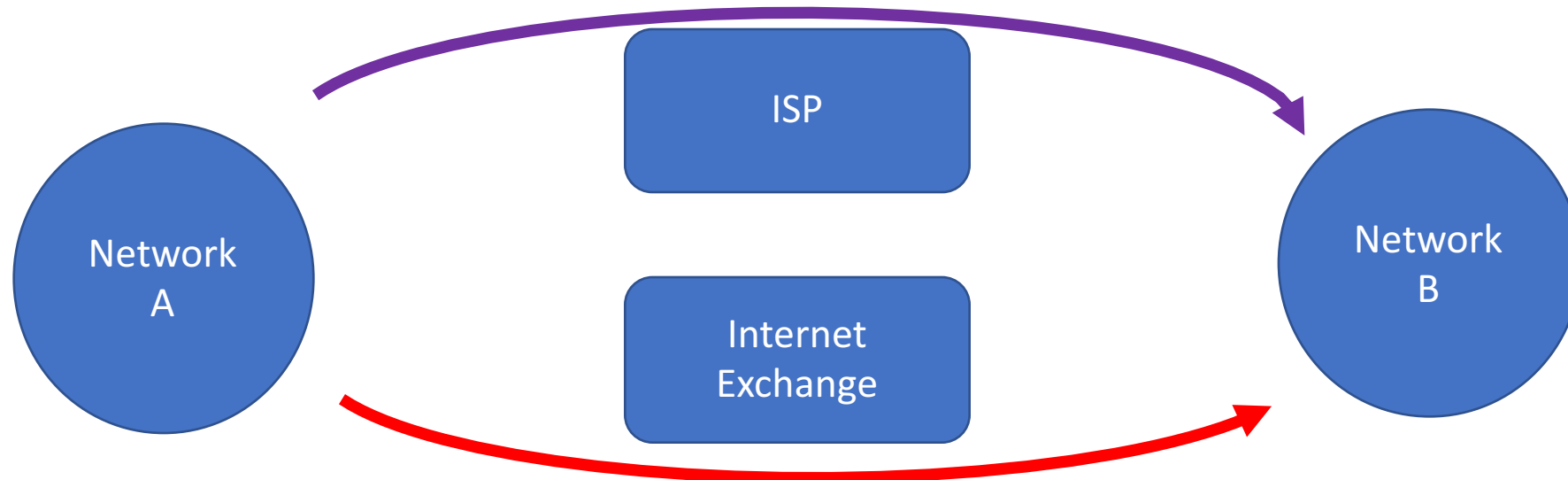
“Filtering at IXPs is hard”



- Many IXPs have come to realize their responsibilities to the Internet ecosystem and the commercial benefits of a more secure product.
- <http://peering.exposed/>
 - 9 out of top 10 IXPs are filtering, tenth will later this year. **IX.br** making good progress
- IXP filtering has become much easier, there are multiple fully featured configuration generators:
 - <https://www.ixpmanager.org/>
 - <http://arouteserver.readthedocs.io/>

Route servers must begin dropping RPKI Invalids

- Route servers *by definition* provide partial Internet tables
- No guarantees whatsoever that a given route will be available via RS
- When a route server drops a prefix, **worst case scenario is rerouting** – not an outage.



Italian IXP status – IRR vs RPKI

IXP	Secure based on IRR?	RPKI Origin Validation?
TOP-IX	Yes	No
NaMeX	Yes	No
DE-CIX Palermo	Yes	No
MINAP Milan	Yes	No
MIX-IT	Yes	No
VSIX	Yes	No
TIX	No	No

Not everyone needs to do RPKI

- Because of the centralization of the web, if a select few companies deploy RPKI Origin Validation – millions of people benefit
- (google, cloudflare, amazon, pch/quad9, facebook, akamai, fastly, liberty global, comcast, etc...)
- I think only 20 companies or so need to do Origin Validation for there to be big benefits...
- <https://dyn.com/blog/bgp-dns-hijacks-target-payment-systems/>

“RPKI Origin Validation is useless without Path Validation aka BGPSEC”

- The lack of path validation can be resolved through two methods:
 - Densely peer with each other (Example: Google & Akamai have 126+ facilities in common with each other)
 - An AS_PATH blocking mechanisms like “[peerlock](#)”
- Both effectively are “path validation for 1 hop”
- Perhaps “1 hop” already is good enough 😊

“There is no healthy software ecosystem”

- RIPE NCC Validator v3 is works and actively maintained
- NLNetlabs is released a RPKI Cache Validator (Routinator 3000)
- OpenBSD is looking to fund a third validator implementation
- Almost all serious routing vendors have RPKI support (Cisco, Juniper, BIRD, Nokia, FRR – and more are on the way)
- Solution: more users results in better software, start using!



Timeline

- All ISPs, create [RPKI ROAs](#) it's easy!
- IXPs – start doing RPKI Origin Validation on your route servers **now**
- **Quite some companies are deploying RPKI OV before the end of the year!**
- In 2019 RPKI data will be used to clean up IRR
- Hopefully the ARIN RPKI TAL situation will improve

Conclusion

