Routing Security Roadmap

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What’s this talk about?

• Differences between IRR and RPKI semantics
• What issues the industry faces
• Using the hegemonic IRR aggregator duopoly for good
Average view on routing security
Perception: it is hopeless, too many holes...
But really, there is a only a **finite** amount of hurdles...
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
Exhaustive list of issues in the current ecosystem

• IRRdb / database inaccuracy (stale, autopiloted, non-validated)
• IXPs and ISPs not filtering
• Lack of Path Validation
• Lack of sufficient and good enough software
IRR – what is broken what can be fixed?

• Some IRR dbs 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

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](http://www.nanog.org) and through [ARIN-Consult](http://www.arin.net) mailing list
- [https://teamarin.net/2018/07/12/the-path-forward/](https://teamarin.net/2018/07/12/the-path-forward/)

“Improve, or kill it”
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
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!
Improving security at the "aggregator"?

Data sources
- RIPE IRR
- NTTCOM
- RADB
- APNIC
- ...

Aggregators
- whois.radb.net
- rr.ntt.net

Clients
- bgpq3
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](https://github.com)
• Extend IRRd so that when IRR information is in direct conflict with a RPKI ROA – the conflicting information is suppressed ([Github](https://github.com))
RPKI filter at the aggregators

Data sources
- RIPE IRR
- NTTCOM
- RADB
- APNIC
- ...

Aggregators
- whois.radb.net
- rr.ntt.net

Clients
- bgpq3
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

This idea is also being discussed in RIPE community
OK – so current status

• IRRs not validating: no longer problematic

• 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/](http://peering.exposed/)
  • 9 out of top 10 IXPs are filtering, tenth will later this year. [IX.br](http://IX.br) making good progress

• IXP filtering has become much easier, there are multiple fully featured configuration generators:
  • [https://www.ixpmanager.org/](https://www.ixpmanager.org/)
  • [http://arouteserver.readthedocs.io/](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.
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 released their RPKI Cache Validator (Routinator 3000)
• OpenBSD is looking to fund/develop 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

• IETF meetings should start now!
• IXPs – start doing RPKI Origin Validation on your route servers now
• Quite some companies are deploying RPKI OV before the end of the year!
• ISPs / CDNs
  • if you are pointing default somewhere and have local peering, do it now
• In 2019 RPKI data will be used to clean up IRR
• Hopefully the ARIN RPKI TAL situation will improve in 2019
Conclusion