The RPKI Wayback Machine
(or: Ziggy says there's a 50% chance we'll end up in 2011)

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What we wanted to do

• At NLnet Labs, **we make RPKI Relying Party software** called Routinator

• **Routinator** has seen a lot of uptake in production (thank you!)

• We want to **test our software** to ensure it is robust

• Enter:
  8 years of RPKI ROA data for all the RIRs provided by RIPE NCC!
How we processed the data

• RIPE NCC archived all RPKI repositories pretty much since RPKI day zero

• We got dumps in .tar.gz files with all RPKI objects, but no historic TALs

• So we wrote a tool we called "Ziggy" to transport us back in RPKI time
Interlude: Ziggy!

• Remember Quantum Leap? I do :-)

![Interlude: Ziggy!](image-url)
What does Ziggy do?

- You can give Ziggy (our Python script) a date, and it will then:
  - Find and unpack all .tar.gz files for that date, in a Routinator-friendly structure
  - Recreate TALs based on the trust anchors from the archives
  - Run Routinator using "faketime" for the specified date
- We did this from January 2011 to February 2019
Quick recap: jargon

• Reminder (also if you read the slides later):

• **RPKI** Resource Public Key Infrastructure

• **ROA** Route Origin Authorisation
  (authorises a certain AS to announce certain prefixes)

• **VRP** Verified ROA Payload (yes, acronym in acronym...)
  (a cryptographically valid statement about a prefix from a ROA)
Growth of VRPs over time

1st day RIPE data validates

Three ASes deaggregate ROAs ('disable' MaxLength)

Single AS deaggregates ROAs


Number of VRPs (IPv4 prefixes)
Of course *also* for IPv6 ;-)
Prefix size in VRPs over time (IPv4)

Takeaway:
Average prefix size decreasing over time
Max Length in VRPs over time (IPv4)

Takeaway: Max Length is used and decreasing over time
Prefix size in VRPs over time (IPv6)

Takeaway:
Prefix size also decreasing
Max Length in VRPs over time (IPv6)

Takeaway:
Again, Max Length used and decreasing
Use of Max Length over time

Takeaway:
Max Length used more for IPv6 than IPv4

Takeaway:
Max Length use slowly growing again
One more thing: average prefix size

Compare this to Geoff's story in routing!
For IPv6 same(-ish) thing
Coverage over time

2018-04-01
Conclusions

• We wanted to test Routinator; turns out RPKI use took some time to stabilise to a well-defined standard
  → Action item: support older standards in Routinator

• Very interesting data, raises lots of questions and can help study how RPKI is deployed in practice

• Next step: compare this against routing information over the same period (from RIS, RouteViews, ...)
  → Paper to be presented at ACM IMC 2019 in Amsterdam, Oct. 21-23
Open data

• A big **thank you to** the **RIPE NCC and to Emile Aben** in particular for providing us with the RPKI dataset!

• The data is now also available as open data: [https://ftp.ripe.net/rpki](https://ftp.ripe.net/rpki)
Grab our free OSS tools!

• Routinator:
  https://github.com/NLnetLabs/routinator

• Secure Routing Stats (experimental):
  https://github.com/NLnetLabs/secure-routing-stats
  (produces the graphs with world maps)

• Ziggy:
  https://github.com/NLnetLabs/ziggy
Thank you! Questions?

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BONUS SLIDES

Some more graphs we got from Ziggy that didn't make it to the talk, because "time" ;-)
Number of ASes with a VRP (IPv4)

ASes with at least one VRP (IPv4)

AFRINIC
APNIC
ARIN
LACNIC
RIPE

1st day RIPE data validates
Number of ASes with a VRP (IPv6)

1st day RIPE data validates
Number of distinct prefixes (IPv4)

Three ASes deaggregate ROAs ('disable' MaxLength)

Single AS deaggregates ROAs

1st day RIPE data validates

Compare to VRP counts
Prefix size distribution RIRs (IPv4)

Data for Jan. 2019
Prefix size distribution RIRs (IPv6)

Data for Jan. 2019
Prefix vs. Max Length (IPv4)
Prefix vs. Max Length RIRs (IPv6)

Data for Jan. 2019
Differences between RIRs

Takeaway:
Max Length use differs significantly between RIRs