



# A one-year review of RPKI operations

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# NTT's RPKI Origin Validation announcement



## NTT Improves Security of the Internet with RPKI Origin Validation Deployment

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### Get Started

## However...

- *RPKI requires additional knowledge*
- *RPKI requires additional procedures*

- You want to announce a new prefix, but you forget about RPKI
  - Are you sure it will be “unknown”?
- You do not forget about RPKI, but you forget about timing
  - Publication time
  - Propagation time



# A review of 2021



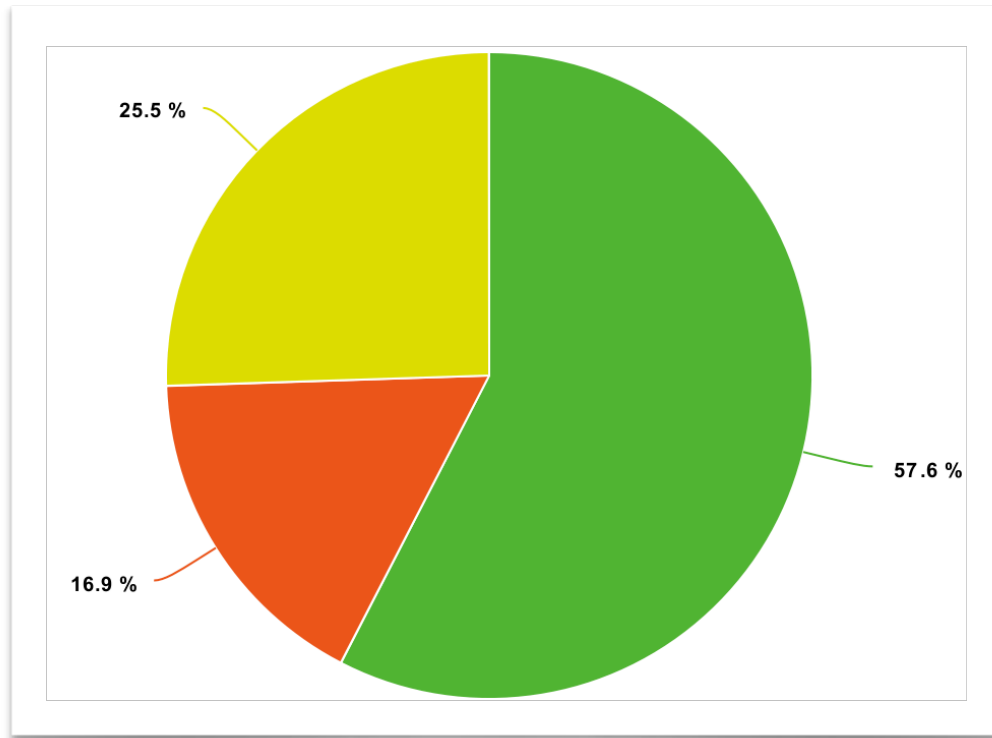
- I reviewed 1 year of RPKI-related alerts generated by our BGPalerter installation
- I divided the alerts in 3 categories:
  1. Wrong maxLength
  2. We announced a customer's prefix, but they had no ROA for AS2914 (AS mismatch due to customer's ROA)
  3. We migrated prefixes from one AS to another, but no ROA update (AS mismatch)

# A review of 2021

Wrong maxLength

We announced a customer's prefix, but they had no ROA for AS2914 (AS mismatch due to customer's ROA)

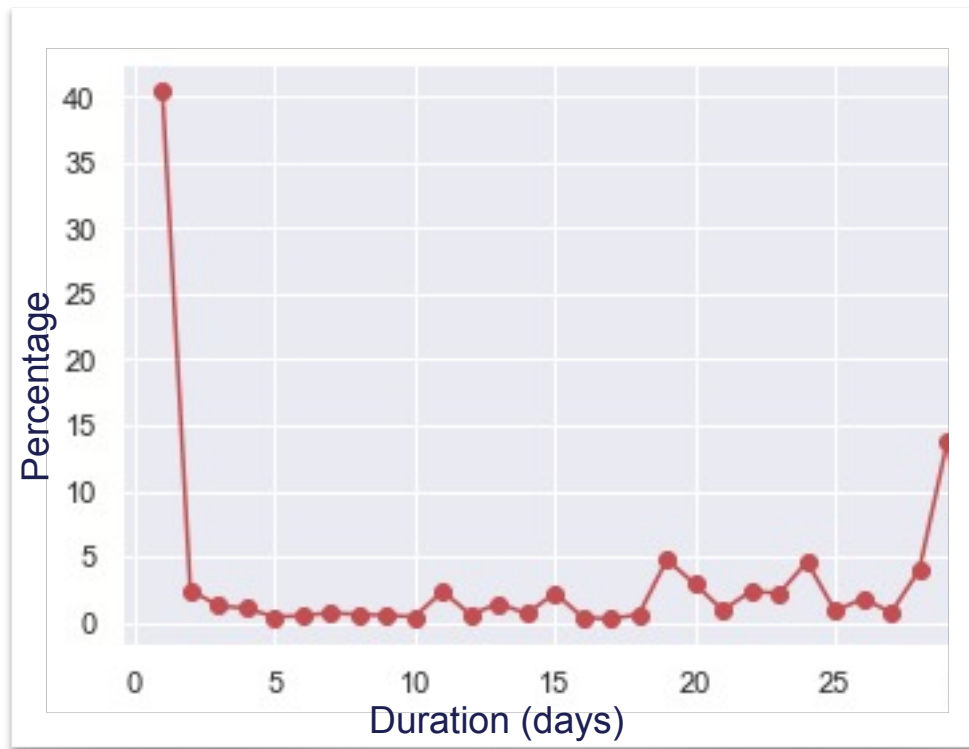
We migrated prefixes from one AS to another, but no ROA update (AS mismatch)



- Invalid announcements can be just transient
  - e.g., you announce before the ROA is public

**But how do you define “transient” if you are not monitoring?**

# Invalid MaxLength 2021 - 1 month window





# How did we address this?

# How did we address this?



1. Introduced a new automation platform
2. Improved our monitoring
3. Introduced a strict procedure to follow
4. Improved communication with customers

# Before seeing how, let's see the results



where we stepped-up our game

- **86.84% reduction of RPKI-invalid announcements**
- With the new system we staged/tested and monitored 565 new ROAs

# NTT's IP Management Platform (automation + monitoring)



Percentage of prefixes covered by ROAs



Percentage of monitored prefixes



BGPalerter is monitoring



RPKI data up to date



6 ROAs are staged

Select RIR



AFRINIC



APNIC



ARIN



LACNIC



RIPE

<input type="checkbox"/>	Prefix	Description	RIR	Holder	Announced by	Status ↓
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<input type="checkbox"/>	207.21.128.0/18		ARIN	2914	2914	BGP: visible ROA: staged RPKI: valid monitored
--------------------------	-----------------	--	------	------	------	--

<input type="checkbox"/>	209.189.0.0/17		ARIN	2914	2914	BGP: visible RPKI: valid monitored
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<input type="checkbox"/>	81.93.176.0/20		ARIN	2914	2914	BGP: visible RPKI: valid monitored
--------------------------	----------------	--	------	------	------	------------------------------------

<input type="checkbox"/>	208.123.221.0/24		ARIN	2914	2914	BGP: visible RPKI: valid monitored
--------------------------	------------------	--	------	------	------	------------------------------------

<input type="checkbox"/>	184.30.224.0/20		ARIN	2914	2914	BGP: visible monitored
--------------------------	-----------------	--	------	------	------	------------------------

<input type="checkbox"/>	130.94.0.0/16		ARIN	2914	2914	BGP: visible RPKI: valid monitored
--------------------------	---------------	--	------	------	------	------------------------------------

## Prefix 207.21.128.0/18

### Summary

#### RPKI

##### CURRENT STATUS

RPKI valid

##### CURRENT ROAS ⓘ

207.21.128.0/18, 18, 2914, ARIN

##### FUTURE STATUS

RPKI valid ⓘ

##### FUTURE ROAS ⓘ

207.21.128.0/18, 18, 2914, ARIN  
207.21.128.0/18, 22, 2914, ARIN

##### ROA STATUS

Staged ⓘ

##### COVERING ROAS

<input type="checkbox"/>	Prefix	AS	Max Length	TA	Status ↓	Action
<input type="checkbox"/>	207.21.128.0/18	2914	22	ARIN	staged ⓘ	added
<input type="checkbox"/>	207.21.128.0/18	2914	18	ARIN	stable ⓘ	

# Our four stages for ROAs



- **Staged** - the ROA exists only in the local database
  - RPKI validation is performed on a merge of public ROAs and staged ROAs
  - If what currently announced (or what is supposed to be announced) is RPKI valid, **all** the ROAs covering the prefix can be committed
- **Committed** - the ROA is ready to be published
  - The ROA is sent to the proper repo (e.g., RIR)
- **Public** - the ROA is visible on public repos
  - RPKI is up to date now
- **Stable** - the ROA has been monitored for 24 hours without issues
  - The monitoring will continue forever



- Most of the logic is implemented in BGPalerter
  - <https://github.com/nttgin/BGPalerter>
  - Real-time monitoring for BGP and RPKI
  - It is easy to use
    - Auto-configuration
    - No installation required - It's just a binary that you run
    - No data collection required
  - *Hijack detection, visibility loss, path monitoring, and RPKI monitoring*

- You will receive an alert if:
  - Your AS is announcing RPKI invalid prefixes (e.g., not matching prefix length)
  - Your AS is announcing prefixes not covered by ROAs
  - ROAs covering your prefixes disappeared
  - A ROA involving any of your prefixes or ASes was deleted/added/edited
  - TA malfunction or corrupted VRP file
  - A ROA is expiring

# Examples of alerts



**incoming-webhook** APP 12:21

rpkidiff

ROAs change detected: added <185.236.24.0/22, 3949, 24, ripe>



**incoming-webhook** APP 12:51

rpkidiff

ROAs change detected: removed <2406:7ec0:6800::/40, 140868, 48, apnic>; removed <2406:7ec0:8300::/48, 4713, 48, apnic>; removed <2406:7ec0:8600::/44, 4713, 44, apnic>

rпки

The route 216.42.128.0/17 announced by AS2914 is not RPKI valid. Valid ROAs: 216.42.0.0/16|AS2914|maxLength:16

# Shout outs to some amazing projects



- RIPE RIS Live
  - real-time, free, and has 600+ peers worldwide
  - It's an amazing project from RIPE NCC
  - Want to peer? <https://ris.ripe.net> or ask **Michela Galante** (RIPE NCC)
- OpenBSD rpki-client
  - <https://www.rpki-client.org/>
  - Exports data about expiring ROAs (thanks Job Snijders)
  - Runs on any Linux and BSD distribution



- Mutually Agreed Norms for Routing Security
- A list of concrete actions that you can take for ISPs, IXPs, CDNs, HW vendors

# RPKI infrastructure malfunctions



- 12 August 2020
  - BGPalerter reports many prefixes "No longer covered by ROA" in ARIN
    - Users think it's a BGPalerter false positive (e.g., <https://github.com/nttgin/BGPalerter/issues/324>)
  - ARIN announcement <https://www.arin.net/announcements/20200813/>
  - **Time for a new TA monitoring feature!**
- 06 February 2021
  - TWNIC ROAs disappear
  - BGPalerter sends alerts
  - Hardware failure reported by TWNIC

## rpkidiff

ROAs change detected: removed <61.58.32.0/20, 2914, 24, apnic>; removed <122.255.80.0/20, 2914, 24, apnic>

## rpki

The route 61.58.32.0/20 announced by AS2914 is no longer covered by a ROA.

## rpki

The route 122.255.80.0/20 announced by AS2914 is no longer covered by a ROA.



# RPKI infrastructure malfunctions



- 18 March 2021
  - We discover that we missed RIPE ROAs in a validation cycle
    - This happened already in the past.
  - We found a manifest containing references to not available certs
  - We report this to the RIPE NCC staff, and they fix it
    - <https://www.ripe.net/ripe/mail/archives/routing-wg/2021-May/004345.html>
- 17 June 2021
  - We discovered LACNIC disappearing over rsync
  - We whatsapp our friends at LACNIC and they fix it



**incoming-webhook** APP 17:28

rpkidiff

Possible TA malfunction: 100.00% of the ROAs disappeared from lacnic

# RPKI infrastructure malfunctions



- 1 February 2022
  - JPNIC partial TA malfunction
  - Several ROAs were expiring soon
  - We report it to JPNIC, and they fix it, it was a disk full
  - <https://www.nic.ad.jp/en/topics/2022/20220202-01.html>

incoming-webhook APP 12:43

rpkidiff

The following ROAs will expire in less than 2 hours: <153.128.0.0/10, 4713, 24, apnic>; <180.0.0.0/10, 4713, 24, apnic>; <114.160.0.0/11, 4713, 24, apnic>; <153.192.0.0/11, 4713, 24, apnic>; <27.114.0.0/17, 4713, 24, apnic>; <58.88.0.0/13, 4713, 24, apnic>; <60.32.0.0/12, 4713, 24, apnic>; <61.112.0.0/15, 4713, 24, apnic>; <61.118.0.0/15, 4713, 24, apnic>; <61.126.0.0/15, 4713, 24, apnic>; <61.199.0.0/16, 4713, 24, apnic>; <61.207.0.0/16, 4713, 24, apnic>; <61.208.0.0/16, 4713, 24, apnic>; <61.214.0.0/16, 4713, 24, apnic>; <114.144.0.0/12, 4713, 24, apnic>; <118.0.0.0/12, 4713, 24, apnic>; <118... [Show more](#)

# RPKI infrastructure malfunctions



- 16 February 2022
  - rrdp.ripe.net becomes unreachable AND too many connections to rsync
  - BGPalerter detects the issue
  - It was a DNS misconfiguration
  - <https://www.ripe.net/ripe/mail/archives/routing-wg/2022-February/004522.html>

**rpkidiff**

Possible TA malfunction or incomplete VRP file: 100.00% of the ROAs disappeared from ripe

# Thank you.

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