RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Introduction to RPKI

Webinar

RIPE NCC Learning & Development

Agenda

Is BGP safe?

ROAs

Validation Tools

Validation

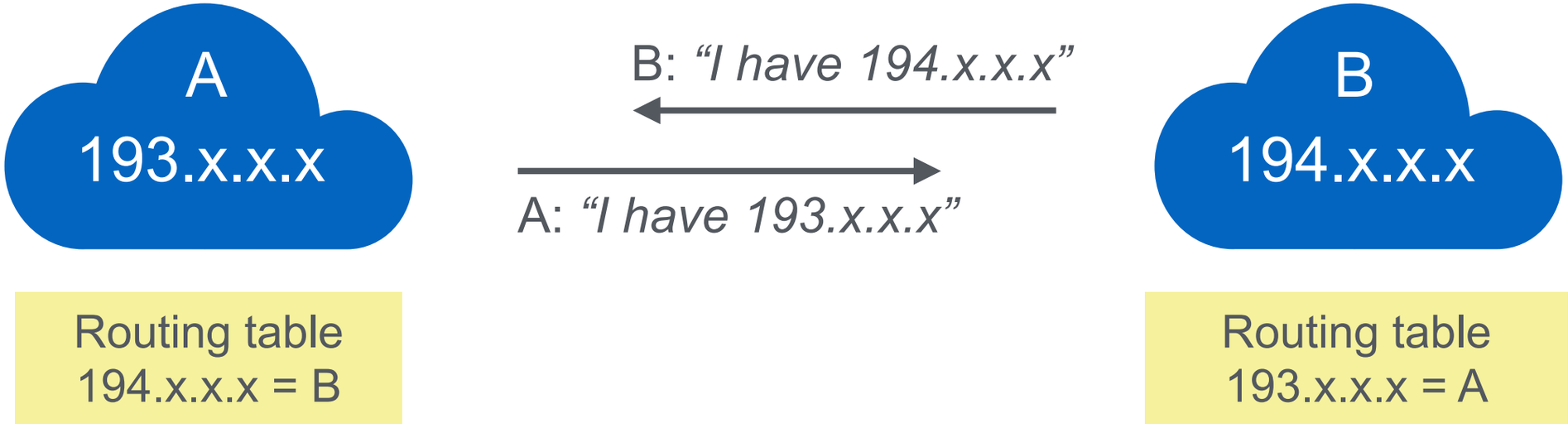
Is BGP safe?

Routing on the Internet

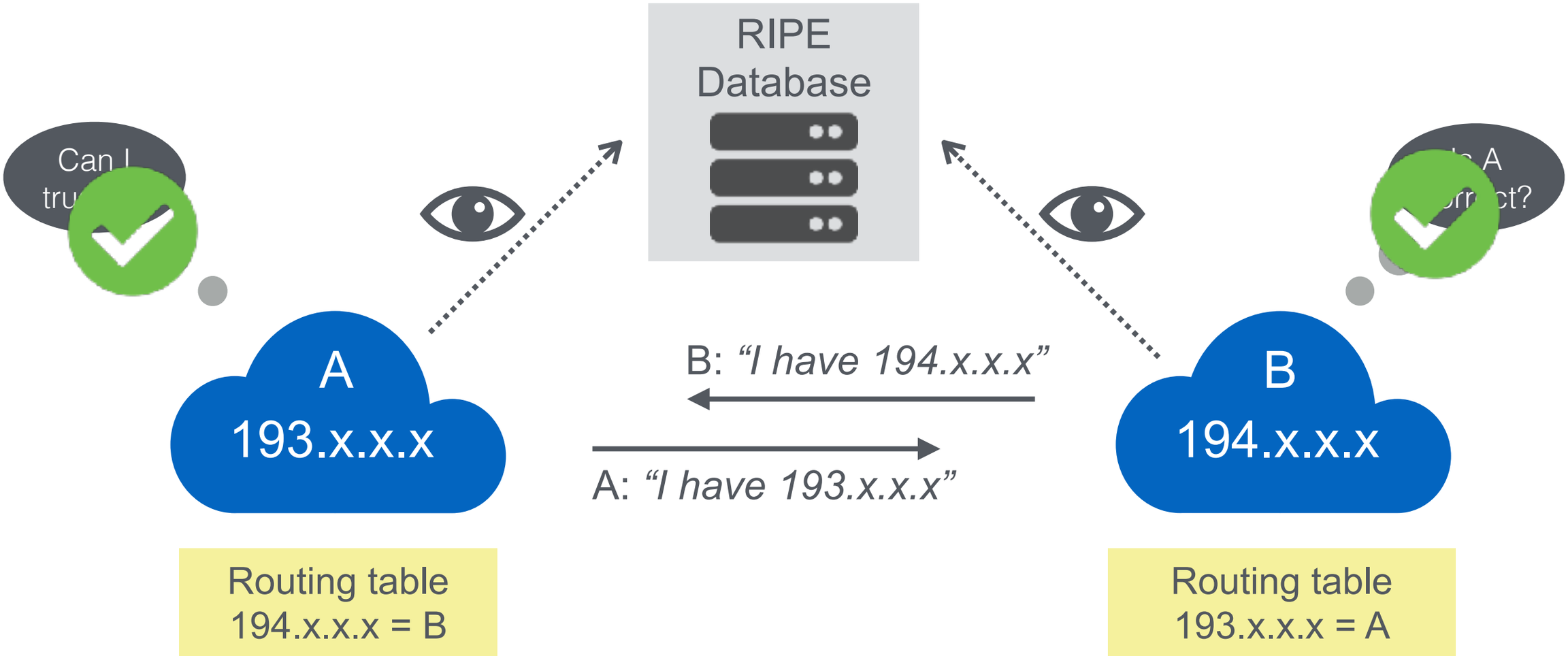
Can I trust B?

Is A correct?

"BGP protocol"



Routing on the Internet



Accidents Happen

- Fat Fingers
  - 2 and 3 are really close on our keyboards….
- Policy Violations (leaks)
  - Oops, we did not want this to go on the public Internet
  - Infamous incident with Pakistan Telecom and YouTube

Incidents Are Common

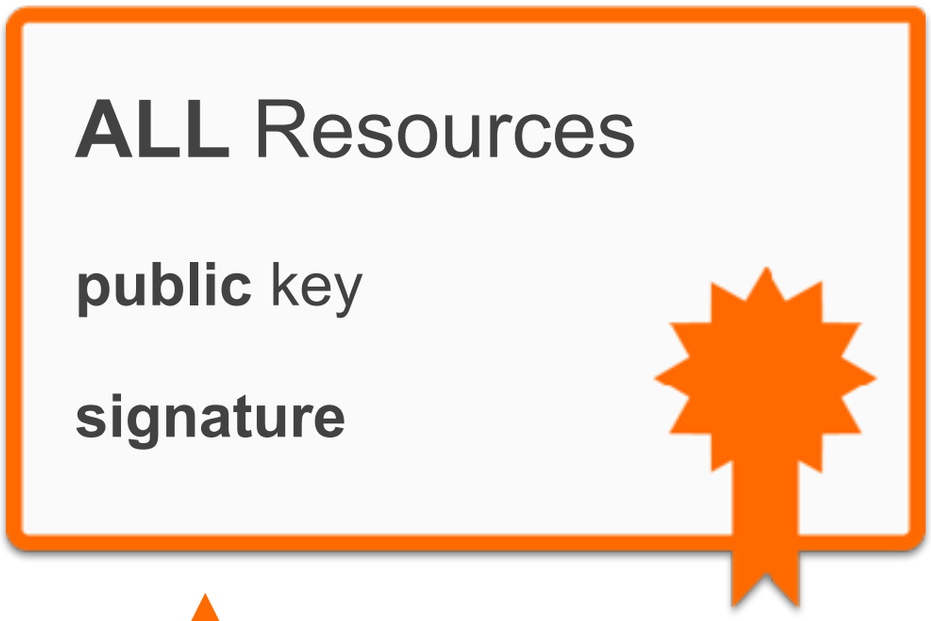
- 2019 Routing Security Review
  - 12,600 incidents
  - 4,4% of all ASNs affected
  - 3,000 ASNs are victims of at least one incident
  - 1,300 ASNs caused at least one incident

Source: https://bgpstream.com

Resource Public Key Infrastructure

- Ties IP addresses and ASNs to public keys
- Follows the hierarchy of the registries
- Authorised statements from resource holders
  - “ASN X is authorised to announce my Prefix Y”
  - Signed, holder of Y

RPKI Chain of Trust

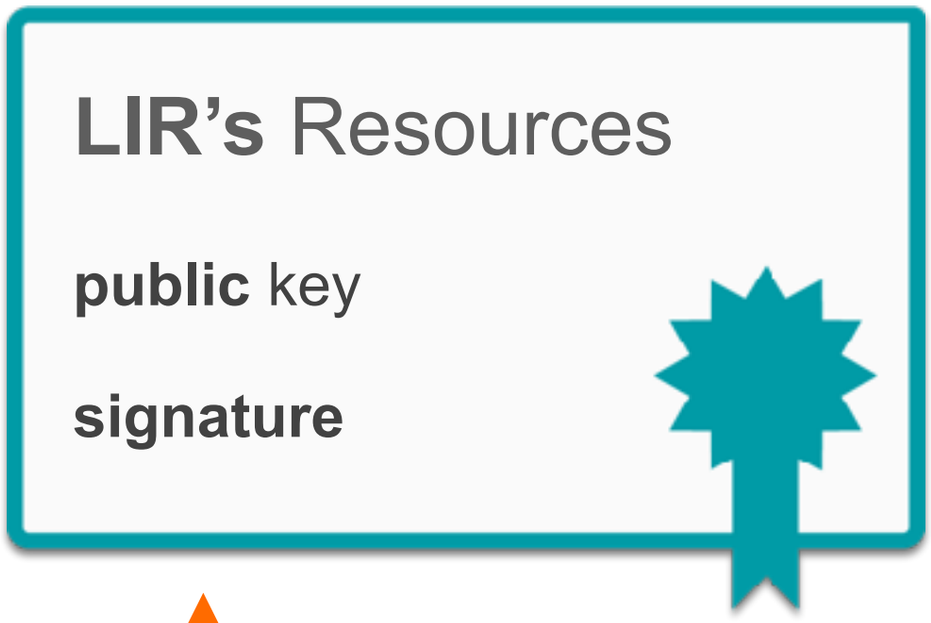


RIPE NCC Root Certificate

Self-signed

Root's **private** key

RPKI Chain of Trust



LIR Certificate

Signed by the Root private key

Root's **private** key

ROAs

ROA (Route Origin Authorisation)

- A ROA is…
- LIRs can create a ROA for each one of their resources (IP address ranges)
- Multiple ROAs can be created for an IP range
- ROAs can overlap

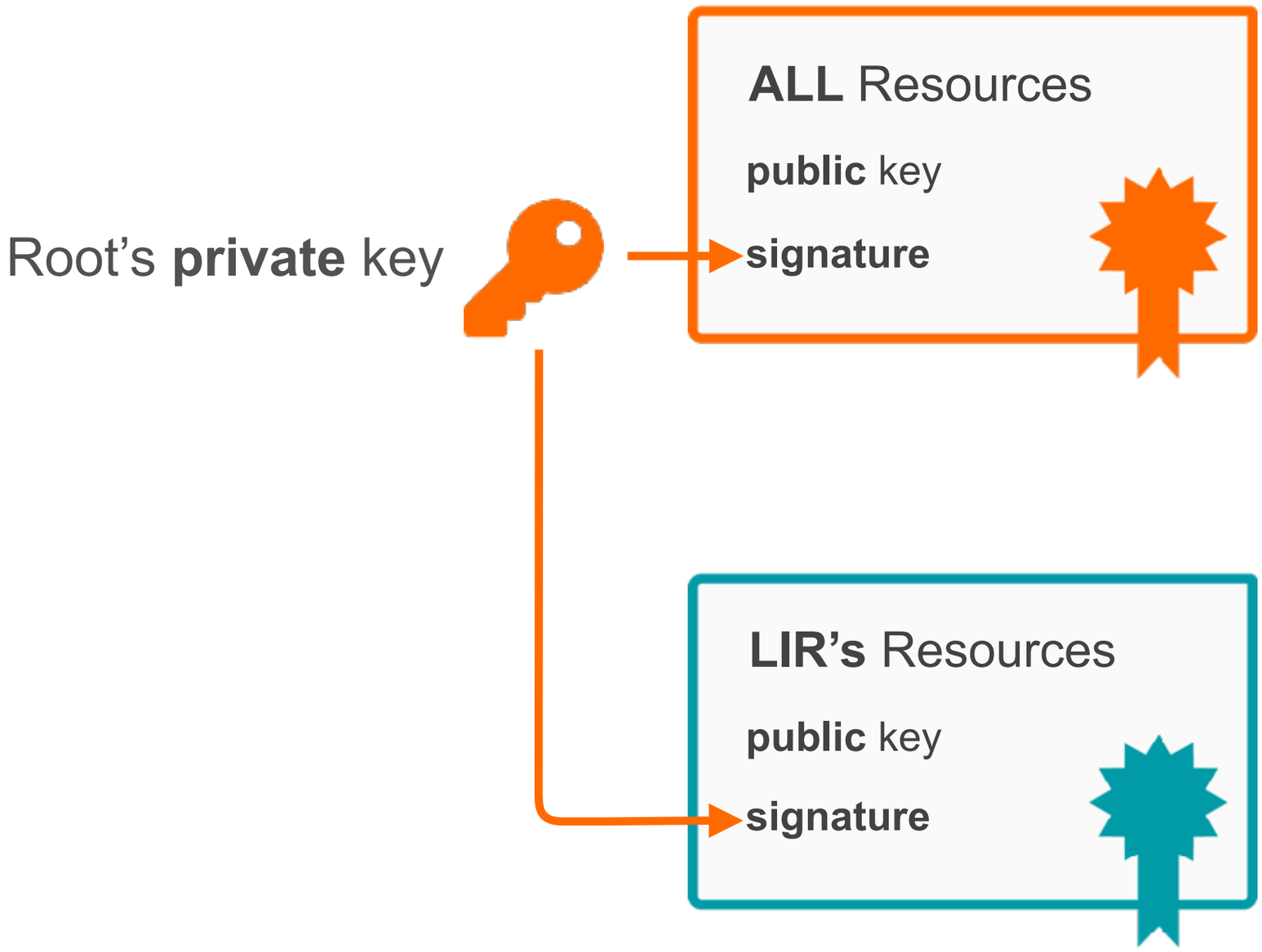
What is in a ROA ?

Prefix → The network for which you are creating the ROA

Origin ASN → The ASN that's supposed to be originating the BGP Announcement

Max Length → The Maximum prefix length accepted for this ROA

RPKI Chain of Trust



Route Origin Authorisation

ROA

signature

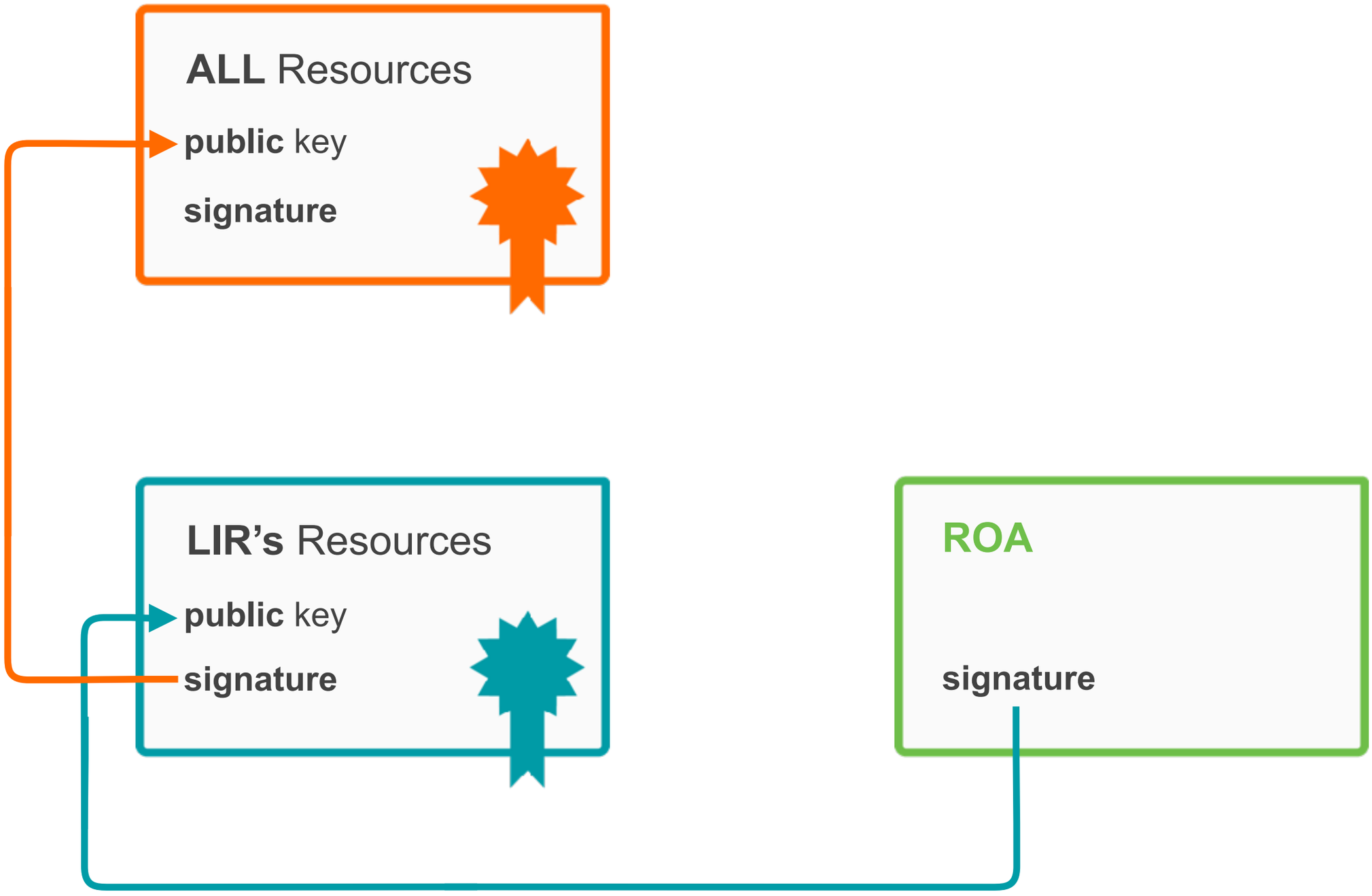
LIR's **private** key

Prefix

is authorised to be announced by

AS Number

RPKI Chain of Trust



Hosted RPKI

- Automatic signing and key roll overs
  - One click setup of resource certificate
  - User has a valid and published certificate for as long as they are the holder of the resources
  - All the complexity is handled by the hosted system
- Lets you focus on creating and publishing ROAs
  - Match your intended BGP configuration

Creating ROAs

RPKI Dashboard

9 CERTIFIED RESOURCES | NO ALERT EMAIL CONFIGURED

41 BGP Announcements

4 Valid | 1 Invalid | 36 Unknown

4 ROAs

3 OK | 1 Causing problems

BGP Announcements | Route Origin Authorisations (ROAs) | History

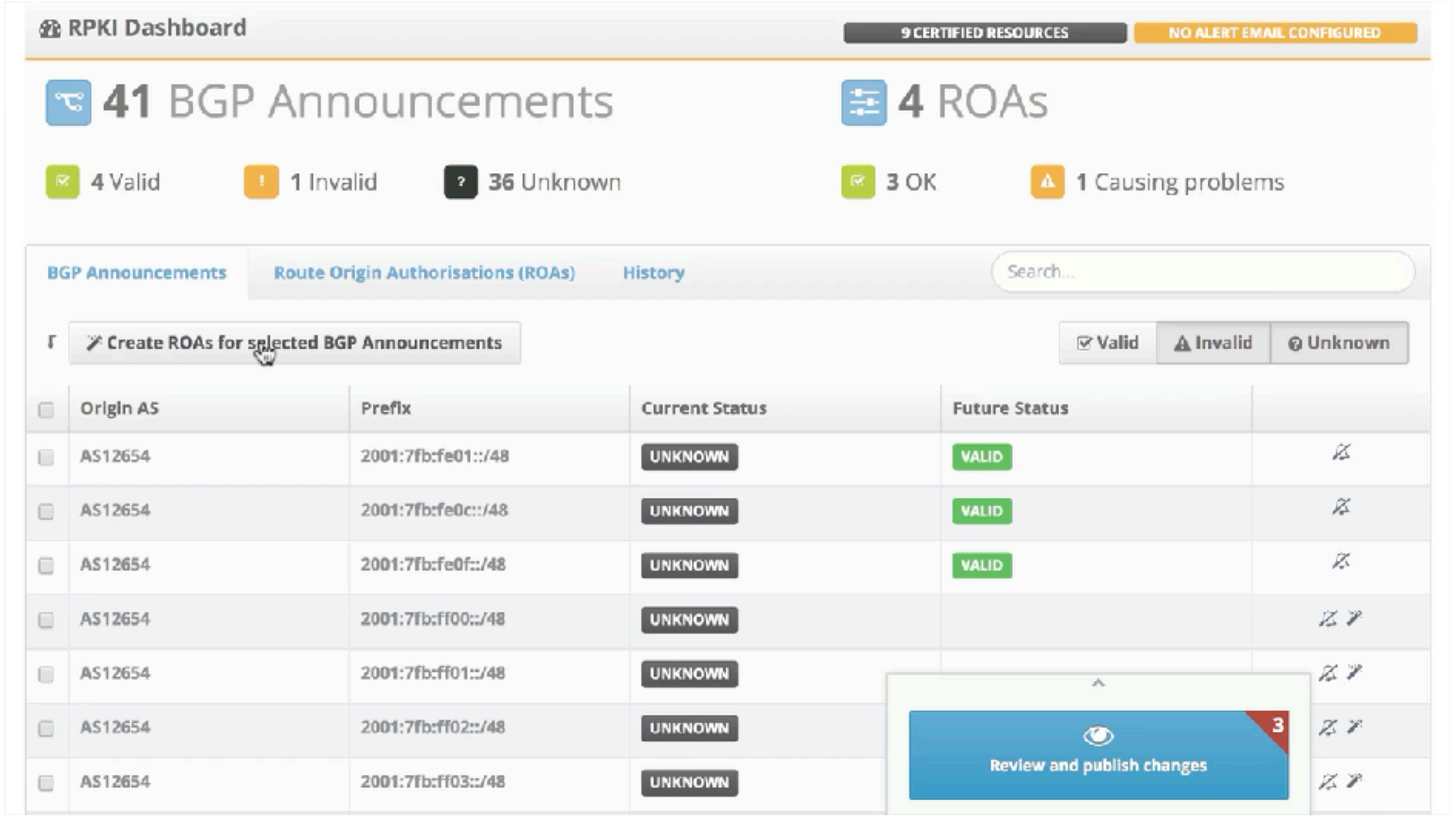
Search...

Create ROAs for selected BGP Announcements

Valid | Invalid | Unknown

Origin AS	Prefix	Current Status
AS12654	2001:7fb:fe01::/48	UNKNOWN
AS12654	2001:7fb:fe0c::/48	UNKNOWN
AS12654	2001:7fb:fe0f::/48	UNKNOWN
AS12654	2001:7fb:ff00::/48	UNKNOWN
AS12654	2001:7fb:ff01::/48	UNKNOWN
AS12654	2001:7fb:ff02::/48	UNKNOWN
AS12654	2001:7fb:ff03::/48	UNKNOWN

Reviewing changes



Checking the effects

RPKI Dashboard

9 CERTIFIED RESOURCES | NO ALERT EMAIL CONFIGURED

41 BGP Announcements

7 Valid | **1** Invalid | **33** Unknown

7 ROAs

6 OK | **1** Causing problems

BGP Announcements | Route Origin Authorisations (ROAs) | History

Search...

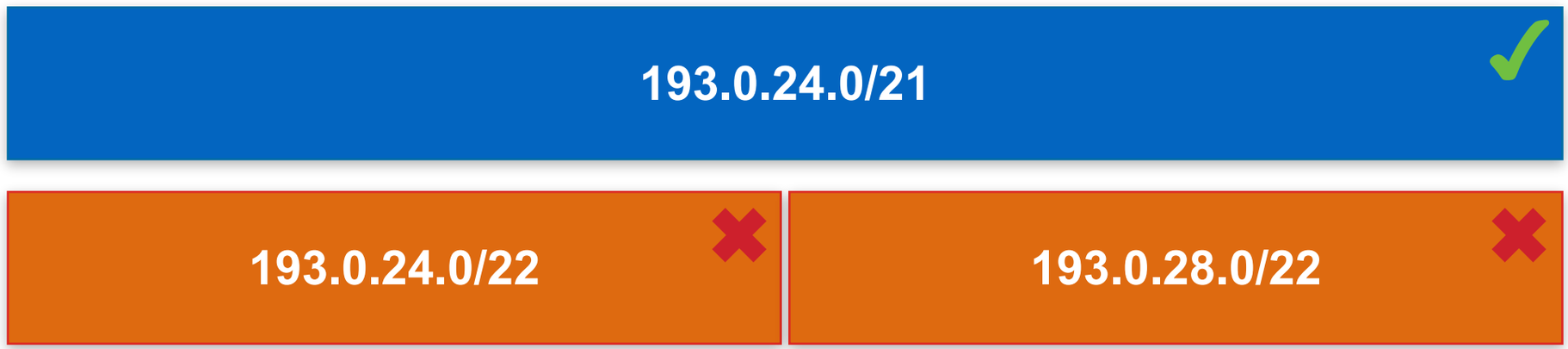
Create ROAs for selected BGP Announcements

Valid | Invalid | Unknown

Origin AS	Prefix	Current Status
AS12654	2001:7fb:ff00::/48	UNKNOWN
AS12654	2001:7fb:ff01::/48	UNKNOWN
AS12654	2001:7fb:ff02::/48	UNKNOWN
AS12654	2001:7fb:ff03::/48	UNKNOWN
AS12654	2001:7fb:ff04::/48	UNKNOWN
AS12654	2001:7fb:ff05::/48	UNKNOWN
AS12654	2001:7fb:ff07::/48	UNKNOWN

ROA

193.0.24.0/21
AS2121
Max Length: /21

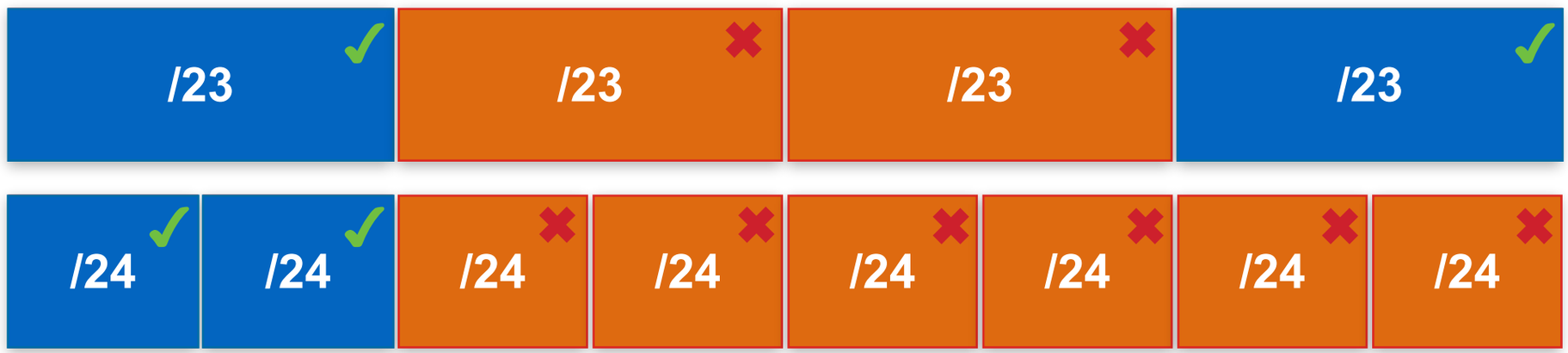


ROA

193.0.24.0/23
AS2121
Max Length: /24

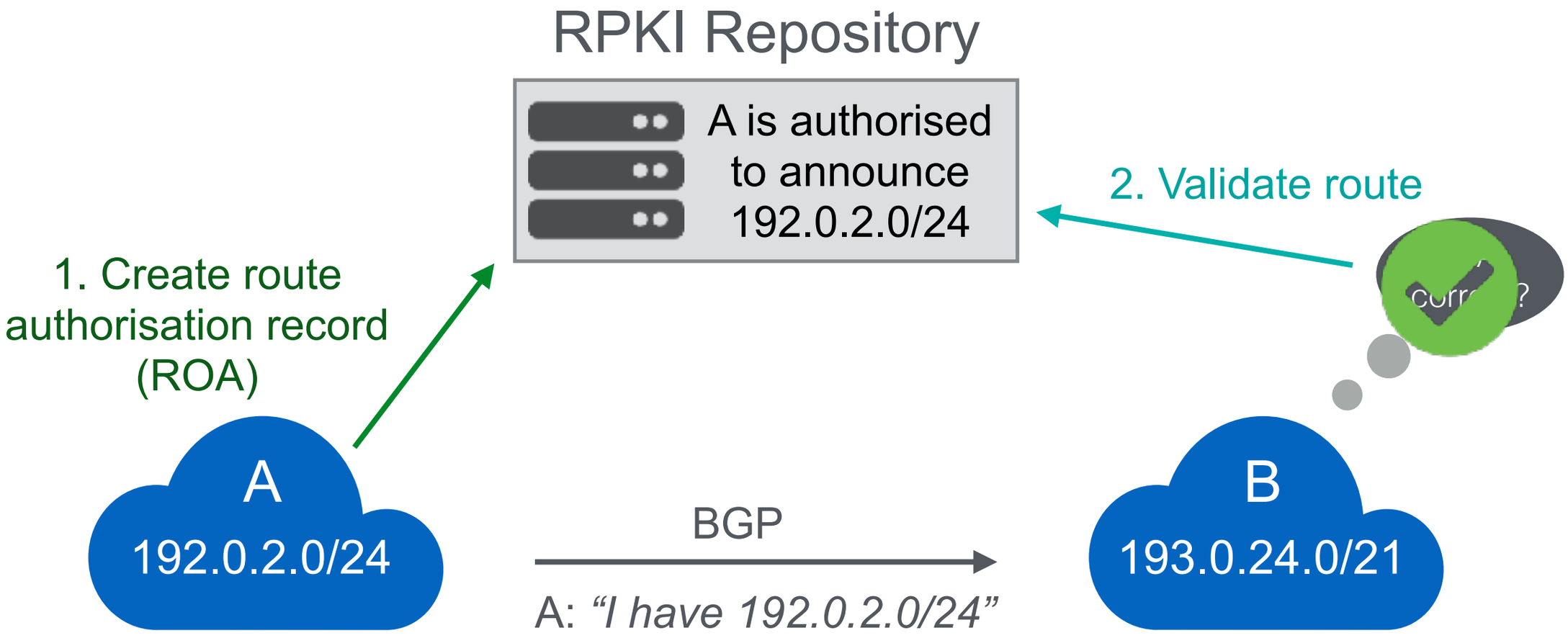
ROA

193.0.30.0/23
AS2121
Max Length: /23



Validation Tools

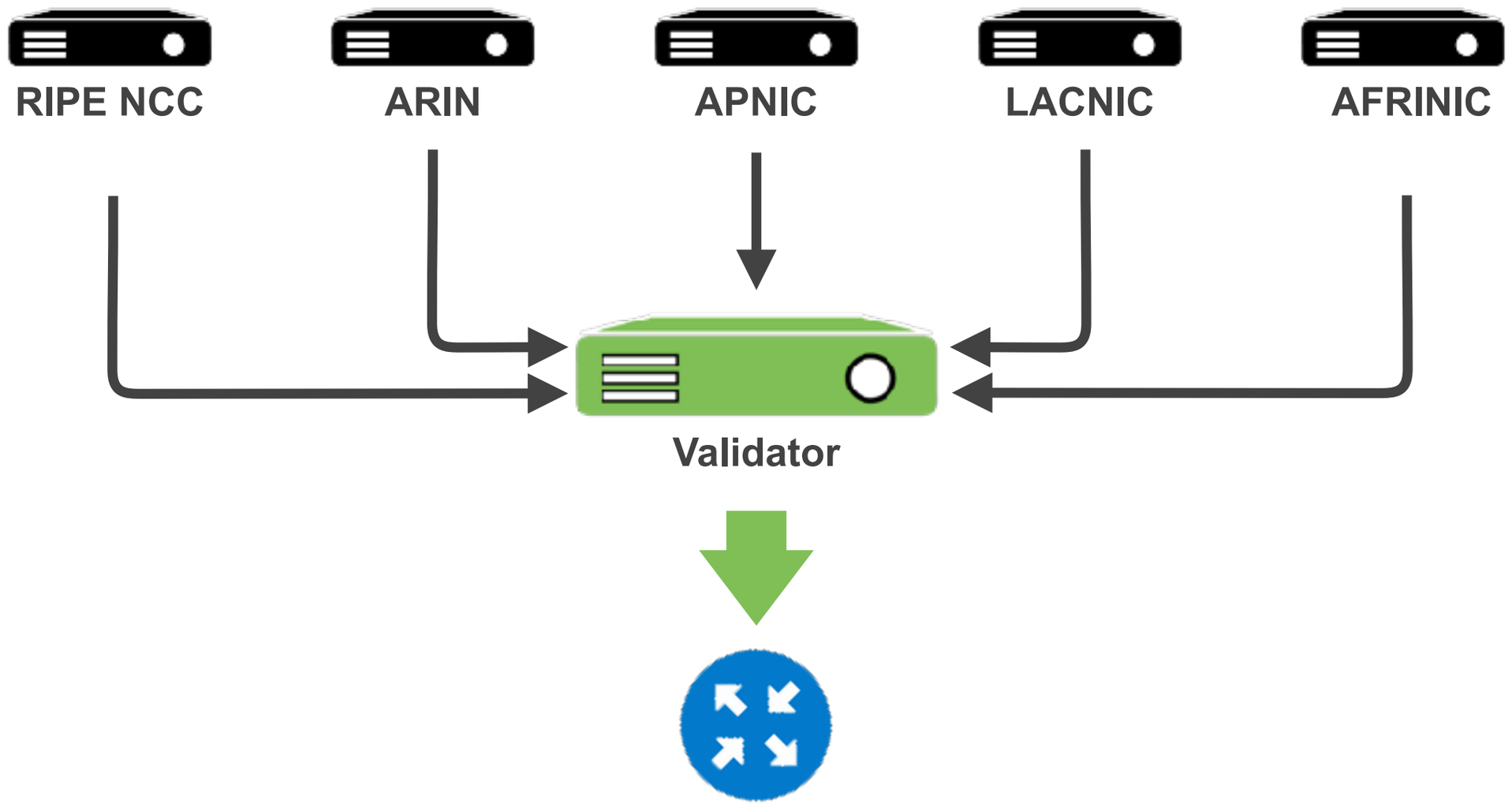
Routing on the Internet



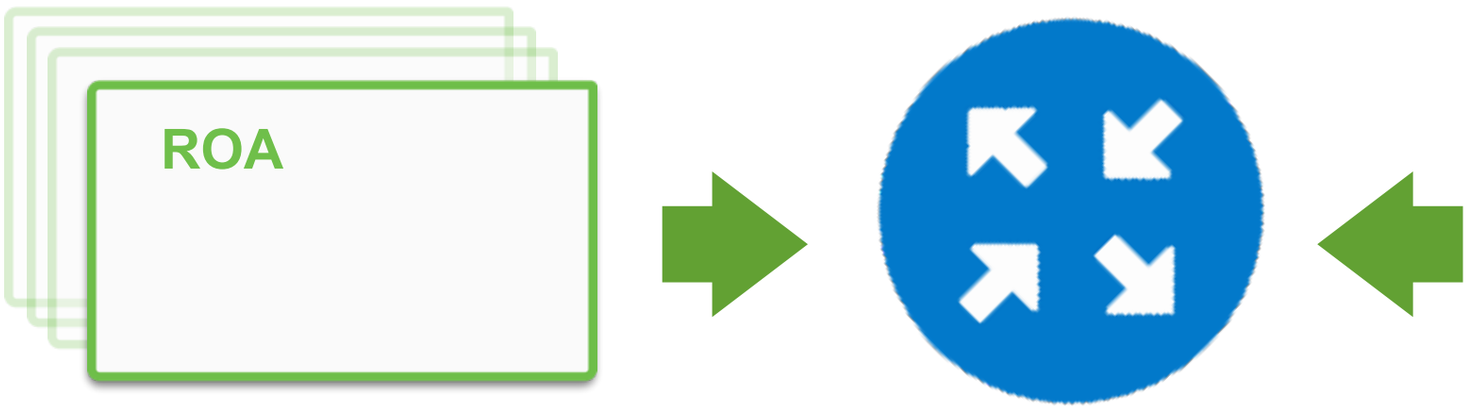
RPKI Validators

- Software that creates a local “validated cache” with all the valid ROAs
  - Downloads the RPKI repository from the RIRs
  - Validates the chain of trust of all the ROAs and associated CAs
  - Talks to your routers using the RPKI-RTR Protocol

Relying Party



Relying Party



BGP Announcements

AS111	10.0.7.30/22
AS222	10.0.6.10/24
AS333	10.4.17.5/20
AS111	10.0.7.30/22
AS111	10.0.7.30/22
AS111	10.0.7.30/22

BETTER ROUTING DECISIONS

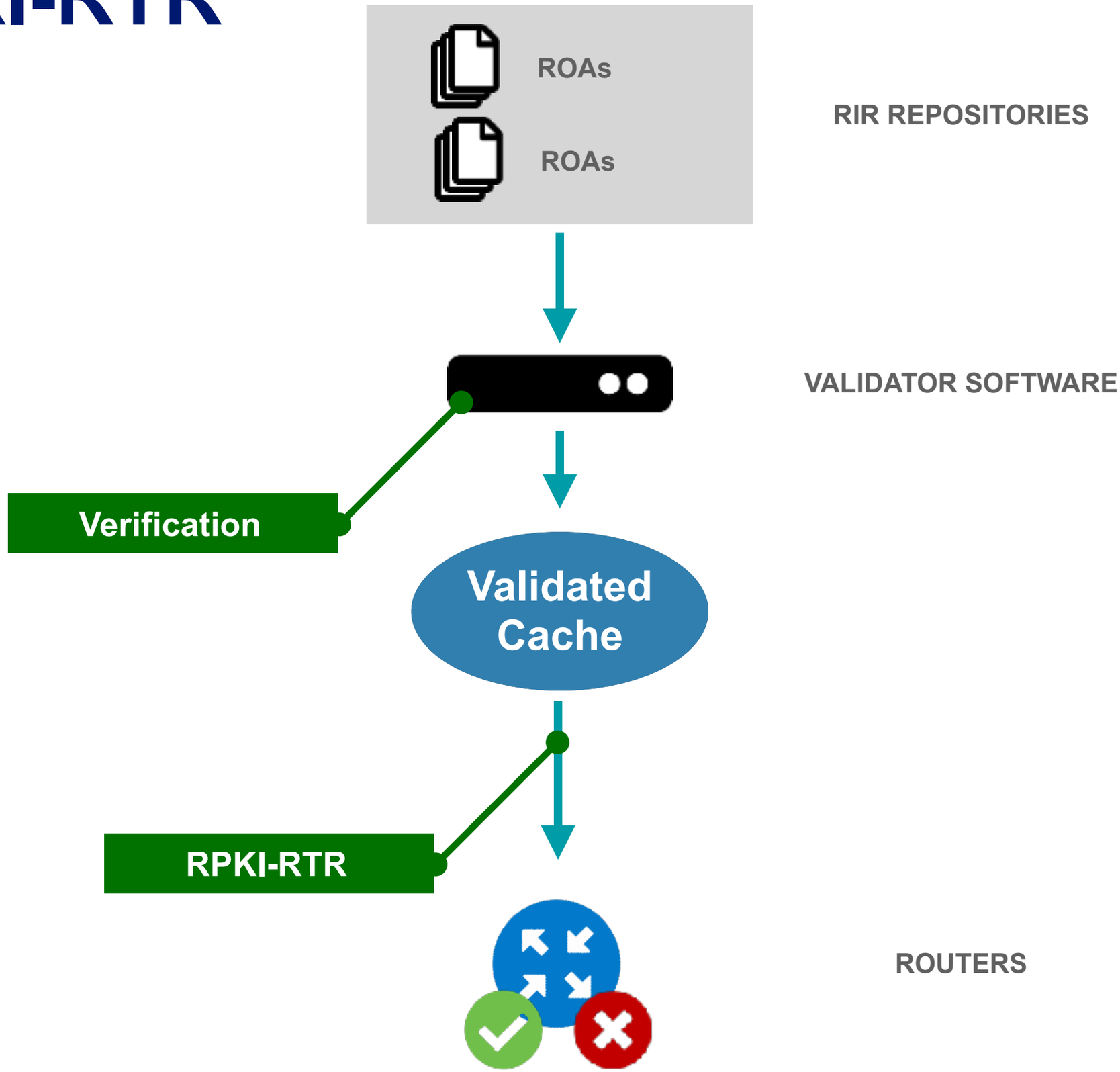
RPKI Validator Options

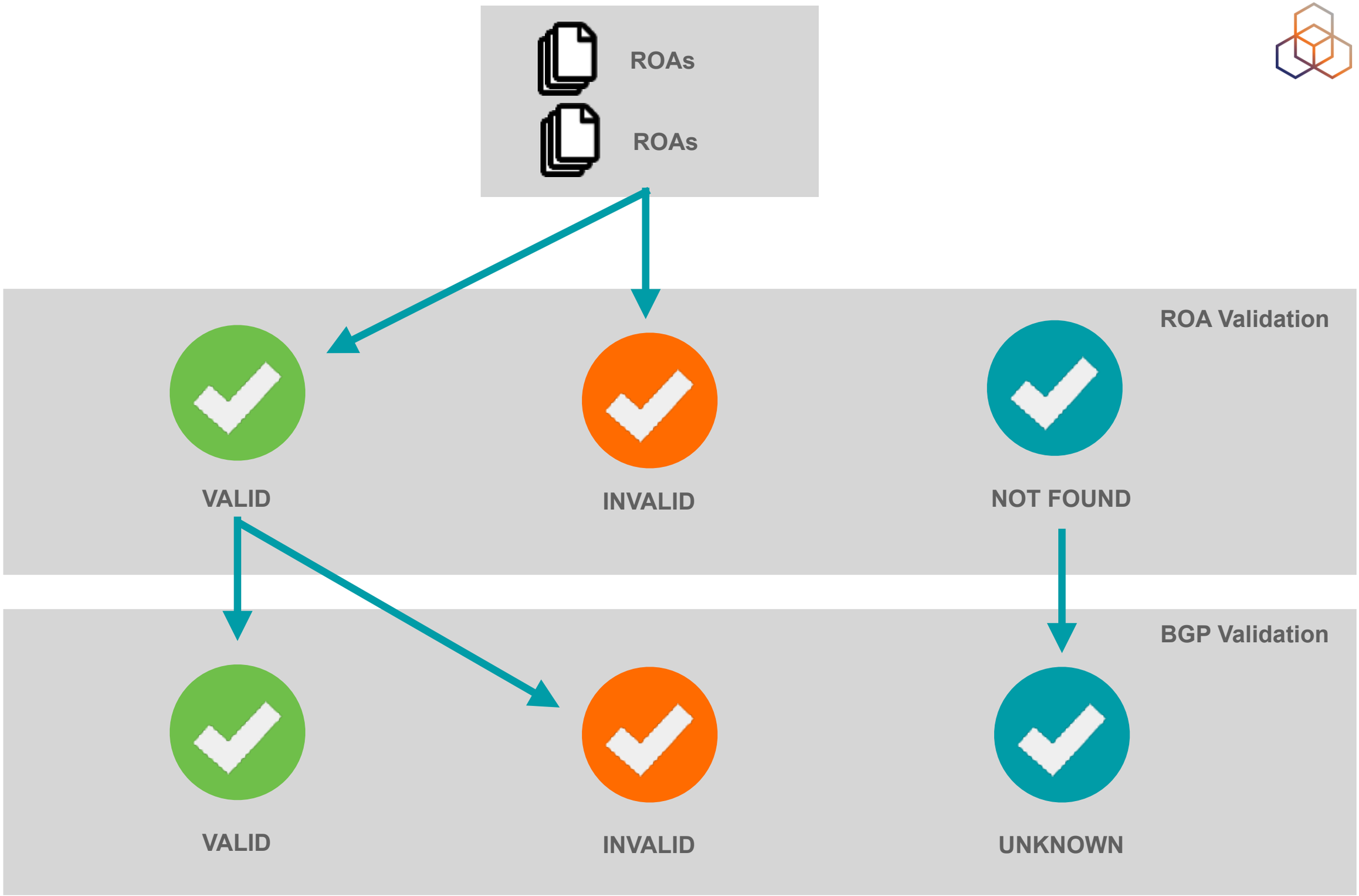
January 1, 2021 no new features!

July 1, 2021 end of support!

- **RIPE NCC Validator 3.2**
  - Java based
- **Routinator**
  - Built with Rust, built by NLNetlabs
- **OctoRPKI**
  - Cloudflare’s Relying Party software, written in the Go
- **Dragon Research Labs Validating Cache**
  - Written in Python

RPKI-RTR


ROAs
ROAs
RIR REPOSITORIES
VALIDATOR SOFTWARE
Verification
Validated Cache
RPKI-RTR
ROUTERS


ROAs
ROAs
ROA Validation
VALID
INVALID
NOT FOUND
BGP Validation
VALID
INVALID
UNKNOWN

Invalids

- Invalid ROA
  - The ROA in the repository cannot be validated by the client (ISP) so it is not included in the validated cache
- Invalid BGP announcement
  - There is a ROA in validated cache for that prefix but for a different AS.
  - Or the max length doesn’t match.
- If no ROA in the cache then announcement is “unknown”

Whitelisting

- If there is an invalid ROA for a network that's important for you or your customers, you can whitelist it
- This is done on your local validator software
  - It creates a "fake" ROA for the resources you want
- It allows you to contact the operator to fix their ROA
  - Think of e-mail, contact forms, etc…

Questions

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The End!

Край

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Fí

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Кінець

Konec

Kraj

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Fund

پایان

Kpaj

Lõpp

Beigas

Vége

Son

An Críoch

הסוף

Endir

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Sfârşit

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Pabaiga

Tmiem

Koniec

Fim

Amaia

Loppu