



**RIPE NCC**

RIPE NETWORK COORDINATION CENTRE

# Securing BGP

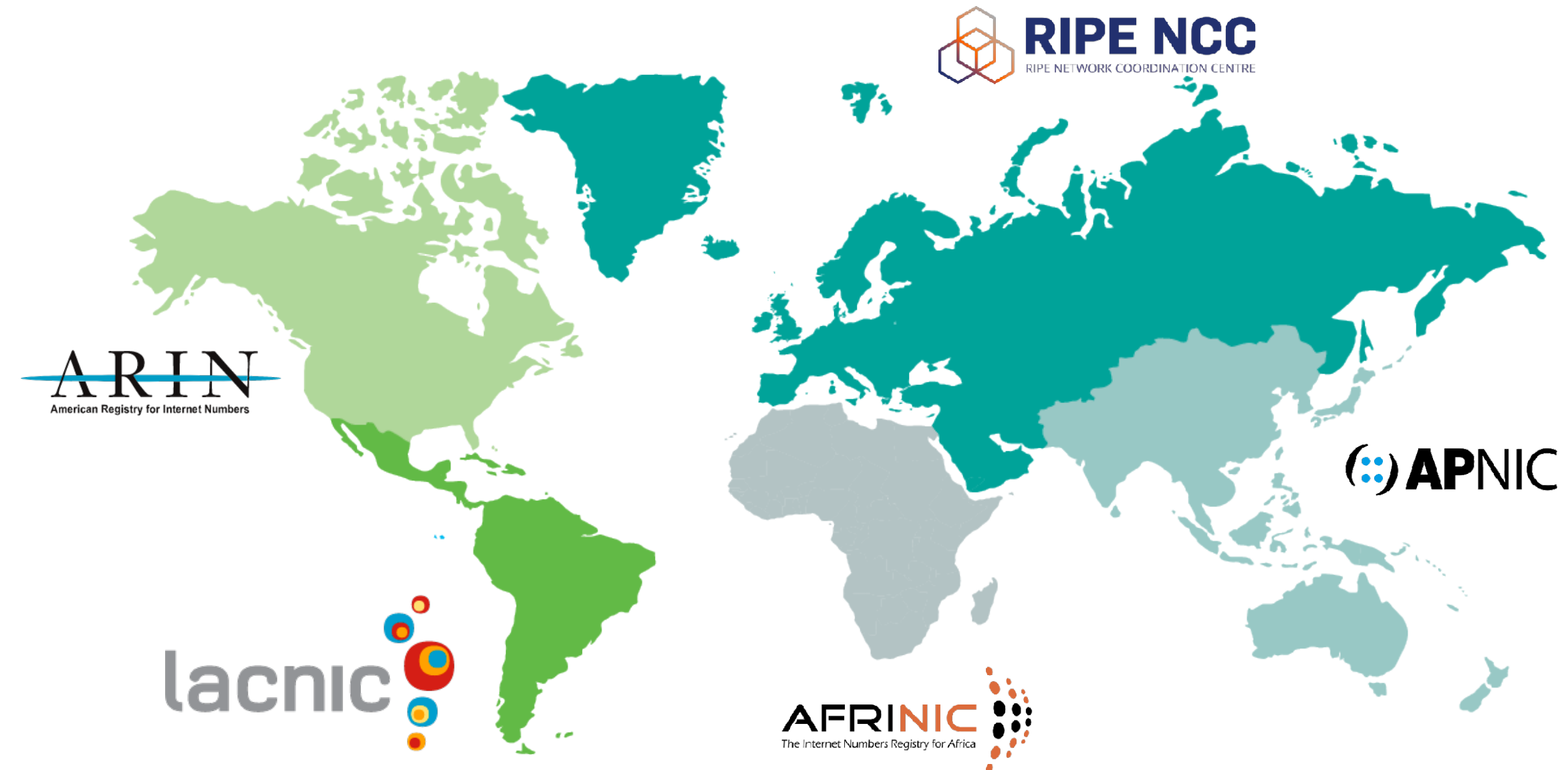
One Hop At A Time

Nathalie Trenaman | 21 October | Cybersprint Office

# RIPE NCC



- Not-for-profit, membership based (vereniging)
- Funded by membership fees
- Based in Amsterdam
- Established in 1992
- ~160 employees



# What We Do



- Distributing IPv6, IPv4, AS numbers to 24.000 members in 76 countries
- Operating the largest internet measurement platform (ATLAS)
- RIPE Database
- RPKI
- K-root

# Interesting Times!



DYLAN TWENEY BUSINESS 02.03.2011 09:58 AM

## No Easy Fixes as Internet Runs Out of Addresses

The Internet is about to run out of addresses

### The IPv4 party is over

Nov 27, 2019

Microsoft Runs Out of US Address Space For Azure

### The Internet has run out of IP addresses (sort of)

BY AMANDA SCHUPAK  
JULY 3, 2015 / 6:00 AM / CBS NEWS



### IPv4 addresses hit black market

By Chike onwuegbuchi  
01 July 2016 | 2:24 am

## We've finally run out of IPv4 addresses

By Shawn Knight September 25, 2015, 10:15 AM | 39 comments

### This Time, There Really Are NO IPv4 Internet Addresses Left

Thursday, October 17th, 2019 (4:06 pm) - Score 38,853

{\* NETWORKS \*}

## We are absolutely, definitively, completely and utterly out of IPv4 addresses, warns RIPE

So will you all please move to IPv6? World: Nope.

Kieren McCarthy in San Francisco

Mon 25 Nov 2019 // 22:31 UTC

# Administrative Trends...



- Source: <https://ipv4marketgroup.com/ipv4-pricing/>

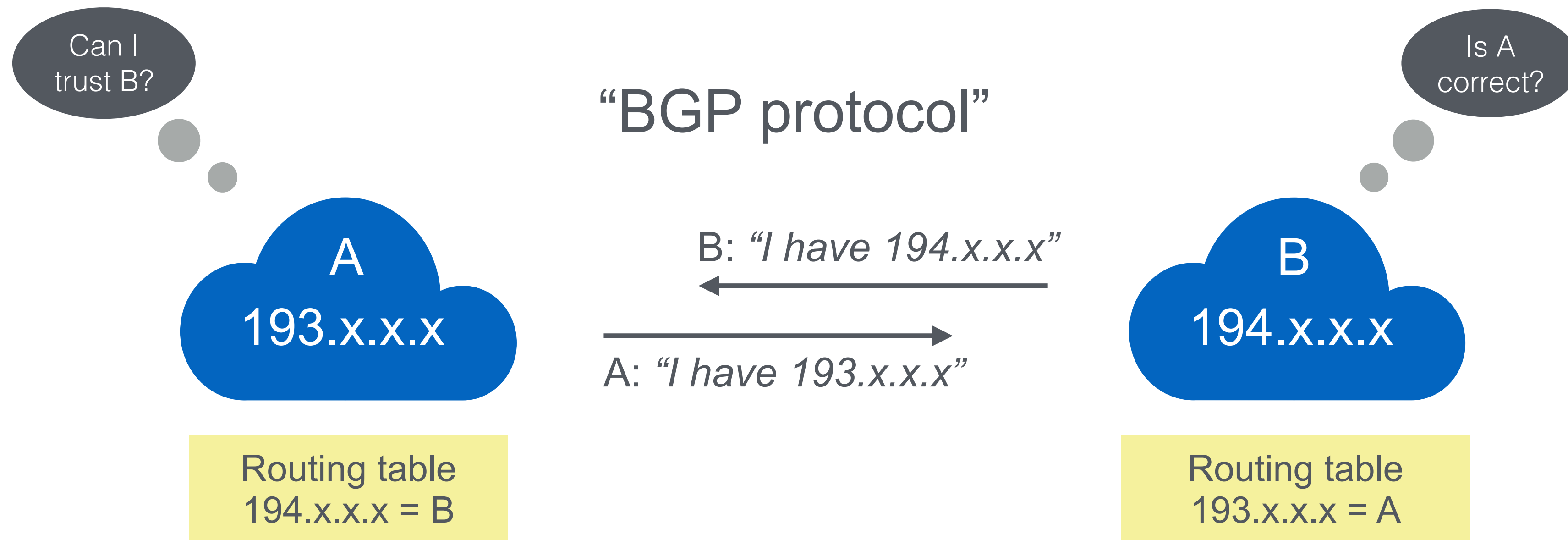




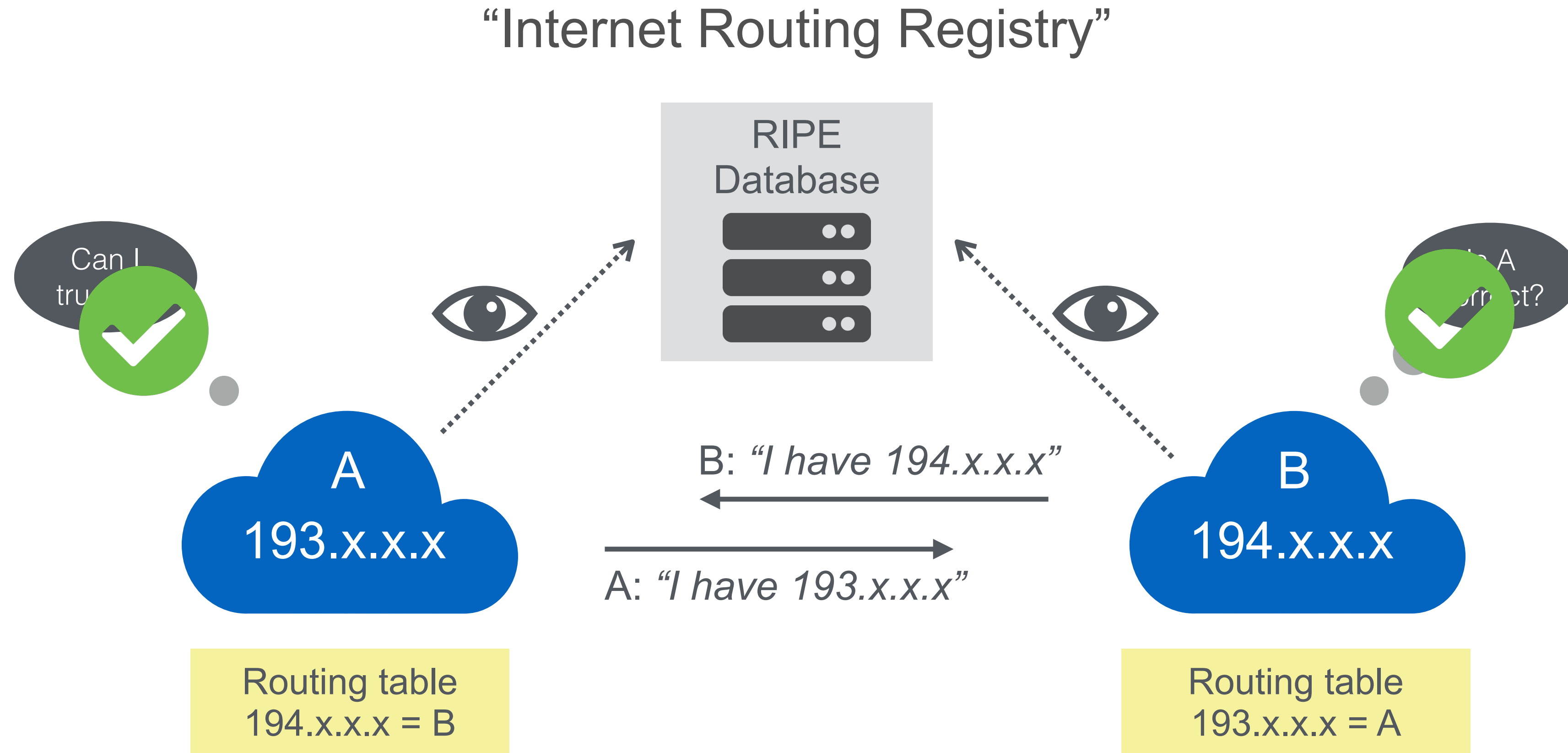
**BGP**

A More Technical Part

# Routing on the Internet



# 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
- Incidents attract media attention nowadays
  - Facebook, anyone?

# Or Worse....



- April 2018
  - BGP and DNS Hijack
  - Targeting MyEtherWallet
  - Unnoticed for two hours

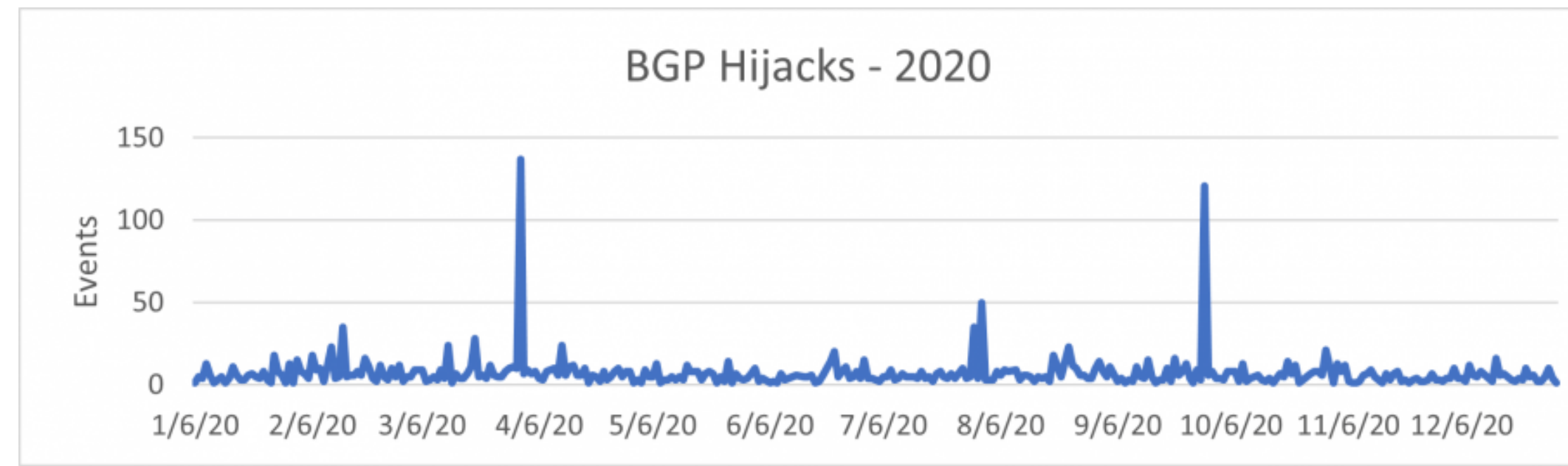


# Incidents Are Common

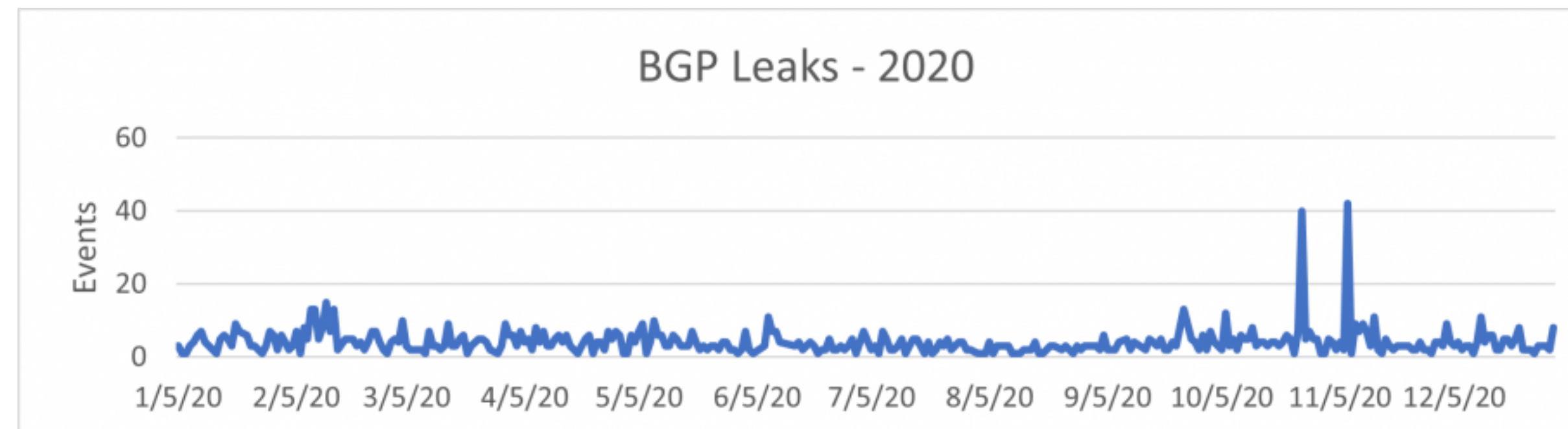


- 2020 Routing Security Review

- 2477 BGP hijack events



- 1396 Route Leaks



Source: <https://www.manrs.org/2021/02/bgp-rpki-and-manrs-2020-in-review/>

# Internet Routing Registry



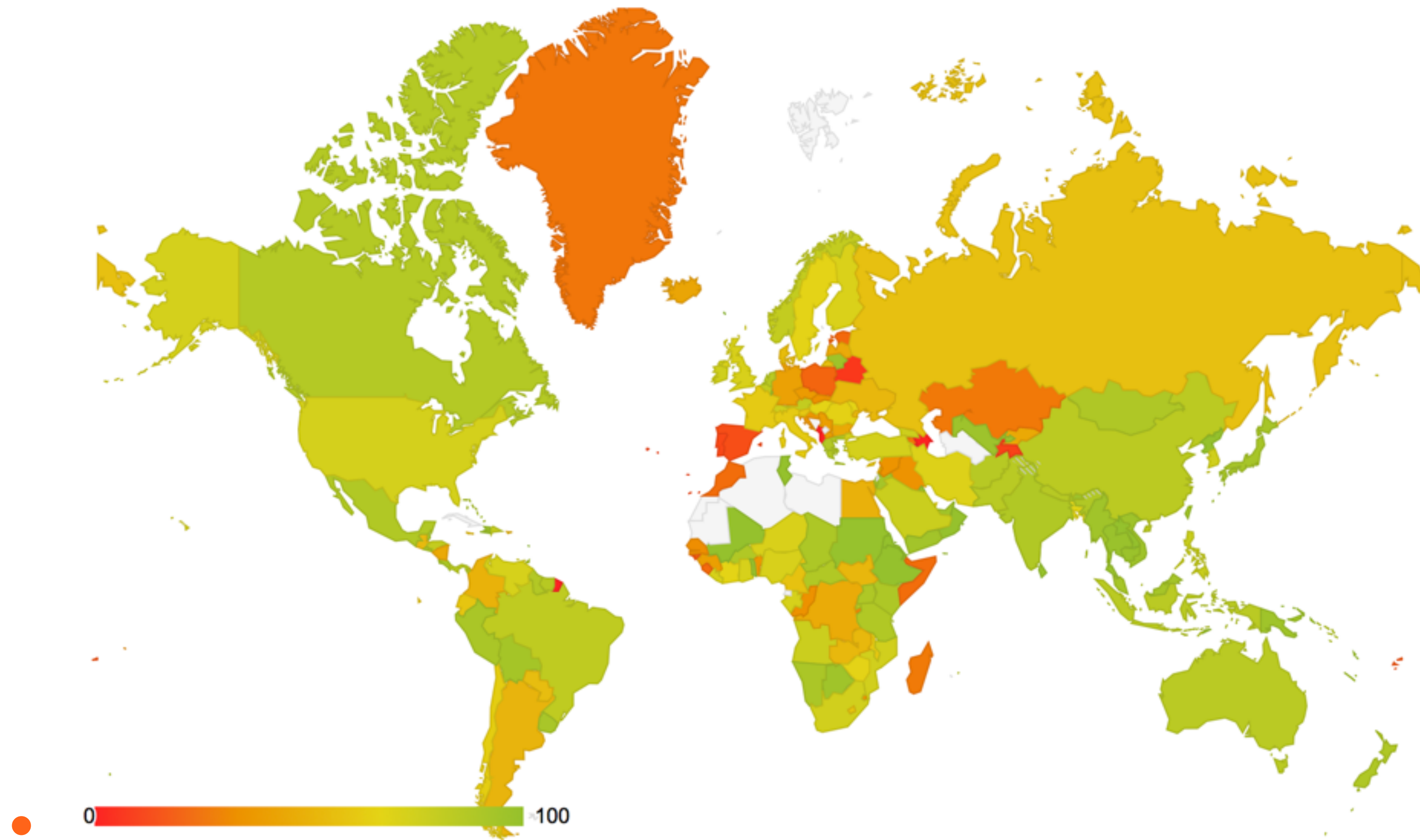
- Many exist, most widely used
  - RIPE Database
  - RADB
- Verification of holdership over resources
  - RIPE Database for RIPE Region resources only
  - RADB allows paying customers to create any object
  - Lots of the other IRRs do not formally verify holdership

# Problem Statement



- Some IRR data cannot be fully trusted
  - Accuracy
  - Incomplete data
  - Lack of maintenance
- Not every RIR has an IRR
  - Third party databases need to be used (RADB, Operators)
  - No verification of who holds IPs/ASNs







# Resource Public Key Infrastructure

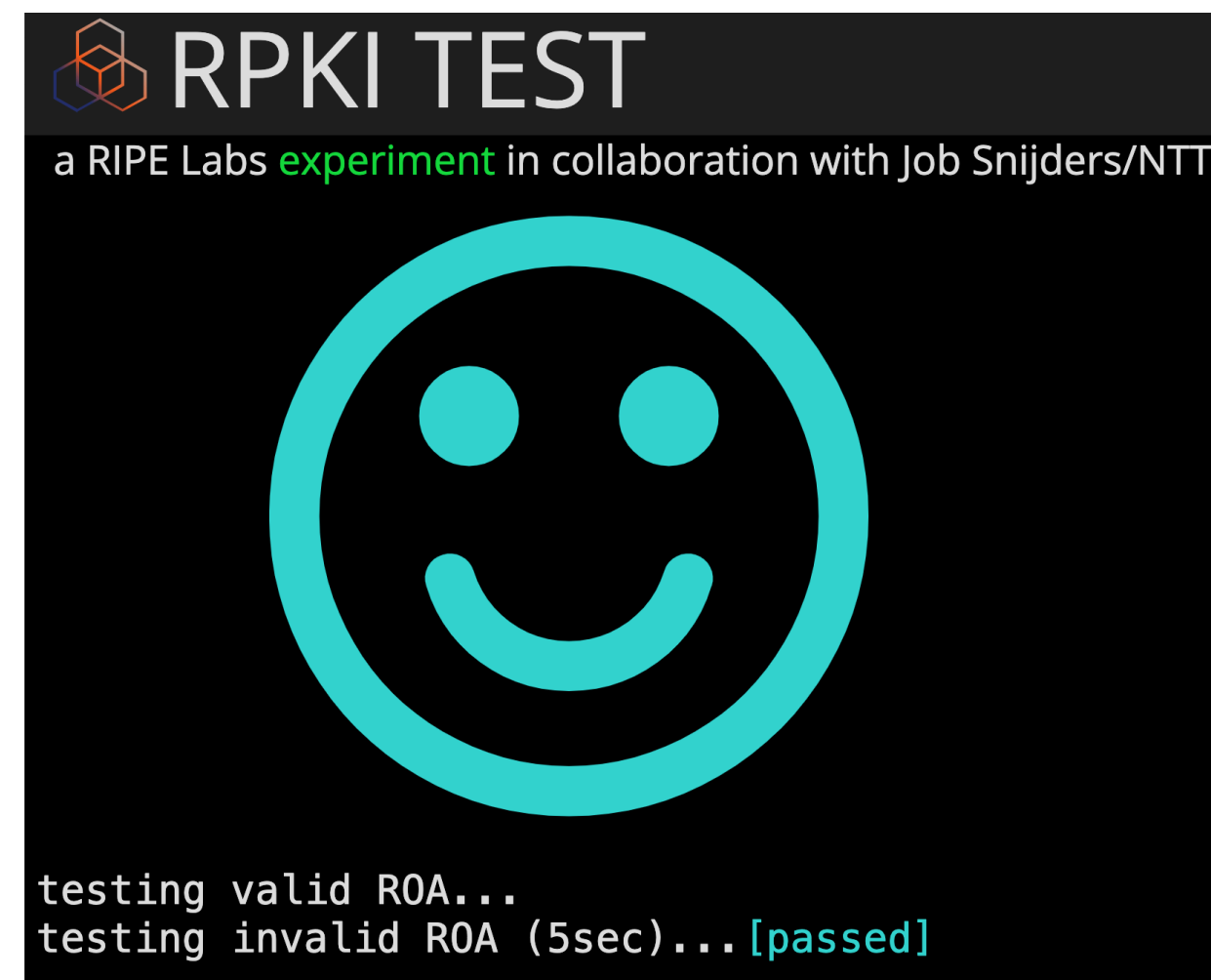


- Developed by the IETF, standardised in 2011
- Ties IP addresses and ASNs to public keys
- Follows the hierarchy of the registries
- Authorised statements from resource holders
  - “ASN X is authorised to announce my Prefix Y”
  - Signed, holder of Y
- X.509 certificates with extensions for IP address and ASN

# What It Does



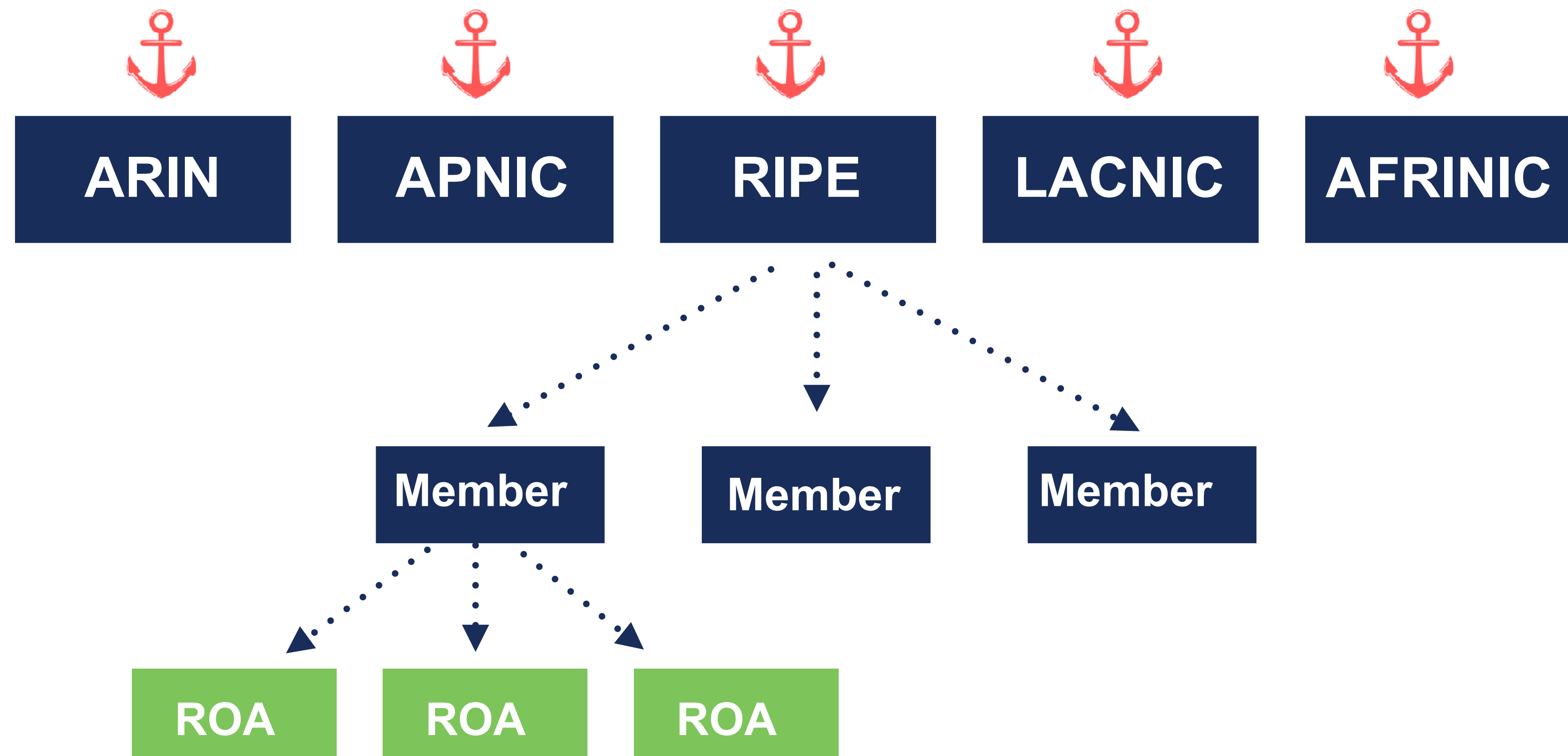
- Allows IP address holders to create digitally signed (and verifiable) statements about their BGP routing intentions
- Allows network operators to make more informed (and trusted) routing decisions



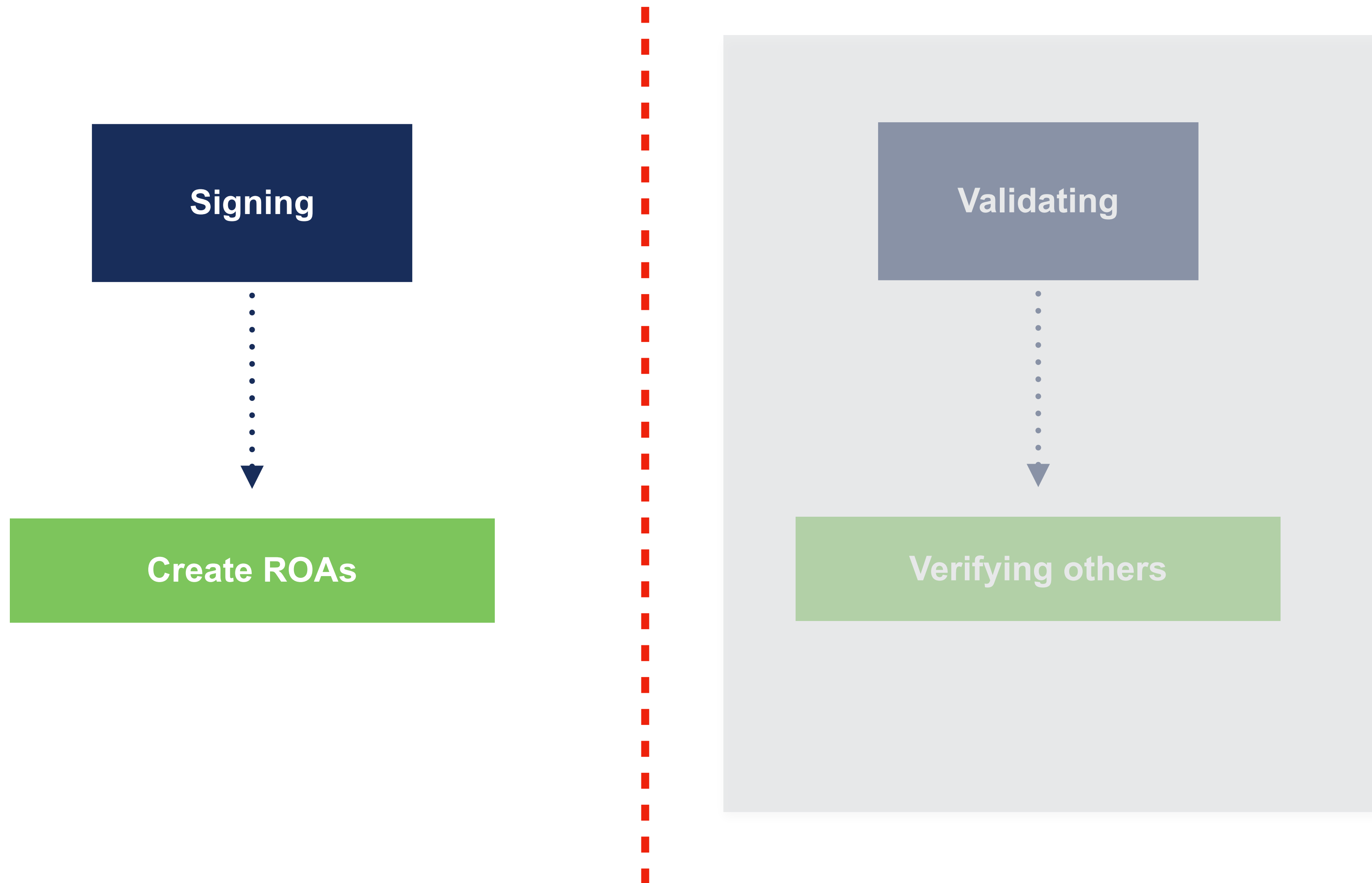
# RPKI Certificate Structure



Certificate hierarchy follows allocation hierarchy



# Two elements of RPKI



# RIPE NCC Hosted Solution



RPKI Dashboard 3 CERTIFIED RESOURCES ALERTS ARE SENT TO 5 ADDR

**2 BGP Announcements**  
2 Valid 0 Invalid 0 Unknown

**2 ROAs**  
2 OK 0 Causing problems

**BGP Announcements** **Route Origin Authorisations (ROAs)** History

Create ROAs for selected BGP Announcements  Valid  Invalid  Unknown

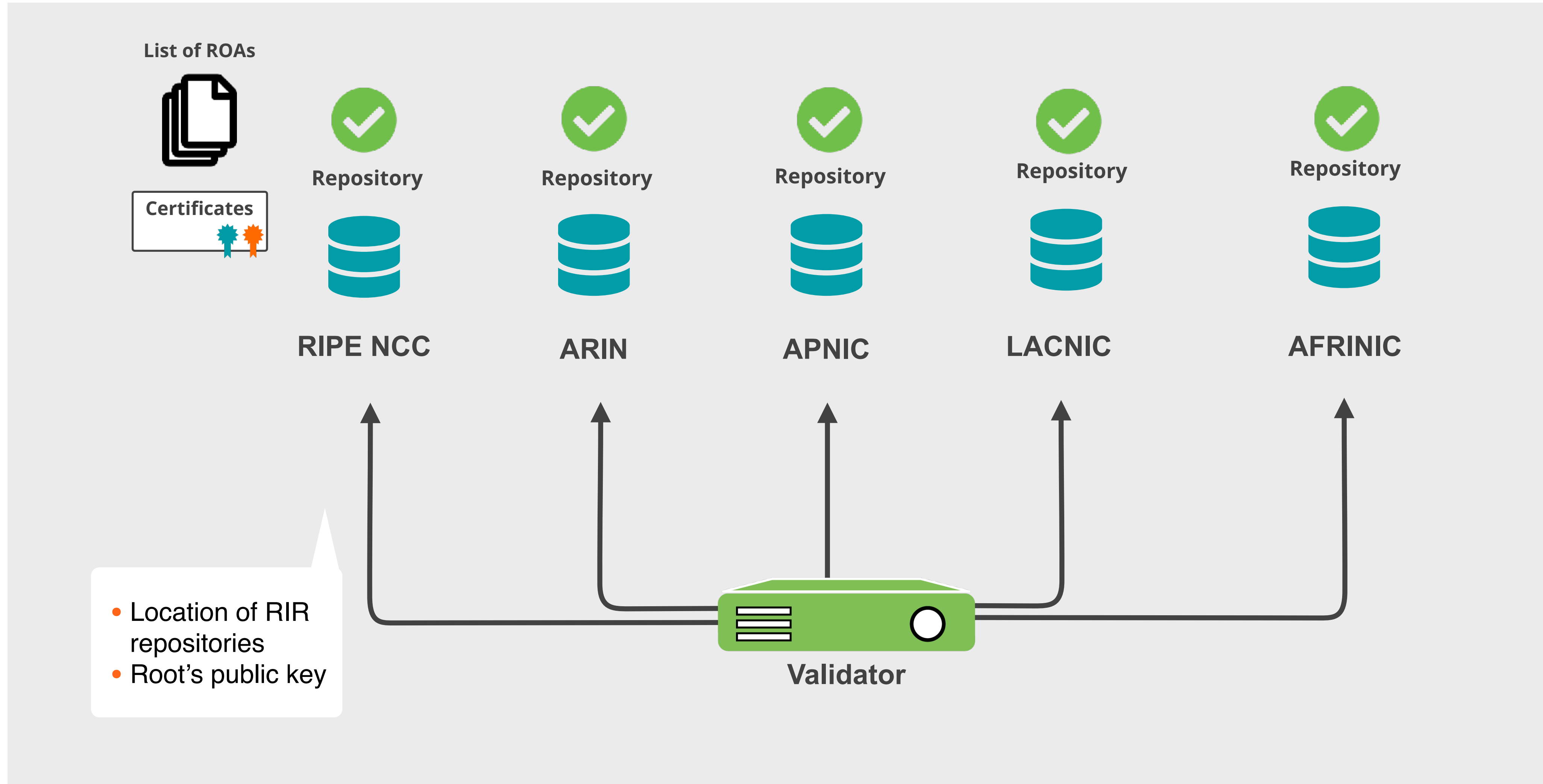
<input type="checkbox"/> Origin AS	Prefix	Current Status	
<input type="checkbox"/> AS2121	193.0.24.0/21	VALID	
<input type="checkbox"/> AS2121	2001:67c:64::/48	VALID	

Show  ▾

[Looking for ROA Certification for PI resources?](#)

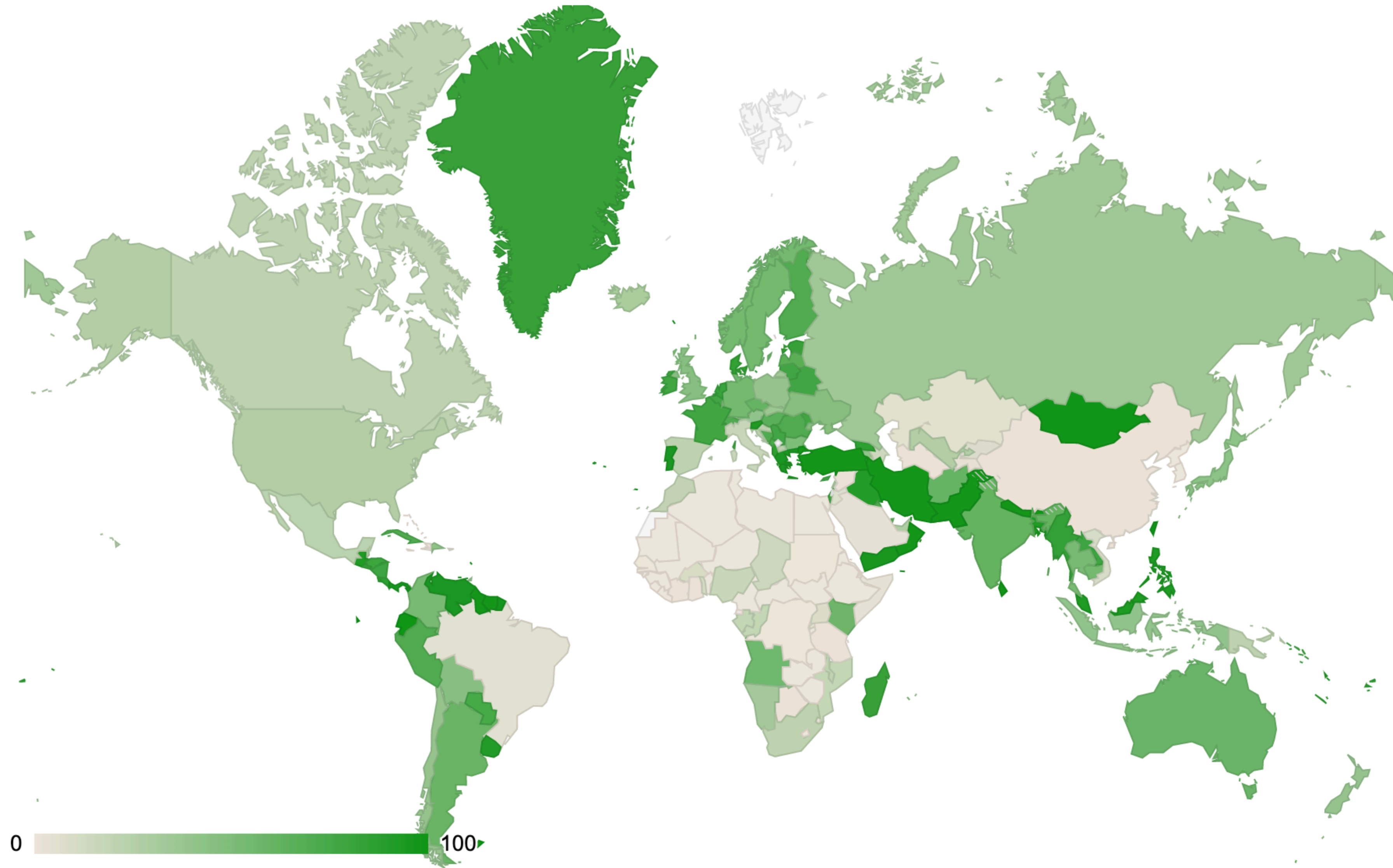
[Revoke hosted CA](#)

# How It Works



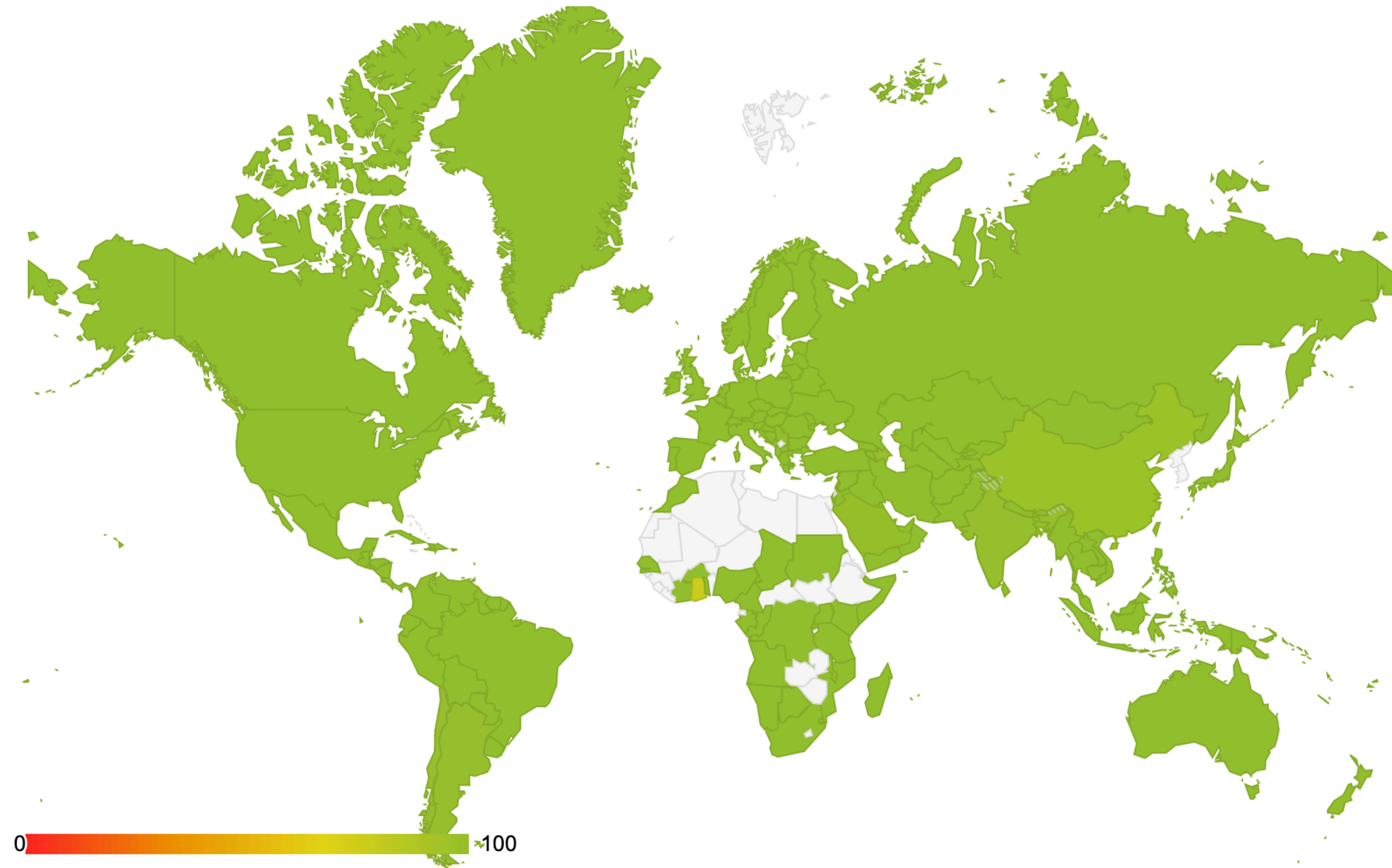


Select a graph: IPv4 space covered

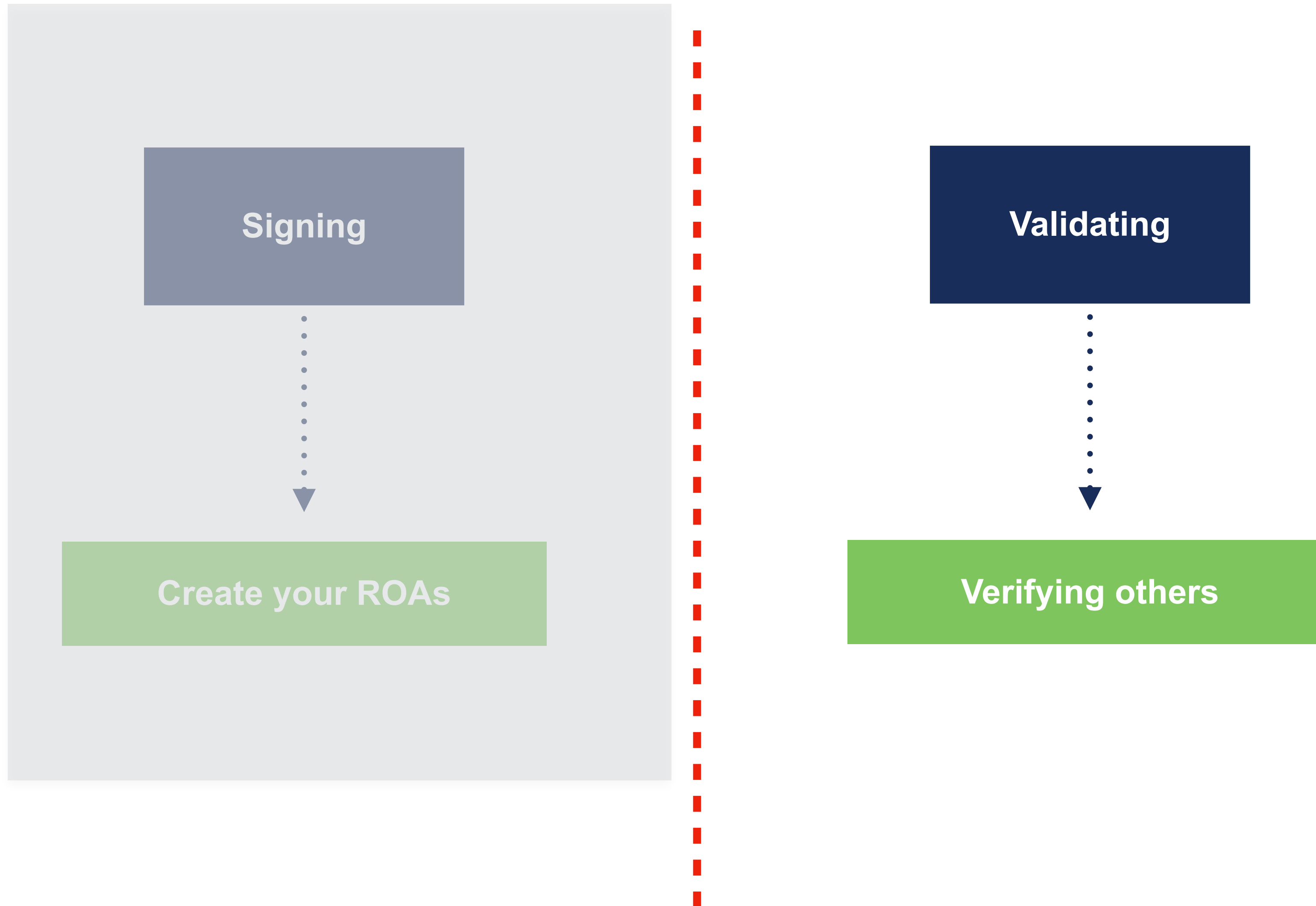




Select a graph: IPv4 space valid as fraction of covered ▾



# Two elements of RPKI

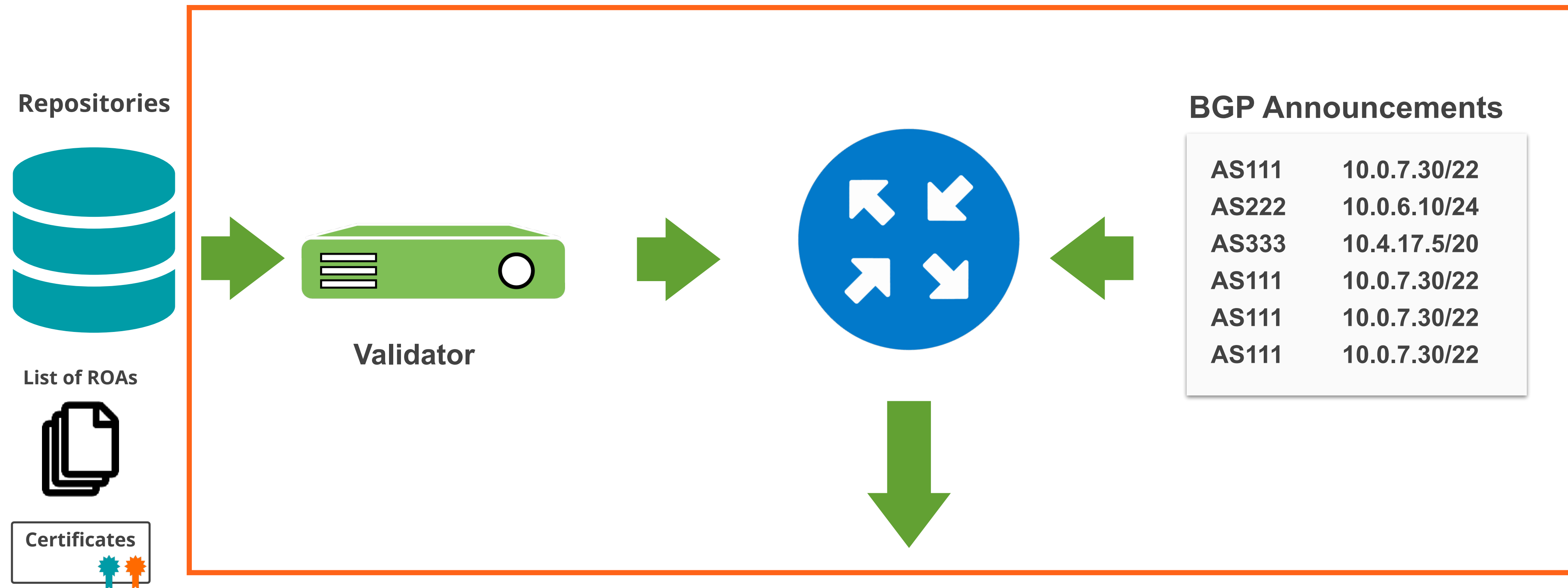


# RPKI Validation



- Verifying the information provided by the others
- Goal is to validate the “origin of BGP announcements”
- Known as Route Origin Validation (ROV)
  
- :- ( : You only can verify the origin
- :- ): It does prevent most typos to spread

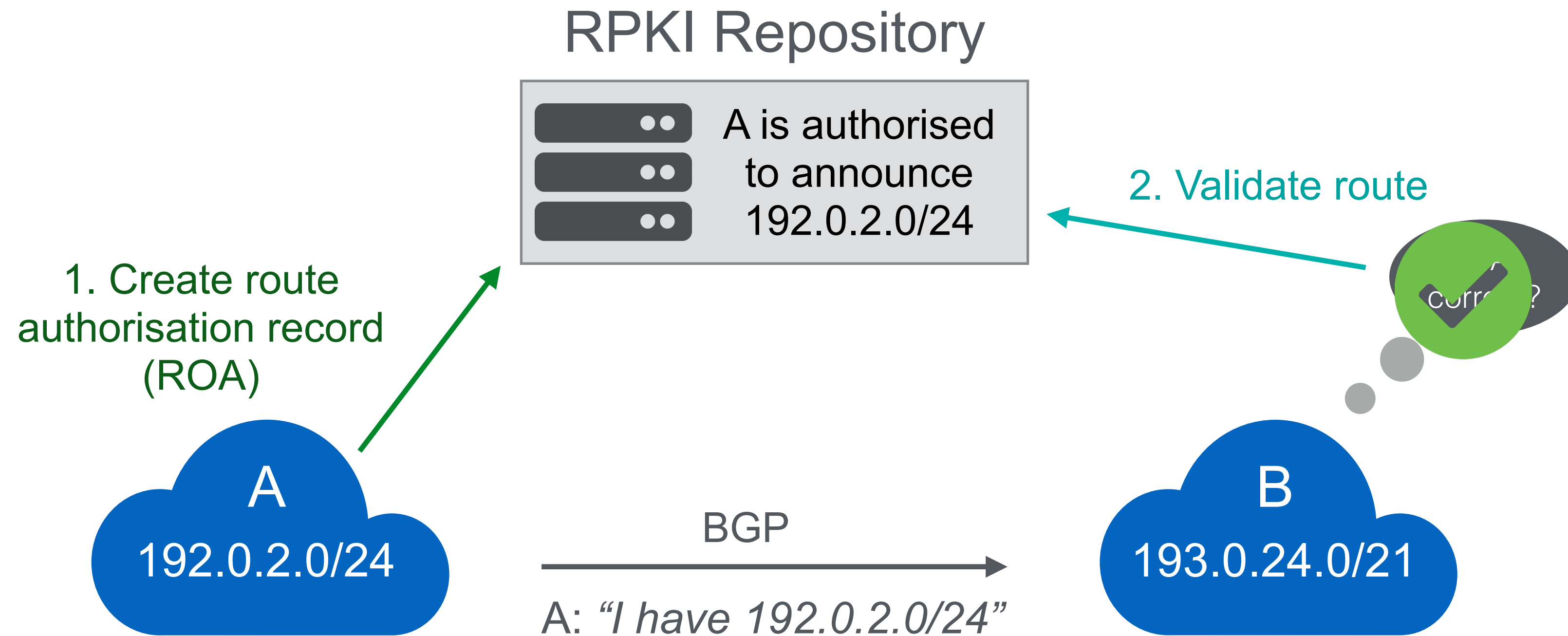
# Relying Party



**BETTER ROUTING DECISIONS**



# Routing on the Internet

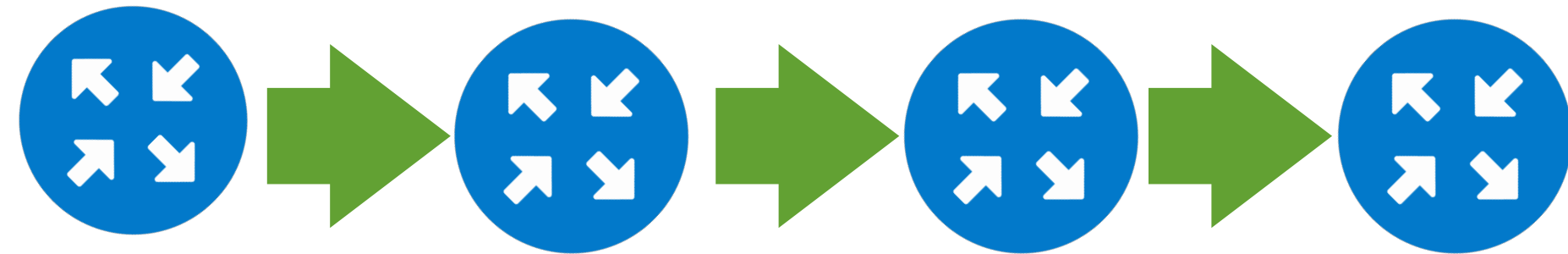




# What's Next?




- Full AS Path validation!



- All IETF drafts/standards are building blocks on RPKI
  - BGPsec
  - ASPA
  - AS-Cones
  - Blockchain (just kidding!)

# Very Useful Tools



- <https://rpki-validator.ripe.net/ui/>
  - A public user interface for a validator (Routinator)
- <https://ihr.iijlab.net/ihr/en-us/>
  - To see RPKI invalid BGP routes per country (and a lot of other cool stuff)
- <https://ring.nlnog.net/> 
  - Shell access (ping, trace route) from 479 networks in 55 countries
- <https://atlas.ripe.net/>
  - Largest free internet measurement platform, 11838 vantage points



# How To Get Started?

- Read up! This is a great starting point:
  - <https://rpki.readthedocs.io/en/latest/>
- Tons of help & troubleshooting BGP on IRC (yeah..)
  - <https://nlnog.net/irc/> #NLNOG on IRCnet
- Global RPKI “helpline” (350+ experts) on Discord
  - <https://discord.com/invite/WaPgs8vEKy>
- Drop me an e-mail :) [nathalie@ripe.net](mailto:nathalie@ripe.net)



**Questions**

