RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Developments in Routing Security

Nathalie Trenaman | April 2019 | SEE8

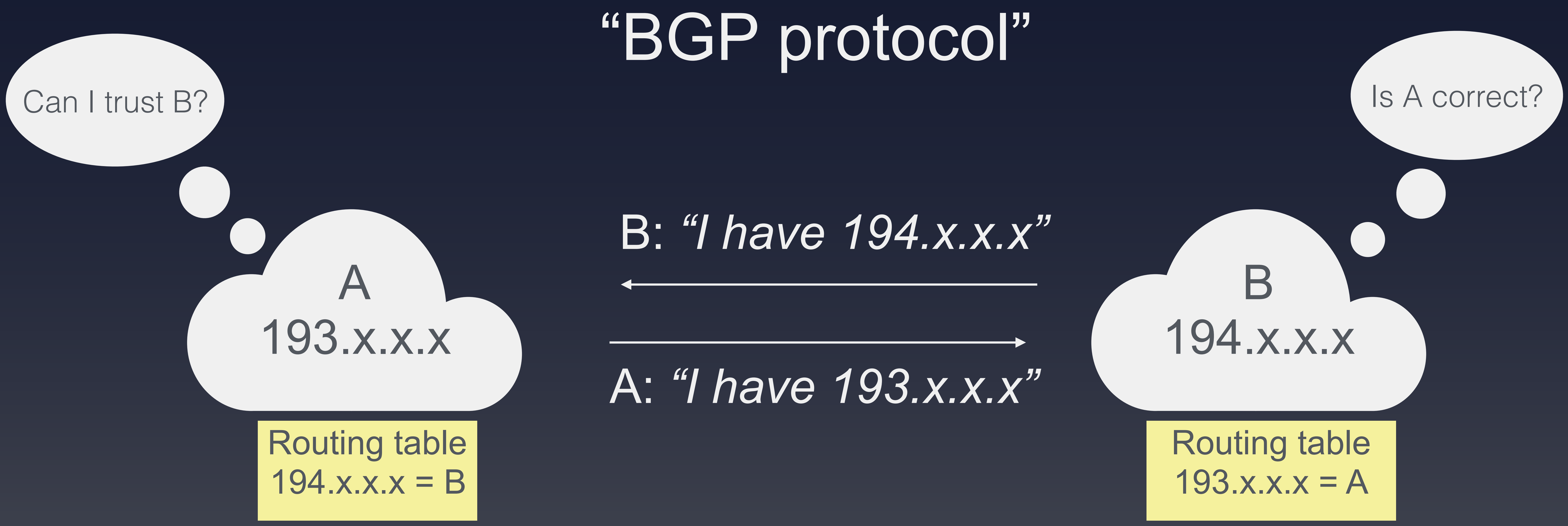
Who We Are

- We manage IP and ASN allocations in Europe, the Middle East and parts of Central Asia
  - Ensure unique holdership
  - Document holdership in the RIPE Database (whois)
  - Enable operators to document use of their address spaces

Routing Security is in Our DNA

- In 1994, RIPE-181 was the first document published that used a common language to describe routing policies
- We co-developed standards for IRR and RPKI
- We are one of the five RPKI Trust Anchors
- Our Validator tool was, until recently, the only production-grade tool to do Origin Validation

Routing on the Internet



“BGP protocol”

Can I trust B?

Is A correct?

A
193.x.x.x

B
194.x.x.x

B: *“I have 194.x.x.x”*

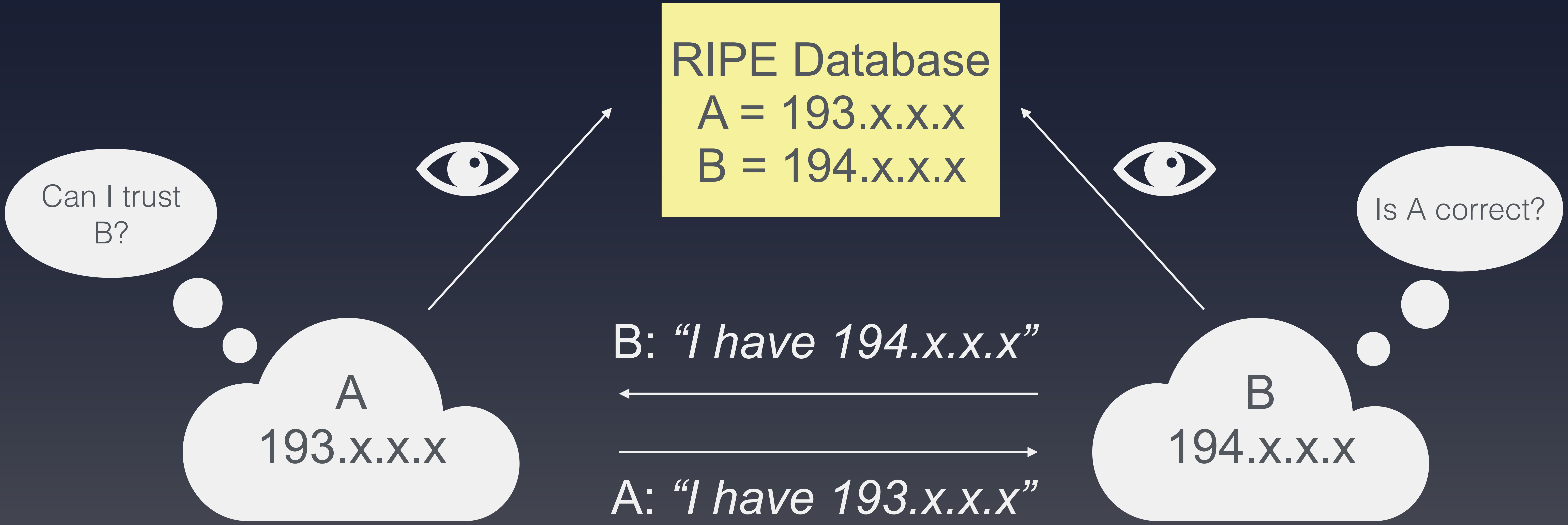
A: *“I have 193.x.x.x”*

Routing table
194.x.x.x = B

Routing table
193.x.x.x = A

How to Secure Routing?

“Internet Routing Registry”



RIPE Database
A = 193.x.x.x
B = 194.x.x.x

Can I trust B?

Is A correct?

A
193.x.x.x

B
194.x.x.x

B: *“I have 194.x.x.x”*

A: *“I have 193.x.x.x”*

Internet Routing

- Border Gateway Protocol
  - BGPv4, 1994
- The problem remains
  - No built-in security in BGP Protocol

Accidents Happen

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

Or Worse…

- **April 2018**
  - BGP and DNS hijack
  - Targeting MyEtherWallet
  - Unnoticed for 2 hours

Incidents Are Common

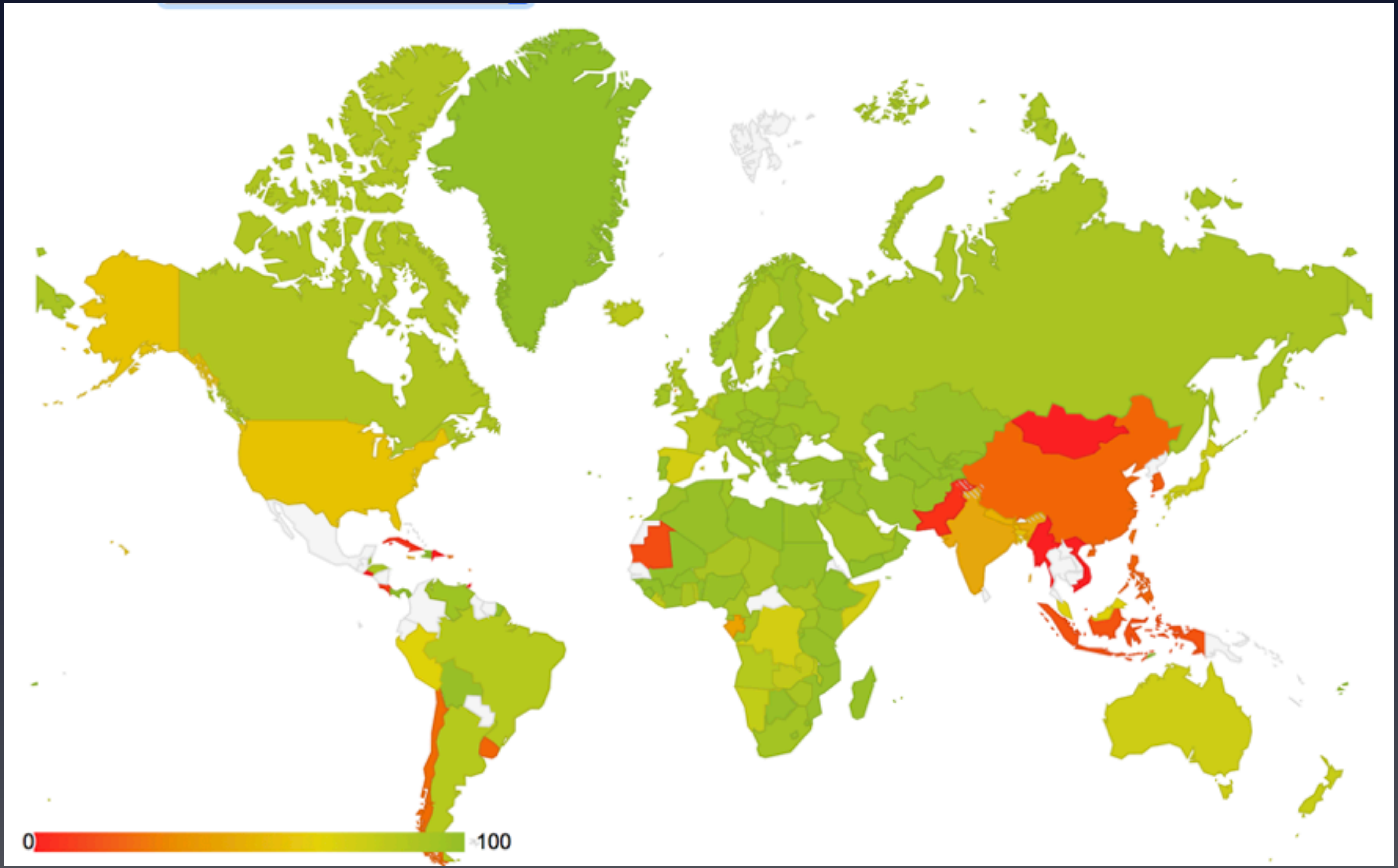
- **2018 Routing Security Review**
  - 12.6k incidents
  - 4.4% of all ASNs affected
  - 3k ASNs victims of at least one incident
  - 1.3k ASNs caused at least one incident

source: https://www.bgpstream.com/

Internet Routing Registry

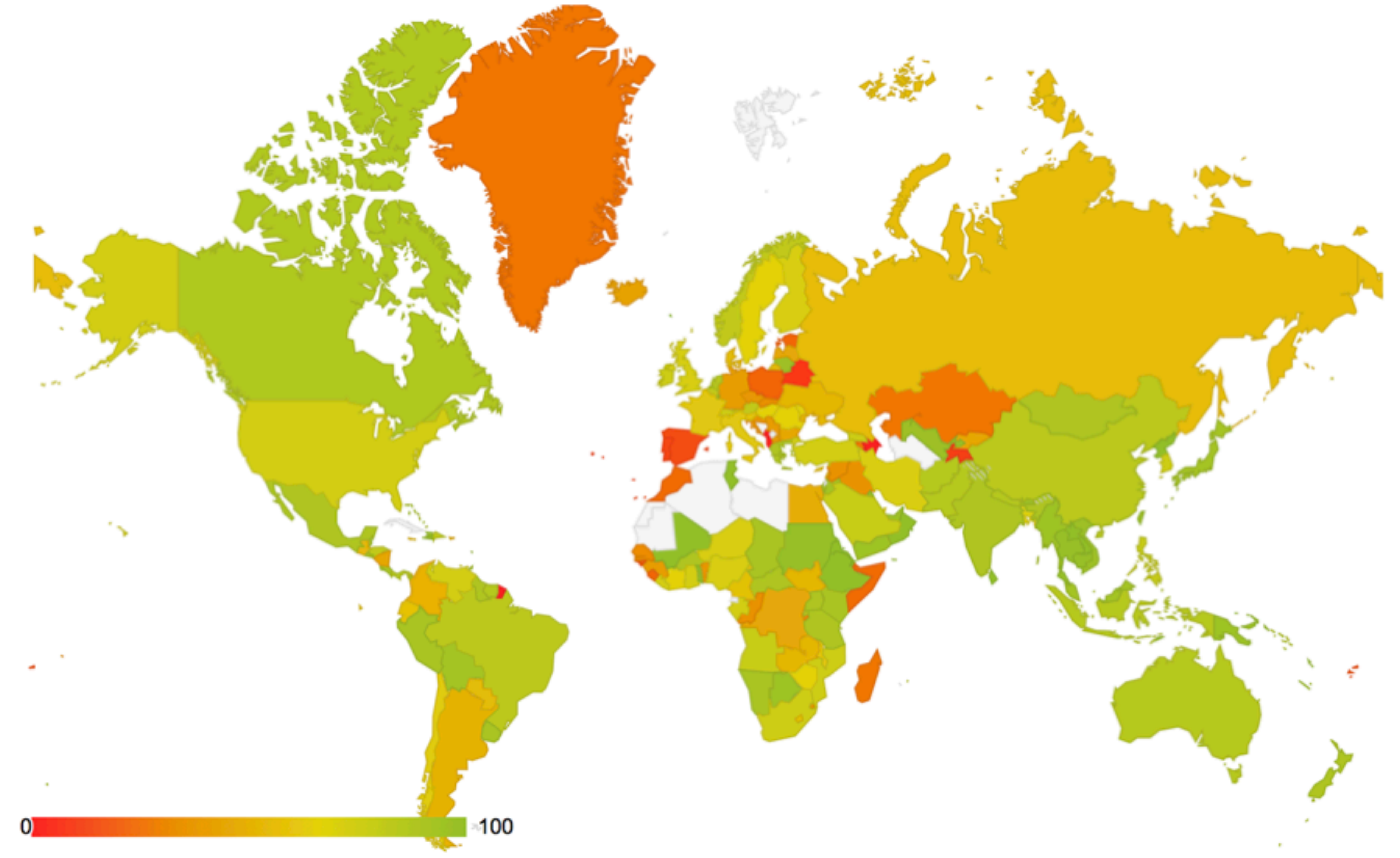
- Many exist, most widely used
  - RIPE Database
  - RADB
- Verification of holdership over resources
  - RIPE Database for RIPE region resources only
  - RADB allows paying customers to create any object
  - Lots of the other IRRs do not formally verify holdership

Accuracy - RIPE IRR



Accuracy - Valid announcements / covered announcements

Accuracy - RADB IRR



Accuracy - Valid announcements / covered announcements

Resource Public Key Infrastructure

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

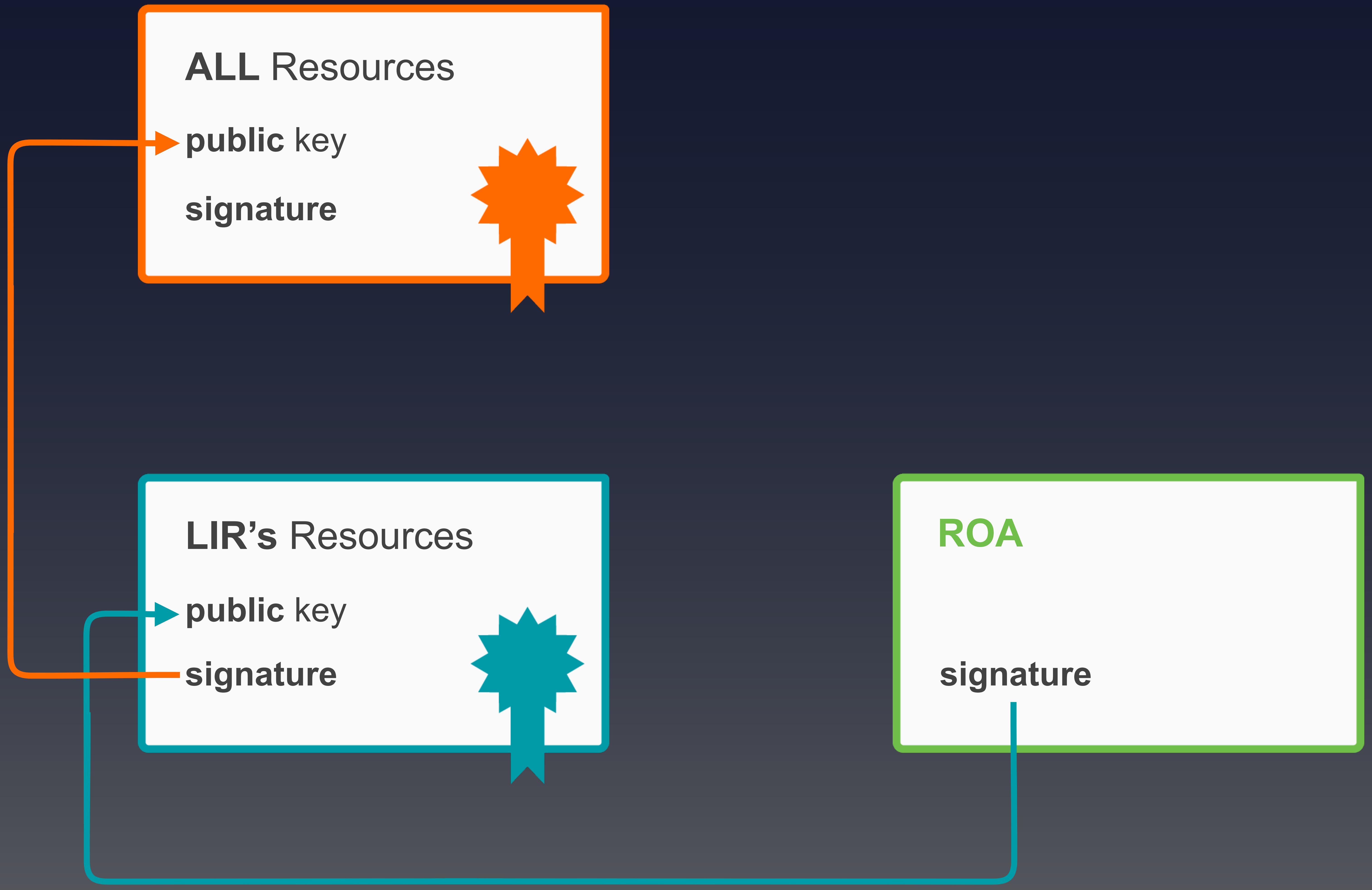
Resource Public Key Infrastructure

- Operated since 2008 by all RIRs
  - Community-driven standardisation (IETF)
  - IRR was not sufficient (incomplete, incorrect)
- Adds crypto-security to Internet Number Resources

Operators Are In Control

- We show member announcements
  - Member chooses to authorise or not
  - Does not need to worry about the crypto
  - It is there, but let the machines handle it…
- APNIC and LACNIC also have easy-to-use portals
  - Uptake and quality of data is a function of the interface

RPKI Chain of Trust



ALL Resources

public key

signature

LIR's Resources

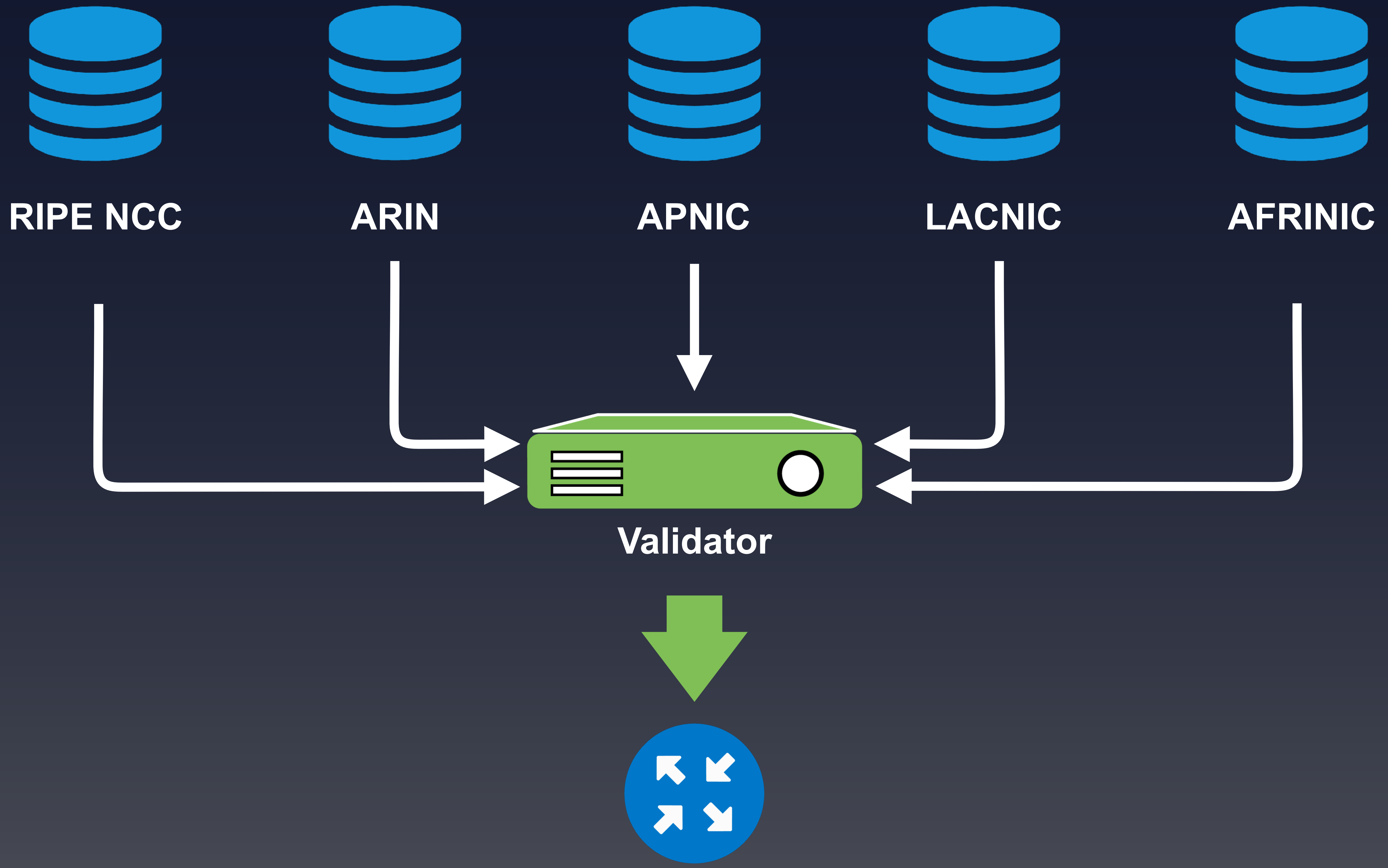
public key

signature

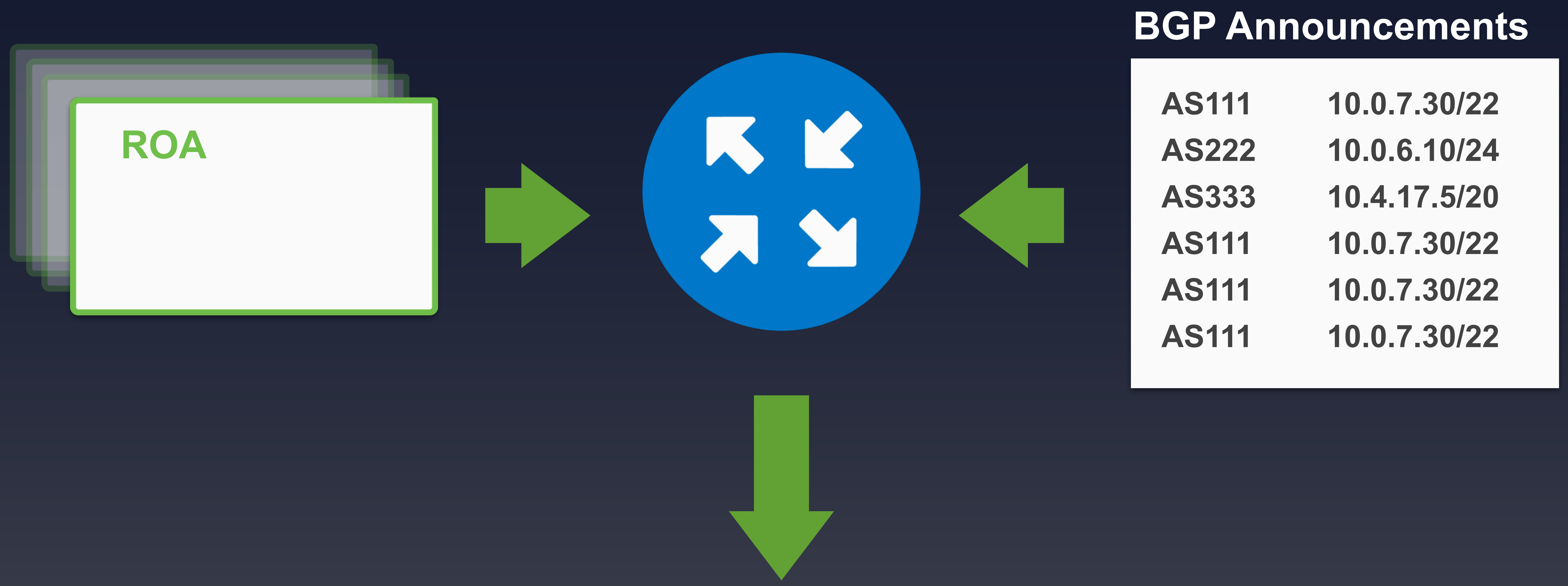
ROA

signature

Route Origin Validation



Route Origin Validation



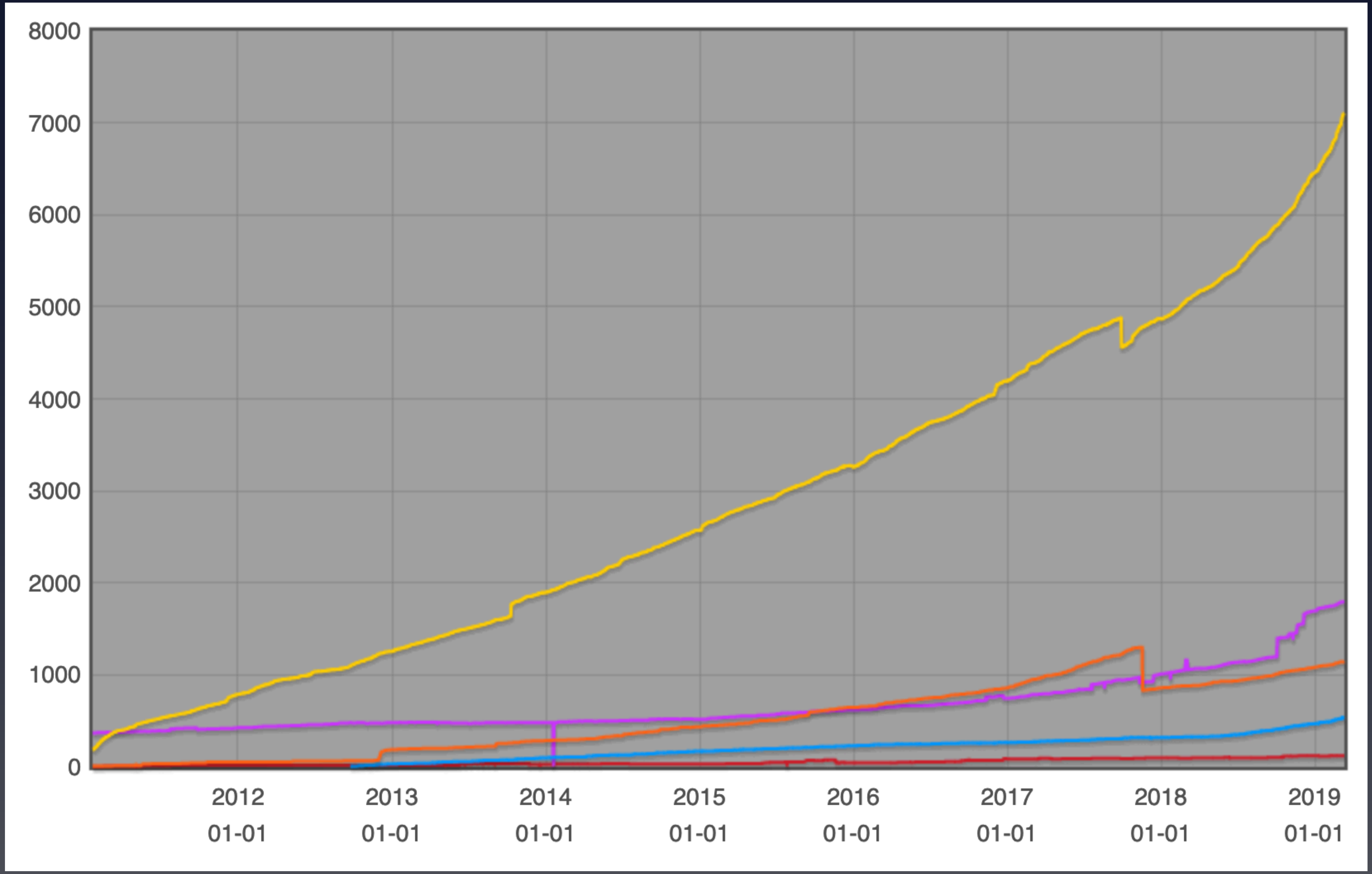
ROA

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

Number of Certificates



⬟ **RIPE NCC: 7100**

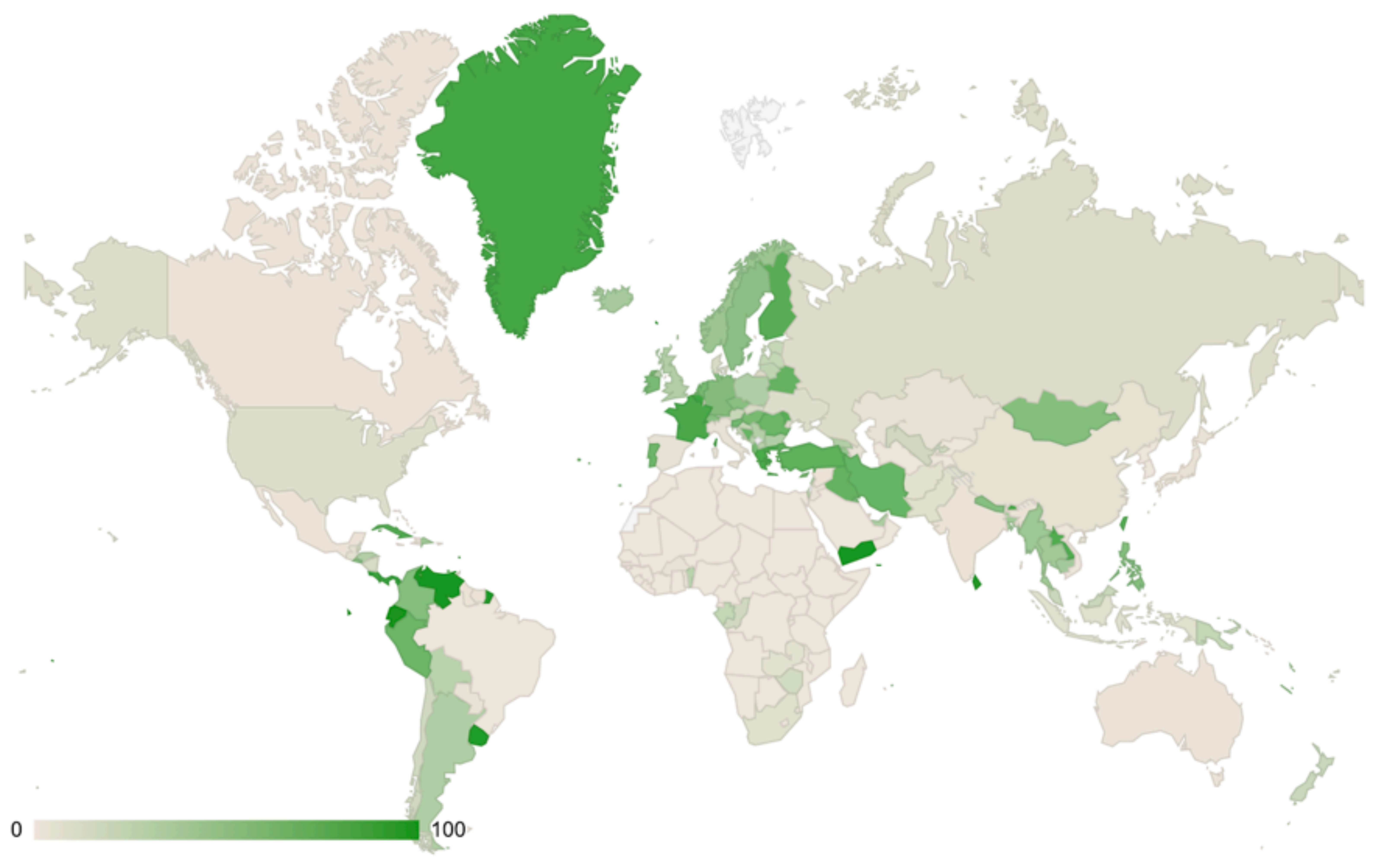
⬟ **APNIC: 1797**

⬟ **LACNIC: 1146**

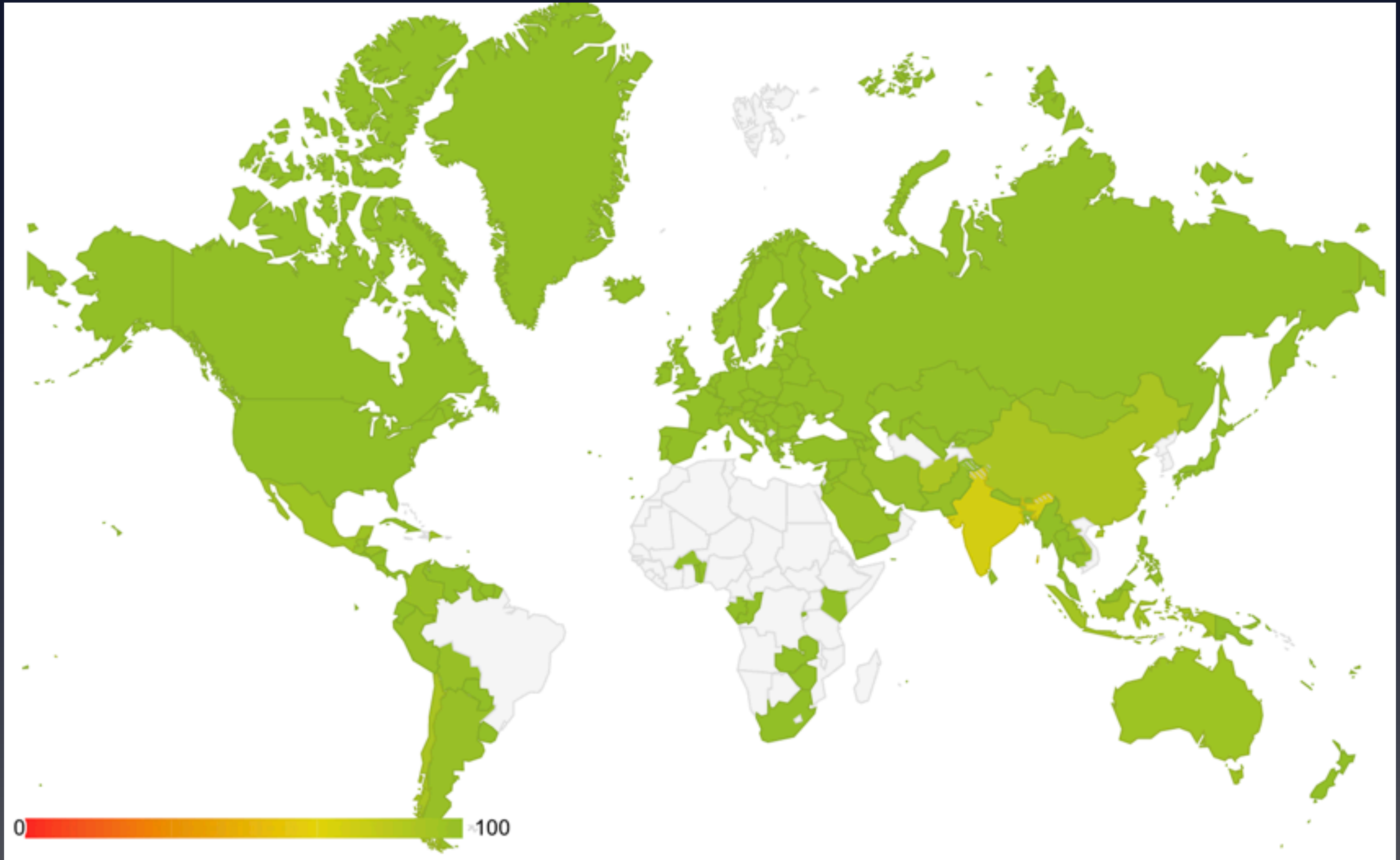
⬟ **ARIN: 538**

⬟ **AFRINIC: 123**

Coverage - RPKI (all RIRs)



Accuracy - RPKI (all RIRs)



IPv4 addresses in valid announcements / covered announcements

RPKI in SEE region

Country	% Addreses	Accuracy
BA	**62%**	**100,0%**
RS	57%	99,9%
HU	57%	99,9%
SI	54%	100,0%
BG	54%	99,9%
AL	52%	99,5%
CZ	46%	99,9%
HR	**18%**	**100,0%**
AT	18%	100,0%
SK	10%	100,0%

source: https://lirportal.ripe.net/certification/content/static/statistics/world-roas.html

Recommendations to Get Started

- Create your ROAs in the LIR Portal
- Pay attention to the Max Length attribute
- Download and run a Validator
- Check validation status manually, which routes are invalid?
- Set up monitoring, for example pmacct
- (https://github.com/pmacct/)

Invalid == Reject

- **What breaks if you reject invalid BGP announcements?**
  - “Not all vendors have full RPKI support, or bugs have been reported”
  - “Mostly nothing” -AT&T
  - “5 customer calls in 6 months, all resolved quickly” -Dutch medium ISP
  - “Customers appreciate a provider who takes security seriously” -Dutch medium ISP
  - “There are many invalids, but very little traffic is impacted” -very large cloud provider

Making the Difference

- Is routing security on your agenda?
- Initiate the conversation with providers and colleagues
- Are you leading by example?

Questions

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