RPKI Tutorial

MENOG 10, Dubai UAE

Marco Hogewoning
Trainer

RIPE NCC

Goals

- Explain where it started
- Learn what resources certificates are
- Learn how to request a certificate
- Learn how to create a Route Origin Authorization
- Learn how to integrate ROAs in your workflow
- Making BGP decisions based on the RPKI
- Lots of live demonstrations

Certification

RIPE NCC

Current Practices in Filtering

- Filtering limited to the edges facing the customer
- Filters on peering and transit sessions are often too complex or take too many resources
  - Do you filter?
- A lot depends on trusting each other
  - Daily examples show this is no longer enough

Limitations of the Routing Registry

- A lot of different registries exist, operated by a number of different parties:
  - Not all of them mirror the other registries
  - How trust worthy is the information they provide?

- The IRR system is far from complete
- Resulting filters are hard to maintain and can take a lot of router memory

Securing BGP Routing

- SIDR working group in the IETF looking for a solution:
  - Is a specific AS authorised to originate an IP prefix?

- Based on open standards:
  - RFC 5280: X.509 Public Key Infrastructure
  - RFC 3779: Extensions for IP addresses and ASNs

The RIPE NCC Involvement in RPKI

- The authority who is the holder of an Internet Number Resource in our region
  - IPv4 and IPv6 address ranges
  - Autonomous System Numbers

- Information is kept in the registry
- Accuracy and completeness are key

Digital Resource Certificates

- Issue digital certificates along with the registration of Internet Resources

- Two main purposes:
  - Make the registry more robust
  - Making Internet Routing more secure
- Added value comes with validation

Using Certificates

- Certification is a free, opt-in service
  - Your choice to request a certificate
    - Linked to your membership
    - Renewed every 12 months
- Certificate does not list any identity information
  - That information is in the RIPE Database
- Digital proof you are the holder of a resource

The PKI System

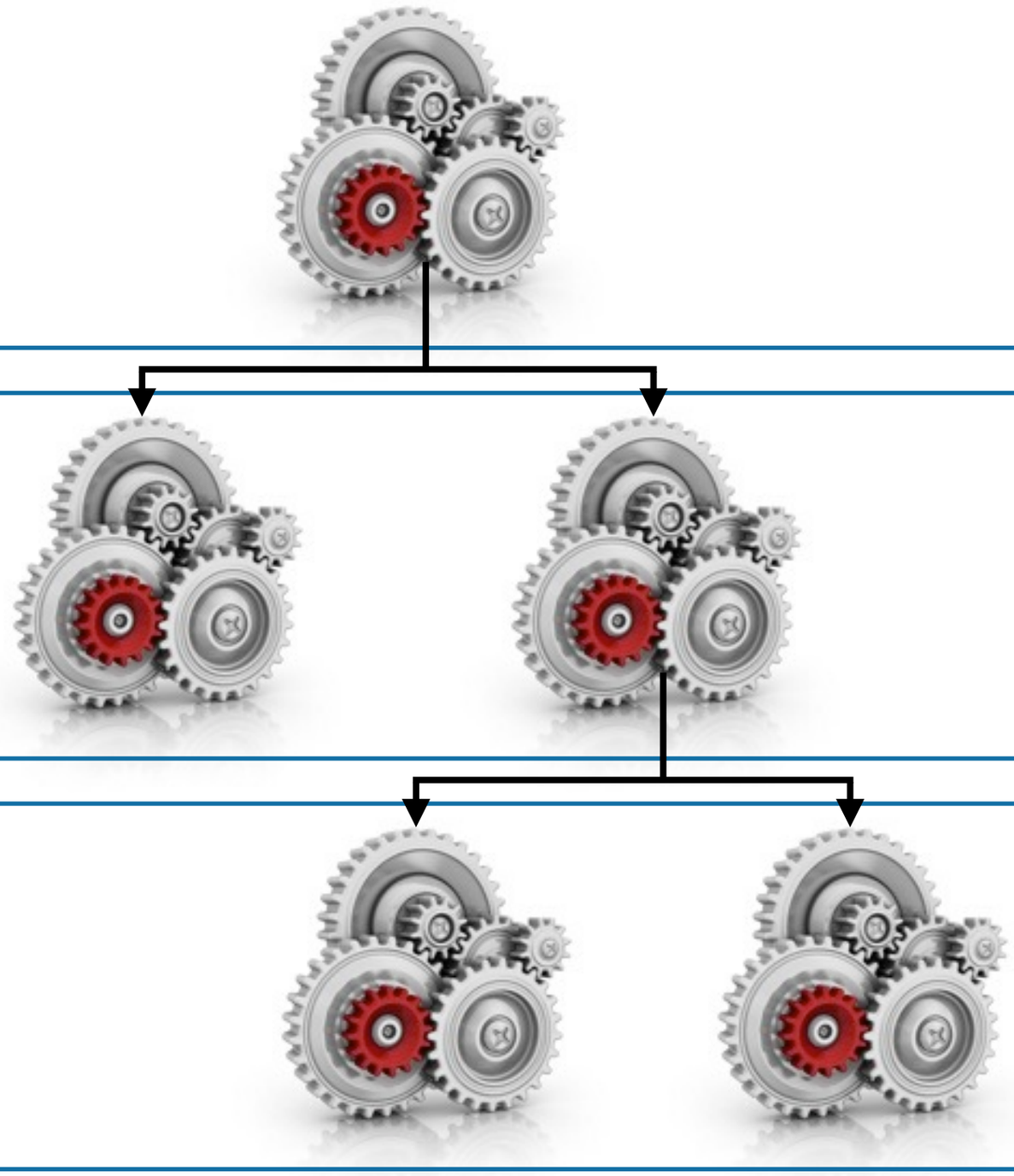
- The RIRs hold a self-signed root certificate for all the resources that they have in the registry
  - They are the trust anchor for the system
- That root certificate is used to sign a certificate that lists your resources
- You can issue child certificates for those resources to your customers
  - When making assignments or sub allocations

Certificate Authority (CA) Structure

Root CA (RIPE NCC)

Member CA (LIR)

Customer CA



Validation

- All certificates are published in publicly accessible repositories
  - RIPE NCC operates one of them
- You can download all certificates and associated public keys
- Using cryptographic tools to verify yourself that all certificates are valid and linked to the root CA

Which Resources Are Certified?

- Everything for which we are 100% sure who the owner is:
  - Provider Aggregatable (PA) IP addresses
  - Provider Independent (PI) addresses marked as "Infrastructure"

- Other resources will be added over time:
  - PI addresses for which we have a contract
  - ERX resources

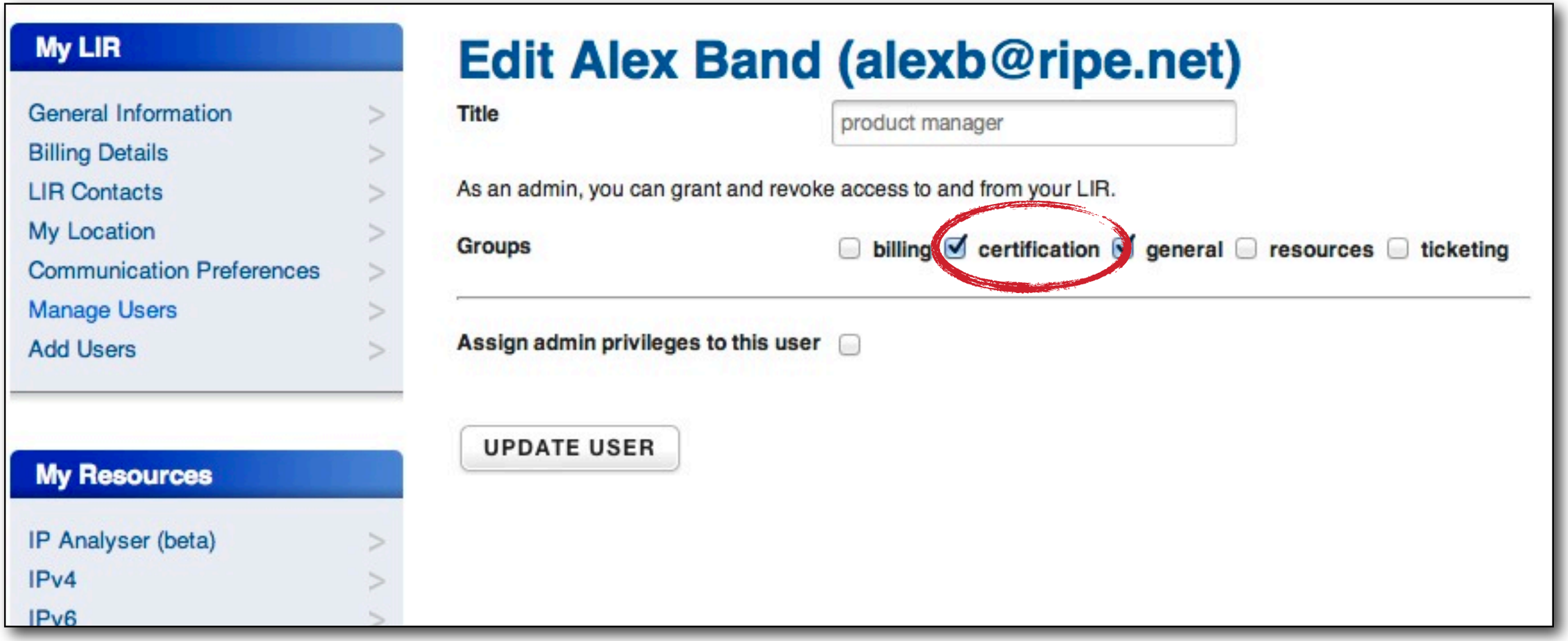
Legacy Address Space

- A project has started to bring legacy resources into the registry system
- Makes the registry more robust and complete:
  - Holders are verified to be legit
  - Information published in the RIPE Database
  - Resources can be certified
- Free service for legacy holders
  - Contact legacy@ripe.net for more information

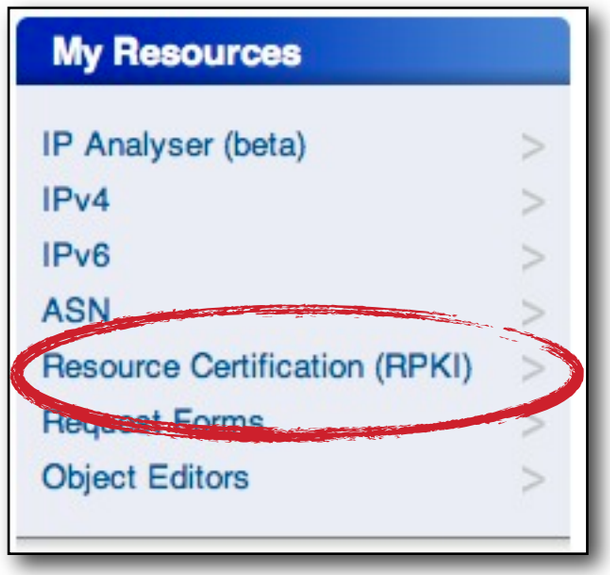
Demo

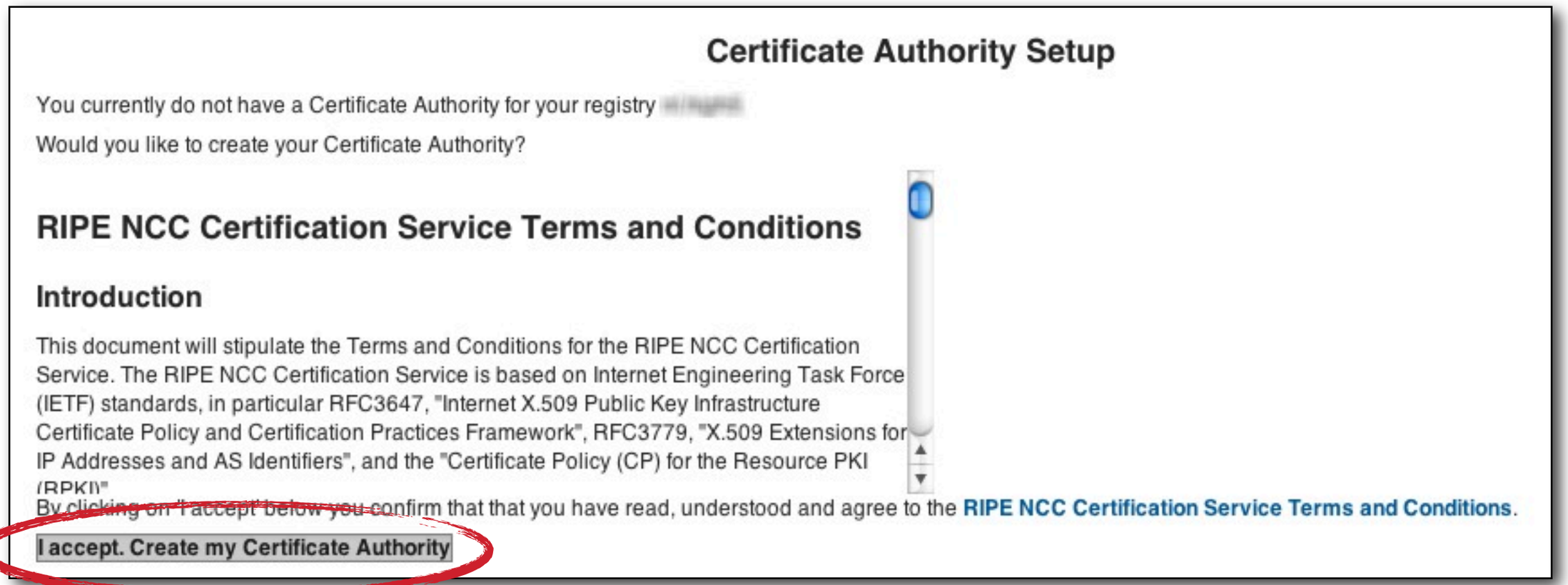
Setting up certification in the LIR Portal

Enabling Access To RPKI



Setting Up a Certificate Authority





Your Resource Certificate

News | My Certified Resources | My ROA Specifications | History | RIPE NCC ROA Repository

Certified Resources

Certificate Authority Name	CN=nl.ripencc-ts
Certified Resources	193.0.24.0/21 2001:67c:64::/48

View Certificate »

News | My Certified Resources | My ROA Specifications | History | RIPE NCC ROA Repository

Resource Certificate

Download »

Serial	231785814
Subject	CN=b2hNZ8inrMFsXKKWPUwV9ryOkXA
Issuer	*CN=u75at9r0D4JbJ3_SFkZXD7C5dmg*
Not valid before	2013-04-02T17:28:16.000Z
Not valid after	2013-07-01T00:00:00.000Z
Resources	193.0.24.0/21, 2001:67c:64::/48
AIA	ca issuer
SIA	ca repository manifest

Validation Result ✓ OK details »

ROA

Route Origination Authorisation

Making a Statement

- You as the certified holder of the IP addresses can decide who should announce these prefixes to the Internet:
  - They can originate from your own ASN
  - Or by a third party on your behalf
  - Maybe a part will be announced by somebody else
- You can use the certificate to “sign” this statement, to prove this is really you

Route Origination Authorisation (ROA)

- Next to the prefix and the ASN which is allowed to announce it, the ROA contains:
  - A minimum prefix length
  - A maximum prefix length
  - An expiry date
- Multiple ROAs can exist for the same prefix
- ROAs can overlap

Publication and Validation

- ROAs are published in the same repositories as the certificates and they keys
- You can download them and use software to verify all the cryptographic signatures are valid
  - Was this really the owner of the prefix?
- You will end up with a list of prefixes and the ASN that is expected to originate them
  - And you can be sure the information comes from the holder of the resources

Demo

Creating a ROA

My ROA Specifications

SANDBOX

News | My Certified Resources | My ROA Specifications | History | RIPE NCC ROA Repository

ROA Specifications

A Route Origin Authorisation (ROA) allows anyone on the Internet to validate that you have authorised the announcement of a specific prefix. Once you create a specification, a ROA is automatically published in the RIPE NCC ROA Repository in the form of a cryptographic object. In your ROA specifications, you state which Autonomous Systems are authorised to originate the prefixes you hold. At all times, your ROA specifications should match your intended BGP routing.

You have not entered any ROA Specifications.

Add ROA Specification »

Current BGP announcements

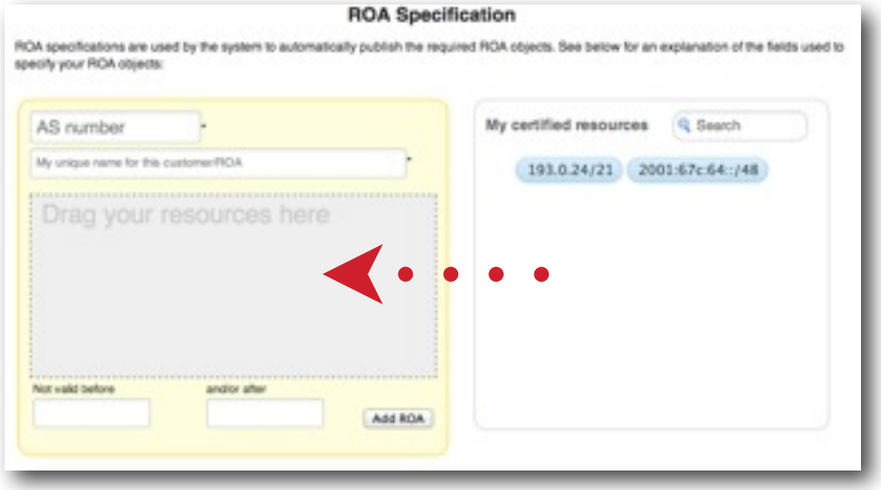
These are the current BGP announcements, as seen by the RIPE NCC Remote Route Collectors, that overlap with your certified resources. Only announcements seen by five or more peers are shown. This data can be up to nine hours old, so recent changes might not be reflected.

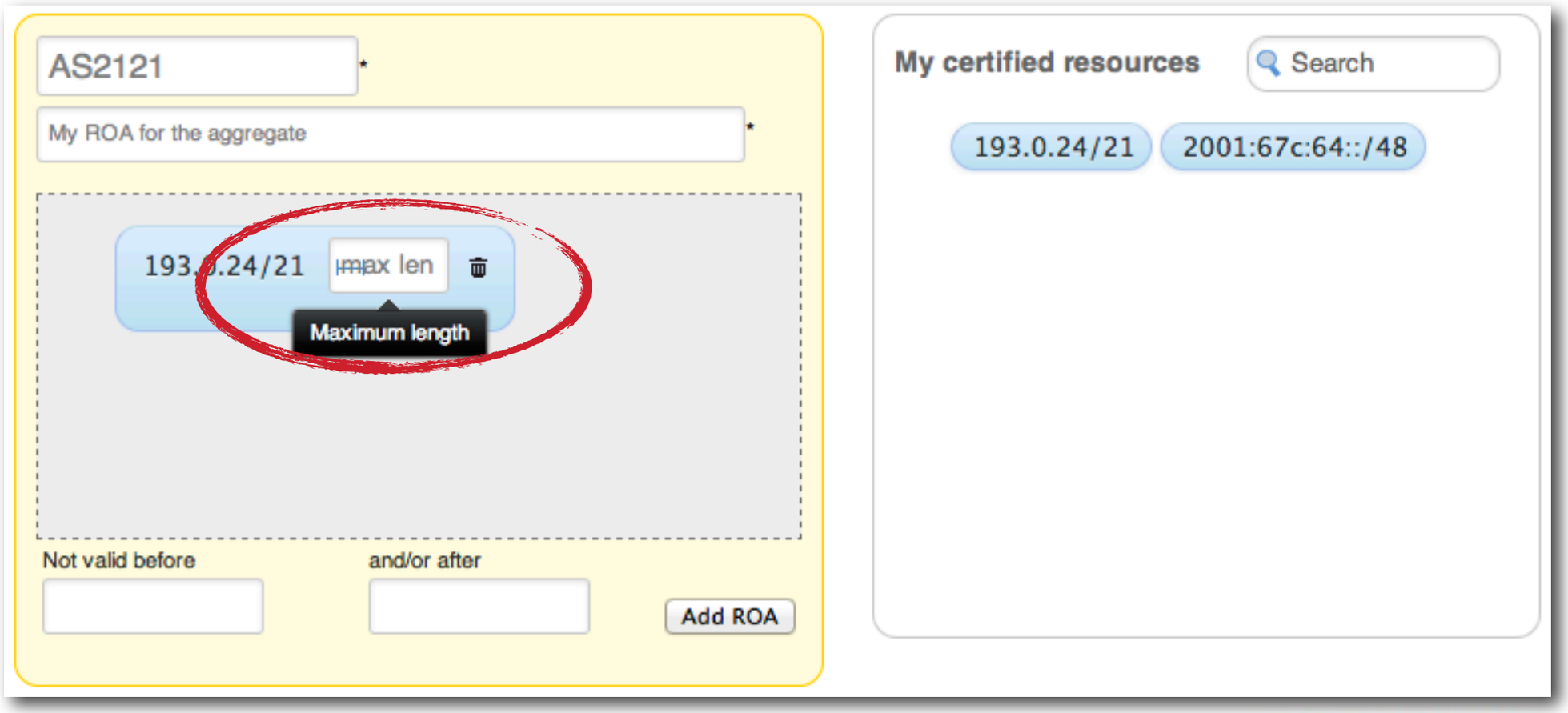
Search:

Origin AS	Prefix	Route Validity
AS2121	193.0.24.0/21	UNKNOWN
AS2121	2001:67c:64::/48	UNKNOWN

Add ROA Specification

SANDBOX





Adding a ROA

SANDBOX

AS2121 *

My ROA for the aggregate *

193.0.24/21 24

2001:67c:64::/48

Not valid before

and/or after

2012-07-01 00:00

Add ROA

Your New ROA

SANDBOX

ROA Specifications

A Route Origin Authorisation (ROA) allows anyone on the Internet to validate that you have authorised the announcement of a specific prefix. Once you create a specification, a ROA is automatically published in the RIPE NCC ROA Repository in the form of a cryptographic object. In your ROA specifications, you state which Autonomous Systems are authorised to originate the prefixes you hold. At all times, your ROA specifications should match your intended BGP routing.

Name	AS number	Prefixes	Not valid before	Not valid after	ROA object		
My ROA for the aggregate	AS2121	193.0.24.0/21 (24)			View »	Edit	Delete

Add ROA Specification »

ROA Object

Download »

AS Number	AS2121	
Resources	Prefix	Maximum Length
	193.0.24.0/21	24
Not valid before	2012-04-02T17:15:28.000Z	
Not valid after	2013-07-01T00:00:00.000Z	
	View certificate details	

Validation Result ✓ OK details »

The ROA Repository

SANDBOX

News | My Certified Resources | My ROA Specifications | History | RIPE NCC ROA Repository

RIPE NCC ROA Repository

These are all of the ROA objects that have been created using the RIPE NCC Certification Service.
These objects are part of the RIPE NCC Certification Repository and as such are subject to **Terms and Conditions**.

All times displayed are UTC.

AS number	Prefixes	Not valid before	Not valid after		
AS2121	193.0.24.0/21	2012-04-02T17:15:28.000Z	2013-07-01T00:00:00.000Z	Details »	Download »
AS3333	2001:67c:2e8::/48	2012-03-13T16:32:10.000Z	2013-07-01T00:00:00.000Z	Details »	Download »
AS12654	84.205.64.0/19 93.175.144.0/20 2001:7fb::/32 2001:7fd::/32	2012-03-13T16:32:10.000Z	2013-07-01T00:00:00.000Z	Details »	Download »
AS20647	91.102.8.0/21 194.29.224.0/19 2a02:f28::/32	2012-04-04T07:31:08.000Z	2013-07-01T00:00:00.000Z	Details »	Download »
AS25152	2001:7fd::/32	2012-03-13T16:32:10.000Z	2013-07-01T00:00:00.000Z	Details »	Download »
AS34347	80.92.112.0/20 195.149.216.0/21 2a02:28e8::/32	2012-04-10T14:11:19.000Z	2013-07-01T00:00:00.000Z	Details »	Download »
AS197000	2001:67c:e0::/48	2012-03-13T16:32:10.000Z	2013-07-01T00:00:00.000Z	Details »	Download »

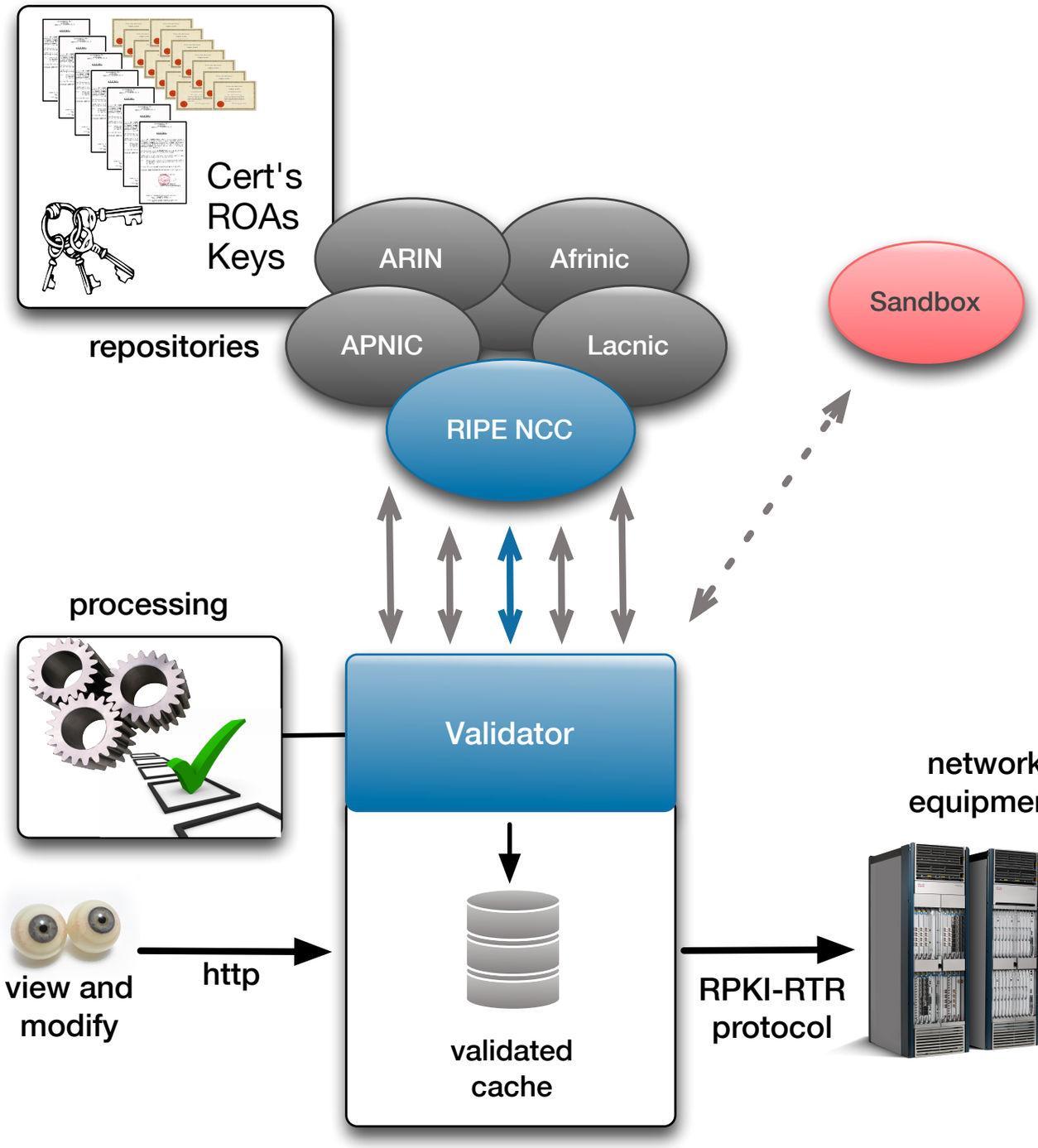
Validator

RIPE NCC

ROA Validation

- All the certificates, public keys and ROAs which form the RPKI are available for download
- Software running on your own machine can retrieve and then verify the information
  - Cryptographic tools can check all the signatures
- The result is a list of all valid combinations of ASN and prefix, the “validated cache”

ROA Validation Workflow



Validation

- Every certificate and ROA is signed using the private key of the issuer
- The public keys in the repository allow you to verify the signature was made using the correct private key
- You can walk the whole RPKI tree structure up to the Root Certificates of the RIRs

Reasons For a ROA To Be Invalid

- The start date is in the future
  - Actually this is flagged as an error
- The end date is in the past
  - It is expired and the ROA will be ignored
- The signing certificate or key pair has expired or has been revoked
- It does not validate back to a configured trust anchor

Modifying the Validated Cache

- The RIPE NCC Validator allows you to manually override the validation process
- Adding an ignore filter will ignore all ROAs for a given prefix
  - The end result is the validation state will be “unknown”
- Creating a whitelist entry for a prefix and ASN will locally create a valid ROA
  - The end result is the validation state becomes “valid”

The Decision Process

- When you receive a BGP announcement from one of your neighbors you can compare this to the validated cache
- There are three possible outcomes:
  - **Unknown**: there is no covering ROA for this prefix
  - **Valid**: a ROA matching the prefix and ASN is found
  - **Invalid**: There is a ROA but it does not match the ASN or the prefix length

Router-RPKI Protocol

- Routers can download the validated cache from the validator and have it available in memory
- The BGP process will check each announcement and label the prefix
- You can instruct your router to look at those labels and make a decision based on it
  - Modify preference values
  - Filter the announcement
  - ...

The Decision is Yours

- The Validator is a tool which can help you making informed decisions about routing
- Using it properly can enhance the security and stability of the Internet
- It is your network and you make the final decision

Exercise/Demo

Using the RIPE NCC Validator

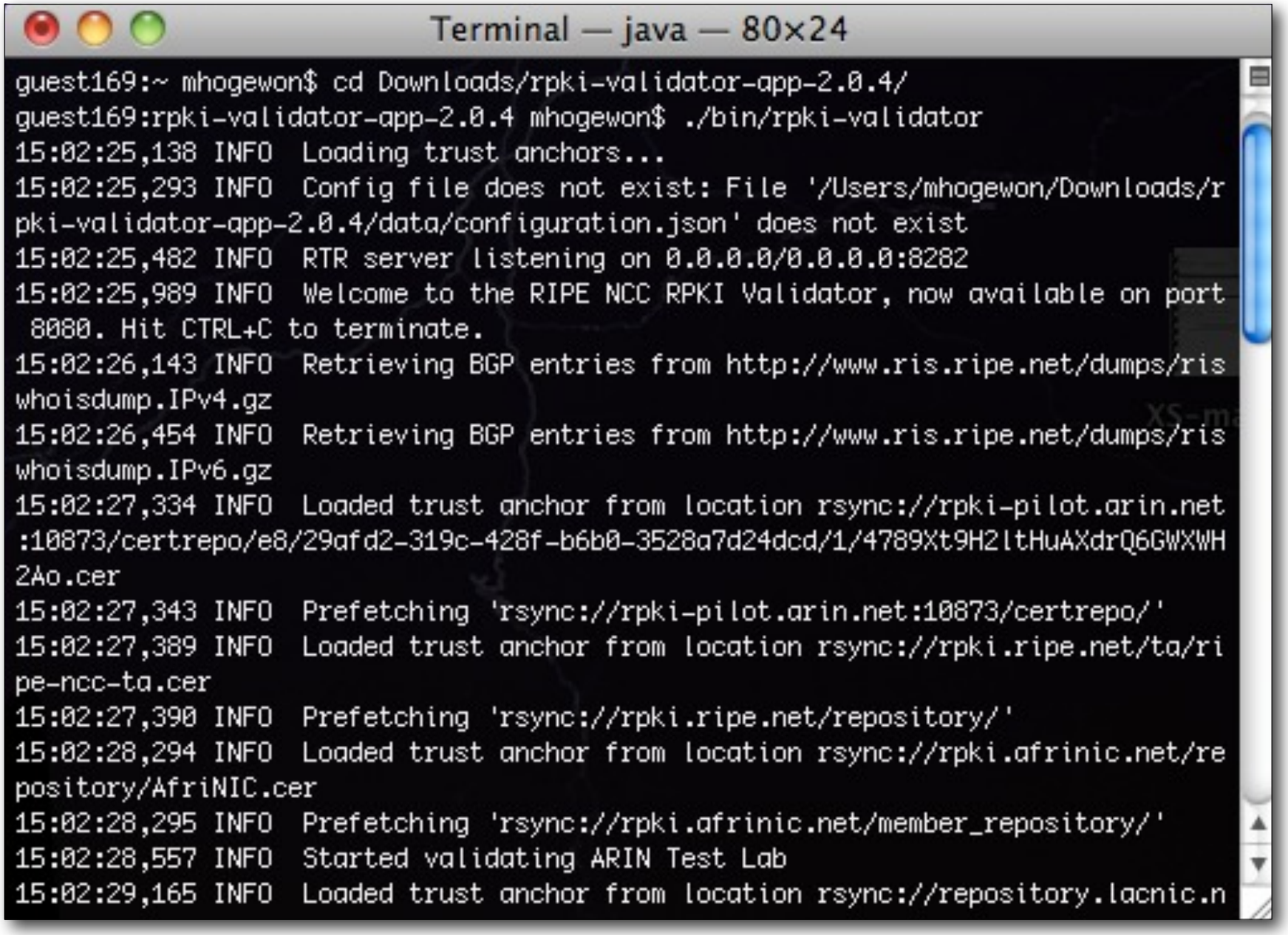
RIPE NCC

Download the Validator

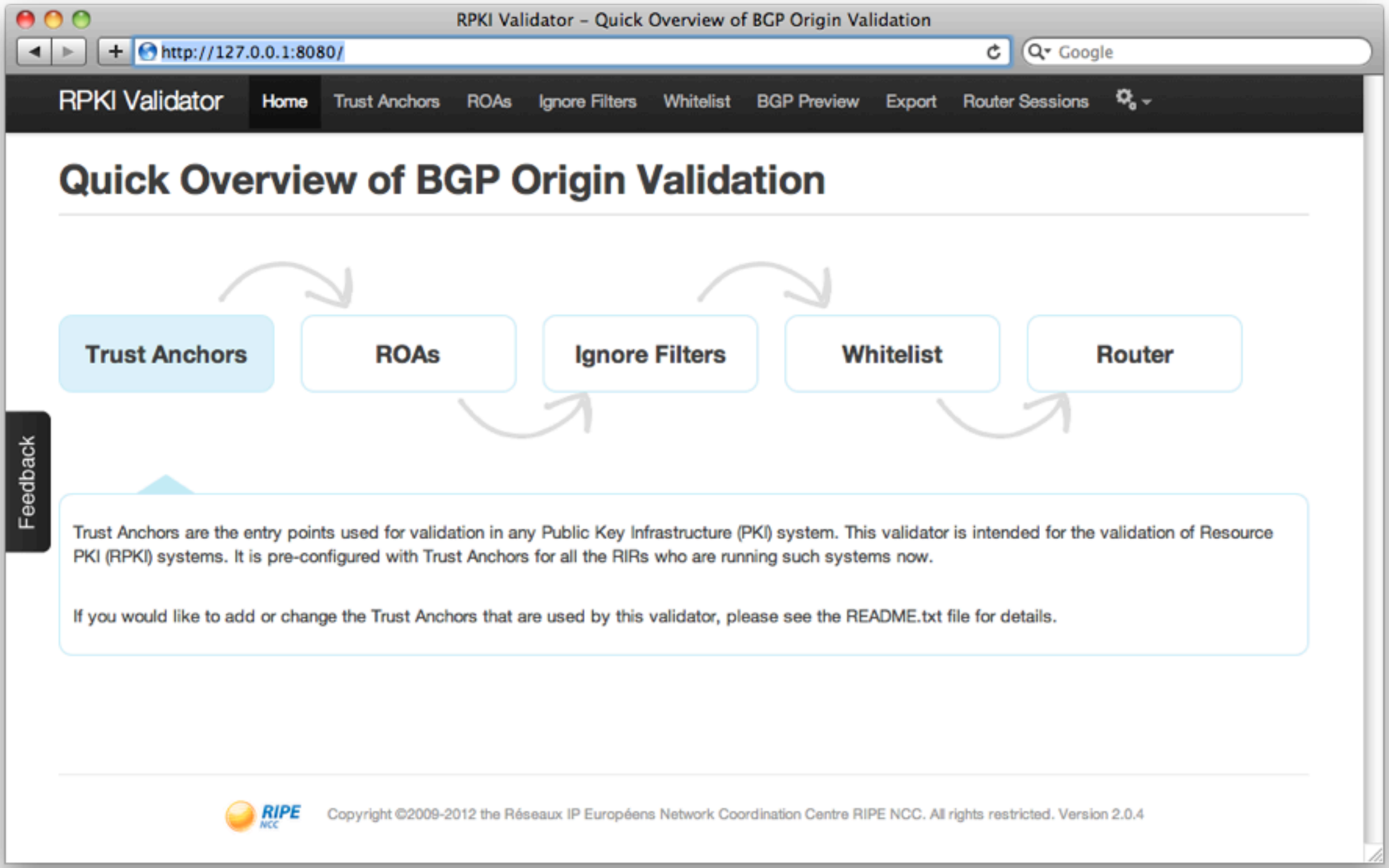
- http://www.ripe.net/certification -> tools

- Requires Java 1.6 and rsync
- No Installation required
  - Unzip the package
  - Run the program
- Interface available on localhost port 8080

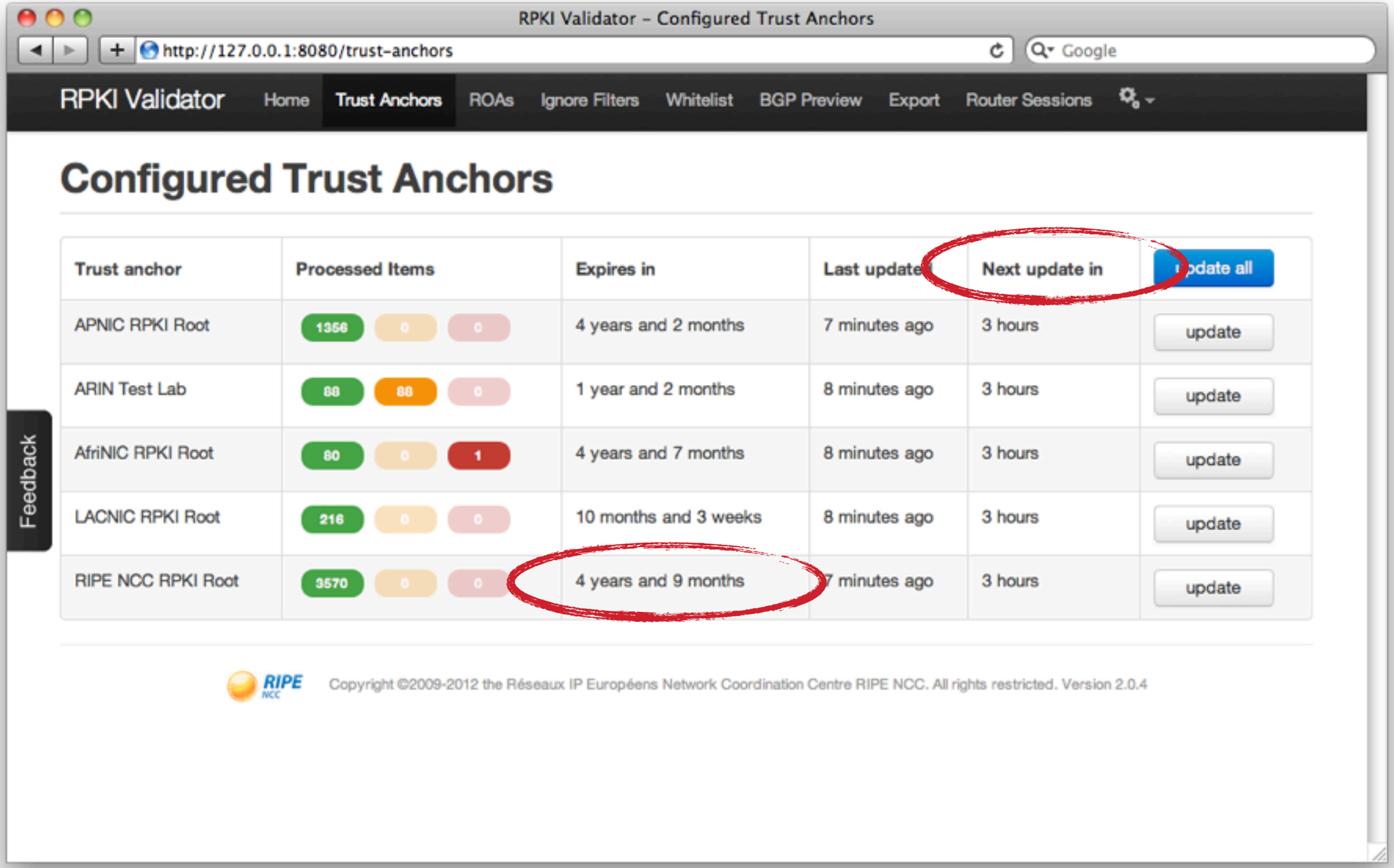
Starting the Validator



The Web Interface



Trust Anchors



Listing All Validated ROAs

RPKI Validator – Validated ROAs

http://127.0.0.1:8080/roas

Google

RPKI Validator | Home | Trust Anchors | ROAs | Ignore Filters | Whitelist | BGP Preview | Export | Router Sessions

Validated ROAs

Validated ROAs from **APNIC RPKI Root, ARIN Test Lab, AfriNIC RPKI Root, LACNIC RPKI Root, RIPE NCC RPKI Root.**

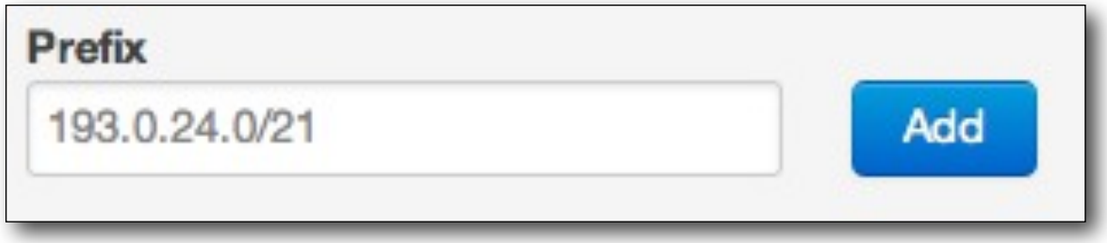
Show 10 entries

Search:

ASN	Prefix	Maximum Length	Trust Anchor
1	10.0.1.0/24	24	ARIN Test Lab
1	192.168.1.0/24	24	ARIN Test Lab
1	61.45.250.0/23	23	APNIC RPKI Root
1	61.45.250.0/23	23	APNIC RPKI Root
21	10.4.0.0/16	16	ARIN Test Lab
22	10.255.1.0/24	24	ARIN Test Lab
42	2001:678:3::/48	48	RIPE NCC RPKI Root
42	194.0.17.0/24	24	RIPE NCC RPKI Root
174	89.207.56.0/21	21	RIPE NCC RPKI Root

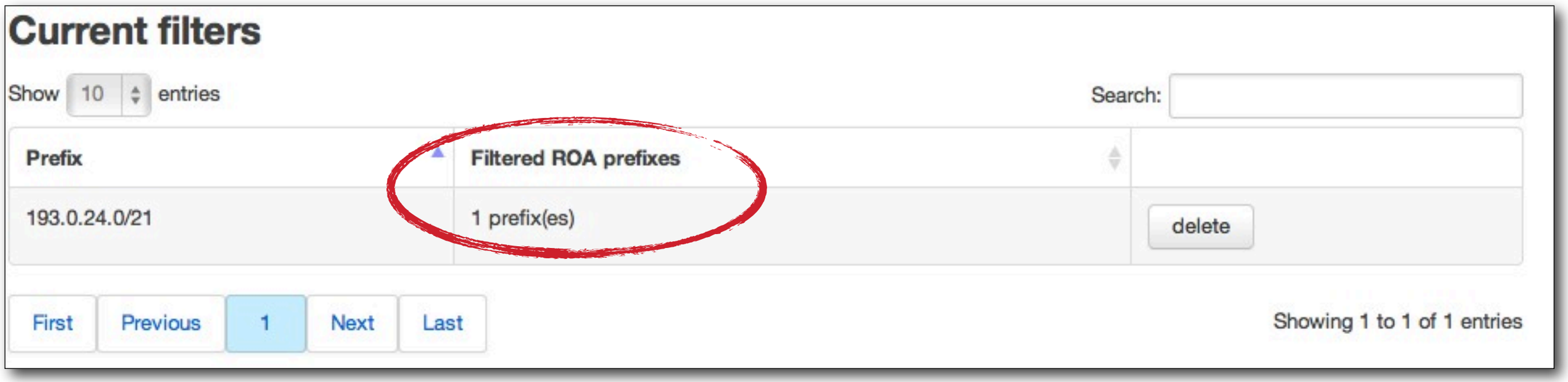
Feedback

Add an Ignore Filter

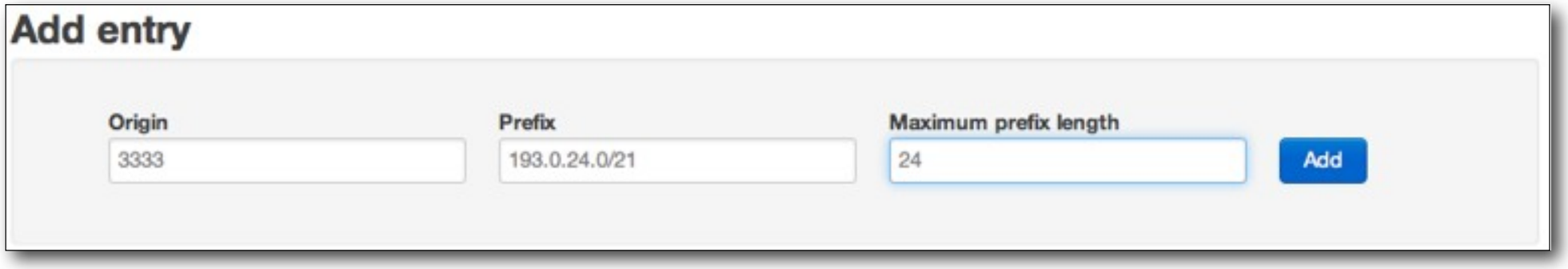


Insert the prefix and click “add”

The overview shows if there is a match

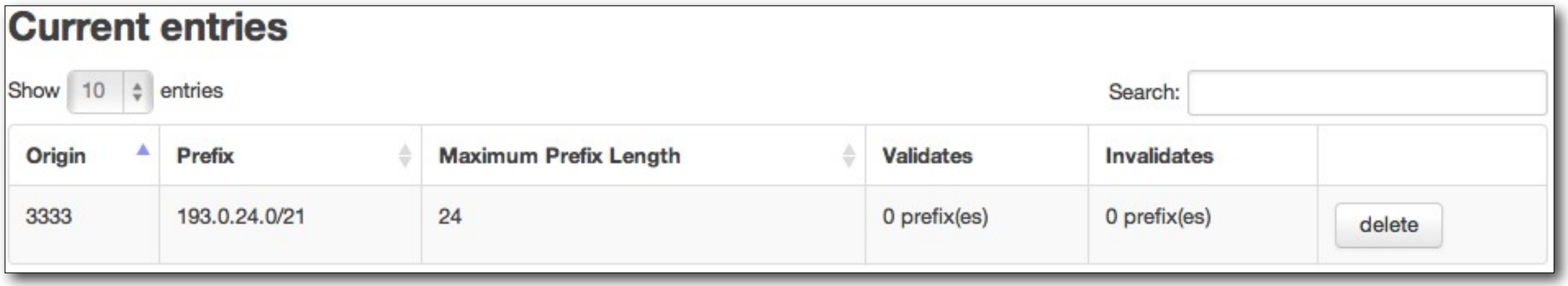


Creating a Whitelist



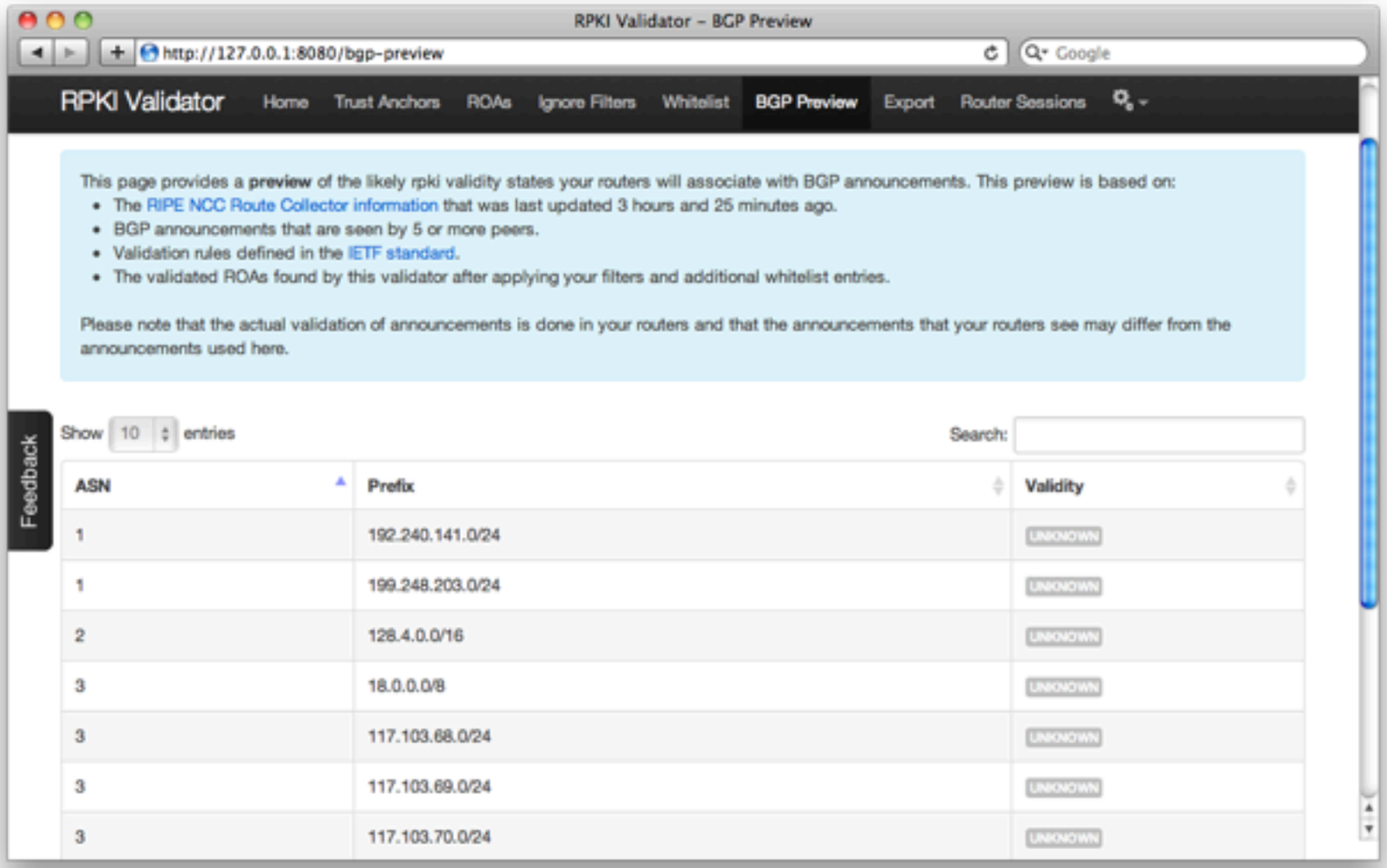
Add the origin, prefix and maximum length

This locally creates a valid (but fake) ROA

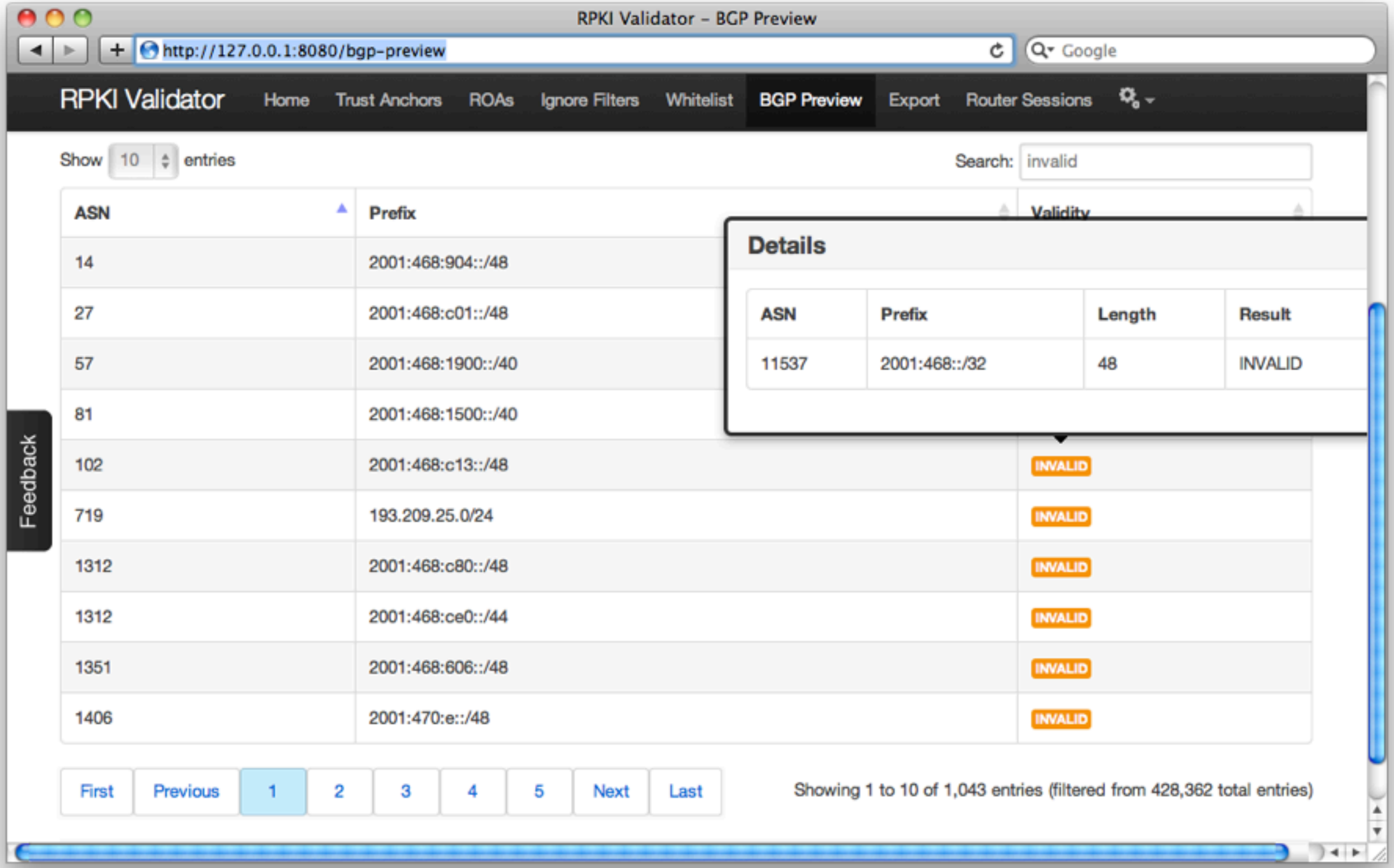


BGP Preview

- The validator downloads a copy of the RIS
  - Allows you to get a hint of what would happen
  - RIS view might be different from your routing table



BGP Preview Detail



Exporting the Validated Cache

- Router sessions
  - Validator listens on 8282 for RPKI-RTR Protocol
  - Routers can connect and download the cache
- Export function
  - Allows you to download a CSV with the cache
  - Can be integrated with your internal workflow
  - Use for statistics or spotting anomalies

Router Integration

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Open Standards

- The RPKI-RTR Protocol is an IETF standard
- All router vendors can implement it
  - Cisco has beta images available
  - Juniper expects it to be in 12.2 (Q312)
  - Quagga has support for it
- Ask your favorite sales person for more information
  - And tell them you like this

Public Testbeds

- A few people allow access to routers that run RPKI and allow you to have a look at it
- RIPE NCC has a Cisco:
  - Telnet to rpki-rtr.ripe.net
  - User: ripe, no password
- Eurotransit has a Juniper:
  - Telnet to 193.34.50.25 or 193.34.50.26
  - Username: rpki, password: testbed

(http://www.ripe.net//certification/tools-and-resources)

Non Hosted

Doing it all yourself

RIPE NCC

Using the RIPE NCC Platform

- Using the hosted system is an easy way to deploy RPKI without high investments
  - Easy to setup a certificate authority and ROAs
  - Key and certificate rollovers are taken care of
  - RIPE NCC system is certified and audited
- Drawback is the RIPE NCC needs to have both your public and private key
  - Needed to create ROAs and certificates
  - Some people say this is less secure

Do It Yourself

- Everything is based on open standards
- You can take matters in your own hand:
  - Setup and run your own Certificate Authority
  - Create the ROAs on your system
  - Optionally have your own publication point
- Communication channel with the RIPE NCC allows you to get your certificate signed by us
  - This is known as the “up down protocol”

Third Party Tools

- RPKI Engine 1.0
  - http://www.hactrn.net/rpki-dox/
  - Includes rcynic validation tool
- RPSTIR (BBN Third Party Tool)
  - http://rpstir.sourceforge.net/
- RTRlib - The RPKI RTR Client C Library
  - http://rpki.realmv6.org/

Roadmap

- Support for non-hosted is still under development by the RIPE NCC
  - Expected release will be third quarter 2012
- We can give you access to beta test
  - Mail certification@ripe.net if you are interested
- More information will be published on the certification website
  - **http://www.ripe.net/certification**

Questions?

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#RPKI

The End!

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