RIPE NCC
RIPE NETWORK COORDINATION CENTRE

RPKI Developments in Routing Security

RSNOG, Belgrade, 21 November 2019

RIPE NCC - Who are we?

- We delegate and manage IP and ASN allocations in Europe, Middle East and Central Asia
  - Ensure unique holdership
  - Register 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: first document using 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

Routing on the Internet

Accidents Happen

- Fat Fingers
- Policy Violations (leaks)
  - Oops, we did not want this to go to the public Internet
  - Infamous accident with Pakistan Telecom and Youtube

Or Worse

- April 2108
  - 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 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)
  - RR was not sufficient (incomplete, incorrect)
  - Adds crypto-security to Internet Number Resources

Elements of RPKI

RPKI Chain of Trust

What's in a ROA

Prefix → The network for which you are creating the ROA

Origin ASN → The ASN supposed to be originating the BGP

Max Length → The Maximum prefix length accepted for this ROA

Route Origin Validation

Route Origin Validation

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

Elements of RPKI

RIR REPOSITORIES

VALIDATOR SOFTWARE

ROUTERS

Number of Certificates

RIPE NCC: 9862

APNIC: 2312

LACNIC: 1421

ARIN:759

AFRINIC:232

Coverage - RPKI (all RIRs)

Accuracy - RPKI (all RIRs)

IPv4 addresses in valid announcements / covered announcements

RPKI in your Region

Country	% Addreses	Accuracy
RS	**66%**	**99.98%**
HU	59%	100.00%
RO	60%	99.98%
BG	31%	99.96%
MK	24%	100.00%
ME	25%	100.00%
BA	62%	99.95%
HR	19%	100.00%
SI	18%	100.00%
AL	81%	100.00%

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

Are you leading by example ?

Questions ?

The End!

Край

Y Diwedd

Fí

Finis

النهاية

Соңы

Վերջ

Liðugt

Ende

Finvezh

Кінець

Konec

Kraj

Ënn

Fund

پایان

Kpaj

Lõpp

Beigas

Vége

Son

An Críoch

הסוף

Endir

Fine

Sfârşit

Fin

Τέλος

Einde

Конец

Slut

Slutt

დასასრული

Pabaiga

Tmiem

Koniec

Fim

Amaia

Loppu