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Legal Barriers to Securing the Routing Architecture

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This Study

- Origins
  - Perceived differences in Resource Public Key Infrastructure (RPKI) adoption in Europe and Latin America vs. North America
  - Concerns regarding potential legal barriers to RPKI adoption in North America
  - National Science Foundation's interest in translational research
- Goals
  - Catalog the claimed barriers to RPKI adoption
  - Independently evaluate the legal and institutional barriers
  - Suggest viable solutions that balance the interests of all stakeholders

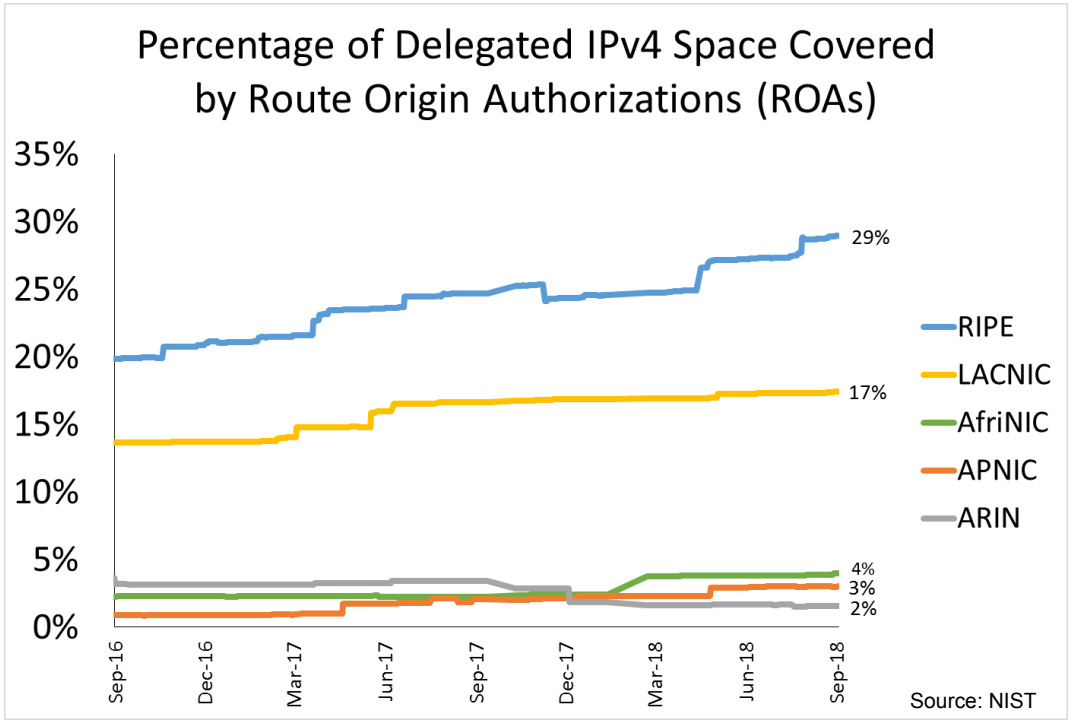
This Study

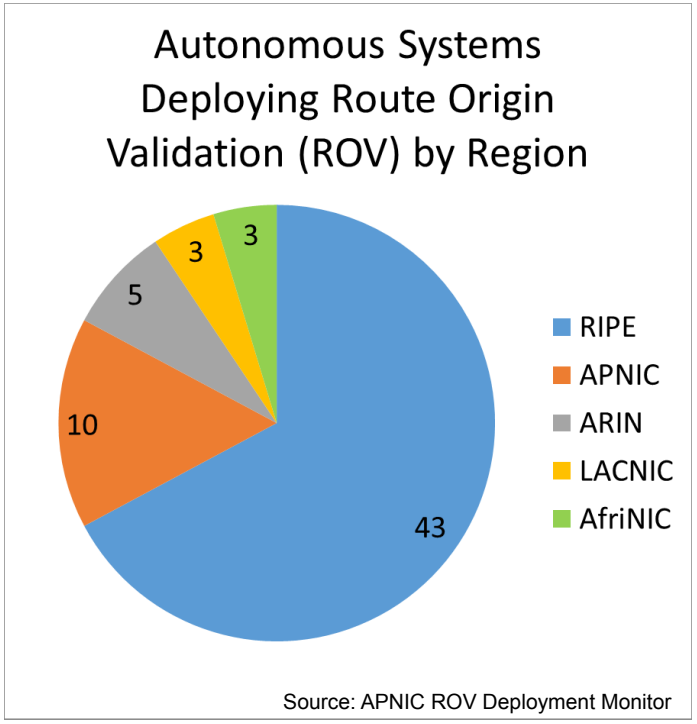
- Methods
  - Independent legal analysis
  - Interviews with over three dozen members of the routing community
    - Types of organizations include commercial firms, government, academia, and nonprofits
    - Roles include engineers, lawyers, researchers, and policymakers
  - Discussions with American Registry of Internet Numbers (ARIN) and other key stakeholders
- Focus
  - General evaluation of current regime
  - Comparison across different regions

Presentation Roadmap

- **Background**
- RPKI-based filtering
- RPKI-based signing
- Other legal mechanisms to spur deployment
- Potential next steps for the routing community

Global RPKI Deployment





- ARIN's repository appears less utilized than others (Cartwright-Cox, 2018)

Non-Legal Barriers

- Limited demand for RPKI and limited budgets
- Difficulty reaching critical mass
  - RPKI provides limited value until both signing and filtering are widespread
  - The ease of each depends on software and support
- Concerns about lack of robust software tools

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RPKI-Based Route Filtering

- Filtering entails dropping or "depreferring" routes based on RPKI information
- Requires access to RPKI certificate repositories offered by the Regional Internet Registries (RIRs)
  - Direct access: use of RPKI repositories (via Trust Anchor Locators, or TALs) to conduct Route-Origin Validation (ROV)
  - Indirect access: third-party provision of route-filtering support built atop ROV

Legal Structure of TAL Access

- Leading validator software provided by Réseaux IP Européens Network Coordination Centre (RIPE NCC) comes preloaded with all TALs except ARIN's

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The Trust Anchor Locator (TAL) files for four Regional Internet Registries are included
with this distribution: AFRINIC, APNIC, LACNIC and RIPE NCC.

To access ARIN's TAL, you will have to agree to ARIN's Relying Party Agreement. Please
visit this ARIN web page for more information:

  https://www.arin.net/resources/rpki/tal.html
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- Four RIRs allow access to TALs without agreements
- ARIN requires acceptance of a Relying Party Agreement (RPA)

Barriers to TAL Access

- Visiting ARIN's site is not a serious *technical* barrier
- But the RPA is an *institutional* barrier
  - Increased difficulty distributing validation software with ARIN's TAL preloaded (but may have made some progress)
  - Need for legal approval

Risks of TAL Provision

- All actors should reduce operational risk
  - Prepare for potential RPKI outages (e.g., RIPE NCC Feb. 2, 2013)
  - Prepare for conflicting data in multiple RPKI repositories (may be solved)
  - Configure operations to accommodate such contingencies (see RFC 7115)
- Community needs to assess legal risks amid uncertainty
  - There are no direct legal precedents
    - No record of lawsuits against an RIR for RPKI
    - No record of lawsuits against providers of the roots for TLS, SSL, DNSSEC, or IRR
  - But past history does not guarantee future results (i.e., lack of past lawsuits in other contexts does not guarantee no future lawsuits over RPKI)

Legal Risks of TAL Provision

- Low risk of strict products liability for RPKI
- Negligence liability is manageable, but cannot be eliminated
  - Industry best practices can establish reasonableness of RIRs' practices
  - User misuse is a defense
  - Tail risks still remain (especially in light of the litigiousness of the U.S.)
  - Negligence is often a jury question (cannot always end litigation early)
- Residual risk of defense costs justifies the existence of the RPA
  - Even rapidly dismissed cases require resources to defend
  - Contract terms represent the traditional way to manage such risks
  - U.S. law requires explicit agreement (online terms & conditions not sufficient)

Optimizing TAL Access

- Can we do more to enable possibilities for third-party providers?
  - We have already made some progress, thanks to a constructive dialog on the NANOG listserv
  - Community is now exploring ways to build click-through approval into distribution system for validator software
- Are there particular clauses that bear closer scrutiny?
  - Prohibited conduct clause
  - Indemnification, arbitration, and choice of law clauses

Prohibited Conduct Clause

- Prohibits sharing RPKI info in "machine-readable format"
- Blocks potentially valuable research and third-party software support
- Hinders integrated provision by third-party providers that combine RPKI information with other information (e.g., DNS, IRRs) to support real-time routing

RIR Prohibited Conduct

RIR	RPA Analogs: Prohibited Conduct (Paraphrases)
ARIN	Prohibits sharing in a machine-readable format
AFRINIC	No agreement
APNIC	No specific prohibitions
LACNIC	No agreement
RIPE NCC	Prohibits use for unsanctioned purposes, including advertising, market research, and similar

Proposal for Prohibited Conduct

- Discussions are ongoing whether to revise to permit reasonable, security-focused sharing and research (not for real-time routing)
- Community should consider the potential benefits of enabling sharing of machine-readable RPKI information to enable combining ROAs with other information to support real-time routing

Governmental TAL Access

- Some governmental entities can't sign indemnification, arbitration, or choice-of-law clauses
  - U.S. Antideficiency Act
  - California State Contracting Manual
- ARIN already alters the RPA for these entities
- ARIN and NANOG community should broadly publicize this policy
- Government agencies should share information about such alterations

Nongovernmental TAL Access

- Some claim indemnification clause poses a barrier
- Clause triggers organizational policies requiring legal consultation
- Clause raises risk
  - Note: organizations sign indemnification clauses in other contexts
  - Question is whether benefits of doing so exceed the risks

RIR Indemnification: Validation-Side

RIR	RPA Analogs: Key Clauses Allocating Liability (Paraphrases)
ARIN	• Disclaimer of warranties • Indemnify, defend, and hold harmless • Applies to claims asserted by third parties in connection with actions taken by the RP or users downstream of the RP
AFRINIC	• No agreement
APNIC	• No agreement; online terms and conditions include indemnification, but not duty to defend or hold harmless
LACNIC	• No agreement
RIPE NCC	• Disclaimer of warranties

Alternative Contractual Approaches to the RPA

- Indemnification clause
- "As is" disclaimer of warranties and statement of risks
  - Commonly seen in software and information licenses
  - Reduce risk of negligence liability
  - Also employed by RIPE NCC
  - May require more extended court proceedings to establish non-liability

Evaluating Exclusive Reliance on "As Is"

- Arguments in favor
  - Would bring ARIN in line with other RIRs
  - Would bring the RPA in line with agreements for DNS Root Trust Anchors, OpenSSL Toolkit
- Arguments against
  - Would be less protective to ARIN than other agreements (*i.e.*, ISP service agreements)
  - May impose greater costs on ARIN for benefits to the larger community

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RPKI Key Access by Government

- To access RPKI private keys, address space holders must sign a Registration Services Agreement (RSA) or a Legacy RSA (LRSA)
- RSA/LRSA clauses raise similar problems to RPA
  - Indemnification clause
  - Choice-of-law clause
- ARIN already offers a similar solution (alters the RSA and LRSA for these entities)
- ARIN and NANOG community should broadly publicize this policy
- Government agencies should share information about such alterations

RPKI Key Access by Legacy Address Holders

- LRSA contains a "no property rights" acknowledgment
  - Unclear whether this is a "but for" barrier to RPKI adoption—but still a barrier
  - Interesting data point: low levels of RPKI deployment in IPv6
- Issue of residual ownership is conceptually independent from RPKI key access
  - Our analysis does not mean to take a position on this issue
  - Our analysis attempts to decouple the two issues

RIPE NCC's Approach to Decoupling the Issue

- RIPE NCC offers a "non-member services" pathway
  - Provides access to RPKI keys
  - Does not require registration
  - Does not address issue of transfer rights
  - Is provided pursuant to conditions
  - Requires payment of a fee (€1,400 annually/same as membership fee)

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Procurement Policy

- Procurement policies can prompt suppliers to act
- The private sector has leverage
  - Major customers and network actors can push suppliers to implement RPKI (e.g., AMSIX)
  - Private actors can consider joining consortia like Mutually Agreed Norms for Routing Security (MANRS)
  - Major actors can include RPKI in compliance checklists
- The public sector has significant leverage as well
  - Governmental policy has pushed for the adoption of past security measures
  - NANOG community should consider whether to advocate for governmental RPKI requirements

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Next Steps

- Build on current progress
  - Potentially embedding approval of RPA in validator software distribution
  - Potential revisions to the prohibited conduct clause
  - Acknowledgement of exceptions for government entities
- Make sure the entire community understands the requirements for best-practices compliance
- Address the non-legal barriers to RPKI adoption
- Evaluate proposals to alter ARIN's RPKI-related agreements
- Evaluate including RPKI in procurement requests
- Engage in dialogue re community-level goals for routing security

Questions and Discussion