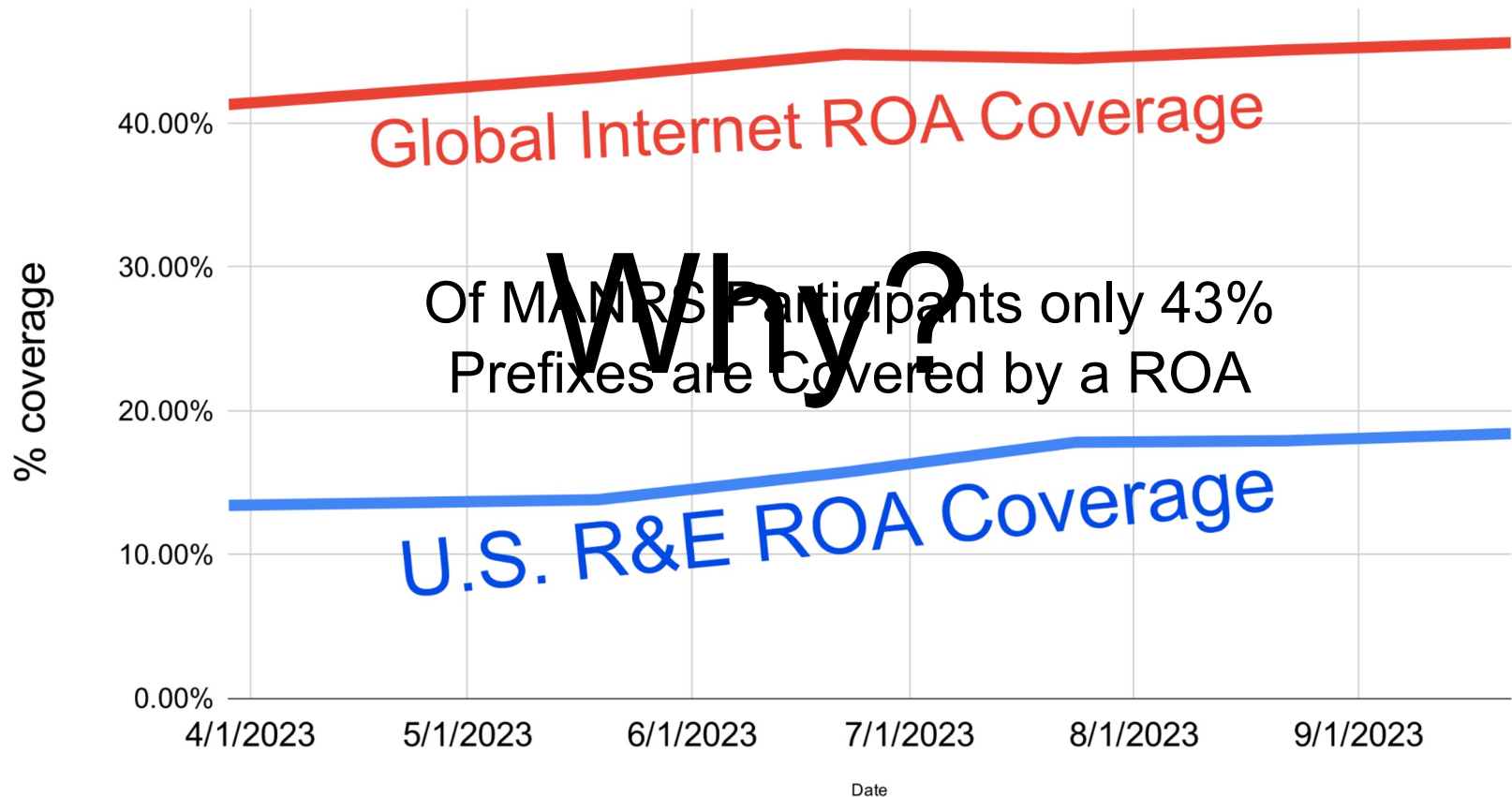


The Challenges of RPKI-ROA Diffusion within US R&E

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Internet2 % ROA Coverage (AS11537)



Global Internet ROA Coverage

Why?
Of MANRS Participants only 43%
Prefixes are Covered by a ROA

U.S. R&E ROA Coverage

About Internet2

Internet2 is a non-profit organization responsible for operating the backbone of the U.S. National Research and Education Network (NREN).

We connect 46 regional and state networks.

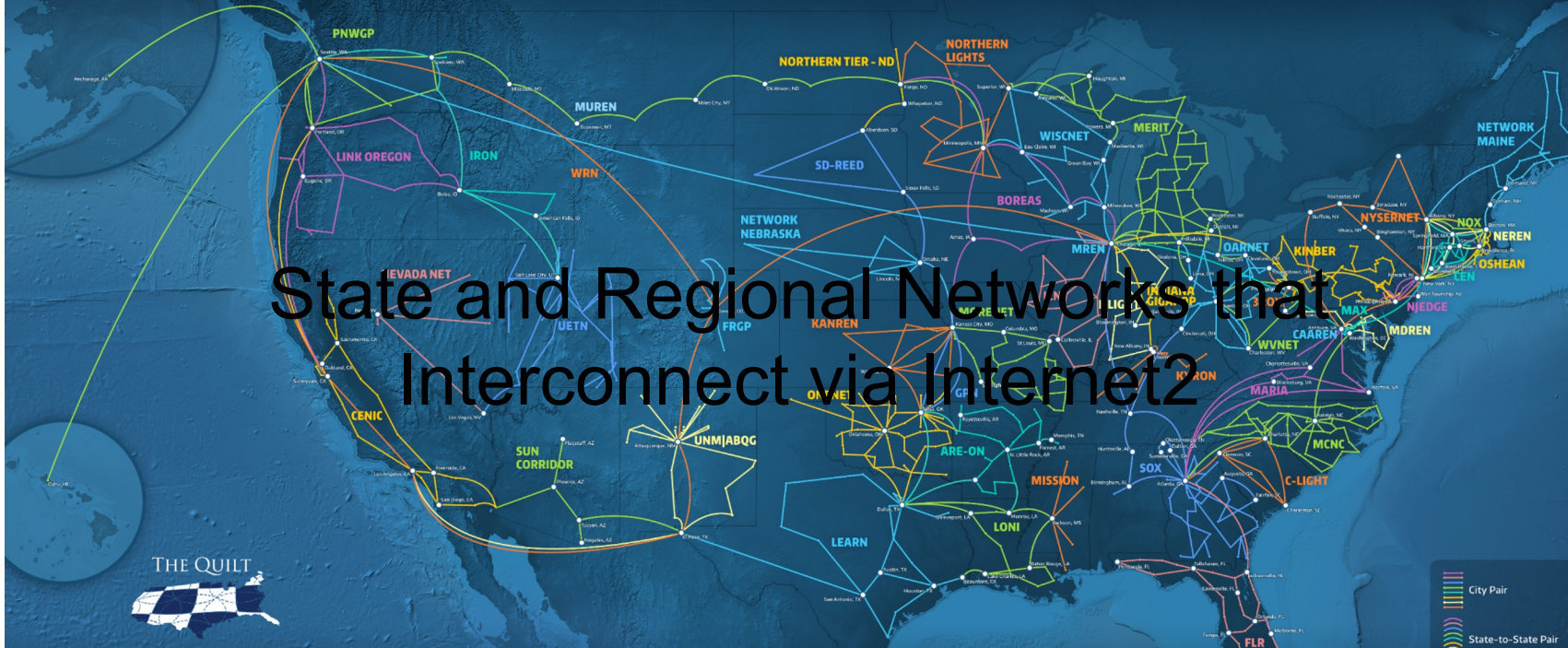
Through these networks, Internet2 serves over 330 research universities and tens of thousands of Community Anchor Institutions.

Internet2 doesn't provide full transit.

Internet2's efforts are driven by our community.

REGIONAL RESEARCH & EDUCATION NETWORKS IN THE UNITED STATES

State and Regional Networks that Interconnect via Internet2



QUILT MEMBERS & AFFILIATES





Internet2 is one of many National Research and Education Backbones



Global Adoption of RPKI-ROAs also lags

The global NREN routing table

- 16K covering prefixes
- 3.4K of ROAs
- just over 20% ROA coverage

About organizations Internet2 interconnects

1,100+ origin ASNs - [CAIDA](#) | **ASRank 58**

80%+ of IP assignments are legacy resources (early adopters)

Most of the 80% are not covered by an ARIN agreement

An average of two IP assignments per origin ASN

As recently as 2018, low participation in IRR (60%)

Scale spans from research-intensive universities (hundreds) to K12 schools (thousands)








The Problem

RPKI-ROV transfers some of the technical burden of routing security from the internet service provider towards the IP address holder.

This works for well-resourced IP address holders (e.g., cloud providers, ISPs, etc.)

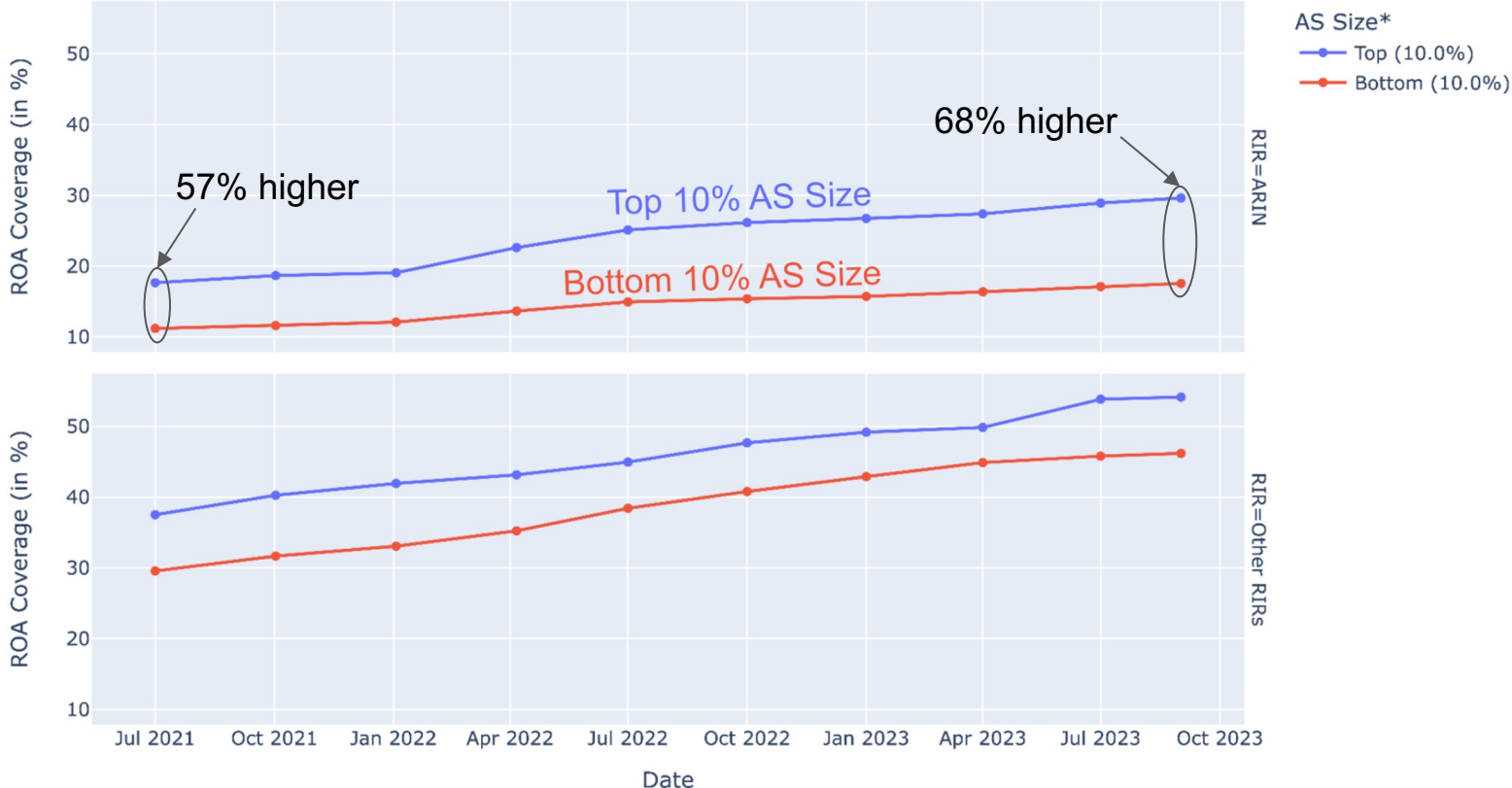
Not so much for K12 school districts, community colleges, and some universities.

The Burden of Routing Security Controls

Control	Origin Network	Transit Network
Filter Routes From Customer		
Publish policy via IRR		
Publish policy via auth-IRR		
Publish RPKI-ROA		
Publish ASPA		
Publish origin router cert (BGPsec)		

ROA Statistics from Deepak Gouda, Cecilia Testart - Georgia Institute of Technology

Date vs ROA Coverage (in %)



RPKI Data Source: Internet Health Report (IIR), RIR Data Source: WHOIS
*AS Size: Top 10% and Bottom 10% ASes by number of /24 address blocks originated

Barriers to RPKI-ROA Adoption

The Internet2 Community Adopted IP Early

- 45% of IP allocations are legacy without an ARIN agreement.
- While ARIN has vastly improved their agreement, it still raises legal concerns.
- Many of our members are state institutions, governed by state laws... and those can be rather restrictive.

Barriers to RPKI-ROA Adoption

As of February 2023, 700 Internet2-connected organizations lacked an ARIN agreement.

Despite progress, outreach, and workshops, 600 organizations remain without agreements.

Negotiating the agreement for public institutions can take months.

Barriers to RPKI-ROA Adoption

Routing security may not have a natural champion

- Typically not the CISO.
- It says “security”, but security teams often see this as the network team’s responsibility.
- “Our ISP/regional network/Internet2/DDoS scrubbing service protects our networks, so they’re already secure, right?”

Barriers to RPKI-ROA Adoption

- **Lack of urgency**
 - No current outage, never experienced a route leak (*that we know of*) before, etc.
 - ARIN's pricing changes for legacy resources may create some urgency for small institutions.
- **Our leadership isn't hearing this elsewhere**
 - **Internet2 is working on this one...**

What is Internet2 doing to improve RPKI-ROA adoption?

Messaging - to leaders, decision makers, and engineers in our community.

Education - everything from answering “what is ARIN?” to how to create a ROA.

Support - ROAthons, webinars, individual support sessions, reporting, etc.

Working with ARIN to streamline the agreement process.

Making better progress

Messaging - “Is your network critical infrastructure?”, to benefit from our security services (e.g., Route Origin Validation), ROAs must be created and maintained.

Transit Provider with ROV - let your users know they can benefit from creating ROAs

Outsourcing Elements of Routing Security

Internet service providers, and others, could offer routing security services.

Using ARIN's Route POC capability, smaller organizations could outsource the maintenance of RPKI and IRR Objects.

How can we reduce the barriers of outsourcing routing security?

Seeing Improvement

Within US R&E we're seeing improvements in the adoption of RPKI-ROAs.

There's increasing awareness of routing security.

We think there's opportunity for other sectors to use a similar approach.

Thank You!