



ARIN

American Registry for Internet Numbers

Resource Public Key Infrastructure

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May 11, 2023

Internet2 Routing Integrity Initiative



“Each of us protecting all of us”

Improve community’s adoption of best practices that strengthen the resilience and reliability of data movement across the R&E network ecosystem to support our shared missions

It is a challenge that requires the participation of the entire Internet2-networked community and beyond

Why is Routing Security Important?



“Each of us protecting all of us”

Routing attacks & misconfigurations can:

- Disrupt your internet connection (usually easy to detect)
- Detour your internet traffic (harder to detect)
- Make unauthorized use of your IP addresses (can be very hard to detect)

Practicing routing security mitigates these attacks, for your network and others.

Key Points

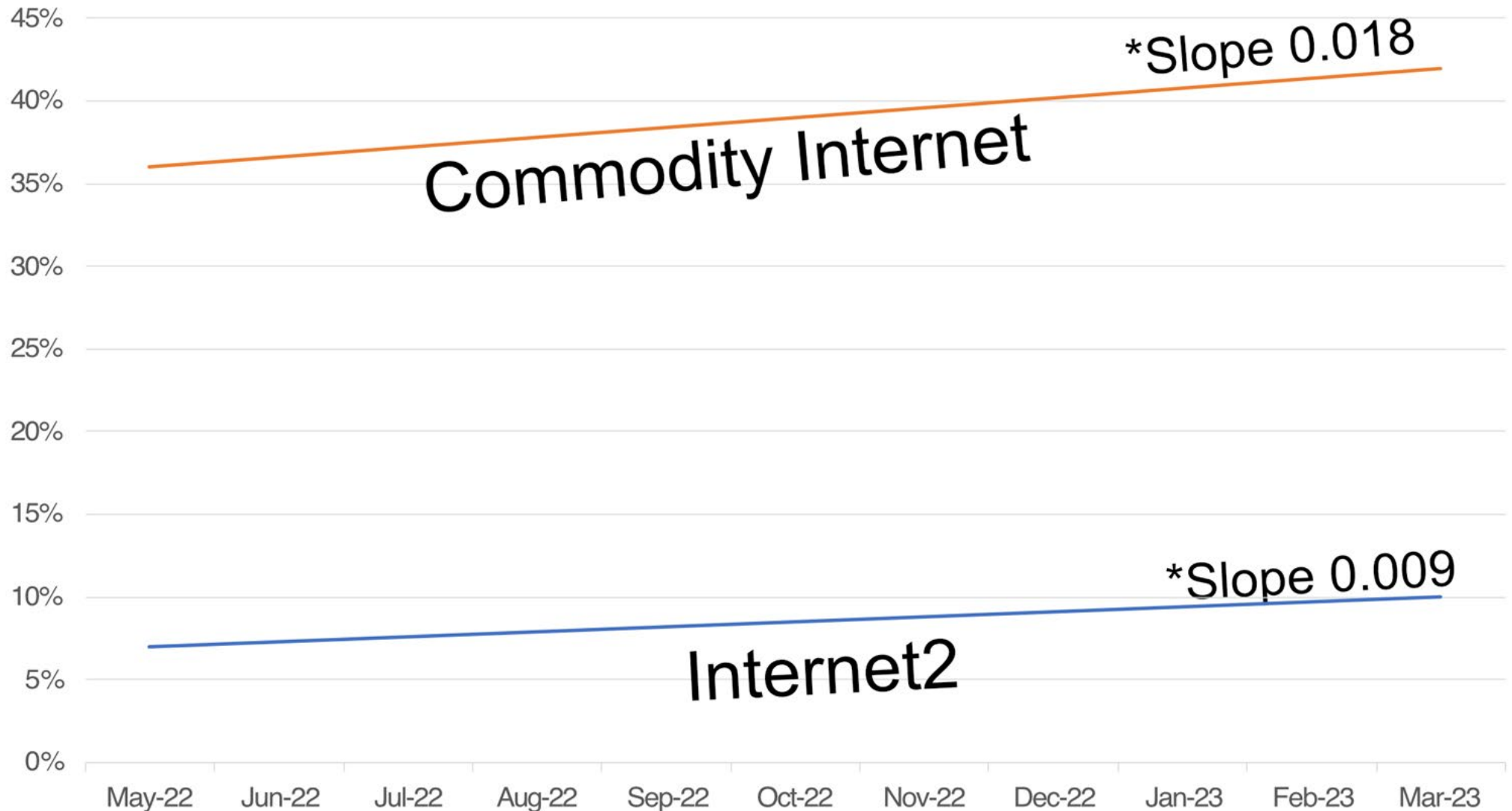
- Covering your IP numbers with an ARIN agreement allows you to make your network more secure
- Signing the ARIN agreement this year locks in lower fees (20-40x lower)
- It's easier to successfully request changes in the agreement if you follow ARIN's guidance
- ARIN has changed the "No Property Rights" section to make it more appealing

What is our leadership responsibility to contribute to a secure Internet?

Our community lags behind:

- RPKI ROA adoption 10% vs “commodity” Internet 42% (ROAs are the routing security easy button)
- DNSSEC adoption 8%
- IPv6 adoption (for services) 18% (likely most are due to outsourcing of email), only 27% of I2-connected ASNs originate a IPv6 route.

Percent of Routes
Protected by RPKI-ROAs



* dimensional slope (% over days)



ARIN is Here to Help



John Sweeting
ARIN Chief
Customer Officer



Michael Abejuela
ARIN General
Counsel



Jon Worley
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Technology Architect



Agenda

RSA/LRSA Changes

Fee Changes in 2024

How RPKI Can Help Your
Routing Security

RPKI Services

A faint, light blue network diagram with nodes and connecting lines is visible in the background of the slide.

ARIN & the RSA/LRSA Changes

Legacy Resource History

Internet Protocol (IP) address space was originally administered by Jon Postel via a function known as the Internet Assigned Numbers Authority (IANA)



Internet number resources were allocated liberally



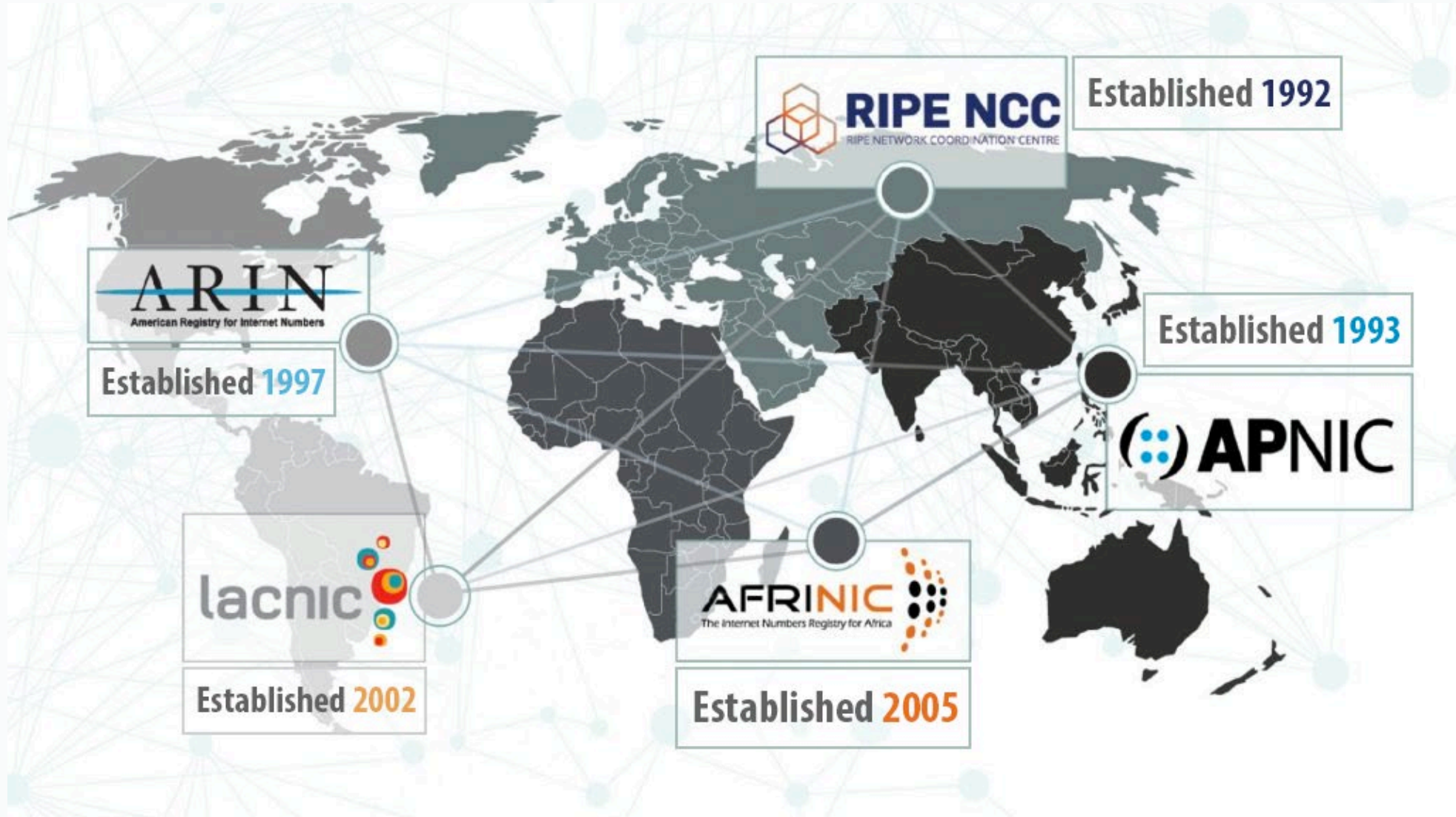
Organizations made a simple request and there was no written contract



The Internet grew globally, and distribution could not be managed this way



ARIN in the RIR System



ARIN provides Internet Registry services to everyone

That *includes* organizations that were issued address space *prior* to ARIN's formation in December 1997 – called **Legacy customers**



Over time, advanced services have been developed, including **Internet Routing Registry (IRR)** and **Resource Public Key Infrastructure (RPKI)**

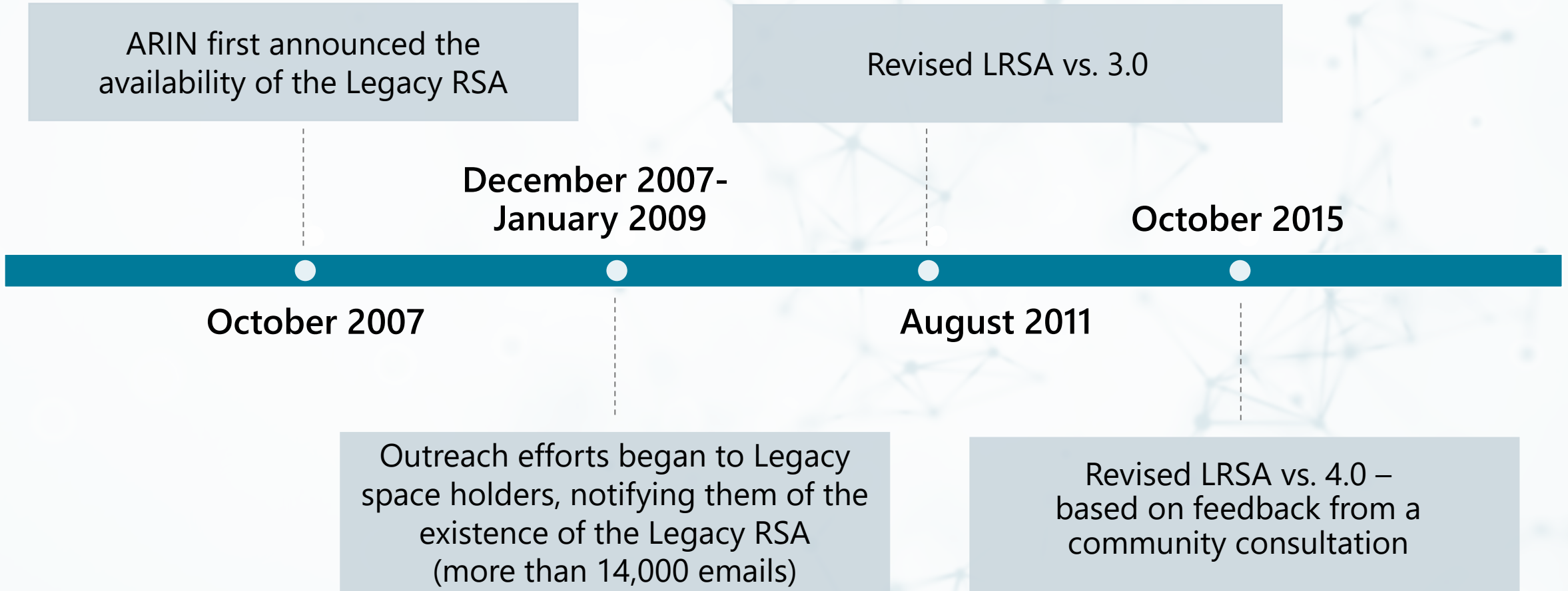
Access to ARIN Services

In order to access all of ARIN's services, an organization must enter into a

- **Registration Services Agreement (RSA)** or
- **Legacy Resource Services Agreement (LRSA)**



A Brief History of the ARIN LRSA



A Brief History of the ARIN LRSA

July 2022

Community consultation to modify
Section 7 from LRSA

September 2022

Revised LRSA vs. 5.0 –
Based on feedback from the
community consultation

Terms have always ensured better or equal treatment compared to RSA signatories

Resources not under an RSA or LRSA? Let's solidify your Organization's relationship with ARIN!

You'll have a contract specifying your rights to an address block and entitlement to ARIN services

Solidifies the foundation of your organization's business with ARIN

Provides validation with clearly defined legal rights and responsibilities for number resources

ARIN Agreements

Recent change to Section 7 of the RSA/LRSA-
the subject of notable community feedback over
the years

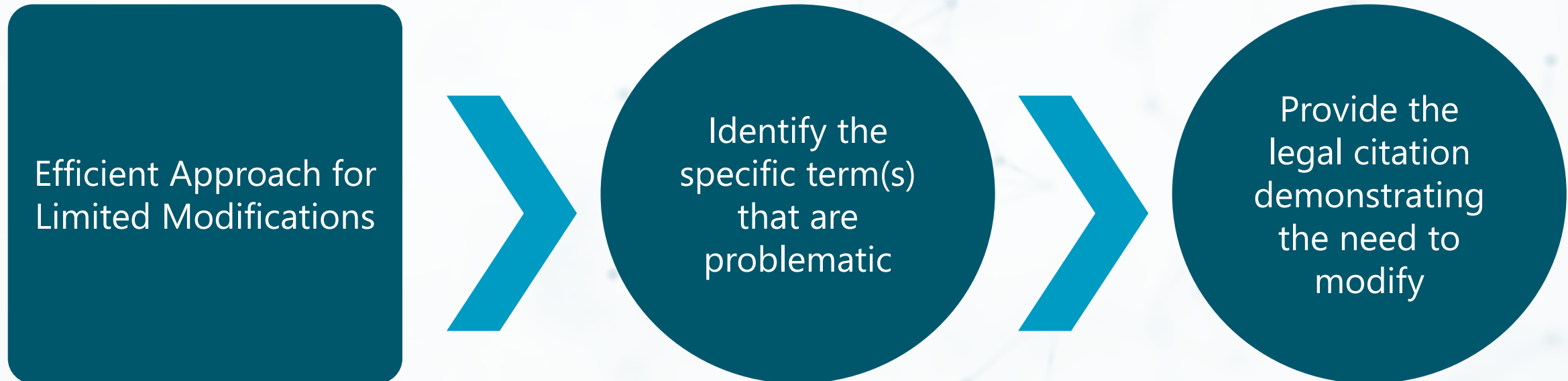
Removed representations in
the previous version

Renamed from "No Property Rights" to "Acknowledged
Rights To Included Number Resources"



Tips for Governmental Entities

ARIN is amenable to limited modifications of the RSA/LRSA for governmental agencies where an agency cannot, by law, agree to certain terms (e.g., indemnification)





Tips for Governmental Entities

We understand the complex contracting process for governmental entities and have streamlined the process for requesting modifications



Recent process updates have removed the need for execution of multiple agreements for an organization's resources:

- Update to the current RSA
- Use of addendum to cover Legacy resources
- Eliminate the need to "*click*" to accept RPKI Terms of Service

Expiration of Annual Legacy Maintenance Fee Cap

- Beginning on 1 January 2024, there will be **no** fee cap on annual Legacy maintenance fees for Legacy resources brought under an agreement after **31 December 2023**
- The Fee cap **will** continue for Legacy resources brought under an agreement **before 1 January 2024**

The logo consists of two concentric circles, the inner one being a darker blue and the outer one a lighter blue. The text 'ARIN Fees' is centered within the circles.

**ARIN
Fees**



Benefits of the ARIN Agreement



Access to Routing Security services:
Authenticated IRR
**Hosted RPKI-ROAs*



Participation in
ARIN's
governance



An agreement that
specifies the
registration services
that announce to the
Internet who holds
your IP addresses

A faint, light blue network diagram with nodes and connecting lines is visible in the background of the slide.

How Authenticated IRR & RPKI can help your Routing Security



What is Authenticated IRR?

The Internet Routing Registry (IRR) is a mechanism for **providing verification** for legitimate BGP announcements by mapping an ASN to a list of networks

ARIN now provides users with the ability to create, update, and delete **objects in ARIN's authenticated IRR database** using ARIN Online or ARIN's RESTful API



What is RPKI?

RPKI is a public key infrastructure that creates a **chain of resource certificates that follows the same structure** as the way IP addresses and AS numbers are handed down¹

RPKI gives the legitimate holder of a block of IP addresses the opportunity to make an **authoritative statement about which AS is authorized** to originate their prefix¹



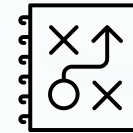
Why is RPKI Important?



Establishes a **level of trust** that the RPKI information is authentic and is confirmed coming from the authorized holder of the resources



The RPKI gives network operators a **method to make better judgments** on which is the valid source (origin) of a route announcement



RPKI can **limit the impact** of a configuration mistake or nefarious activity of a bad actor



Steps of RPKI



Legitimate resource holders obtain a resource certificate

Organizations make signed statements about the resources

Data is fetched from the RIR, confirms chain of cryptography, caches valid content

Network operators can act based on RPKI validity state

Global RPKI ecosystem enhances routing security

How RPKI Data is Used

Route Origin Authorization (ROA) Objects

- Resource holders state: This prefix should be originating from this ASN
- ROAs are stored in databases called repositories

Relying Party Software (Validator)

- Fetches the contents of the repositories
- Confirms the cryptographic chain back to the RIR Trust Anchor

How RPKI Data is Used

Routing Decisions

- Data in Validator's cache is compared to announcements views in the global BGP table to establish the validity state
- Network Operators can choose to make routing decisions based on the RPKI validity state

Performance and value will grow

- More resource holders create ROAs for their prefixes
- More network operators act based on the validity state

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ARIN's RPKI Services – which one is right for you?



Three RPKI Deployment Options at ARIN

Hosted

- Easiest to use; Recommended for most organizations just getting started with RPKI. Nearly 98% of ARIN participants use Hosted RPKI.

Delegated

- Highest responsibility and uptime requirement; only organizations with in-depth knowledge of RPKI and resources to run a Certificate Authority (CA) and a publication server should select Delegated RPKI.

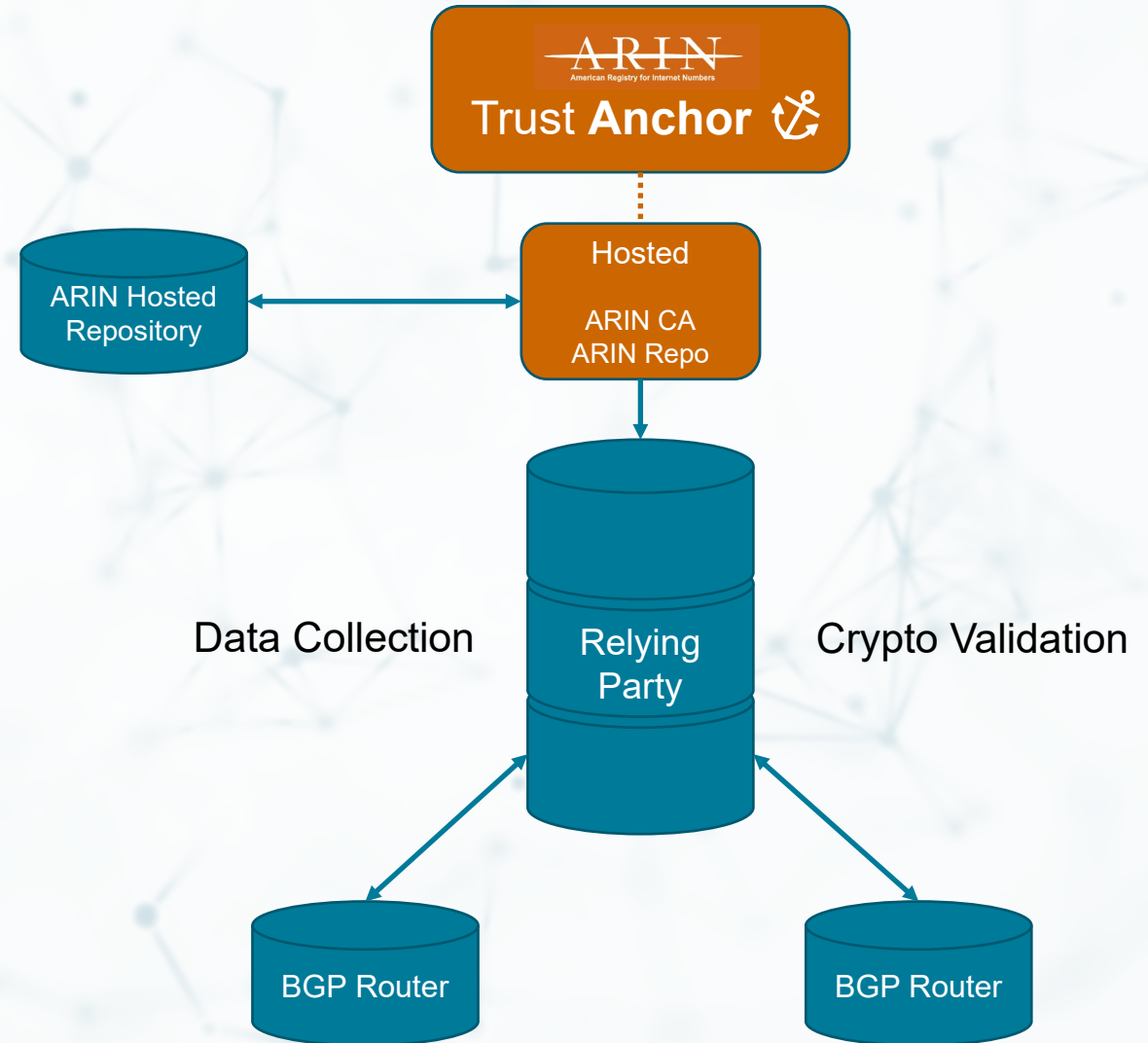
Hybrid – Repository Publication Service

- Suggested for organizations that wish to retain cryptographic control, and do not want to maintain the high availability repository and publication functions.



Hosted RPKI Service

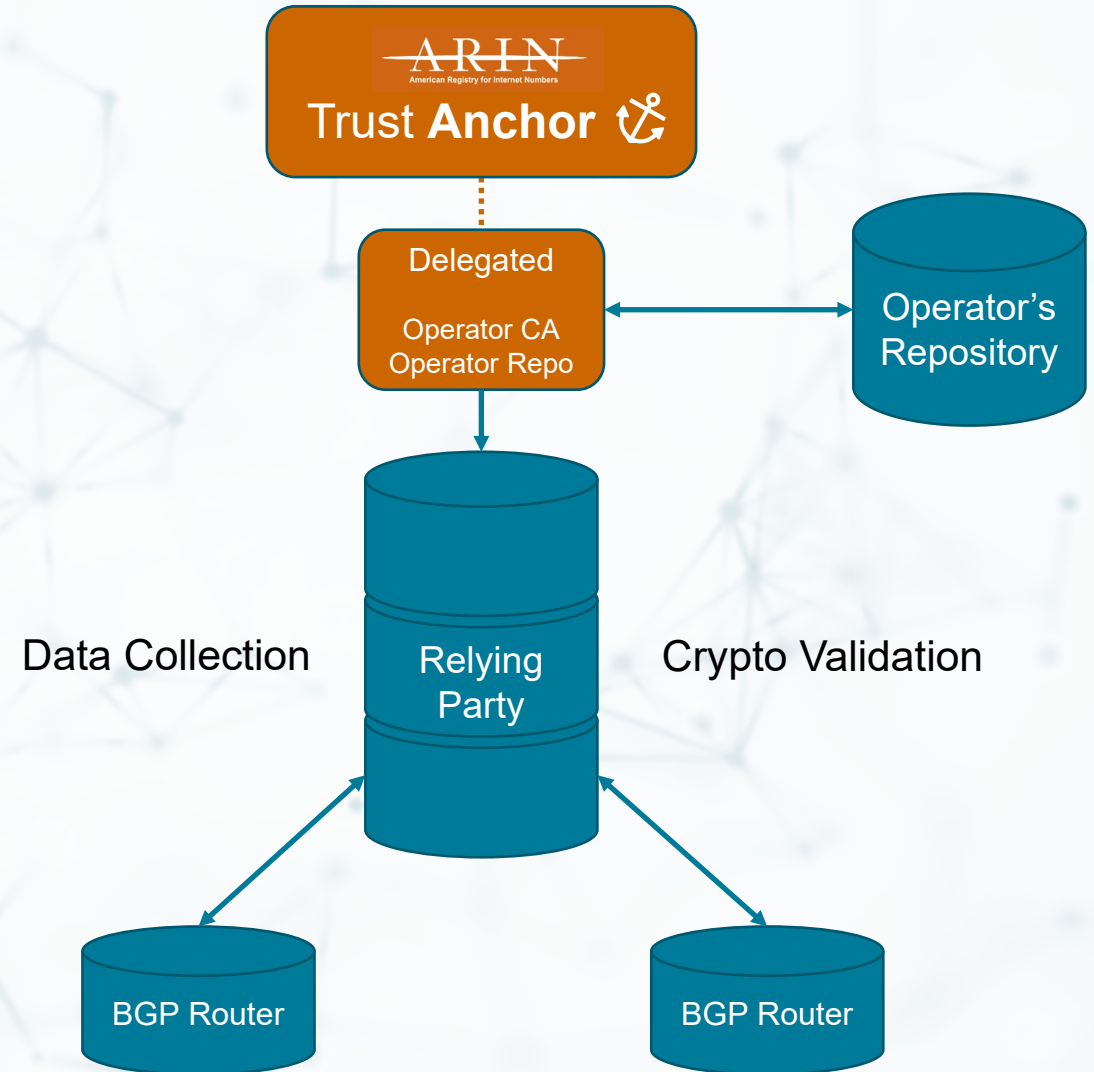
- Certificate Authority (CA) managed by ARIN
- Repository and Publication services run by ARIN
- Org creates and maintains their ROAs
- Accessed via ARIN Online portal or the RESTful API





Delegated RPKI Service

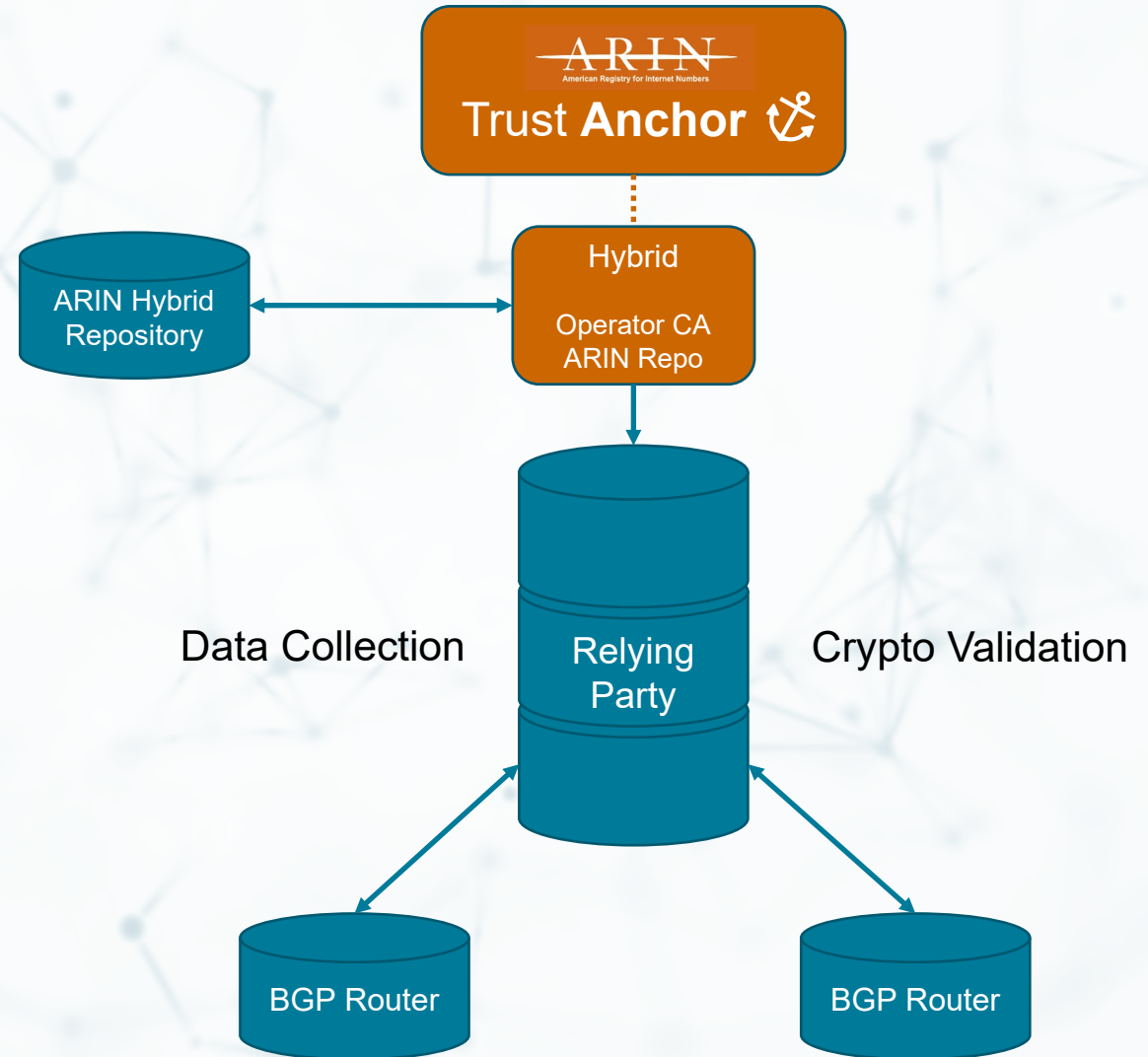
- The organization has more control and independence
- Runs their own CA to manage object signing
- Separation of the publication of cryptographic functions





Repository Publication Service (Hybrid RPKI)

- Maintain control and independence of Delegated RPKI
- Runs their own CA to manage object signing
- Off-load Repository and Publication services to ARIN



In Conclusion



State of the ARIN Agreement Adoption

What we see in the Internet2 R&E community:

- 2,203 ARIN direct IP address assignments
- 1,023 (46%) without an ARIN Agreement
- \$1,876,124,160 Market value of IP numbers not covered by ARIN agreement!

Many mistakenly believe their IP addresses are covered by an ARIN agreement:

- No agreement required to manage Whois information (i.e., portal access doesn't require an agreement)
- You may be receiving and paying ARIN bills for other resources



ARIN Agreement Fee Changes (for Legacy resources)

For legacy resources in 2023, ARIN's fees are \$175/yr. That's \$175/yr for any number of legacy resources. **Signing an agreement this year locks in fee increases of \$25/yr.**

- Waiting until next year (or longer) to sign an ARIN agreement will result in fees subject to ARIN's normal fee schedule. For a single /16, the current fee schedule is \$4,000/yr (approx. 22 times higher than the legacy fee schedule).
- Across the Internet2 community, this difference adds up to **\$2M/yr** in fees for agreements signed after 2023, vs **\$75K/yr** in fees for agreements signed this year.



ARIN is here to help



Email questions to:
routing.security@arin.net



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ARIN Community Grant Program

Applications now open through June 2

Provides financial grants in support of initiatives that improve the overall Internet industry and Internet user environment

- Internet technical improvements
- Registry processes and technology improvements
- Informational outreach on topics such as IPv6, Internet governance, etc.
- Research



ANY QUESTIONS

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Thank You