Interact with ARIN & learn how you can drive the future of the Internet.

ARIN on the Road: Bringing You Answers

Chicago, Illinois
22 March 2012
Today’s Agenda

Introductions and Collection of Discussion Topics

History of the RIRs, ARIN and Internet Governance

Requesting and Managing Internet Number Resources through ARIN Online

ARIN’s Customer-facing RESTful Web Services

Current Status of IPv4 and IPv6 in the ARIN Region

Number Resource Policies and Procedures

ARIN’s Policy Development Process

Current Policy Discussions

DNSSEC and RPKI: Value-added Services beyond the Numbers

The Importance of Participating in the ARIN Community

Q&A/ Open Mic Session/Adjournment
Self Introductions and Suggestions for Discussion Topics

• Name?
• Organization?
• ARIN topic that you are especially interested in?
History of ARIN and Internet Governance

Susan Hamlin
Director, Communications and Member Services
What is an RIR?

- An RIR is an organization that manages the allocation and registration of Internet number resources within a particular region of the world.
  - Internet number resources include IP addresses and autonomous system (AS) numbers.
Regional Internet Registries
Historical Timeline

1980s
Internet Registry (IR) function contracted by DoD to SRI International

1980s
NSFNET/ARPANET - Jon Postel managed addressing via DoD contract; this was called the Internet Assigned Numbers Authority (IANA)

1991
RFC 1261: DoD IR function contract moved to Network Solutions, Inc.

1992
RFC 1366: Regional IRs established; RIPE NCC formed

1993
IR function contracted by NSF to NSI; InterNIC formed, DoD oversight ends. APNIC formed.

Government Oversight

Registrant

Registrant
Historical Timeline

2005  Regionalization complete; AfriNIC formed

2002  Regionalization continues; LACNIC formed

1998  ICANN formed by US Gov’t (top level technical coordination)

1997  IR regionalization continues; ARIN formed. USG oversight of IR function ends.
### RIR Structure

<table>
<thead>
<tr>
<th>Not-for-profit</th>
<th>Membership Organization</th>
<th>Community Regulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fee for services, not number resources</td>
<td>• Broad-based&lt;br&gt;- Private sector&lt;br&gt;- Public sector&lt;br&gt;- Civil society</td>
<td>• Community developed policies&lt;br&gt;• Member-elected executive board&lt;br&gt;• Open and transparent</td>
</tr>
</tbody>
</table>
# RIR Services

<table>
<thead>
<tr>
<th>Number Resources</th>
<th>Organization</th>
<th>Policy Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>• IP address allocation &amp; assignment</td>
<td>• Elections</td>
<td>• Maintain email discussion lists</td>
</tr>
<tr>
<td>• ASN assignment</td>
<td>• Meetings</td>
<td>• Conduct public policy meetings</td>
</tr>
<tr>
<td>• Directory services</td>
<td>• Information dissemination</td>
<td>• Publish policy documents</td>
</tr>
<tr>
<td>• Whois</td>
<td>• Website</td>
<td></td>
</tr>
<tr>
<td>• IRR</td>
<td>• Newsletters</td>
<td></td>
</tr>
<tr>
<td>• Reverse DNS</td>
<td>• Roundtables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Training</td>
<td></td>
</tr>
</tbody>
</table>
The NRO exists to protect the unallocated number resource pool, to promote and protect the bottom-up policy development process, and to act as a focal point for Internet community input into the RIR system.
## Who Provisions IP Addresses and ASNs?

| ICANN/IANA | Top level technical coordination of the Internet (Names, Numbers, Root Servers)  
|           | Manage global unallocated IP address pool  
|           | Allocate number resources to RIRs  

| RIR | Manage regional unallocated IP address pool  
|     | Allocate number resources to ISPs/LIRs  
|     | Assign number resources to End-users  

| ISP/LIR | Manage local IP address pool for use by customers and for infrastructure  
|        | Allocate number resources to ISPs  
|        | Assign number resources to End-users |
Number Resource Provisioning Hierarchy

ICANN / IANA
(Internet Assigned Numbers Authority)
Manage global unallocated IP address pool

Allocate

RIRs
(AfriNIC, APNIC, ARIN, LACNIC, RIPE NCC)
Manage regional unallocated IP address pool

Allocate

ISP

Allocate

Re-Allocate

ISP

End Users

Assign

End Users
"Applying the principles of stewardship, ARIN, a nonprofit corporation, allocates Internet Protocol resources; develops consensus-based policies; and facilitates the advancement of the Internet through information and educational outreach."
About ARIN

- One of five Regional Internet Registries (RIRs)
- Established December 1997
- Provides services related to the technical coordination and management of Internet number resources
- Services the US, Canada, and 22 economies in the Caribbean
- Is a non-profit, community-based organization governed by a member-elected executive board
ARIN’s Service Region

ARIN’s region includes Canada, many Caribbean and North Atlantic islands, and the United States.
ARIN’s Core Services

• Like the other RIRs, ARIN:
  – Allocates and assigns Internet number resources
  – Maintains Whois, in-addr.arpa, and other technical services
  – Facilitates policy development
  – Provides training, education and outreach
  – Participates in the global Internet community
2012 Community Outreach Events

Key Messaging on IPv6:

- ARIN on the Road (New York, Chicago, more)
- Consumer Electronics Show
- Internet2 Joint Techs
- V6 World Congress
- North American IPv6 Summit
- Interop
- The Cable Show
- CANTO (Caribbean Association of National Telecommunication Organizations)
- Caribbean Telecommunications Union ICT Roadshows
- CaribNOG
• Definition of Internet governance*:

... the development and application by governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet.

• ARIN is working to educate governments and international organizations about the RIR bottom-up and multi-stakeholder policy process.

• ARIN provides technical advice with regard to Internet number resource management based on community consensus-based policy.

• ARIN is working to ensure that the multi-stakeholder community based model is understood and valued in the global Internet governance policy debate.

*as defined in 2005 by The World Summit on the Information Society (WSIS)
ARIN on Social Media

www.TeamARIN.net

www.facebook.com/TeamARIN

www.twitter.com/TeamARIN

www.linkedin.com/groups?gid=834217

www.youtube.com/TeamARIN
Q&A
Requesting and Managing Internet Number Resources through ARIN Online

Jon Worley
Senior Resource Analyst
Overview

• Request and Manage Number Resources
  – Recently Added ARIN Online Functionality
  – RESTful Provisioning
• Recently Implemented Policies
• Status of IPv4
• Future Services
Major Changes in Functionality

1) Resource Requests
2) POC Validation
3) Reverse DNS Zone Management
4) DNSSEC
5) View Invoices
6) WhoWas
Requesting IP addresses & ASNs

• Via ARIN Online only

• Officer attestation for IP requests now done via a signed form (instead of email)

• Can no longer specify resource POCs or reverse DNS delegation in request
Annual POC Validation

- Annual validation of each POC handle required (NRPM 3.6)

- If an ARIN Online account is linked to any POC that has been unvalidated for 60+ days, the system forces validation by preventing the account from performing normal actions.
Reverse DNS

- All reverse zones managed individually now

- All zone management takes place inside ARIN Online or via REST calls (no templates!)
Reverse DNS in ARIN Online

**Manage Reverse DNS**

The chart below shows each reverse DNS zone you are authoritative for, any nameservers delegated to that zone, any Delegation Signer (DS) resource record key tags registered to that zone, and the names of any organizations in Whois who have the authority to manage the delegation for the reverse DNS zone. If you have SWIPed address blocks to customers in ARIN’s Whois, you may see their organization name listed in the Authorized Organizations column.

Note: For IPv4, zones are created at the octet boundary (18, 16, 24) based on the size of the directly-issued address block(s) from ARIN. For the customer to have authority, the SWIPed address block must fall within the same octet level of the directly-issued network. If a network is re-assigned out of multiple net blocks, it is possible that authority to manage reverse DNS will be given for only some of the zones. The same applies to IPv6, though zones are created at the nibble boundary.

Using the check boxes below, select the reverse delegation(s) you wish to modify. If you choose more than one delegation, the new nameservers or DS records you specify will automatically apply to all the delegations you select.

Select All / Deselect All

<table>
<thead>
<tr>
<th>SELECT</th>
<th>DELEGATION</th>
<th>NAMESERVERS</th>
<th>DS RECORD KEY TAGS</th>
<th>AUTHORIZED ORGANIZATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>80.147.204.in-addr.arpa.</td>
<td>AUTHNS1.MPLS.QWEST.NET AUTHNS2.DNVR.QWEST.NET AUTHNS3.STLL.QWEST.NET</td>
<td></td>
<td>Qwest Communications Company, LLC U S WEST Internet Services</td>
</tr>
<tr>
<td>☐</td>
<td>81.147.204.in-addr.arpa.</td>
<td>AUTHNS1.MPLS.QWEST.NET AUTHNS2.DNVR.QWEST.NET AUTHNS3.STLL.QWEST.NET</td>
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</tr>
<tr>
<td>☐</td>
<td>82.147.204.in-addr.arpa.</td>
<td>AUTHNS1.MPLS.QWEST.NET AUTHNS2.DNVR.QWEST.NET AUTHNS3.STLL.QWEST.NET</td>
<td></td>
<td>Qwest Communications Company, LLC U S WEST Internet Services</td>
</tr>
<tr>
<td>☐</td>
<td>83.147.204.in-addr.arpa.</td>
<td>AUTHNS1.MPLS.QWEST.NET AUTHNS2.DNVR.QWEST.NET AUTHNS3.STLL.QWEST.NET</td>
<td></td>
<td>Qwest Communications Company, LLC U S WEST Internet Services</td>
</tr>
</tbody>
</table>

[MODIFY NAMESERVERS] [MODIFY DS RECORDS]
Reverse DNS in ARIN Online

Manage Reverse DNS

Using the text fields on the right, specify the hostnames (not the IP addresses) of the nameservers that should be authoritative for ALL the reverse DNS delegations listed on the left. Please note that any modifications will be applied to all listed delegations.

SELECTED DELEGATIONS IN - NET-204-147-80-0-1

81.147.204.in-addr.arpa.

HOSTNAMES OF NAMESERVERS

| Nameserver 1: | AUTHNS1.MPLS.QWEST.NET |
| Nameserver 2: | AUTHNS2.DNVR.QWEST.NET |
| Nameserver 3: | AUTHNS3.STTL.QWEST.NET |
| Nameserver 4: | |
| Nameserver 5: | |
| Nameserver 6: | |
| Nameserver 7: | |
| Nameserver 8: | |
| Nameserver 9: | |
| Nameserver 10: | |
| Nameserver 11: | |
| Nameserver 12: | |
| Nameserver 13: | |

[APPLY TO ALL]  [CANCEL]
Querying ARIN’s Whois

Query for the zone directly:

```
whois> 81.147.204.in-addr.arpa

Name: 81.147.204.in-addr.arpa.
Updated: 2006-05-15
NameServer: AUTHNS2.DNVR.QWEST.NET
NameServer: AUTHNS3.STTL.QWEST.NET
NameServer: AUTHNS1.MPLS.QWEST.NET

Ref: http://whois.arin.net/rest/rdns/81.147.204.in-addr.arpa.
```
Reverse DNS

- ARIN issues blocks without any working DNS
  - Must establish delegations after registration
Reverse DNS

• Authority to manage reverse zones follows SWIP
  –“Shared Authority” model
Joe's Bar and Grill has reassigned a /24 to HELLO WORLD. Both can manage the /24 zone.
DNSSEC

- Same interface as reverse DNS
- DS records generated by user
- Zone must have nameservers before you can add DS records
1) Paste DS Record
2) Parse DS Record
3) Apply
View Invoices

- Can now view paid and open invoices via ARIN Online
- Goes back 2 years
- Available to Admin, Tech, and Billing POC
WhoWas

- Historical Information for registration of IP addresses and AS numbers
- Provided as a series of TSV files in .zip
- Requires agreement to WhoWas ToU
- Scheduled for public availability 3/24/2012 (this Saturday)
Template Changes

- Resource request templates deprecated
- Transfers and SWIPs still done with templates
- API key required to authorize processing
  - Generated via ARIN Online
  - [http://www.arin.net/features/api_keys.html](http://www.arin.net/features/api_keys.html)
ARIN’s Customer-facing RESTful Web Services

Tim Christensen
Quality Assurance Manager
REST - The New Services

• Three RESTful Web Services
  – Whois-RWS
    • Exposes our public Whois data via REST
  – Reg-RWS (or Registration-RWS)
    • Registration and maintenance of your data in a programmatic fashion
  – Bulk Whois
    • Download of Bulk Whois is now done RESTfully
What is REST?

• Representation State Transfer

• As applied to web services
  – defines a pattern of usage with HTTP to create, read, update, and delete (CRUD) data
  – “Resources” are addressable in URLs

• Very popular protocol model
  – Amazon S3, Yahoo & Google services, …
The BIG Advantage of REST

- Easily understood
  - Any modern programmer can incorporate it
  - Can look like web pages
- Re-uses HTTP in a simple manner
  - Many, many clients
  - Other HTTP advantages
- This is why it is very, very popular with Google, Amazon, Yahoo, Twitter, Facebook, YouTube, Flickr, ...
What does it look like? And who can use it?

Where the data is.
What type of data it is.
The ID of the data.

http://whois.arin.net/rest/poc/KOSTE-ARIN

It is a standard URL. Go ahead, put it into your browser.
Where can more information on REST be found?

- RESTful Web Services
  - O’Reilly Media
  - Leonard Richardson
  - Sam Ruby
Whois-RWS

• Publicly accessible, just like traditional Whois
• Searches and lookups on IP addresses, AS numbers, POCs, Orgs, etc…
• Very popular
  – As of March, 2011, constitutes 40% of our query load
• For more information:
  – http://www.arin.net/resources/whoisrws/index.html
Registration RESTful Web Service (Reg-RWS)

- Programmatic way to interact with ARIN
  - Intended to be used for automation
  - Not meant to be used by humans
- Useful for ISPs that manage a large number of SWIP records
- Requires an investment of time to achieve those benefits
Reg-RWS

• Requires an API Key
  – You generate one in ARIN Online
• Register and manage your data
  – But only your data
• More information
  – [http://www.arin.net/resources/restful-interfaces.html](http://www.arin.net/resources/restful-interfaces.html)
  – We are working on enhanced documentation – to be released soon
Example – Reassign Detailed

- Your automated system issues a PUT call to ARIN using the following URL:

The call contains the following data:

```
<net xmlns="http://www.arin.net/regrws/core/v1" >
  <version>4</version>
  <comment></comment>
  <registrationDate></registrationDate>
  <orgHandle>HW-1</orgHandle>
  <handle></handle>
  <netBlocks>
    <netBlock>
      <type>A</type>
      <description>Reassigned</description>
      <startAddress>10.129.0.0</startAddress>
      <endAddress>10.129.0.255</endAddress>
      <cidrLength>24</cidrLength>
    </netBlock>
  </netBlocks>
  <parentNetHandle>NET-10-129-0-0-1</parentNetHandle>
  <netName>HELLOWORLD</netName>
  <originASes></originASes>
  <pocLinks></pocLinks>
</net>
```
Example – Reassign Detailed

ARIN’s web server returns the following to your automated system:

```
<net xmlns="http://www.arin.net/regrws/core/v1" >
  <version>4</version>
  <comment></comment>
  <registrationDate>Tue Jan 25 16:17:18 EST 2011</registrationDate>
  <orgHandle>HW-1</orgHandle>
  <handle>NET-10-129-0-0-2</handle>
  <netBlocks>
    <netBlock>
      <type>A</type>
      <description>Reassigned</description>
      <startAddress>10.129.0.0</startAddress>
      <endAddress>10.129.0.255</endAddress>
      <cidrLength>24</cidrLength>
    </netBlock>
  </netBlocks>
  <parentNetHandle>NET-10-129-0-0-1</parentNetHandle>
  <netName>HELLOWORLD</netName>
  <originASes></originASes>
  <pocLinks></pocLinks>
</net>
```
Reg-RWS Has More Than Templates

- Only programmatic way to do IPv6 Reassign Simple
- Only programmatic way to manage Reverse DNS
- Only programmatic way to access your ARIN tickets
Testing Your Reg-RWS Client

• We offer an Operational Test & Evaluation environment for Reg-RWS
• Your real data, but isolated
  – Helps you develop against a real system without the worry that real data could get corrupted.
• For more information:
Obtaining RESTful Assistance

- ARIN Online’s Ask ARIN feature
- arin-tech-discuss mailing list
  - Make sure to subscribe
  - Someone on the list will help you ASAP
  - Archives on the web site
- Registration Services Help Desk telephone not a good fit
  - Debugging these problems requires a detailed look at the method, URL, and payload being used
Bulk Whois

• You must first sign an AUP
  – ARIN staff will review your need to access bulk Whois data
• Also requires an API Key
• More information
  – http://www.arin.net/resources/request/bulkwhois.html
Q&A
Current Status of IPv4 and IPv6 in the ARIN region

Jon Worley
Senior Resource Analyst
Inventory Report

• IANA IPv4 free pool now exhausted
  – ARIN received its last /8 from IANA in mid-February
• At that time, ARIN had \( \sim5.49/8 \) equivalents in its available pool
• Daily inventory published on ARIN’s web site
Inventory updated daily @ 8PM ET
1.5% of the subscriber Org IDs hold 80% of the non-legacy IPv4 addresses.

The remaining 98.5% of the Org IDs hold 20% of the non-legacy IPv4 addresses.
2011 Requests for IPv4 Address Space (by category)

**Feb 3, 2011- IANA depletion**
2011 IPv4 Delegations Issued By ARIN (listed in /24s)

**Feb 3, 2011 - IANA depletion**
Drop In IPv4 Consumption Rate

- ISP additional allocation supply dropped from 12 to 3 months at IANA IPv4 free pool depletion
- ARIN issued only 60,042 /24s to ISPs in the year since then
  - 2004-2007 (6 mo.): 170,368 /24s per yr
  - 2008-2010 (12 mo.): 180,982 /24s per yr
Historically Slow?

- Pre-IANA depletion, the fewest number of /24s issued in a 3 month period was 10,985 (July 2009 to September 2009)

- June 2011 to August 2011: 3,029 /24s

- 73% drop? Yeah, I’d say that’s historically slow
3 Month Supply?

• Previous rate with 3 month need
  – 1999-2003 (3 mo): 104,186 /24s per year
  – But that was with a /13 cap

• Annoyance Factor
  – 3 month need should just mean requesting more often, right?
  – Median days to complete request
    • X-small to Large: 5-8 days
    • X-Large: 19 days (very small sample size)
Jan 2011 Run on the Bank?

- 24,343 /24s issued month before IANA depletion
- Jan 2011 – Feb 2012: 77,894 /24s per 12 months
  - Comparable to previous annual low of 79,168 in 2003
  - But that was when we had a /13 cap
IPv4 Transfer Market?

• 7,546 /24s transferred via 8.3 in 2011

• Adding that to the number issued results in 84,859 /24s per year
  – Low, but not unprecedented
    • 1999: 81,039 /24s
    • 2002: 87,708 /24s
    • 2003: 79,168 /24s
Conclusions

• Even factoring in 8.3 transfers and the Jan 2011 “run on the bank”, 2011-present has been one of the slowest burn rates we’ve seen

• Near future will be important
  – Will large ISPs turn to the transfer market?
  – Has there been a permanent reduction in demand, or is this an anomaly?
Post-Depletion World

• While availability of IPv4 addresses cannot be assured, there will be ways network operators may be able to obtain additional IPv4 addresses
  – Transfers to Specified Recipients
  – Specified Transfer Listing Service (STLS)
  – Waiting List for Unmet IPv4 Requests
Transfers to Specified Recipients

• Resources no longer required to be under RSA

• If resources are not maintained under RSA, verification of title may take some time
  – Attestation from officer required if resources not under LRSA/RSA

• RSA coverage = smoother transfer
• 3 ways to participate
  – Listers: have available IPv4 addresses
  – Needers: looking for more IPv4 addresses
  – Facilitators: available to help listers and needers find each other

• Major Uses
  – Matchmaking
  – Obtain preapproval for a transaction arranged outside STLS
IPv4 Waiting List

• Starts when ARIN can’t fill a justified request
• Option to specify smallest acceptable size
• If no block available between approved and smallest acceptable size, option to go on the waiting list
• May receive only one allocation every three months
IPv4 Churn

- ARIN does get back IPv4 addresses through returns, revocations, and reclamations
  - Return = voluntary
  - Revoke = for cause (usually nonpayment)
  - Reclaimed = fraud or business dissolution

- From 1/1/2005 to 1/11/2012, ARIN got 230,899 /24s (= 902 /16s or 3.52 /8s) equivalents back
Burn Rate vs. Chum Rate

<table>
<thead>
<tr>
<th></th>
<th>/14</th>
<th>/15</th>
<th>/16</th>
<th>/17</th>
<th>/18</th>
<th>/19</th>
<th>/20</th>
</tr>
</thead>
<tbody>
<tr>
<td># issued since IANA depletion</td>
<td>5</td>
<td>7</td>
<td>14</td>
<td>23</td>
<td>50</td>
<td>60</td>
<td>246</td>
</tr>
<tr>
<td>avg # reclaimed per year</td>
<td>3</td>
<td>2</td>
<td>17</td>
<td>11</td>
<td>31</td>
<td>75</td>
<td>126</td>
</tr>
</tbody>
</table>
2011 IPv6 Address Allocations and Requests

**Feb 3, 2011 - IANA depletion**
ISP Members with IPv4 and IPv6

3,796 ISP subscriber members

- 2,437 IPv4 Only (64%)
- 1,359 IPv4 and IPv6 (36%)

*as of 11 Jan 2012
ISP Members with IPv4 and IPv6

IPv4-only and IPv4+v6 ISPs

<table>
<thead>
<tr>
<th></th>
<th>2010Q1</th>
<th>2010Q3</th>
<th>2011Q1</th>
<th>2011Q3</th>
<th>2012Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>% IPv4 Only</td>
<td>80%</td>
<td>75%</td>
<td>70%</td>
<td>66%</td>
<td>64%</td>
</tr>
<tr>
<td>% IPv4 and IPv6</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>34%</td>
<td>36%</td>
</tr>
</tbody>
</table>

ARIN
American Registry for Internet Numbers
Who Are the Players in the Transition to IPv6?

• Broadband Access Providers
• Internet Service Providers
• Internet Content Providers
• Enterprise Customers
• Equipment Vendors
• Government Organizations
IPv6 Adoption Needs

• IPv6 address space
• IPv6 connectivity (native or tunneled)
• Operating systems, software, and network management tool upgrades
• Router, firewall, and other hardware upgrades
• IT staff and customer service training
IPv4 & IPv6 - The Bottom Line

- IPv4 is depleting quickly; IPv6 must be adopted for continued Internet growth.
- IPv6 is not backwards compatible with IPv4; for the foreseeable future, the Internet must run both IP versions (IPv4 & IPv6) at the same time.
- Deployment is already underway: Today, there are organizations attempting to reach your mail, web, and application servers via IPv6...
Resources

- IPv6 Info Center  
  www.arin.net/knowledge/ipv6_info_center.html
  - Community Use Slide Deck
  - ARIN IPv6 Board Resolution
  - IPv6 Letter to CEOs
- IPv6 Wiki  
  www.getipv6.info
- Knowledge  
  www.arin.net/knowledge/
- Outreach Microsite  
  www.TeamARIN.net
- Social Media at ARIN  
  www.arin.net/social.html
- Deploy 360 Programme  
  www.internetsociety.org/deploy360/
Q&A
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The Importance of Participating in the ARIN Community

Q&A/ Open Mic Session/Adjournment
Number Resource Policies and Procedures

Jon Worley
Senior Resource Analyst
3 Month Supply For ISPs

• Prior to IANA IPv4 exhaustion, experienced ISPs could get a 12 month supply
• Dropped to 3 month supply immediately upon IANA exhaustion
• Policy proposal submitted on 1/27/2012 would take us back to 12 months until we have to use our last /8
IPv6 End-user Changes

- **Before**: Block size based on HD-Ratio
  - Complex (used logarithms)
- **After**: Block size based solely on number of sites within a network

<table>
<thead>
<tr>
<th>Number of Sites</th>
<th>Block Size Justified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/48</td>
</tr>
<tr>
<td>2-12</td>
<td>/44</td>
</tr>
<tr>
<td>13-192</td>
<td>/40</td>
</tr>
<tr>
<td>193-3,072</td>
<td>/36</td>
</tr>
<tr>
<td>3,073-49,152</td>
<td>/32</td>
</tr>
</tbody>
</table>
IPv6 End User Block Sizes

* Since new policy implemented on 3/16/2011
Better IPv6 Allocation for ISPs

• Now fully implemented

• Allows ISPs to have uniform subnets
  – Each “serving site” gets a block large enough to number the largest serving site
  – Must be nibble-aligned: /48, /44, /40, etc.
Example

- An ISP has 37 PoPs
  - The largest PoP has 1,084 customers
  - Wants to assign a /48 to each customer

- /37 smallest block that has 1,084 /48s (2,048)
- Each of the 37 PoPs gets a /36 (round to nibble)

- Smallest block that contains 37 /36s is a /30 (64 /36s)

- ISP A gets a /28 (round to nibble)
IPv6 ISP Block Sizes

* Since new policy implemented 9/27/2011
Standardize IP Reassignment Registration Requirements

- Abuse contact required for all ORGs
- New policies for ISPs with residential customers that dynamically draw IP addresses from pools
  - must submit SWIP information for each market area
  - must show 80% assigned with a 50-80% utilization rate across markets
- IPv6 /64 and larger static reassignments must be visible via SWIP/RWhois
IPv6 Subsequent Allocations for Transitional Technologies

- ISPs with an initial allocation for native IPv6 can request a separate block to be used for IPv4 -> IPv6 transitional technology
  - 6rd is the most common example, but the policy doesn’t specify a technology

- /24 maximum allocation
  - Allows a typical ISP to map a /56 to each of their existing IPv4 addresses in a 6rd deployment
Specified Recipient Transfers

• NRPM 8.3 allows transfer of unused IPv4 addresses
• Can now receive a 24 month supply
  – Must qualify for an assignment/allocation under current policy and provide a detailed 24 month deployment plan
• Single aggregate requirement removed
M&A Transfer Changes

- Must develop a plan to show justified use via growth, returning resources, or transferring unused IPv4 addresses to another org
- Must demonstrate asset transfer
  - Company ownership not sufficient
  - Has to be the users, equipment, etc. using the resources
Routing Registry Upgrade

• New software deployed 9/29/2011
• Support for MD5-PW and PGP authentication
• Mail-from works a little differently
  – If you encounter problems, contact us directly for a manual upgrade
Q&A
Policy Development Process (PDP)

http://www.arin.net/policy/pdp.html
Policy Development Principles

Open
- Developed in open forum
  - Public Policy Mailing List
  - Public Policy Meetings
- Anyone can participate

Transparent
- All aspects documented and available on website
  - Policy process, meetings, and policies

Bottom-up
- Policies developed by the community
- Staff implements, but does not make policy
Who Plays a Role in the Policy Process?

Community
- Submit proposals
- Participate in discussions and petitions

Advisory Council (elected volunteers)
- Facilitate the policy process
- Develop policy that is “clear, technically sound and useful”
- Determine consensus based on community input
Roles...

**ARIN Board of Trustees (elected volunteers)**
- Provide corporate fiduciary oversight
- Ensure the policy process has been followed
- Ratify policies

**ARIN Staff**
- Provide feedback to community
  - Staff and legal assessments for all proposals
  - Policy experience reports
- Implement ratified policies
Basic Steps

1. Community member submits a proposal
2. Community discusses the proposal on the “List”
3. AC creates a draft policy or abandons the proposal
4. Community discusses the draft policy on the “List” and at the meeting
5. AC conducts its consensus review
6. Community performs last call
7. Board adopts
8. Staff implements
Petitions

Anyone dissatisfied with a decision by the AC can petition in order to keep a proposal moving forward

- Occurs between proposal and draft policy stage
- 5 day petition period
- Needs 10 different people from 10 different organizations to publicly support the petition

*11 petitions to date
Number Resource Policy Manual

NRPM is ARIN’s policy document
- Version 2012.2 (10 Feb 2012)
- 26th version

Contains
- Change Logs
- Available as PDF
- Index

http://www.arin.net/policy/nrpm.html
Policies in the NRPM

• IPv4 Address Space
• IPv6 Address Space
• Autonomous System Numbers (ASNs)
• Directory Services (Whois)
• Reverse DNS (in-addr)
• Transfers
• Experimental Assignments
• Resource Review Policy
References

Policy Development Process
http://www.arin.net/policy/pdp.html

Draft Policies and Proposals
http://www.arin.net/policy/proposals/index.html

Number Resource Policy Manual
http://www.arin.net/policy/nrpm.html
Current Policy Discussions

Jon Worley
Senior Resource Analyst
Current Draft Policies and Proposals

• 6 Active Draft Policies
  – On the list for adoption discussion; to be presented at upcoming Public Policy Meeting

• 1 Policy Proposal
  – Newer items; under development
Draft Policies

• **ARIN-2011-1: Globally Coordinated Transfer Policy**
  – Would allow transfers to/from the ARIN region
    • The two RIRs must have compatible transfer policy
    • Need required (transfers are needs-based)
  – AC recommended adoption; Board asked for one more discussion at the upcoming Public Policy Meeting, and, instructed staff to work on implementation in the meantime in order to be ready after the Vancouver meeting

• **ARIN-2011-7: Compliance Requirement**
  – Sets the consequence if ISPs do not maintain accurate customer reassignment information
    • Instructs ARIN to cease reverse DNS services after 60 days
    • After 90 days ARIN may initiate revocation
Draft Policies...

• **ARIN-2012-1: Clarifying requirements for IPv4 transfers**
  - Establishes criteria for 8.3 Specified Transfers
    • Ineligible for additional space for 12 months
    • Cannot have received space from ARIN in previous 12 months
  - Adds similar criteria to Inter-RIR transfers
  - Establishes a /24 minimum prefix size

• **ARIN-2012-2: IPv6 Subsequent Allocations Utilization Requirement**
  - Makes it easier for ISPs to request additional allocations as they increase their number of sites
Draft Policies...

- **ARIN-2012-3 ASN transfers**
  - Adds ASNs to specified transfers.

- **ARIN-2012-4 Return to 12 Month Supply and Reset Trigger to /8 in Free Pool**
  - ISPs would again be able to request a 12-month supply of address space from ARIN (vs. current 3-month supply). The policy would return to a 3-month supply when a /8’s worth of address space remains in ARIN’s free pool.
Draft Policies - Awaiting further developments

• **ARIN-2011-5: Shared Transition Space for IPv4 Address Extension**
  – Creates a shared IPv4 /10 (e.g. draft-shirasaki-nat444-03)
  – Under Board review; Board asked ARIN to work with the IETF/IAB
  – 24 Feb 2012 “The IESG will approve the draft.”
  – draft-weil-shared-transition-space-request

• **ARIN-2011-9 (Global Proposal): Global Policy for post exhaustion IPv4 allocation mechanisms by the IANA**
  – Would allow returns to IANA and IANA to issue space out to the RIRs.
  – Awaiting ICANN Board ratification.
• **ARIN-prop-165 Eliminate Needs-Based Justification on 8.3 Specified Transfers**
  - Eliminates the needs-based justification from 8.3 transfers
  - AC abandoned
    • Petition possible, or closed
How Can You Get Involved?

There are two methods to voice your opinion:

– Public Policy Mailing List

– Public Policy Meeting
  
  (in person or remote)
ARIN Meetings

• Two meetings a year
• Check the ARIN Public Policy Meeting site 4-6 weeks prior to meeting
  – Proposals/Draft Policies on Agenda
  – Discussion Guide (summaries and text)
  – Attend in Person/Remote Participation

• AC meeting last day
  – Watch list for AC’s decisions
  – Last Calls – For or against?
Public Policy Mailing List (PPML)

- Open to anyone
- Easy to subscribe to
- Contains: ideas, proposals, draft policies, last calls, announcements of adoption and implementation, and petitions
- Archives available
- RSS feed available

https://www.arin.net/participate/mailing_lists/index.html
References

- **Draft Policies & Proposals**
  - [https://www.arin.net/policy/proposals/index.html](https://www.arin.net/policy/proposals/index.html)

- **ARIN Public Policy Mailing List**
  - [https://www.arin.net/participate/mailing_lists/index.html](https://www.arin.net/participate/mailing_lists/index.html)
Q&A
DNSSEC and RPKI: Value-added Services beyond the Numbers

Tim Christensen
Quality Assurance Manager
Agenda

- DNSSEC – a brief update
- RPKI – the major focus
  - What is it?
  - What it will look like within ARIN Online?
Why are DNSSEC and RPKI important?

• Two critical resources
  – DNS
  – Routing

• Hard to tell when resource is compromised

• Focus of ARIN-region government funding
What is DNSSEC?

- DNS responses are not secure
  - Easy to spoof
  - Notable malicious attacks
- DNSSEC attaches signatures
  - Validates responses
  - Can not spoof
Changes required to make DNSSEC work

- Signing in-addr.arpa., ip6.arpa., and delegations that ARIN manages
- Provisioning of DS Records
  - ARIN Online
  - RESTful interface (deployed July 2011)
Using DNSSEC in ARIN Online

- Available on ARIN’s website
http://www.arin.net/knowledge/dnssec/

![Click To Play](image-url)
RPKI Pilot

• Available since June 2009
  – ARIN-branded version of RIPE NCC software
    http://rpki-pilot.arin.net
• >50 organizations participating
What is RPKI?

• Attaches certificates to network resources
  – AS Numbers
  – IP Addresses

• Allows ISPs to associate the two
  – Route Origin Authorizations (ROAs)
  – Follow the address allocation chain to the top
What is RPKI?

- Allows routers to validate Origins
- Start of validated routing
- Need minimal bootstrap info
  - Trust Anchors
  - Lots of focus on Trust Anchors
What does RPKI Create?

- It creates a repository
  - RFC 3779 (RPKI) Certificates
  - ROAs
  - CRLs
  - Manifest records
  - Supports “ghostbusters” records
A Repository Directory containing an RFC3779 Certificate, two ROAs, a CRL, and a manifest
Repository Use

• Pull down these files using “rcynic”
• Validate the ROAs contained in the repository
• Communicate with the router marking routes “valid”, “invalid”, “unknown”
• Up to ISP to use local policy on how to route
Possible Flow

- RPKI Web interface -> Repository
- Repository aggregator -> Validator
- Validated entries -> Route Checking
- Route checking results -> local routing decisions (based on local policy)
Resource Cert Validation

Resource Allocation Hierarchy

AFRINIC  RIPE NCC  APNIC

ICANN

ARIN

LACNIC

Issued Certificates

Route Origination Authority

“ISP4 permits AS65000 to originate a route for the prefix 192.2.200.0/24”

Attachment: <isp4-ee-cert>

Signed,
ISP4 <isp4-ee-key-priv>
Resource Cert Validation

Resource Allocation Hierarchy

AFRINIC  RIPE NCC  APNIC  ARIN  LACNIC

 Issued Certificates

Route Origination Authority

“ISP4 permits AS65000 to originate a route for the prefix 192.2.200.0/24”

Attachment: <isp4-ee-cert>

Signed, ISP4 <isp4-ee-key-priv>

1. Did the matching private key sign this text?
Route Origination Authority
“ISP4 permits AS65000 to originate a route for the prefix 192.2.200.0/24”
Attachment: <isp4-ee-cert>
Signed,
ISP4 <isp4-ee-key-priv>

2. Is this certificate valid?
Route Origination Authority
"ISP4 permits AS65000 to originate a route for the prefix 192.2.200.0/24"

Attachment: <isp4-ee-cert>

Signed,
ISP4 <isp4-ee-key-priv>

3. Is there a valid certificate path from a Trust Anchor to this certificate?
Why is RPKI taking a while?

- Intense review of liabilities by legal team and Board of Trustees created additional requirements at ARIN XXVI
- Two new big requirements
  - Non-repudiation in ROA generation for hosted CAs
  - Thwart “Evil Insider” (rogue employee) from making changes
Tight coupling between resource certificate / ROA entities and registration dataset at the database layer. Once certs/ROAs are created, they must be maintained if the registered dependents are changed.
Development before ARIN XXVI

With a few finishing touches, ready to go Jan 1, 2011 with Hosted Model, Delegated Model to follow end of Q1.

Highly influenced by RIPE NCC entities.

Everything is Java, JBoss, Hibernate.
Changes Underway Since ARIN XXVI

In-browser ROA request signing via AJAX.

Minor changes.

Database Persistence

RPKI Engine

HSM

Message driven engine which delegates to the HSM.

Custom programming on IBM 4764’s to enable all DER encoding and crypto.

HSM coding is in C as extensions to IBM CCA. Libtasn1 used for DER encoding.
Example – Creating an ROA

There are two ways to submit a Route Origination Authorization (ROA) request.

**Browser Signed ROA Request:** Allows you to enter in each required field separately and digitally sign the request with your RSA private key within the browser.

**Signed ROA Request:** Allows you to submit a digitally signed ROA request. This method requires you to construct a precisely formatted text block containing your ROA request information, and then to sign it with and RSA private key which you create. More details on the formatting requirements are provided in a link in the signed ROA tab.

**Submit Browser Signed ROA**  **Submit Signed ROA**

*Name: 
*Origin AS: 
*Validity Start Date: 04/07/2011
Enter the date in mm/dd/yyyy format.

*Validity End Date: 04/07/2015
Enter the date in mm/dd/yyyy format.

Prefix: [Add]
Max Length: 
Select Signing Private Key: [Browse] [Key Not Loaded]

This key will not be uploaded to ARIN.
There are two ways to submit a Route Origination Authorization (ROA) request.

**Browser Signed ROA Request:** Allows you to enter in each required field separately and digitally sign the request with your RSA private key within the browser.

**Signed ROA Request:** Allows you to submit a digitally signed ROA request. This method requires you to construct a precisely formatted text block containing your ROA request information, and then to sign it with an RSA private key which you create. More details on the formatting requirements are provided in a link in the signed ROA tab.

### Submit Browser Signed ROA

- **Name:**
- **Origin AS:**
- **Validity Start Date:** 04/07/2011
  - Enter the date in mm/dd/yyyy format.
- **Validity End Date:** 04/07/2015
  - Enter the date in mm/dd/yyyy format.
- **Prefix:**
  - **Max Length**
  - **Add**

Select Signing Private Key: **Key Loaded**

**Click to Remove**

This key will not be uploaded to ARIN.
There are two ways to submit a Route Origination Authorization (ROA) request.

**Browser Signed ROA Request**: Allows you to enter in each required field separately and digitally sign the request with your RSA private key within the browser.

**Signed ROA Request**: Allows you to submit a digitally signed ROA request. This method requires you to construct a precisely formatted text block containing your ROA request information, and then to sign it with your RSA private key which you create. More details on the formatting requirements are provided in a link in the signed ROA tab.

**Submit Browser Signed ROA**

- **Name**: TestROA
- **Origin AS**: AS123
- **Validity Start Date**: 04/07/2011
- **Validity End Date**: 04/07/2015
- **Prefix**: 174.128.0.0 /23

**Submit Signed ROA**

- **Select Signing Private Key**: Key Loaded

* denotes required field

This key will not be uploaded to ARIN.

SIGN AND CONTINUE
<table>
<thead>
<tr>
<th><strong>Name:</strong></th>
<th>Test ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin AS:</strong></td>
<td>123</td>
</tr>
<tr>
<td><strong>Validity Period:</strong></td>
<td>04-07-2011 - 04-07-2015</td>
</tr>
<tr>
<td><strong>Resources:</strong></td>
<td>174.128.0.0/23</td>
</tr>
<tr>
<td><strong>Signature:</strong></td>
<td>vGNHCrOlqUGfCJzRWwhJViTPXeyxhWtt79pyqa3UJISuhFbuhZVQdlhJ1uRZszmmCM33EvO16QeO/HMUw+WPw==</td>
</tr>
</tbody>
</table>
ROUTE ORIGINATION AUTHORIZATION

ROUTE ORIGINATION AUTHORIZATION REQUEST SUBMITTED

Thank you for submitting your route origination authorization request. Your request has been assigned ticket number:

ARIN-20110407-X3

You can also view the status of your request using Track Tickets.
Updates within RPKI outside of ARIN

- The four other RIRs are in production with Hosted CA services
- Major routing vendor support being tested
- Announcement of public domain routing code support
ARIN Status

• Hosted CA anticipated in 2012

• We intend to add up/down code required for delegated model after Hosted CA completed
Why is this important?

• Provides more credibility to identify resource holders
• Helps in the transfer market to identify real resource holders
• Bootstraps routing security
Q&A
The Importance of Participating in the ARIN Community

Susan Hamlin,
Director, Communications and Member Services
Learn More and Get Involved

Your participation

Important, critical, needed, appreciated...

Get Involved in ARIN

Public Policy Mailing List
ARIN Suggestion and Consultation Process
Member Elections
Public Policy and Member’s Meetings

http://www.arin.net/participate/
ARIN Mailing Lists

http://www.arin.net/participate/mailing_lists/index.html

ARIN Announce: arin-announce@arin.net

ARIN Discussion: arin-discuss@arin.net

ARIN Public Policy: arin-ppml@arin.net

ARIN Consultation: arin-consult@arin.net

ARIN Issued: arin-issued@arin.net

ARIN Technical Discussions: arin-tech-discuss@arin.net

Suggestions: arin-suggestions@arin.net
ARIN Consultation and Suggestion Process

- Open for business September 2006
- Last revision February 2012
- 19 community consultations
  - one open – RSA Version 11. Comments encouraged through 23 March,
  - http://www.arin.net/participate/acsp/acsp_consultations.html
- 154 suggestions
  - 17 remain open; 4 closing later this month
  - http://www.arin.net/participate/acsp/acsp_suggestions.html
Board of Trustees
Advisory Council
NRO Number Council

Must be a General Member on record on 1 January 2012 in order to be eligible to vote in the 2012 elections

- Call for Nominations: 6 August - 4 September
- Deadline to Establish Voter Eligibility: 9 October
- Final Candidates Announced: 11 October
- Online Elections Open:
  - NRO NC 17 - 24 October
  - Board and Advisory Council 24 October - 3 November
- Three Year Terms Begin: 1 January 2013
Next ARIN Meetings

• Discuss policies
• Enjoy social events
• Network with colleagues
• Participate remotely

Apply for the fellowship to attend an ARIN meeting for free!

www.arin.net/participate/meetings
Almost done!

- ARIN will waive the registration fee for today’s attendees for either ARIN Vancouver or Dallas
- Survey
- ARIN staff will be available until 4 PM
Q&A
**Survey**

Complete for a chance to win a $200 Amazon Gift Card!

Name: ________________________________

Organization: ________________________________

Email Address (optional, if you would like any additional information from us)

☐ check here to have your contact info shared with other ARIN on the Road attendees upon request.

1. What type of organization do you represent?
   - ☐ Internet Service Provider
   - ☐ Network Operator
   - ☐ Equipment Vendor
   - ☐ Content Provider
   - ☐ Other (please specify): __________

2. How did you hear about ARIN on the Road?
   - ☐ ARIN Announce mailing list
   - ☐ Personalized email
   - ☐ Social media
   - ☐ From colleague/friend
   - ☐ Phone call
   - ☐ Other (please specify): __________

3. Did you gain a better understanding of how the Internet governance process works?
   - ☐ Yes
   - ☐ No

Comments: ________________________________

4. What is the most valuable thing you learned at ARIN on the Road?

Comments: ________________________________

5. How would you rate your overall experience at ARIN on the Road?

   1 2 3 4 5 6 7 8 9 10

   ☐ Awful
   ☐ Terrible

Comments: ________________________________

6. Is there any additional information about/from ARIN you would like receive on a regular basis?
   - ☐ Yes
   - ☐ No

If so, what subject(s) are you interested in hearing about? ________________________________