Internet Operations
and
the RIRs
Overview

• ARIN and the Regional Internet Registry (RIR) System
• IP Number Resources, DNS and Routing
• IP Address Management
• Whois
ARIN and the RIR System
About ARIN

• One of five Regional Internet Registries

• Issues Internet number resources; facilitates consensus based policies and promotes the advancement of the Internet through education and outreach

• Services 25 Economies in the Caribbean and North America

• Nonprofit corporation based in Chantilly, VA, established December 1997

• 100% community funded
Regional Internet Registries

- ARIN
- AfriNIC
- LACNIC
- RIPE NCC
- APNIC
ARIN’s region includes Canada, many Caribbean and North Atlantic islands, and the United States.
### RIR Structure

<table>
<thead>
<tr>
<th><strong>Not-for-profit</strong></th>
<th><strong>Membership Organization</strong></th>
<th><strong>Community Regulated</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fee for services, not number resources</td>
<td>Open</td>
<td>Community developed policies</td>
</tr>
<tr>
<td>100% community funded</td>
<td>Broad-based</td>
<td>Member-elected executive board</td>
</tr>
<tr>
<td></td>
<td>- Private sector</td>
<td>Open and transparent</td>
</tr>
<tr>
<td></td>
<td>- Public sector</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Civil society</td>
<td></td>
</tr>
</tbody>
</table>
## RIR Services

<table>
<thead>
<tr>
<th>Number Resources</th>
<th>Organization</th>
<th>Policy Development</th>
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</thead>
</table>
| - IP address allocation & assignment  
  - ASN assignment  
  - Directory services  
    - Whois  
    - IRR  
  - Reverse DNS | - Elections  
  - Meetings  
  - Information dissemination  
    - Website  
    - Newsletters  
    - Roundtables  
  - Training | - Maintain e-mail discussion lists  
- Conduct public policy meetings  
- Publish policy documents |

ARIN
American Registry for Internet Numbers
On the Internet, you are nothing but an IP address!

- [www.nro.net](http://www.nro.net) - 193.0.0.131
- [www.icann.org](http://www.icann.org) - 192.0.34.163
- [www.isoc.org](http://www.isoc.org) - 206.131.253.68
- [www.ripe.net](http://www.ripe.net) - 192.0.0.214
- [www.afrinic.net](http://www.afrinic.net) - 196.216.2.1
- [www.apnic.net](http://www.apnic.net) - 202.12.29.20
- [www.arin.net](http://www.arin.net) - 192.149.252.7
- [www.lacnic.net](http://www.lacnic.net) - 200.160.2.15
- [www.isoc.org](http://www.isoc.org)
What is an IP Address?

An **Internet Protocol (IP) address** is a number that identifies a device on a computer network.

- Every device directly connected to the Internet needs a unique IP address.

- There are two types of IP addresses - IPv4 and IPv6.
Quick History of the Internet Protocol

• Internet Protocol version 4 (IPv4, or just “IP”)
  – First developed for the original Internet (ARPANET) in spring 1978
  – Deployed globally with growth of the Internet
  – Total of 4 billion IP addresses available
  – Used by every ISP and hosting company to connect customers to the Internet
  – Allocated based on documented need

• Internet Protocol version 6 (IPv6)
  – Design started in 1993 when IETF forecasts showed IPv4 depletion between 2010 and 2017
  – Completed, tested, and available for production since 1999
  – Total of 340,282,366,920,938,463,463,374,607,431,768,211,456 IP addresses available
  – Used and managed similar to IPv4
# About IPv4 and IPv6

<table>
<thead>
<tr>
<th></th>
<th>Internet Protocol version 4 (IPv4)</th>
<th>Internet Protocol version 6 (IPv6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deployed</strong></td>
<td>1981</td>
<td>1999</td>
</tr>
<tr>
<td><strong>Address Size</strong></td>
<td>32-bit number</td>
<td>128-bit number</td>
</tr>
<tr>
<td><strong>Address Format</strong></td>
<td>Dotted Decimal Notation: 192.149.252.76</td>
<td>Hexadecimal Notation: 3FFE:F200:0234:AB00:0123:4567:8901:ABC D</td>
</tr>
<tr>
<td><strong>Prefix Notation</strong></td>
<td>192.149.0.0/24</td>
<td>3FFE:F200:0234::/48</td>
</tr>
<tr>
<td><strong>Number of Addresses</strong></td>
<td>$2^{32} = \sim 4,000,000,000$</td>
<td>$2^{128} = \sim 340,000,000,000,000,000,000,000,000,000$</td>
</tr>
</tbody>
</table>
IPv4 Depletion is Imminent

- 5 RIRs together have been allocating, on average, 10-12 /8s each year

- Demand for IPv4 continues from organizations around the world

- IANA has issued eight /8s to the 5 RIRs in 2010

- There are 18 /8s remaining at the IANA as of 31 May 2010

- IANA IPv4 free pool depletion COULD happen in early 2011
What is a Domain Name?

A **domain name** is a label that a person uses in place of an IP address to locate a site on the Internet, like www.arin.net.
What is the Domain Name System (DNS)?

The **Domain Name System (DNS)** is a way to store and retrieve information about domain names and IP addresses.
IP Addresses are Not Domain Names

- **IP Address [Identifier]**
  - “Computer-friendly”
  - Unique number identifies computer on Internet
  - Used for routing (moving information across an internetwork from a source to a destination)

- **DNS Name [Reference]**
  - “People-Friendly”
  - Maps host name to unique IP address
  - A means of storing and retrieving information about hostnames and IP addresses in a distributed database
Using Domain Names

The Internet

1. My Computer asks the DNS where to find www.cemet.cn

DNS

www.cemet.cn?

2001:0C 00:8888::
My Computer
Using Domain Names

The Internet

DNS

2. The DNS provides the IPv4 or IPv6 address for the requested URL.

202.112.0.46
2001:0400::

2001:0C 00:8888::
My Computer

American Registry for Internet Numbers
Using Domain Names

The Internet

3. My Computer queries the appropriate server for the IP address provided by the DNS.

DNS

202.112.0.46
2001:0400::

2001:0C00:8888::
My Computer

2001:0400::
www.cernet.cn
What is an Autonomous System Number (ASN)?

- A globally unique number (16 or 32 bit) used by routing protocols (like BGP) to identify an autonomous system (a connected group of IP networks that adhere to a single, clearly defined routing policy)
  - 4,294,967,296 AS numbers (or $2^{32}$)
  - e.g. 36863 (16 bit), 393225 (32 bit)
What is Routing?

Routing is the act of moving information across an internetwork from a source to a destination.
Network

Instead, the computers can connect to a single router.
Point-to-Point Networking

Six computers need to communicate with each other.
Point-to-Point Networking

Each computer communicates with the other computers on its network, creating a total of 15 connections.
Point-to-Point Networking

On a larger network, individual connections become unmanageable.
Interconnected Networks

Each network can link to other networks via its router.
Interconnected Networks

Each network can link to other networks via its router.

Each segment receives IP addresses.
Administrative Grouping

Groups of devices with a single, clearly defined routing policy may be assigned an Autonomous System Number (ASN).
Registries provide Internet number resources to help divide internetworks into interconnected, autonomous groups of devices.
# Internet Address Routing

## The Internet

<table>
<thead>
<tr>
<th>Internetwork Routing Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.128/9</td>
</tr>
<tr>
<td>60.100/16</td>
</tr>
<tr>
<td>60.100.0/20</td>
</tr>
<tr>
<td>135.22/16</td>
</tr>
<tr>
<td>...</td>
</tr>
</tbody>
</table>
Internet Address Routing

1. The network announces an IP address range.

Announce 202.12.29.0/24

Internet Address Routing Table

- 4.128/9
- 60.100/16
- 60.100.0/20
- 135.22/16
- ...

The Internet

202.12.29.0/24
The Internet Address Routing

2. The range is added to a specific table within a router.

The Internet

Announce 202.12.29.0/24

Internetwork Routing Table

- 4.128/9
- 60.100/16
- 60.100.0/20
- 135.22/16
- **202.12.29.0/24**
- ...

202.12.29.0/24
3. The router can redistribute information to devices within the network.
Internet Address Routing

1. Traffic enters the network according to the routing table.

Traffic 202.12.29.142

Local Router

Routing Table

- 202.12.29.0/25
- 202.12.29.128/25

202.12.29.0/24

202.12.29.142
2. The local router directs traffic to the appropriate device according to its own routing table.
Global Internet Routing
Global Internet Routing

With a coordinated numbering system, you can build a network of networks.
Terms

• **Allocate**
  – to issue number resources to ISPs (LIRs) for internal networks and for further sub-delegation to customers

• **Assign**
  – to issue number resources to end-users for internal networks only

• **Legacy Space**
  – Numbering resources issued prior to the establishment of the RIRs
    • Issued without a contract
    • Currently maintained and updated by ARIN
    • Honeypot for criminality
### Who are the Provisioning Organizations?

<table>
<thead>
<tr>
<th>Organization</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| 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  
Assign

ISPs

End Users

Re-Allocate  
Re-Assign

ISPs  
End Users

End Users
Data Verification

- Orgs and POCs registered first
  - All new Orgs vetted and authenticated
    - Secretary of State websites
    - Westlaw
    - SEC
    - Legal documents
- Organizations making modifications vetted every 12 months
What is WHOIS?

• A general purpose registry directory service

• Serves a variety of purposes:
  – Number Registry
  – Name Registry
  – Routing Registry

• Differs in usage and content depending on registry
What’s in ARIN’s Whois?

• Registration information about
  – IP addresses and AS numbers issued by ARIN
  – IP addresses and AS numbers issued by the Central Registry (pre-RIR or legacy)
  – Organizations that hold these resources (ORGs)
  – Points of Contact (POCs) for resources or organizations
  – Reallocated/reassigned networks (from ISPs to customers)
What’s not in ARIN’s Whois?

• Information about
  – Domain names
  – Host names
  – Reassignments/reallocations by ISPs using their own Whois servers (called RWHOIS)
  – Military networks (see [http://www.nic.mil](http://www.nic.mil))

• Routing information

• Geographic location of the network
  – Addresses shown not necessarily the physical location of the resource
Whois Tips

• Data not always accurate
  – Registrant’s responsibility to update
  – Legacy space rarely updated
• Not all customer reallocations/reassignments in Whois
  – Those smaller than /29 (generally)
  – Those registered in RWHOIS server
  – Private residence info not shown
• If you need data not shown in Whois, may need subpoena
What Other Information Might ARIN Have?

- Information about an organization’s network
  - Peering or exchange points to which the network may directly connect
  - An organization’s internal utilization information
  - IP ranges utilizing specific types of services, e.g., DSL, webhosting, dial-up, etc.

- Historical Data
  - Previous Points of Contact for the network
  - Address ranges an organization may have renumbered out of and returned to ARIN
  - Previous address registrants subsequent to a transfer or merger

- More detailed reassignment information
- Financial transaction records and billing POCs
- Corporate papers and list of officers
Useful Links
RIR’s Whois

- ARIN
  http://whois.arin.net/ui/
- AfriNIC
  http://www.afrinic.net/cgi-bin/whois
- APNIC
  http://www.apnic.net/search/index.html
- LACNIC
  http://lacnic.net/cgi-bin/lacnic/whois
- RIPE NCC
  http://www.ripe.net/perl/whois
Number and Name Lookup Services

• Domain registries
  http://www.iana.org.gtld/gtld.htm
  http://www.iana.org/cctld/cctld-whois.htm

• GeekTools
  http://www.geektools.org/whois.php
Routing Information

- Route Views
  http://www.routeviews.org

- RIS
  http://www.ripe.net/projects/ris/index.html

- Looking glass information
  http://www.caida.org/analysis/routing/reversetrace/

- Blacklisting
  http://www.mxtoolbox.com/blacklists.aspx
Questions?