IP Addressing and the RIR System

Prepared & Presented By
The Number Resource Organization
Consisting of the Five RIRs
AfriNIC, APNIC, ARIN, LACNIC, RIPE NCC
Overview

• IP Addressing
  – What is an IP address?
  – How does an IP address make the Internet work?

• The RIR System
  – Where did the RIRs come from?
  – What does an RIR look like?
  – How does an RIR manage IP address space?
IP Addressing
What is an IP Address?
“On the Internet, nobody knows you’re a dog…”

by Peter Steiner, from The New Yorker, (Vol.69 (LXIX) no. 20)
“On the Internet...”
You are nothing but an IP Address!

www.google.com

216.239.39.99

66.135.208.101

209.217.36.32

199.166.24.5

www.google.com

202.12.29.20

198.41.3.45

4.17.168.6

www.google.com

On the Internet...
You are nothing but an IP Address!

www.redhat.com

202.13.223.20

www.apnic.net

www.ebay.com

202.113.200.1

www.dogs.biz

www.gnso.org

www.ebay.com

www.doggie.com

www.ietf.org

www.ietf.org

www.ietf.org

www.ietf.org

www.gnso.org
What is an Address?

• An identifier which includes information about how to find its subject
  • (according to some rules of interpretation)

• Normally hierarchical
  – Each part provides more specific detail

• For example…ways to find APNIC
  – +61 7 3858 3188
  – www.apnic.net
  – pwilson@apnic.net
  – 202.12.29.142
What is an IP Address?

• Internet identifier including information about how to reach a network location
  • (via the Internet routing system)

• IPv4: 32-bit* number. Written in Dotted Decimal Notation
  205.150.58.7
  4 billion different host addresses

• IPv6: 128-bit* number. Written in Hex Decimal Notation
  2001:0503:0C27:0000:0000:0000:0000:0000
  16 billion billion network addresses

* bit = binary digit
What else is an IP Address?

- Necessary for Internet Routing
- A finite “Common Resource”
- Never “owned” by address users
  - Are not property
  - Cannot be bought, sold, traded…
  - Provided on Non-Permanent Basis for Use
  - Returned to Provider When No Longer Required

- Not dependent upon the DNS
How does an IP address make the Internet work?
Internet Geography

- “Nations” of the Internet are networks
  - “Frontiers” are border routers
  - “Treaties” are peering relationships between networks
- It’s a very dynamic world…
  - New nations are formed daily
  - New borders are established hourly
  - Routing tables change by the minute
  - Driven almost entirely by industry
  - No centralised control
- Very different from “traditional” networks
  - Telephony for example
Telephone Network Routing

+61 7 3858 3188

Global

Prefix Table
+1
+44
+61
+886
+91
...

National

Prefix Table
2
3
7
...

Local

Prefix Table
...

Prefix Table
+61 7 3858 3188
Internet Address Routing

The Internet

Global Routing Table

<table>
<thead>
<tr>
<th>Prefix</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><strong>202.12.29.0/24</strong></td>
</tr>
</tbody>
</table>

Announce
202.12.29.0/24

Traffic
202.12.29.0/24
Internet Address Routing

Traffic
202.12.29.142

Local Router

Local Routing Table
202.12.29.0/25
202.12.29.128/25

202.12.29.0/24

202.12.29.142
Global Routing Table

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

The Internet

Global Internet Routing
IP Addresses are not Domain Names

• IP Address [Identifier]
  – “Computer-friendly”
  – Unique number identifies computer on Internet
  – Used for routing

• DNS Name [Reference]
  – “People-Friendly”
  – Maps host name to unique IP address
  – Not used for routing
IP addresses are not domain names...

The Internet

DNS

202.112.0.46
2001:0400::

www.cernet.cn ?

My Computer

2001:0C00:8888::

www.cernet.cn

2001:0400::
Definitions

• Routing
  The act of moving information across an internetwork from a source to a destination.

• Domain Name System [DNS]
  A means of storing and retrieving information about hostnames and IP addresses in a distributed data base.
The RIR System
Where did the RIRs Come From?
RIR System Evolution

- 1981: Central Registry
- 1991: ARIN (American Registry for Internet Numbers)
- 1993: APNIC
- 1996: Ripe NCC
- 1997: LACNIC
- 2001: AfriNIC
- 2002: NRO
- 2003: ICANN
- 2005:
- 2006:
RIR Service Regions

<table>
<thead>
<tr>
<th>Organization</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>AfriNIC</td>
<td>2005</td>
</tr>
<tr>
<td>APNIC</td>
<td>1993</td>
</tr>
<tr>
<td>ARIN</td>
<td>1997</td>
</tr>
<tr>
<td>LACNIC</td>
<td>2002</td>
</tr>
<tr>
<td>RIPE NCC</td>
<td>1992</td>
</tr>
<tr>
<td>AFRINIC</td>
<td>1999</td>
</tr>
<tr>
<td>ICANN</td>
<td>2003</td>
</tr>
<tr>
<td>NRO</td>
<td></td>
</tr>
</tbody>
</table>
Formed by the Regional Internet Registries to formalize their cooperative efforts, 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.
What does an RIR Look Like?
## 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></td>
<td></td>
</tr>
<tr>
<td>• 100% membership funded</td>
<td>• Open</td>
<td>• Community Developed Polices</td>
</tr>
<tr>
<td></td>
<td>• Broad-based</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Private Sector</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Public Sector</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Civil Society</td>
<td>• Member Elected Executive Board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Open and transparent processes</td>
</tr>
</tbody>
</table>
### RIR Services

<table>
<thead>
<tr>
<th>Number Resources</th>
<th>Organization</th>
<th>Policy Development Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>• IP Address Allocation Assignment</td>
<td>• Elections</td>
<td>• Maintain e-mail 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>– Web Site</td>
<td></td>
</tr>
<tr>
<td>– IRR</td>
<td>– Newsletters</td>
<td></td>
</tr>
<tr>
<td>• DNS (reverse)</td>
<td>– Round Tables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Training</td>
<td></td>
</tr>
</tbody>
</table>
How does an RIR Manage IP Address Space?
Why Manage IP Address Space?

Address Space Constraints Require Good Stewardship

• Technical Requirements
  – Defined Characteristics Create a Finite Common Resource
  – Network Topology Realities
• Prevent Capricious Consumption
• Ensure Fair Distribution to All
How Are IP Addresses Managed?

- Conserve
- Aggregate
- Unique
- Fair
- Neutral
- Consistent
- Impartial
- Administration Principles
- Consistent

Policy Objectives
Administration
## Address Management Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provision</strong></td>
<td>The act of allocating or assigning IP Address Space.</td>
</tr>
<tr>
<td><strong>Allocation</strong></td>
<td>The act of providing IP Address space to a service provider.</td>
</tr>
<tr>
<td><strong>Assignment</strong></td>
<td>The act of providing IP Address space to an enterprise.</td>
</tr>
<tr>
<td><strong>Service Provider</strong></td>
<td>Entity that provides Internet transit service to enterprises and other service providers.</td>
</tr>
<tr>
<td><strong>Enterprise</strong></td>
<td>Entity that provides Internet access to its community.</td>
</tr>
</tbody>
</table>
### Discussing IPv4

[Formerly]

<table>
<thead>
<tr>
<th>Class</th>
<th>Host Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Class C</td>
<td>256</td>
</tr>
<tr>
<td>4 Class C</td>
<td>1,024</td>
</tr>
<tr>
<td>16 Class C</td>
<td>4,096</td>
</tr>
<tr>
<td>1 Class B</td>
<td>65,536</td>
</tr>
<tr>
<td>1 Class A</td>
<td>16,777,216</td>
</tr>
</tbody>
</table>
### Discussing IPv4

[Now]

<table>
<thead>
<tr>
<th>CIDR Prefix</th>
<th>Class Equivalent</th>
<th>Host Addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>/24</td>
<td>1 Class C</td>
<td>256</td>
</tr>
<tr>
<td>/22</td>
<td>4 Class C</td>
<td>1,024</td>
</tr>
<tr>
<td>/20</td>
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</tr>
<tr>
<td>/16</td>
<td>1 Class B</td>
<td>65,536</td>
</tr>
<tr>
<td>/8</td>
<td>1 Class A</td>
<td>16,777,216</td>
</tr>
</tbody>
</table>
How Are IP Addresses Provisioned?

1. Need Address
2. Meet Criteria?
   - YES: Apply
   - NO: Go to ISP
3. Initial Application?
   - NO: Receive Resource
   - YES: Registration Service Agreement

Community Establishes Criteria Through Policy Development Process
### Who Are the IP Address Provisioning Organizations?

<table>
<thead>
<tr>
<th>ICANN</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IANA</td>
<td></td>
</tr>
<tr>
<td>• Allocate to RIRs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RIR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AFRINIC, APNIC, ARIN, LACNIC, RIPE NCC</td>
<td></td>
</tr>
<tr>
<td>• Allocate to Service Providers</td>
<td></td>
</tr>
<tr>
<td>• Assign to Enterprises</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NIR/LIR/ISP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reallocate to Service Providers</td>
<td></td>
</tr>
<tr>
<td>• Reassign to Enterprises</td>
<td></td>
</tr>
</tbody>
</table>
Policy Development Process
RIR Policy Development Process

- Need
- OPEN
- NO Accreditation • Inclusive • Accessible
- Evaluate
- Discuss
- ‘BOTTOM UP’
- TRANSSPARENT
- Implement
- Consensus
- Internet Community Proposes, Discusses, & Approves Policy
- Documented, Published & Accessible PDP, Policies, & Procedures
- Consensus

WSIS PREPCOM 3
IP Addressing and the RIR System
Geneva
The RIR PDP in the Global PDP

![Diagram showing the relationship between Regional Communities, Regional Policies, Global Policies, NRO EC, ASO, and ICANN.]

Policy-making Community ➡ Facilitators ➡
# Public Policy Meetings

<table>
<thead>
<tr>
<th>RIR</th>
<th>DATE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AfriNIC</td>
<td>12-14 December 2005</td>
<td>Cairo</td>
</tr>
<tr>
<td>APNIC</td>
<td>28 February - 3 March 2006</td>
<td>Perth</td>
</tr>
<tr>
<td>ARIN</td>
<td>26 – 28 October 2005</td>
<td>Los Angeles</td>
</tr>
<tr>
<td>LACNIC</td>
<td>22- 26 May 2006</td>
<td>TBA</td>
</tr>
<tr>
<td>RipeNCC</td>
<td>10 – 14 October 2005</td>
<td>Amsterdam</td>
</tr>
</tbody>
</table>
Links


http://www.nro.net  http://www.icann.org
Thank You
Discussion