APNIC Training

Internet Resource Management

17 November 2009 – Nadi, Fiji

Sixth PacNOG Meeting, Conference and Educational Workshop

In conjunction with PITA
Introduction

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    • Training Officer
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    • Internet Resource Analyst (Helpdesk)
    • tanya@apnic.net
Assumptions & Objectives

Assumptions

- Are current or prospective APNIC members
- Have not submitted many requests
- Are not familiar or up-to-date with address policies
- Are not familiar with procedures
- Are interested in address management

Objectives

- To provide an understanding of address management
- To provide a working knowledge of the procedures for requesting resources from APNIC and managing these
- To keep membership up-to-date with the latest policies
- Liaise with members.
Overview

• IRMe
  – **Introduction to APNIC**
    – APNIC policy development process
    – Internet registry policies
    – IP address request (Demo)
    – Second opinion request
    – IPv6 Overview
    – APNIC whois database
    – MyAPNIC (Demo)
    – Autonomous System Numbers
    – Reverse DNS
    - APNIC Helpdesk
What is APNIC?

• Regional Internet Registry (RIR) for the Asia Pacific region
  – One of five RIRs currently operating around the world
  – Non-profit, membership organisation

• Industry self-regulatory body
  – Consensus-based
  – Open
  – Transparent decision-making and policy development

• Meetings and mailing lists
  – http://meetings.apnic.net/29
  – http://www.apnic.net/community/participate/join-discussions/sigs
## What does APNIC do?

<table>
<thead>
<tr>
<th>Resource service</th>
<th>Policy development</th>
</tr>
</thead>
<tbody>
<tr>
<td>• IPv4, IPv6, ASNs</td>
<td>• Facilitating the policy development process</td>
</tr>
<tr>
<td>• Reverse DNS delegation</td>
<td>• Implementing policy changes</td>
</tr>
<tr>
<td>• Resource registration</td>
<td></td>
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<tr>
<td>• Authoritative registration server</td>
<td></td>
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<tr>
<td>• whois</td>
<td></td>
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<tr>
<td>• IRR</td>
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</table>

<table>
<thead>
<tr>
<th>Information dissemination</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>• APNIC meetings</td>
<td>• Face to Face</td>
</tr>
<tr>
<td>• Web and ftp site</td>
<td>• Via e-learning</td>
</tr>
<tr>
<td>• Publications, mailing lists</td>
<td>- Subsidised for members</td>
</tr>
<tr>
<td>• Outreach seminars</td>
<td></td>
</tr>
</tbody>
</table>

http://www.apnic.net/community/lists/

Schedule:  
http://www.apnic.net/training
Where is the APNIC region?
APNIC is NOT

• A network operator
  – Does not provide networking services
    • Works closely with APRICOT forum

• A standards body
  – Does not develop technical standards
    • Works within IETF in relevant areas (IPv6 etc)

• A domain name registry or registrar
  • Will refer queries to relevant parties
APNIC from a Global Perspective
Internet Registry Structure
APNIC IPv4 allocations by economy

Number of IPv4/8s by Economy

- CN: 13.01
- JP: 9.49
- KR: 4.42
- AU: 2.33
- TW: 1.60
- IN: 1.14
- HK: 0.50
- ID: 0.44
- VN: 0.41
- NZ: 0.37
- TH: 0.32
- SG: 0.27
- PH: 0.27
- MY: 0.27
- PK: 0.11

http://www.apnic.net/stats/o3/ as of 01/10/2009
Global policy Coordination

The main aims of the NRO:

• To protect the unallocated number resource pool
• To promote and protect the bottom-up policy development process
• To facilitate the joint coordination of activities e.g., engineering projects
• To act as a focal point for Internet community input into the RIR system
Global policy coordination

The main function of ASO:

• ASO receives global policies and policy process details from the NRO
• ASO forwards global policies and policy process details to ICANN board
Questions?
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  - APNIC Helpdesk
You are part of the APNIC Community!

- **Open** forum in the Asia Pacific
  - Open to any interested parties

- A voice in regional Internet operations through participation in APNIC
Participation in policy development

• Why should I bother?
  – Responsibility as an APNIC member
    • To be aware of the current policies for managing address space allocated to you
  – Business reasons
    • Policies affect your business operating environment and are constantly changing
    • Ensure your ‘needs’ are met
  – Educational
    • Learn and share experiences
    • Stay abreast with ‘best practices’ in the Internet
Policy Development Process

Anyone can participate

Internet community proposes and approves policy

All decisions & policies documented & freely available to anyone
The Policy Development Process

Need  Discuss  Consensus  Implement

Before meeting:
- Submit proposed policy or amendment to APNIC Secretariat
- SIG Chair posts proposal to SIG mailing list
- Community discusses proposal on SIG mailing list

At APNIC meeting:
- Face-to-face discussion in SIG sessions
  - Consensus? No
- Report of SIG decision to AMM
  - Consensus? No

After meeting:
- Final call for public comments announced on SIG mailing list
- Community discusses proposal on SIG mailing list
- SIG Chair posts outcome of SIG mailing list discussions
  - Consensus? No

Proposal endorsed by Executive Council (EC)
- Implementation

You can participate!
More information about policy development can be found at:
http://www.apnic.net/community/policy
How to Make Your Voice Heard

• Contribute on the public mailing lists
  – http://www.apnic.net/community/participate/join-discussions
  – Attend meetings
  – Or send a representative
  – Watch webcast (video streaming) from the meeting web site
  – Read live transcripts from APNIC web site
  – And express your opinion via Jabber chat

• Give feedback
  – Training or seminar events
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Allocation and Assignment

Allocation
“*A block of address space held by an IR (or downstream ISP) for subsequent allocation or assignment*”

- Not yet used to address any networks

Assignment
“*A block of address space used to address an operational network*”

- May be provided to ISP customers, or used for an ISP’s infrastructure (‘self-assignment’)

Allocation and Assignment

APNIC Allocates to APNIC Member

APNIC Member Allocates to downstream Assigns to end-user

Downstream Assigns to end-user

Customer / End User

APNIC Allocation

Member Allocation

Sub-Allocation

Customer Assignments
Portable & non-portable

Portable Assignments
- Customer addresses independent from ISP
  - Keeps addresses when changing ISP
- Bad for size of routing tables
- Bad for QoS: routes may be filtered, flap-dampened

Non-portable Assignments
- Customer uses ISP’s address space
  - Must renumber if changing ISP
- Only way to effectively scale the Internet

Portable allocations
- Allocations made by APNIC/NIRs
- Describes “portability” of the address space
Internet Resource Management Objectives

Conservation
- Efficient use of resources
- Based on demonstrated need

Aggregation
- Limit routing table growth
- Support provider-based routing

Registration
- Ensure uniqueness
- Facilitate trouble shooting

Uniqueness, fairness and consistency
Why do we Need Policies?
- Global IPv4 Delegations (in /8)

Source: Internet Number Resource Report - Number Resource Organization (NRO)
Growth of the Global Routing Table

Projected routing table growth without CIDR

Dot-Com boom

CIDR deployment

Sustainable growth?

http://bgp.potaroo.net/as1221/bgp-active.html
APNIC Policy Environment

“IP addresses not freehold property”
- Assignments & allocations on license basis
  - Addresses cannot be bought or sold
  - Internet resources are public resources
  - ‘Ownership’ is contrary to management goals

“Confidentiality & security”
- APNIC to observe and protect trust relationship
  - Non-disclosure agreement signed by staff
APNIC Allocation Policies

• Aggregation of allocation
  – Provider responsible for aggregation
  – Customer assignments /sub-allocations must be non-portable

• Allocations based on demonstrated need
  – Detailed documentation required
    • All address space held to be declared
  – Address space to be obtained from one source
    • routing considerations may apply
  – Stockpiling not permitted
Initial IPv4 Allocation

• APNIC minimum IPv4 allocation size /22
  – Two of the criteria for an initial allocation have been updated to show:
    • An ISP must have used a /24 from their upstream provider or demonstrate an immediate need for a /24
    • An ISP must demonstrate a detailed plan for use of a /23 within a year
APNIC Allocation Policies

• Transfer of address space
  – Not automatically recognised
    • Return unused address space to appropriate IR

• Effects of mergers, acquisitions & take-overs
  – Will require contact with IR (APNIC)
    • contact details may change
    • new agreement may be required
  – May require re-examination of allocations
    • requirement depends on new network structure
Address Assignment Policies

• Assignments based on requirements
  • Demonstrated through detailed documentation
  • Assignment should maximise utilisation
    – minimise wastage

• Classless assignments
  • showing use of VLSM

• Size of allocation
  – Sufficient for up to 12 months requirement
Portable assignments

• Small multihoming assignment policy
  – For (small) organisations who require a portable assignment for multi-homing purposes

Criteria
1a. Applicants currently multihomed OR
1b. Demonstrate a plan to multihome within 1 month

2. Agree to renumber out of previously assigned space

Demonstrate need to use 25% of requested space immediately and 50% within 1 year
Policy for IXP Assignments

• Criteria
  – 3 or more peers
  – Demonstrate “open peering policy”

• APNIC has a reserved block of space from which to make IXP assignments
Portable Critical Infrastructure Assignments

• What is Critical Internet Infrastructure?
  – Domain registry infrastructure
    • Root DNS operators, gTLD operators, ccTLD operators
  – Address Registry Infrastructure
    • RIRs & NIRs
    • IANA

• Why a specific policy?
  – Protect stability of core Internet function

• Assignment sizes:
  – IPv4: /24
  – IPv6: /32
Sub-allocations

- No max or min size
  - Max 1 year requirement
- Assignment Window & 2\(^{nd}\) Opinion applies
  - to both sub-allocation & assignments
    - Sub-allocation holders don’t need to send in 2\(^{nd}\) opinions
Sub-allocation Guidelines

• Sub-allocate cautiously
  – Seek APNIC advice if in doubt
  – If customer requirements meet min allocation criteria:
    • Customers should approach APNIC for portable allocation

• Efficient assignments
  – ISPs responsible for overall utilisation
    • Sub-allocation holders need to make efficient assignments

• Database registration (WHOIS Db)
  – Sub-allocations & assignments to be registered in the db
Supporting Historical Resource Transfer

- Bring historical resource registrations into the current policy framework
  - Allow transfers of historical resources to APNIC members
    - the recipient of the transfer must be an APNIC members
    - no technical review or approval
    - historical resource holder must be verified
    - resources will then be considered "current"

- Address space subject to current policy framework
Questions?
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Address Plan Example
Addressing Plan

• To complete documentation
  – First need a technical PLAN
    • Documenting the architecture of the present and eventual goal

  – IP addressing is fundamental part of network design

  – IP addressing ‘planning’ example to follow..
Some Icons

Router
(layer 3, IP datagram forwarding)

Network Access Server
(layer 3, IP datagram forwarding)

Ethernet switch
(layer 2, packet forwarding)
Addressing Plan

• Identify components of network
  – Customer services
  – ISP internal infrastructure

• Identify phases of deployment
  – Starting off, 6 months, 12 months

• Identify equipment and topology changes
  – Need for redundancy
  – Need for increased scale
Network Plan

• Starting off

15 hosts
NOC operations

5 hosts
Virtual web (name based)

10 hosts
Internal DNS, Web Mail servers

15 hosts
ISP Infrastructure

Interconnected resilience

Customer services

Dialup services
16 modems

Leased line services
5-8 customers

Upstream ISP
Network Plan

- WAN point to point /30
- 10 hosts
- 15 hosts
- 5 hosts
- 15 hosts
- 16 dialup modems
- 5-8 leased line customers
- ‘ip unnumbered’ to customers
- ‘ip unnumbered’ to upstream ISP
- One loopback interface per assigned router /32
Addressing Plan

- Initial addressing plan

- numbers of host addresses (interfaces)

| network-plan | 16 | analogue dialup modems, vendor ‘x’ |
| network-plan | 5  | LAN -web hosting (Name-based hosting) |
| network-plan | 128| 5-8 leased line customers (/28) |
| network-plan | 15 | LAN -NOC and Ops management |
| network-plan | 10 | LAN -mail,DNS, web servers internal |
| network-plan | 4  | loopback router interfaces |
| network-plan | 10 | router WAN ports (x 5 lines) |
Network Plan

- 6 months later
  - scale increased
  - redundancy

- increased number of hosts on all LANs
- added new dial up equipment
- added new router and LAN for redundancy

- upstream ISP added new router and LAN for redundancy
- increased number of leased line customers
- replaced original modem
- increased number of leased line customers
- increased number of dial up modems (2PRI)
- increased number of hosts name-based
- increased number of dialup modems (2PRI)
Addressing Plan

• Network plan at 6 months
  - increases in hosts (interfaces)

| network-plan: | 16/60 | 2 PRI dialup modems, vendor ‘y’ |
| network-plan: | 5/11  | LAN -web hosting (Name-based hosting) |
| network-plan: | 128/480 | 30 leased line customers (pool) |
| network-plan: | 15/25 | LAN -NOC and Ops management |
| network-plan: | 10/16 | LAN -mail,DNS, web servers internal |
| network-plan: | 4/6  | loopback router interfaces |
| network-plan: | 10/16 | router WAN ports (x 8 lines) |

| network-plan: | 0/60 | 2 PRI dialup modems |
| network-plan: | 0/8  | LAN-secondary servers |

Changed description

New hardware
Network Plan

12 months total
- site redundancy
- greater complexity
- efficiency

- redundancy of WAN connections
- now numbered links for BGP4
- added new customer router
- 30 → 60 leased line customers ip unnumbered
- 60 → 240 dialup modems (8PRI)
- 40 hosts
- 8 hosts
- 11 hosts
- 16 → 35 host
- 60 → 240 dialup modems (8PRI)
- two pieces of essential equipment
- 60 → 240 dialup modems (8PRI)
- 40 hosts
Addressing Plan

- Network plan at 12 months
  - increases in hosts (interfaces)
  - one year total

<table>
<thead>
<tr>
<th>Network plan</th>
<th>16/60/</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 PRI dialup modems, vendor x</td>
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<td></td>
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<tr>
<td>Network-plan:</td>
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<td>240</td>
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<tr>
<td>8 PRI dialup modems, vendor y</td>
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<td></td>
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<tr>
<td>Network-plan:</td>
<td>5/11/</td>
<td>11</td>
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<tr>
<td>LAN - web hosting (Name-based hosting)</td>
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<tr>
<td>Network-plan:</td>
<td>128/480/</td>
<td>960</td>
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<tr>
<td>60 leased line customers (pool)</td>
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<td>Network-plan:</td>
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<tr>
<td>LAN - NOC and Ops management</td>
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<td>Network-plan:</td>
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<td>LAN - mail, DNS, web servers internal</td>
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<td>Network-plan:</td>
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<tr>
<td>LAN-secondary servers</td>
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<td></td>
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<tr>
<td>Network-plan:</td>
<td>10/16/</td>
<td>16</td>
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<tr>
<td>router WAN ports (x 8 lines)</td>
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<td></td>
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<tr>
<td>Network-plan:</td>
<td>4/6</td>
<td>12</td>
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<tr>
<td>loopback router interfaces</td>
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</table>
Addressing Plan

• Can now determine subnet sizes

<table>
<thead>
<tr>
<th>Network-Plan</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>256</td>
<td>16/60/240</td>
</tr>
<tr>
<td></td>
<td>256</td>
<td>0/60/240</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>5/11/11</td>
</tr>
<tr>
<td></td>
<td>1024</td>
<td>128/480/960</td>
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<tr>
<td></td>
<td>64</td>
<td>15/25/40</td>
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<td></td>
<td>64</td>
<td>10/16/35</td>
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<tr>
<td></td>
<td>16</td>
<td>0/8/8</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>10/16/16</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>4/6/12</td>
</tr>
</tbody>
</table>

- 8 PRI dialup modems, vendor x
- 8 PRI dialup modems, vendor y
- LAN - web hosting (Name-based hosting)
- 60 leased line customers (pool)
- LAN - NOC and Ops management
- LAN - mail, DNS, web servers internal
- LAN-secondary servers
- router WAN ports (x 8 lines)
- loopback router interfaces
# Addressing Plan

- Addressing plan for network-plan
  - re-ordered **large to small** according to relative subnet size
  - determination of relative subnet addresses

<table>
<thead>
<tr>
<th>Network-Plan</th>
<th>Subnet Size</th>
<th>Description</th>
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<tr>
<td>0.0.0.0</td>
<td>1024</td>
<td>128/480/960</td>
</tr>
<tr>
<td>0.0.4.0</td>
<td>256</td>
<td>16/60/240</td>
</tr>
<tr>
<td>0.0.5.0</td>
<td>256</td>
<td>0/60/240</td>
</tr>
<tr>
<td>0.0.6.0</td>
<td>64</td>
<td>10/16/35</td>
</tr>
<tr>
<td>0.0.6.64</td>
<td>64</td>
<td>15/25/40</td>
</tr>
<tr>
<td>0.0.6.128</td>
<td>32</td>
<td>10/16/16</td>
</tr>
<tr>
<td>0.0.6.160</td>
<td>16</td>
<td>5/11/11</td>
</tr>
<tr>
<td>0.0.6.176</td>
<td>16</td>
<td>0/8/8</td>
</tr>
<tr>
<td>0.0.6.192</td>
<td>16</td>
<td>4/6/12</td>
</tr>
</tbody>
</table>

- cumulative total 0.0.6.208
Addressing Plan

Addressing plan for network-plan

- connect to the Internet (full-time, part-time)?

<table>
<thead>
<tr>
<th>Network-Plan</th>
<th>Subnet Mask</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0.0.0</td>
<td>255.255.252.0</td>
<td>YES 1024 128/480/960 60 leased customers</td>
</tr>
<tr>
<td>0.0.4.0</td>
<td>255.255.255.0</td>
<td>PART 256 16/60/240 8 PRI dial up modems..</td>
</tr>
<tr>
<td>0.0.5.0</td>
<td>255.255.255.0</td>
<td>PART 256 0/60/240 8 PRI dial up modems..</td>
</tr>
<tr>
<td>0.0.6.0</td>
<td>255.255.255.192</td>
<td>YES 64 10/16/35 LAN -mail,DNS, web internal</td>
</tr>
<tr>
<td>0.0.6.64</td>
<td>255.255.255.192</td>
<td>YES 64 15/25/40 LAN -NOC &amp; Ops mgmt</td>
</tr>
<tr>
<td>0.0.6.128</td>
<td>255.255.255.224</td>
<td>YES 32 10/16/16 Router WAN ports (x8)</td>
</tr>
<tr>
<td>0.0.6.160</td>
<td>255.255.255.240</td>
<td>YES 16 5/11/11 LAN -web hosting (Name-based)</td>
</tr>
<tr>
<td>0.0.6.176</td>
<td>255.255.255.240</td>
<td>YES 16 0/8/8 LAN -secondary servers</td>
</tr>
<tr>
<td>0.0.6.192</td>
<td>255.255.255.240</td>
<td>YES 16 4/6/12 loopback router interfaces</td>
</tr>
</tbody>
</table>
Addressing Plan

- Addressing plan complete
  - total planned for customer assignments /22
  - total planned for ISP infrastructure /24 + /23

<table>
<thead>
<tr>
<th>Network Plan</th>
<th>Address Range</th>
<th>Status</th>
<th>Count</th>
<th>Subnets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0.0.0</td>
<td>255.255.252.0</td>
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- 60 leased line customers
- 8 PRI dial up modems...
- 8 PRI dial up modems...
- LAN -mail,DNS, web internal
- LAN -NOC & Ops mgmnt
- Router WAN ports (x 8 lines
- LAN -web hosting (Name-based)
- LAN -secondary servers
- Loopback router interfaces

- detailed, efficient and accurate
Requesting IP Resources
IP Address Request

• You are required to be an APNIC member in order to initiate your IP Address Request.

• However you can apply for membership and an initial address allocation at the same time.

• http://www.apnic.net/services/become-a-member
ISP Address Request - Overview

• Contact Details
• Network Information
• Existing Customer Network Information
• Existing Infrastructure Network Information
• Future Network Plan
• Additional Information
Streamline Processes

- Applicant details
- Organisation details
- Membership and Internet number resources
  - IPv4
  - IPv6
  - ASN
- Existing network plan
- Future network plan
- Additional information

Membership only

Confirm and submit
ISP Address Request

• Hostmaster Administration
  – <hostmaster@apnic.net> mailbox filtered
    • Requires member account name
      – Subject: IP Address Request [CONNECT-AU]

• Ticketing system
  – Every request is assigned a ticket
    • Please keep # in subject line of email eg.
      – [APNIC #14122] [CHINANET-CN]

• New staff at ISP
  – Require an ‘introduction’ to APNIC
    • To ensure confidentiality
ISP Address Request Instructions

• Complete the documentation
  – ISP Address Request Form
    • Web Form:
      – http://www.apnic.net/services/become-a-member
      – Plain text
      – http://ftp.apnic.net/apnic/docs/isp-address-request

• The more detailed and precise
  – Fewer iterations with APNIC
    • Quicker resolution time

• Read the quick tips!
  http://www.apnic.net/faq/isp-request-tips.htm
ISP Request Evaluation

• ‘Infrastructure’ & ‘network-plan’
  – Policy
    • Technical descriptions are detailed enough so APNIC can understand why subnet size was chosen
    • Do customer projections match infrastructure plans?
    • Efficient subnet assignments
  – ‘Best current practice’
    • Name based virtual web hosting
    • Dynamic dial up
Virtual Web Hosting

• Name based hosting
  – ‘Strongly recommended’
    • Use ‘infrastructure’ field to describe web servers

• IP based hosting
  – Permitted on technical grounds
    – SSL, virtual ftp..
    – Use ‘infrastructure’ field to describe web servers
  – Special verification for IP based
    – If more than /22 used for this purpose
    – Requestor must send list of URLs of virtual domain and corresponding IP address
Cable, DSL Services

• Greater than 1:1 contention ratio
  – Preferred because conserves address space
    • Definition of 1:1 contention ratio
      – Can be either statically or dynamically assigned
      – Means 1 IP address per customer

• Choice of addressing is optional for members
  • dynamic addressing is encouraged

• Verification for DSL Services
  – Equipment details
    • Ex: B-RAS, Number of ports
  – Purchase receipts
Additional Information - Topology & Deployment

• POP topology
  – Diagrams showing network design
  – Diagrams showing POP design
    • does network/POP topology description correlate with addressing plan and current infrastructure?
    • larger requests will require additional documentation

• Deployment plan
  – Give details of phases of deploying equipment
    • does deployment plan match information in network-plan fields?
Additional Information - Equipment and Services

• Equipment and services
  – Specifications, number of ports
    • information that cannot fit onto fields of form
  – Details of how services will be implemented
    • explain acronyms or special services

• Miscellaneous
  – Anything not covered by the form, anything unusual also can be declared
    • Supplementary information very useful to the hostmaster when evaluating your request
Additional Information
- Renumbering & Return Policy

• Renumbering?
  – one-for-one exchange to assist renumbering
  – needs confirmation from upstream ISP to confirm renumbering will take place

• ‘Historical prefix exchange’ policy
  – swap 3 or more discontiguous prefixes for single prefix.
  – Need to contact admin@apnic.net
Evaluation by APNIC

• All address space held should be documented
  • Check other RIR, NIR databases for historical allocations

• ‘No reservations’ policy
  • Reservations may never be claimed
  • Fragments address space
  • Customers may need more or less address space than is actually reserved
First Allocation

• Must meet criteria
  • (discussed in policy section)
• Requires **clear detailed** and **accurate** request
• Implementation of ‘Best Current Practice’
• Efficient assignments planned
• Always a /22 ‘slow start’
  • Exceptions made for very large networks but not common
Subsequent Allocations

• 80% overall utilisation
  • Unless large assignment pending

• Demonstrated conservative assignments

• Correct customer registrations in db
  • Need to fix inconsistencies before next allocation

• Allocation size to cover 1 year need
  • Based on previous utilisation rate

• Contiguous allocation not guaranteed
  • But every effort made
Questions?
Overview

• IRMe
  – Introduction to APNIC
  – APNIC policy development process
  – Internet registry policies
  – IP address request (Demo)

  – **Second opinion request**
    – IPv6 Overview
    – APNIC whois database
    – MyAPNIC (Demo)
    – Autonomous System Numbers
    – Reverse DNS
    - APNIC Helpdesk
What is an Assignment Window?

“The amount of address space a member may assign without a ‘second opinion’”

- All members have an AW
  - Starts at zero, increases as member gains experience in address management

- Second opinion process
  - Customer assignments require a ‘second-opinion’ when proposed assignment size is larger than members AW
Assignment Window

• Size of assignment window
  – Evaluated after about three 2nd-opinion requests
  – Increased as member gains experience and demonstrates understanding of policies
    • Assignment window may be reduced, in rare cases

• Why an assignment window?
  – Monitoring ongoing progress and adherence to policies
  – Mechanism for member education
Overview of 2\textsuperscript{nd} Opinion Form

- Applicant information: Contact details, password
- Type of request: IPv6 / IPv4, Assignment / Sub-allocation
- Network name: Network name, description, country
- Future network plan: Planned IP usage

**IPv4 Sub-allocations**
- IPs held by customer & customer’s customers

**IPv4/IPv6 Assignments**
- IPs held by customer

**Customer assignments to end-sites**

**Sub-allocation infrastructure**

**Additional information**

**Confirm details**

Any additional info that may aid the evaluation

Check your details
2\textsuperscript{nd} Opinion Evaluation (policy)

- **Efficiency**
  - More than 50% used in any one subnet?
  - Can different subnet sizes be used?
  - More than 80% used for previous assignment?

- **Stockpiling**
  - Is all address space held declared on form?
  - Has organisation obtained address space from more than one member/ISP?

- **Registration**
  - Is previous assignment in APNIC database and are they correct and up to date?
2\textsuperscript{nd} Opinion Evaluation

• APNIC & Member evaluation
  – Should be the same

  • If NO, APNIC will ask member to obtain more information
    – iterative process

  • If YES, APNIC approves 2nd opinion request
Dear XXXXXXX,

APNIC has approved your "second opinion" request to make the following assignment:

[netname]

[address/prefix]

* Please ensure that you update the APNIC whois database to register this assignment before informing your customer or requesting reverse DNS delegation. Do this using the form at:

http://www.apnic.net/apnic-bin/inetnum.pl

Important:

Unregistered assignments are considered as "unused"
Customer Assignment

• Member updates internal records
  – Select address range to be assigned
  – Archive original documents sent to APNIC
  – Update APNIC database

• Clarify status of address space
  – APNIC requirement is ‘Non portable’
  – ‘Portable’ assignments are made by APNIC only with the end-user request form
    • Organisation must have technical requirement
Questions?
Overview

• IRMe
  – Introduction to APNIC
  – APNIC policy development process
  – Internet registry policies
  – IP address request (Demo)
  – Second opinion request

– IPv6 Overview
  – APNIC Whois database
  – MyAPNIC (Demo)
  – Autonomous System Numbers
  – Reverse DNS
- APNIC Helpdesk
Rationale

- Address depletion concerns
  - Squeeze on available addresses space
    - Probably will never run out, but will be harder to obtain
  - End to end connectivity no longer visible
    - Widespread use of NAT

IPv6 provides much larger IP address space than IPv4
Main IPv6 Benefits

• Expanded addressing capabilities
• Server-less autoconfiguration ("plug-n-play") and reconfiguration
• More efficient and robust mobility mechanisms
• Built-in, strong IP-layer encryption and authentication
• Streamlined header format and flow identification
• Improved support for options / extensions
IPv6 Addressing

- 128 bits of address space
- Hexadecimal values of eight 16 bit fields
  - 16 bit number is converted to a 4 digit hexadecimal number
- Example:
  - FE38:DCE3:124C:C1A2:BA03:6735:EF1C:683D
    - Abbreviated form of address
      - 4EED:0023:0000:0000:0000:036E:1250:2B00
        → 4EED:23:0:0:0:36E:1250:2B00
        → 4EED:23::36E:1250:2B00
    (Null value can be used only once)
IPv6 Addressing Model

- IPv6 Address type
  - Unicast
    • An identifier for a single interface
  - Anycast
    • An identifier for a set of interfaces
  - Multicast
    • An identifier for a group of nodes
IPv6 Policies and Procedures
IPv6 Address Management Hierarchy
IPv6 Address Policy Goals

• Efficient address usage
  – Avoid wasteful practices

• Aggregation
  – Hierarchical distribution
  – Aggregation of routing information
  – Limiting number of routing entries advertised

• Minimise overhead
  – Associated with obtaining address space

• Registration, Uniqueness, Fairness & consistency
IPv6 Initial Allocation

To qualify for an initial allocation of IPv6 address space, an organization must:

1. Not be an end site (must provide downstream services)
2. Plan to provide IPv6 connectivity to organizations to which it will make assignments, by advertising that connectivity through its single aggregated address allocation
3. Meet one of the two following criteria:
   - Have a plan for making at least 200 assignments to other organizations within two years OR
   - Be an existing ISP with IPv4 allocations from an APNIC or an NIR, which will make IPv6 assignments or sub-allocations to other organizations and announce the allocation in the inter-domain routing system within two years
IPv6 Initial Allocation

- Private networks (those not connected to the public Internet) may also be eligible for an IPv6 address space allocation provided they meet equivalent criteria to those listed above.

- Initial allocation size is /32
  - Default allocation ("slow start")
IPv6 Initial Allocation

• Initial allocations larger than /32 may be justified if:
  – 1. The organization provides comprehensive documentation of planned IPv6 infrastructure which would require a larger allocation; or
  – 2. The organization provides comprehensive documentation of all of the following:
    • its existing IPv4 infrastructure and customer base,
    • its intention to provide its existing IPv4 services via IPv6, and
    • its intention to move some of its existing IPv4 customers to IPv6 within two years.
End Site Assignment Policy for IPv6

• Any size longer than /48
  – Decision is up to ISPs or ISPs
    • Implication: any size between /64 - /48
  – Global coordination is required
  – Assuming the HD ratio changes to a larger value
    • HD ratio measurement unit: /48 => /56
      – Implication: Register all assignments shorter than /56?
    • HD ratio: 0.8 => 0.94
Subsequent Allocation

• Must meet $HD = 0.94$ utilisation requirement of previous allocation (subject to change)
• Other criteria to be met
  – Correct registrations (all /48s registered)
  – Correct assignment practices etc
• Subsequent allocation results in a doubling of the address space allocated to it
  – Resulting in total IPv6 prefix is 1 bit shorter
  – Or sufficient for 2 years requirement
IPv6 Utilisation

• Utilisation determined from end site assignments
  – ISP responsible for registration of all /48 assignments
  – Intermediate allocation hierarchy not considered

• Utilisation of IPv6 address space is measured differently from IPv4
  – Use HD ratio to measure

• Subsequent allocation may be requested when IPv6 utilisation requirement is met
### IPv6 Assignment and Utilisation Requirement

- IPv6 assignment and utilisation requirement policy
  - HD ratio: 0.94
  - Measurement unit: /56

- The HD ratio threshold is
  - \( \text{HD} = \frac{\log(\text{/56 units assigned})}{\log(16,777,216)} \)
  - \( 0.94 = 6,183,533 \times /56 \) units

- Calculation of the HD ratio
  - Convert the assignment size into equivalent /56 units
    - Each /48 end site = 256 x /56 units
    - Each /52 end site = 16 x /56 units
    - Each /56 end site = 1 x /56 units
    - Each /60 end site = 1/16 x /56 units
    - Each /64 end site = 1/256 x /56 units
IPv6 Utilisation (HD = 0.94)

- Percentage utilisation calculation

<table>
<thead>
<tr>
<th>IPv6 Prefix</th>
<th>Site Address Bits</th>
<th>Total site address in /56s</th>
<th>Threshold (HD ratio 0.94)</th>
<th>Utilisation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>/42</td>
<td>14</td>
<td>16,384</td>
<td>9,153</td>
<td>55.9%</td>
</tr>
<tr>
<td>/36</td>
<td>20</td>
<td>1,048,576</td>
<td>456,419</td>
<td>43.5%</td>
</tr>
<tr>
<td>/35</td>
<td>21</td>
<td>2,097,152</td>
<td>875,653</td>
<td>41.8%</td>
</tr>
<tr>
<td>/32</td>
<td>24</td>
<td>16,777,216</td>
<td>6,185,533</td>
<td>36.9%</td>
</tr>
<tr>
<td>/29</td>
<td>27</td>
<td>134,217,728</td>
<td>43,665,787</td>
<td>32.5%</td>
</tr>
<tr>
<td>/24</td>
<td>32</td>
<td>4,294,967,296</td>
<td>1,134,964,479</td>
<td>26.4%</td>
</tr>
<tr>
<td>/16</td>
<td>40</td>
<td>1,099,511,627,776</td>
<td>208,318,498,661</td>
<td>18.9%</td>
</tr>
</tbody>
</table>

RFC 3194

“In a hierarchical address plan, as the size of the allocation increases, the density of assignments will decrease.”
IXP IPv6 Assignment Policy

• Criteria
  – Demonstrate ‘open peering policy’
  – 3 or more peers

• Portable assignment size: /48
  – All other needs should be met through normal processes
  – /64 holders can “upgrade” to /48
    • Through NIRs/ APNIC
    • Need to return /64
IPv6 Portable Assignment for Multi-homing

• The current policy allows for IPv6 portable assignment to end-sites
  – Size: /48, or a shorter prefix if the end site can justify it
  – To be multihomed within 3 months
  – Assignment from a specified block separately from portable allocations address space
How do I Apply for IPv6 Addresses?

1. Check your eligibility for IPv6 addresses
2. Read IPv6 policies
   http://www.apnic.net/policy/ipv6-address-policy
3. Read IPv6 guideline
4. Do you have an APNIC account?
   If not, become an APNIC member or open a non-member account
5. Complete an IPv6 address request form
6. Submit the form hostmaster@apnic.net

Questions:
email: helpdesk@apnic.net
Helpdesk chat: http://www.apnic.net/helpdesk
APNIC IPv6 Delegation by Economy

IPv6 Number of IPv6/32s

No of delegations (/35, /32)

http://www.apnic.net/stats/o3/ as of 26/03/2009
Questions?
Overview

• IRMe
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  – APNIC policy development process
  – Internet registry policies
  – IP address request (Demo)
  – Second opinion request
  – IPv6 Overview

  – APNIC whois database
    – MyAPNIC (Demo)
    – Autonomous System Numbers
    – Reverse DNS
  - APNIC Helpdesk
What is the APNIC Database?

• Public network management database
  – Operated by IRs
    • Public data only
    • For private data: Please see “Privacy of customer assignment” module

• Tracks network resources
  – IP addresses, ASNs, Reverse Domains, Routing policies

• Records administrative information
  – Contact information (persons/roles)
  – Authorisation
Whois Database Query - Clients

• Standard whois client
  • Included with many Unix distributions
  – RIPE extended whois client
    • http://ftp.apnic.net/apnic/dbase/tools/ripe-dbase-client.tar.gz

• Query via the APNIC website
  • http://www.apnic.net/apnic-bin/whois2.pl

• Query clients - MS-Windows etc
  – Many available
## Object Types

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>person</td>
<td>contact persons</td>
</tr>
<tr>
<td>role</td>
<td>contact groups/roles</td>
</tr>
<tr>
<td>inetnum</td>
<td>IPv4 addresses</td>
</tr>
<tr>
<td>inet6num</td>
<td>IPv6 addresses</td>
</tr>
<tr>
<td>aut-num</td>
<td>Autonomous System number</td>
</tr>
<tr>
<td>domain</td>
<td>reverse domains</td>
</tr>
<tr>
<td>route</td>
<td>prefixes being announced</td>
</tr>
<tr>
<td>mntner</td>
<td>(maintainer) data protection</td>
</tr>
</tbody>
</table>

[http://www.apnic.net/db/](http://www.apnic.net/db/)
Inter-related Objects

IPv4 addresses

inetnum:
202.64.10.0 – 202.64.10.255
... 
admin-c: KX17-AP 
technical-c: ZU3-AP 
... 
mnt-by: MAINT-WF-EX 
...

Contact info

person:
... 
nic-hdl: KX17-AP 
...

Contact info

person:
... 
nic-hdl: ZU3-AP 
...

Data protection

mntner:
MAINT-WF-EX 
... 
...
# Database Query – Look-up Keys

<table>
<thead>
<tr>
<th>OBJECT TYPE</th>
<th>ATTRIBUTES – LOOK-UP KEYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>person</td>
<td>name, nic-hdl, e-mail</td>
</tr>
<tr>
<td>role</td>
<td>name, nic-hdl, e-mail</td>
</tr>
<tr>
<td>mntner</td>
<td>maintainer name</td>
</tr>
<tr>
<td>inetnum</td>
<td>network number, name</td>
</tr>
<tr>
<td>domain</td>
<td>domain name</td>
</tr>
<tr>
<td>aut-num</td>
<td>as number</td>
</tr>
<tr>
<td>as-macro</td>
<td>as-macro name</td>
</tr>
<tr>
<td>route</td>
<td>route value</td>
</tr>
<tr>
<td>inet6num</td>
<td>network number, name</td>
</tr>
</tbody>
</table>

* Whois supports queries on any of these objects/keys
# Object Templates

To obtain template structure*, use:

```
whois -t <object type>
```

```
% whois -h whois.apnic.net -t person

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>person</td>
<td>[mandatory]</td>
<td>[single]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[primary/look-up key]</td>
</tr>
<tr>
<td>address</td>
<td>[mandatory]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>country</td>
<td>[mandatory]</td>
<td>[single]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>phone</td>
<td>[mandatory]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>fax-no</td>
<td>[optional]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>e-mail</td>
<td>[mandatory]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[look-up key]</td>
</tr>
<tr>
<td>nic-hdl</td>
<td>[mandatory]</td>
<td>[single]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[primary/look-up key]</td>
</tr>
<tr>
<td>remarks</td>
<td>[optional]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>notify</td>
<td>[optional]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[inverse key]</td>
</tr>
<tr>
<td>mnt-by</td>
<td>[mandatory]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[inverse key]</td>
</tr>
<tr>
<td>changed</td>
<td>[mandatory]</td>
<td>[multiple]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
<tr>
<td>source</td>
<td>[mandatory]</td>
<td>[single]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[ ]</td>
</tr>
</tbody>
</table>
```

*Recognised by the RIPE whois client/server
Person Object Example

– Person objects contain contact information

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>person:</td>
<td>Ky Xander</td>
</tr>
<tr>
<td>address:</td>
<td>ExampleNet Service Provider</td>
</tr>
<tr>
<td>address:</td>
<td>2 Pandora St Boxville</td>
</tr>
<tr>
<td>address:</td>
<td>Wallis and Futuna Islands</td>
</tr>
<tr>
<td>country:</td>
<td>WF</td>
</tr>
<tr>
<td>phone:</td>
<td>+680-368-0844</td>
</tr>
<tr>
<td>fax-no:</td>
<td>+680-367-1797</td>
</tr>
<tr>
<td>e-mail:</td>
<td><a href="mailto:kxander@example.com">kxander@example.com</a></td>
</tr>
<tr>
<td>nic-hdl:</td>
<td>KX17-AP</td>
</tr>
<tr>
<td>mnt-by:</td>
<td>MAINT-WF-EX</td>
</tr>
<tr>
<td>changed:</td>
<td><a href="mailto:kxander@example.com">kxander@example.com</a> 20020731</td>
</tr>
<tr>
<td>source:</td>
<td>APNIC</td>
</tr>
</tbody>
</table>
What is a nic-hdl?

• Unique identifier for a person
• Represents a person object
  – Referenced in objects for contact details
    • (inetnum, aut-num, domain…)
  – format: <XXXX-AP>
• Eg: KX17-AP

person: Ky Xander
address: ExampleNet Service Provider
address: 2 Pandora St Boxville
address: Wallis and Futuna Islands
country: WF
phone: +680-368-0844
fax-no: +680-367-1797
e-mail: kxander@example.com

nic-hdl: KX17-AP
mnt-by: MAINT-WF-EX
changed: kxander@example.com 20020731
source: APNIC
Creating a Person Object

Creating objects in Whois:

http://www.apnic.net/apnic-info/whois_search2/using-whois/updating-whois/Creating-objects

1. Fill out person object form on web
   - Name, e-mail, phone, address etc
   - Tick ‘MNT-NEW’ for temporary protection

2. Completed template is sent to you

3. Forward template to <auto-dbm@apnic.net>

4. Person object created and nic-hdl is generated
**Inetnum Object Example**

– Contain IP address allocations / assignments

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>inetnum:</td>
<td>202.51.64.0 - 202.51.95.255</td>
</tr>
<tr>
<td>netname:</td>
<td>CCNEP-NP-AP</td>
</tr>
<tr>
<td>descr:</td>
<td>Communication &amp; Communicate Nepal Ltd</td>
</tr>
<tr>
<td>descr:</td>
<td>VSAT Service Provider, Kathmandu</td>
</tr>
<tr>
<td>country:</td>
<td>NP</td>
</tr>
<tr>
<td>admin-c:</td>
<td>AS75-AP</td>
</tr>
<tr>
<td>tech-c:</td>
<td>AS75-AP</td>
</tr>
<tr>
<td>mnt-by:</td>
<td>APNIC-HM</td>
</tr>
<tr>
<td>mnt-lower:</td>
<td>MAINT-NP-ARUN</td>
</tr>
<tr>
<td>changed:</td>
<td><a href="mailto:hostmaster@apnic.net">hostmaster@apnic.net</a> 20010205</td>
</tr>
<tr>
<td>status:</td>
<td>ALLOCATED PORTABLE</td>
</tr>
<tr>
<td>source:</td>
<td>APNIC</td>
</tr>
</tbody>
</table>
Whois Database Query - UNIX

% whois zulrich@example.com
% whois zu3-ap
% whois “zane ulrich”

person:      Zane Ulrich
address:     ExampleNet Service Provider
address:     2 Pandora St Boxville
address:     Wallis and Futuna Islands
country:     WF
phone:       +680-368-0844
fax-no:      +680-367-1797
e-mail:      zulrich@example.com
nic-hdl:     ZU3-AP
mnt-by:      MAINT-WF-EX
changed:     zulrich@example.com 20020731
source:      APNIC
APNIC Whois Web Query
APNIC Whois web query

To assist you with debugging problems, this whois query was received from IP Address [203.119.42.131]
Your web client may be behind a web proxy.

Search for
IP address lookups
- 1st level less specific
- All less specific
- 1st level more specific
- All more specific
- Exact match only
- Associated reverse domain

Miscellaneous queries
- Inverse attributes
- Object types

Query hints
- Include "AS" in front of an AS number. Example: AS4808
- Include "-t" (template only) or "-v" (template and description) in front of an object name to view the template
  Example: -t inetnum

For more information see:
ISP Registration Responsibilities

1. Create person objects for contacts
   • To provide contact info in other objects

1. Create mntner object
   • To provide protection of objects (To be discussed later)

1. Create inetnum objects for all customer address assignments as private data
   • But you may change these to be public data if you wish
   • Allocation object created by APNIC
Using the db – Step by Step

1. Allocation (Created by APNIC)
   - person:
     - nic-hdl: KX17-AP
   - Contact info

2. Data Protection
   - mntner:

3. inetnum:
   - ...
   - KX17-AP
   - mnt-by:

4. Customer Assignments (Created by ISP)
   - inetnum:
     - ...
     - mnt-by:

5. inetnum:
   - ...
   - KX17-AP
   - mnt-by:

6. inetnum:
   - ...
   - KX17-AP
   - mnt-by:
Role Object - Example

- Contains contact info for several contacts

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>role:</td>
<td>Xnet IP ADMINISTRATORS</td>
</tr>
<tr>
<td>address:</td>
<td>2000 Miller Road North Sydney</td>
</tr>
<tr>
<td>country:</td>
<td>AU</td>
</tr>
<tr>
<td>phone:</td>
<td>+61-2-93420000</td>
</tr>
<tr>
<td>fax-no:</td>
<td>+61-2-9342-0900</td>
</tr>
<tr>
<td>fax-no:</td>
<td>+61-2-9342-6100</td>
</tr>
<tr>
<td>e-mail:</td>
<td><a href="mailto:noc@xnet.net.au">noc@xnet.net.au</a></td>
</tr>
<tr>
<td>admin-c:</td>
<td>XNC2-AP</td>
</tr>
<tr>
<td>tech-c:</td>
<td>XNC2-AP</td>
</tr>
<tr>
<td>tech-c:</td>
<td>XNB120-AP</td>
</tr>
<tr>
<td>nic-hdl:</td>
<td>XND1-AP</td>
</tr>
<tr>
<td>mnt-by:</td>
<td>MAINT-XNET-AP</td>
</tr>
<tr>
<td>source:</td>
<td>APNIC</td>
</tr>
</tbody>
</table>
Role Object

- Represents a *group* of contact persons for an organisation
  - Eases administration
  - Can be referenced in other objects instead of the person objects for individuals

- Also has a nic-hdl
  - Eg. HM20-AP

http://www.apnic.net/db/role.html
Replacing Contacts in the db  
- using person objects

K. Xander is leaving my organisation. Z. Ulrich is replacing him.

1. Create a person object for new contact (Z. Ulrich).

2. Find all objects containing old contact (K. Xander).

3. Update all objects, replacing old contact (KX17-AP) with new contact (ZU3-AP).

4. Delete old contact’s (KX17-AP) person object.
Replacing Contacts in the db – using a role object

K. Xander is leaving my organisation. Z. Ulrich is replacing him.

I am using a role object containing all contact persons, which is referenced in all my objects.

1. Create a person object for new contact (Z. Ulrich).

2. Replace old contact (KX17-AP) with new contact (ZU3-AP) in role object

3. Delete old contact’s person object.

No need to update any other objects!
Database Protection
- Maintainer Object

mntner: MAINT-WF-EX
descr: Maintainer for ExampleNet Service Provider
country: WF
admin-c: ZU3-AP
tech-c: KX17-AP
upd-to: kxander@example.com
mnt-nfy: kxander@example.com
auth: CRYPT-PW apHJ9zF3o
mnt-by: MAINT-WF-EX
referral-by: MAINT-APNIC-AP
changed: kxander@example.com 20020731
source: APNIC

• protects other objects in the APNIC database
Creating a Maintainer Object

1. Fill out webform
   - Provide:
     • Admin-c & tech-c
     • password
     • email address etc

1. Completed form will be sent to you
2. Forward request to maint-request@apnic.net
3. Maintainer will be created *manually*
   • Manual verification by APNIC Hostmasters

1. Update your person object with mntner

http://www.apnic.net/services/whois_guide.html
Database Protection

• Authorisation
  – “mnt-by” references a mntner object
    • Can be found in all database objects
    • “mnt-by” should be used with every object!

• Authentication
  – Updates to an object must pass the authentication rule specified by its maintainer object
## Authorisation Mechanism

<table>
<thead>
<tr>
<th>Key</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>inetnum:</td>
<td>202.137.181.0 – 202.137.185.255</td>
</tr>
<tr>
<td>netname:</td>
<td>EXAMPLENET-WF</td>
</tr>
<tr>
<td>descr:</td>
<td>ExampleNet Service Provider</td>
</tr>
<tr>
<td>mnt-by:</td>
<td>MAINT-WF-EX</td>
</tr>
</tbody>
</table>

**mntner: MAINT-WF-EX**

<table>
<thead>
<tr>
<th>Key</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>descr:</td>
<td>Maintainer for ExampleNet Service Provider</td>
</tr>
<tr>
<td>country:</td>
<td>WF</td>
</tr>
<tr>
<td>admin-c:</td>
<td>ZU3-AP</td>
</tr>
<tr>
<td>tech-c:</td>
<td>KX17-AP</td>
</tr>
<tr>
<td>upd-to:</td>
<td><a href="mailto:kxander@example.com">kxander@example.com</a></td>
</tr>
<tr>
<td>mnt-nfy:</td>
<td><a href="mailto:kxander@example.com">kxander@example.com</a></td>
</tr>
<tr>
<td>auth:</td>
<td>CRYPT-PW apHJ9zF3o</td>
</tr>
<tr>
<td>mnt-by:</td>
<td>MAINT-WF-EX</td>
</tr>
<tr>
<td>changed:</td>
<td><a href="mailto:kxander@example.com">kxander@example.com</a> 20020731</td>
</tr>
<tr>
<td>source:</td>
<td>APNIC</td>
</tr>
</tbody>
</table>
Authentication Methods

• ‘auth’ attribute
  – Crypt-PW
    • Crypt (Unix) password encryption
    • Use web page to create your maintainer
  – PGP – GNUPG
    • Strong authentication
    • Requires PGP keys
  – MD5
    • Available
Mnt-by & Mnt-lower

- ‘mnt-by’ attribute
  - Can be used to protect any object
  - Changes to protected object must satisfy authentication rules of ‘mntner’ object.

- ‘mnt-lower’ attribute
  - Also references mntner object
  - Hierarchical authorisation for inetnum & domain objects
  - The creation of child objects must satisfy this mntner
  - Protects against unauthorised updates to an allocated range - highly recommended!
## Authentication / Authorisation
- APNIC allocation to member

- Created and maintained by APNIC

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inetnum:</td>
<td>203.146.96.0 - 203.146.127.255</td>
</tr>
<tr>
<td>netname:</td>
<td>LOXINFO-TH</td>
</tr>
<tr>
<td>descr:</td>
<td>Loxley Information Company Ltd.</td>
</tr>
<tr>
<td>Descr:</td>
<td>304 Suapah Rd, Promprab, Bangkok</td>
</tr>
<tr>
<td>country:</td>
<td>TH</td>
</tr>
<tr>
<td>admin-c:</td>
<td>KS32-AP</td>
</tr>
<tr>
<td>tech-c:</td>
<td>CT2-AP</td>
</tr>
<tr>
<td>mnt-by:</td>
<td>APNIC-HM</td>
</tr>
<tr>
<td>mnt-lower:</td>
<td>LOXINFO-IS</td>
</tr>
<tr>
<td>changed:</td>
<td><a href="mailto:hostmaster@apnic.net">hostmaster@apnic.net</a> 19990714</td>
</tr>
<tr>
<td>source:</td>
<td>APNIC</td>
</tr>
</tbody>
</table>

1. Only APNIC can change this object
2. Only LOXINFO-TH can create assignments within this allocation
Authentication / Authorisation

- Member assignment to customer
  - Created and maintained by APNIC member

<table>
<thead>
<tr>
<th>Inetnum</th>
<th>203.146.113.64 - 203.146.113.127</th>
</tr>
</thead>
<tbody>
<tr>
<td>netname</td>
<td>SCC-TH</td>
</tr>
<tr>
<td>descr</td>
<td>Sukhothai Commercial College</td>
</tr>
<tr>
<td>Country</td>
<td>TH</td>
</tr>
<tr>
<td>admin-c</td>
<td>SI10-AP</td>
</tr>
<tr>
<td>tech-c</td>
<td>VP5-AP</td>
</tr>
<tr>
<td>mnt-by</td>
<td>LOXINFO-IS</td>
</tr>
<tr>
<td>changed</td>
<td><a href="mailto:voraluck@loxinfo.co.th">voraluck@loxinfo.co.th</a> 19990930</td>
</tr>
<tr>
<td>source</td>
<td>APNIC</td>
</tr>
</tbody>
</table>

Only LOXINFO-IS can change this object
Privacy of Customer Assignments
Customer Privacy

• Privacy issues
  – Concerns about publication of customer information
  – Increasing government concern

• APNIC legal risk
  – Legal responsibility for accuracy and advice
  – Damages incurred by maintaining inaccurate personal data

• Customer data is hard to maintain
  – APNIC has no direct control over accuracy of data

• Customer assignment registration is still mandatory
What Needs to be Visible?

IANA range

Non-APNIC range

APNIC range

APNIC allocations & assignments

NIR range

NIR allocations & assignments

PORTABLE addresses

ISP

Customer assignments

Infrastructure

Sub-allocations

NON-PORTABLE addresses

must be visible

visibility optional
Questions?
Overview

• IRMe
  – Introduction to APNIC
  – APNIC policy development process
  – Internet registry policies
  – IP address request (Demo)
  – Second opinion request
  – IPv6 Overview
  – APNIC whois database

– **MyAPNIC (Demo)**
  – Autonomous System Numbers
  – Reverse DNS
- APNIC Helpdesk
MyAPNIC

A day-to-day tool to manage your APNIC account and resources
How it Works

APNIC internal system
- Finance system
- Membership & resource system
- Whois master

APNIC public servers
- MyAPNIC server

Firewall

Server

Member ID Person Authority

https://my.apnic.net

Member’s staff

Client
The new MyAPNIC

- Updated look and feel
- Streamlined navigation
- Log in with username and password
- Improved user management
- Resource Certificates
- Low-bandwidth format making it easier to access from anywhere
MyAPNIC Functions

• Resource information
  – IPv4, IPv6, ASN

• Administration
  – Membership detail
  – Contact persons
  – Billing history

• Training
  – Training history
  – Training registration

• Tools
  – Looking glass
Accessing MyAPNIC

- Username and password required for authentication
- Corporate contact requires digital certificate
- Corporate contact can approve new users
- New users do not require digital certificate
MyAPNIC registration

Registration

Your details

Username: vivek
Password (at least 8 characters): 
Confirm password: 
Full name: Vivek Nigam
Email address: vivek@apnic.net
Member account name: APNIC-AP

Register
MyAPNIC Registration

Registration

Your registration

Success

You have successfully registered for MYAPNIC-TEST-AP.

Your token number is WeVOQjLLH1

Please provide your security code to one of your corporate contact(s) below for approval to access MyAPNIC:

- Tom H
- George K

You will receive an email confirming your registration.

Your corporate contact(s) will receive an email informing them of your request for approval to access MyAPNIC.

Login
## Registrations

### Pending registration requests

<table>
<thead>
<tr>
<th>Date (UTC)</th>
<th>Username</th>
<th>Email address</th>
<th>Token</th>
<th>Approve registration</th>
<th>Reject registration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-07-17 06:10:31</td>
<td>test001</td>
<td><a href="mailto:vivek@apnic.net">vivek@apnic.net</a></td>
<td>![Token]</td>
<td>Approve</td>
<td>Reject</td>
</tr>
<tr>
<td>2005-07-03 07:32:26</td>
<td>witastagain</td>
<td><a href="mailto:witalaksono@yahoo.com">witalaksono@yahoo.com</a></td>
<td>![Token]</td>
<td>Approve</td>
<td>Reject</td>
</tr>
<tr>
<td>2005-05-17 04:51:15</td>
<td>dummy123</td>
<td><a href="mailto:vivek@apnic.net">vivek@apnic.net</a></td>
<td>![Token]</td>
<td>Approve</td>
<td>Reject</td>
</tr>
<tr>
<td>2005-06-09 01:45:58</td>
<td>testinguser</td>
<td><a href="mailto:hcbtest01@gmail.com">hcbtest01@gmail.com</a></td>
<td>![Token]</td>
<td>Approve</td>
<td>Reject</td>
</tr>
<tr>
<td>2005-05-21 07:54:21</td>
<td>vivek12345678</td>
<td><a href="mailto:vniogam@hotmail.com">vniogam@hotmail.com</a></td>
<td>![Token]</td>
<td>Approve</td>
<td>Reject</td>
</tr>
<tr>
<td>2005-05-21 02:53:48</td>
<td>Vivtesting</td>
<td><a href="mailto:vniogam@hotmail.com">vniogam@hotmail.com</a></td>
<td>![Token]</td>
<td>Approve</td>
<td>Reject</td>
</tr>
</tbody>
</table>
Digital certificates

- Privileges of Digital Certificate
- Approve new users
- Add or remove contacts
- Update organization details
- Online voting
Manage your membership

Member details

Edit

Account
APNICTRAINING-AU

Tier
Associate

Country/economy
AUSTRALIA

Organization
APNIC TRAINING UNIT

Office address
LEVEL 1, 33 PARK RD

Billing address
Attention: Amante Alvaran / Champika Wijayatunga / Ceci Goldstein
LEVEL 1, 33 PARK RD

Phone
+61-7-38583100

Fax
+61-7-38583199

City
Milton

State
QLD

Post code
4074

Economy
AUSTRALIA

Logo URL

Website
Manage your membership

Edit member details

Account: APNICTRAINING-AU

Organization: APNIC TRAINING UNIT

Office address
Address: LEVEL 1, 33 PARK RD

City: Milton

State/province: QLD

Country/economy: AUSTRALIA

Post code: 4074

Telephone: +61-7-38583100

Fax: +61-7-38583199

Billing address
Attention: Amane Alvaran / Champika Wijayatunga / Cee
Address: Same details as above LEVEL 1, 33 PARK RD
Update contact details

Add new contacts for your APNIC account

Select contact type
Manage Internet Resources

Resource management

Internet resources

Use MyAPNIC to view and update your information about the following Internet resources:

- IPv4
- IPv6
- ASN
- Whois updates
- Maintainers
- Correspondence

Resource request forms

Request more:

- IPv4 addresses
- IPv6 addresses
- AS numbers
## IPv4 Resources

### IPv4 resources

<table>
<thead>
<tr>
<th>Assignment window</th>
<th>Date last reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add reverse DNS domain object</td>
<td>Add public assignment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Start IP</th>
<th>Length</th>
<th>Date</th>
<th>Usage</th>
<th>Assignment status</th>
<th>Reverse DNS</th>
<th>Private</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>203.176.189.0</td>
<td>/24</td>
<td>2008-04-24</td>
<td>100%</td>
<td></td>
<td>update</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:  
- < 20%  
- = 20%  
- = 40%  
- = 60%  
- = 80%  
- > 80%
AS Numbers

- Upload
- Download
- Request more AS numbers

45192  131107
### AS number Resources

**Public data**

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>aut-name</td>
<td>AS45192</td>
</tr>
<tr>
<td>as-name</td>
<td>APNICTRAINING-AS-AP</td>
</tr>
<tr>
<td>descr</td>
<td>2-byte AS number for APNIC Training to.</td>
</tr>
<tr>
<td>country</td>
<td>AU</td>
</tr>
<tr>
<td>admin-c</td>
<td>AT480-AP</td>
</tr>
<tr>
<td>tech-c</td>
<td>AT480-AP</td>
</tr>
<tr>
<td>mnt-lower</td>
<td>MAINT-AU-APNIC.training</td>
</tr>
<tr>
<td>mnt-routes</td>
<td>MAINT-AU-APNIC.training</td>
</tr>
<tr>
<td>mnt-by</td>
<td>MAINT-AU-APNIC.training</td>
</tr>
<tr>
<td>changed</td>
<td><a href="mailto:km-changed@apnic.net">km-changed@apnic.net</a> 20080424</td>
</tr>
<tr>
<td>source</td>
<td>APNIC</td>
</tr>
</tbody>
</table>

**Add new field:**

- **descr**: alter ✓ the as-name ✗ field ✗

Submit update
Useful tools

Tools

MD5

String

Result

Encrypt

APNIC looking glass

The APNIC looking glass allows you to view your network from APNIC routers located in Australia (Brisbane) and Japan (Tokyo).

Enter your IP address (IPv4 or IPv6), choose the router you want to view it from and click 'submit'. Note: The traceroute and ping commands may take a while.

Query type

- BGP
- ping
- traceroute

IP address

View from

APNIC router – Tokyo

Submit
Common Issues

• Issues in getting a certificate
  – Forgetting to send the photo ID
  – Downloading the certificate to the wrong computer

• Accessing MyAPNIC
  – Using a computer without a digital certificate
  – Expired certificate
    • It’s easy to renew! Just send a new request via https://www.apnic.net/ca (renewals do not require photo ID)
Questions?
Overview

- IRMe
  - Introduction to APNIC
  - APNIC policy development process
  - Internet registry policies
  - IP address request (Demo)
  - Second opinion request
  - APNIC whois database
  - MyAPNIC (Demo)
- **Autonomous System Number (ASN)**
  - Reverse DNS
- APNIC Helpdesk
What is an Autonomous System?

- Collection of networks with same routing policy
- Usually under single ownership, trust or administrative control
When do I Need an ASN?

• When do I need an AS?
  – Multi-homed network to different providers and
  – Routing policy different to external peers

RFC1930: Guidelines for creation, selection and registration of an Autonomous System
When Don’t I Need an ASN?

Factors that don’t count:

– Transition and ‘future proofing’
– Multi-homing to the same upstream
  • RFC2270: A dedicated AS for sites homed to a single provider
– Service differentiation
  • RFC1997: BGP Communities attribute
Requesting an AS Number

1. Requested from APNIC for own network infrastructure
   - AS number is “portable”

1. Requested from APNIC for member customer network
   - ASN is “non-portable”
   - ASN returned if customer changes provider

- Transfers of ASNs
  - Need legal documentation (mergers etc)
  - Should be returned if no longer required
Requesting an ASN

• Complete the request form

  – Existing member:
    Will send request from MyAPNIC

  – New Member:
    Can send AS request along with membership application
4 byte AS Numbers
Background

• Previously 2 byte ASN (16 bits)
  – Possibly run into exhaustion by 2010
  – 4 byte ASN was developed by IETF

• Currently 4 byte ASN distribution policy (32 bits)

• Timeline
  – July 1 2009: Default 4 byte ASN, 2 byte ASN on request with documented justification
  – Jan 2010: 4 byte ASN only
4 Byte AS number

• 2-byte only AS number range 0 – 65535 (decimal range 0- 65,535)

• 4-byte only AS number range 1.0 - 65535.65535 (decimal range 65,536 - 4,294,967,295)

• AS number representation
  – AS DOT
  – AS PLAIN
4 Byte AS number

- AS number representation
  - **AS DOT**
  - Based upon 2-Byte AS representation
  - `<Higher2bytes in decimal> . <Lower2bytes in decimal>`
  - For example: AS 65546 is represented as 1.10
  - Easy to read, however hard for regular expressions
  - There is a meta character “.” in regular expression
  - i.e For example, a.c matches "abc", etc., but [a.c] matches only "a", ".", or "c".
4 Byte AS number

• AS number representation

  – AS PLAIN
  – ASPLAIN IETF preferred notation
  – Continuation on how a 2-Byte AS number has been represented historically
  – Notation: The 32 bit binary AS number is translated into a Single decimal value Example: AS 65546
  – Total AS Plain range (0 – 65535 - 65,536 - 4,294,967,295)
4 Byte AS number

APNIC resource range:

- In AS DOT: 2.0 ~ 2.1023
- In AS PLAIN: 131072 ~ 132095

AS number converter

http://submit.apnic.net/cgi-bin/convert-asn.pl
| aut-num:   | AS4777       |
| as-name:  | APNIC-NSPIXP2-AS |
| descr:    | Asia Pacific Network Information Centre |
| descr:    | AS for NSPIXP2, remote facilities site |
| import:   | from AS2500 action pref=100; accept ANY |
| import:   | from AS2524 action pref=100; accept ANY |
| import:   | from AS2514 action pref=100; accept ANY |
| export:   | to AS2500 announce AS4777 |
| export:   | to AS2524 announce AS4777 |
| export:   | to AS2514 announce AS4777 |
| default:  | to AS2500 action pref=100; networks ANY |
| admin-c:  | PW35-AP |
| tech-c:   | NO4-AP |
| remarks:  | Filtering prefixes longer than /24 |
| mnt-by:   | MAINT-APNIC-AP |
| changed:  | paulg@apnic.net 19981028 |
| source:   | APNIC |
Representation of routing policy

• Routing and packet flows

For AS1 and AS2 networks to communicate
  • AS1 must announce to AS2
  • AS2 must accept from AS1
  • AS2 must announce to AS1
  • AS1 must accept from AS2
Representation of routing policy

Basic concept

```
aut-num: AS1
...
import: from AS2
  action pref=100;
  accept AS2
export: to AS2 announce AS1

aut-num: AS2
...
import: from AS1
  action pref=100;
  accept AS1
export: to AS1 announce AS2
```

“action pref” - the lower the value, the preferred the route

"action pref" - the lower the value, the preferred the route
Representation of routing policy

More complex example

- AS4 gives transit to AS5, AS10
- AS4 gives local routes to AS123
Representation of routing policy

aut-num: AS4
import: from AS123 action pref=100; accept AS123
import: from AS5 action pref=100; accept AS5
import: from AS10 action pref=100; accept AS10
export: to AS123 announce AS4
export: to AS5 announce AS4 AS10
export: to AS10 announce AS4 AS5

Not a path
Representation of routing policy

More complex example

• AS4 and AS6 private link1
• AS4 and AS123 main transit link2
• backup all traffic over link1 and link3 in event of link2 failure
Representation of routing policy

**AS representation**

- **aut-num:** AS4
  - **import:** from AS123 action pref=100; accept ANY
  - **import:** from AS6 action pref=50; accept AS6
  - **import:** from AS6 action pref=200; accept ANY
  - **export:** to AS6 announce AS4
  - **export:** to AS123 announce AS4

- **transit traffic over link2**
  - **full routing received**

- **higher cost for backup route**
  - **private link1**

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*Images and diagrams are not transcribed.*
Questions?
Overview

- IRMe
  - Introduction to APNIC
  - APNIC policy development process
  - Internet registry policies
  - IP address request (Demo)
  - Second opinion request
  - IPv6 Overview
  - APNIC whois database
  - MyAPNIC (Demo)
  - Autonomous System Number (ASN)

- Reverse DNS
  - APNIC helpdesk
Reverse DNS - why bother?

- Service denial
  - That only allow access when fully reverse delegated eg. anonymous ftp

- Diagnostics
  - Assisting in trace routes etc

- Spam identification

- Registration
  - Responsibility as a member and Local IR
APNIC & Member responsibilities

• APNIC
  – Manage reverse delegations of address block distributed by APNIC
  – Process members requests for reverse delegations of network allocations

• Members
  – Be familiar with APNIC procedures
  – Ensure that addresses are reverse-mapped
  – Maintain nameservers for allocations
    • Minimise pollution of DNS
**Principles – DNS tree**

- Mapping numbers to names - ‘reverse DNS’

Root DNS

- net
- edu
- com
- arpa
- au

In-addr

RIR

ISP

Customer

22

202

203 210 211..

64

22.64.202.in-addr.arpa
Reverse delegation requirements

• /24 Delegations
  • Address blocks should be assigned/allocated
  • At least two name servers
  • Can ask APNIC to be the secondary zone

• /16 Delegations
  • Same as /24 delegations
  • APNIC delegates entire zone to member
  • Recommend APNIC secondary zone

• < /24 Delegations
  • Read “classless in-addr.arpa delegation”
A reverse zone example

```
$ORIGIN 1.168.192.in-addr.arpa.
@   3600 IN SOA test.company.org. (sys\.admin.company.org.
    2002021301 ; serial
    1h ; refresh
    30M ; retry
    1W ; expiry
    3600 ) ; neg. answ. ttl

    NS ns.company.org.
    NS ns2.company.org.

    1 PTR gw.company.org.
    router.company.org.

    2 PTR ns.company.org.

    ;auto generate: 65 PTR host65.company.org
$GENERATE 65-127 $ PTR host$.company.org.
```
## Example ‘domain’ object

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>domain</td>
<td>124.54.202.in-addr.arpa</td>
</tr>
<tr>
<td>descr</td>
<td>co-located server at mumbai</td>
</tr>
<tr>
<td>country</td>
<td>PK</td>
</tr>
<tr>
<td>admin-c</td>
<td>VT43-AP</td>
</tr>
<tr>
<td>tech-c</td>
<td>IA15-AP</td>
</tr>
<tr>
<td>zone-c</td>
<td>IA15-AP</td>
</tr>
<tr>
<td>nserver</td>
<td>dns.isp.net.pk</td>
</tr>
<tr>
<td>nserver</td>
<td>giasbm01.isp.net.pk</td>
</tr>
<tr>
<td>mnt-by</td>
<td>MAINT-PK-isp</td>
</tr>
<tr>
<td>changed</td>
<td><a href="mailto:gps@isp.net.pk">gps@isp.net.pk</a> 20010612</td>
</tr>
<tr>
<td>source</td>
<td>APNIC</td>
</tr>
</tbody>
</table>
Adding Domain Object to WHOIS

• Using My APNIC (Instant)
• Sending Domain object template to APNIC Helpdesk (1 working day)
• Name servers must be configured before submitting request
Delegation procedures
– request form

• Complete the documentation
  • ftp://ftp.apnic.net/apnic/docs/reverse-dns

• On-line form interface
  – Real time feedback
  – Gives errors, warnings in zone configuration
    • serial number of zone consistent across nameservers
    • nameservers listed in zone consistent
  – Uses database ‘domain’ object
    • examples of form to follow..
Evaluation

• Parser checks for
  – ‘whois’ database
    • IP address range is assigned or allocated
    • Must be in APNIC database
  – Maintainer object
    • Mandatory field of domain object
  – Nic-handles
    • zone-c, tech-c, admin-c
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  – Reverse DNS

- APNIC helpdesk
• **More personalised service**
  - Range of languages:
    Cantonese, Filipino, Mandarin, Thai, Vietnamese etc.

• **Faster response and resolution of queries**
  • IP resource applications, status of requests, obtaining help in completing application forms, membership enquiries, billing issues & database enquiries
APNIC Helpdesk Chat

Helpdesk

The Helpdesk gives members and clients direct access to APNIC Hostmasters to resolve all enquiries.

09:00 to 19:00 (UTC+10 hours)

Phone
+61 7 3858 3188

Fax
+ 61 7 3858 3199

Email
Helpdesk  helpdesk@apnic.net

Nota Please send all requests for resources to Hostmaster with your APNIC
ICONS

IPv6 Wiki

Yes, this site is built in English, but don't let that stop you, even if you're not a native English speaker.

You can use online translation tools to give a rough translation into some languages.

For example:  Google Translate, Yahoo Babel Fish, and so forth. Try it out!

This page is intended as a dynamic space where the internet community can gather various IPv6-related information. The information and links in the APNIC ICONS Wiki IPv6 will be constantly updated.

If you find missing information or want to contribute content, please let us know! You can email <ipv6@apnic.net>, 'Add Comment', or create a thread through the 'Forum' page.

Welcome To ICONS Wiki

Welcome to the new Wiki pages for ICONS (Internet Community of Online Networking Specialists).

Whether you are a vendor, ISP, user, or regulator, we encourage you to contribute anything interesting that you think may be of benefit to others. You can add comments or bookmarks as well as add and edit pages, or build an RSS feed of your favorite area to make sure you are kept up to date with any changes.

You can browse the existing contents as a guest user, however, to add content to ICONS, you simply need to register as an ICONS member.

Safaris Users

Safari users are not currently able to access the Rich Text Editor functionality on the ICONS Wiki. However, they still have full access using Wiki Markup.

Comments (2)

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Questions?
Training Survey

• http://www.tiny.cc/apnictrainingsurvey
Thank you!