

APNIC Training

Internet Resource Management Essentials

01 July 2008, Port Vila, Vanuatu

In conjunction with

PacN G

Introduction

Presenters

- Cecil Goldstein, Training Manager
cecil@apnic.net
- Champika Wijayatunga, Senior Training Specialist
champika@apnic.net
- Elly Tawhai, Senior Internet Resource Analyst
elly@apnic.net

Assumptions & Objectives

Assumptions

- Are current or prospective APNIC member
- Have not submitted many requests
- Are not familiar / up-to-date with policies
- Are not familiar with procedures

Objectives

- Teach members how to request resources from APNIC
- Keep membership up-to-date with latest policies
- Liaise with members
 - ☺ Faces behind the e-mails

Overview

- IRMe
 - Introduction to APNIC
 - APNIC community & policy development
 - APNIC policies – allocation and assignment
 - ISP request evaluation
 - APNIC Whois database
 - MyAPNIC
 - Autonomous System Numbers
 - IPv4 unallocated address space exhaustion
 - IPv6 policy and procedures
 - Reverse DNS delegations – registry procedures

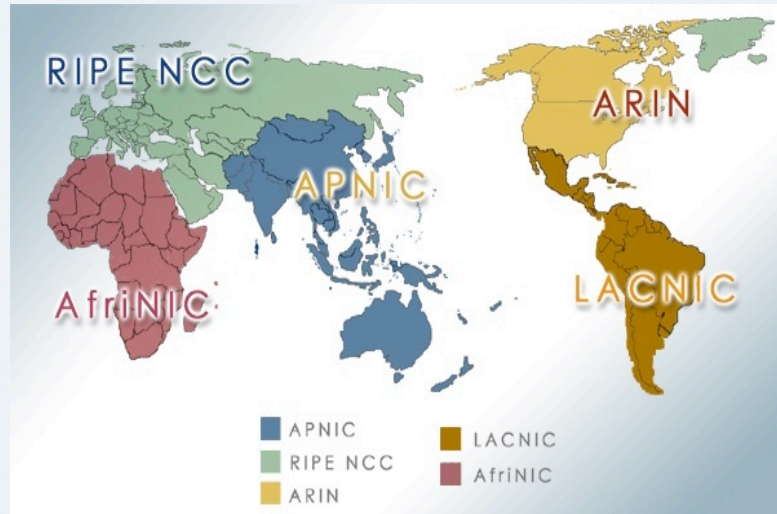
Introduction to APNIC

Asia Pacific Network Information Centre

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
 - Open participation, democratic, bottom-up processes
 - Responsible for distributing Internet resources throughout the AP region
- Industry self-regulatory body
 - Consensus-based, open, and transparent decision-making and policy development
- Meetings and mailing lists
 - Open to anyone
 - <http://www.apnic.net/meetings/23/index.html>
 - <http://www.apnic.net/community/lists/index.html>

Where is APNIC region?



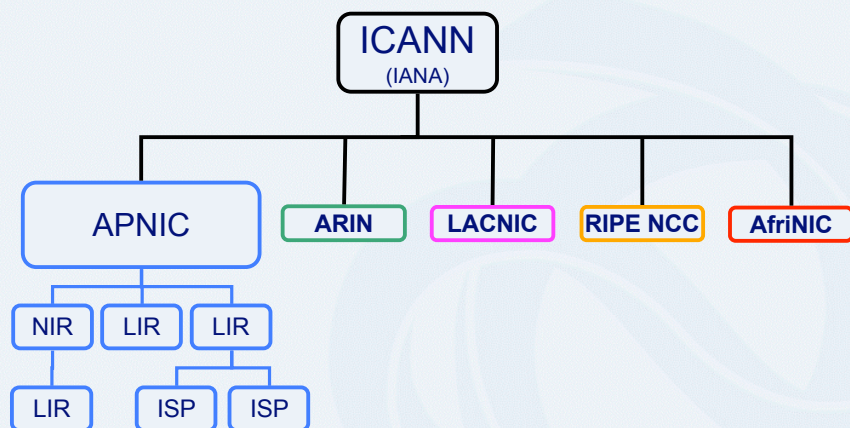
What does APNIC do?

<p><u>Resource service</u></p> <ul style="list-style-type: none"> • IPv4, IPv6, ASNs • Reverse DNS delegation • Resource registration <ul style="list-style-type: none"> • Authoritative registration server <ul style="list-style-type: none"> • whois • IRR 	<p><u>Policy development</u></p> <ul style="list-style-type: none"> • Facilitating the policy development process • Implementing policy changes
<p><u>Information dissemination</u></p> <ul style="list-style-type: none"> • APNIC meetings • Web and ftp site • Publications, mailing lists • Outreach seminars <p>http://www.apnic.net/community/lists/</p>	<p><u>Training & Outreach</u></p> <ul style="list-style-type: none"> • Training <ul style="list-style-type: none"> • Internet Resource management • DNS workshops - Subsidised for members <p>Schedule: http://www.apnic.net/training</p>

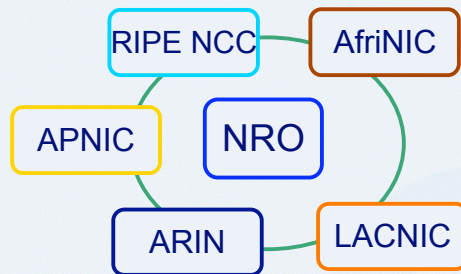
APNIC is NOT

- 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

Internet Registry structure



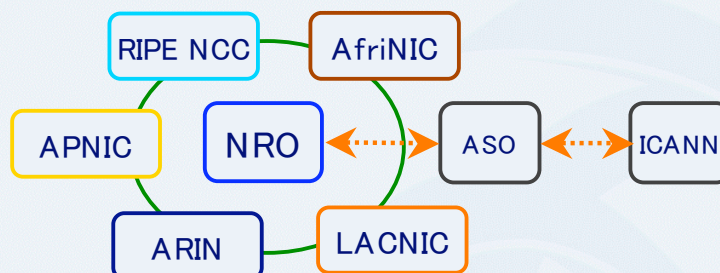
Global policy coordination



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

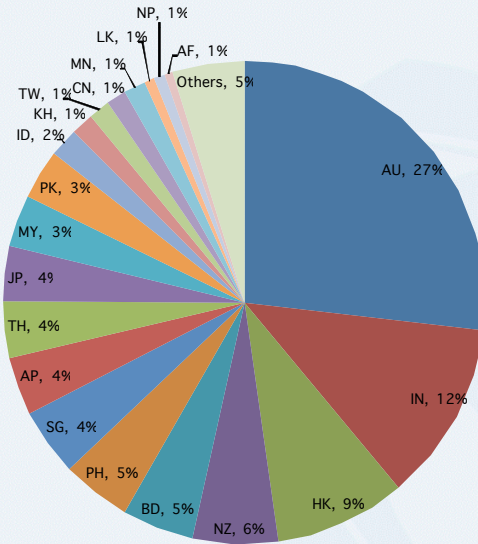
Global policy coordination



The main function of ASO:

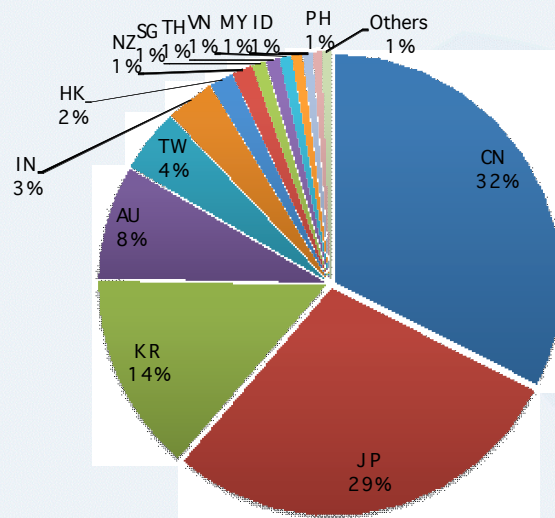
- ASO receives global policies and policy process details from the NRO
- ASO forwards global policies and policy process details to ICANN board

APNIC membership




Source: APNIC statistic data - Last update March 2008

APNIC IPv4 address distribution




Source: APNIC statistic data - Last update March 2008

**APNIC**

Asia Pacific Network Information Centre

Questions ?

**APNIC**

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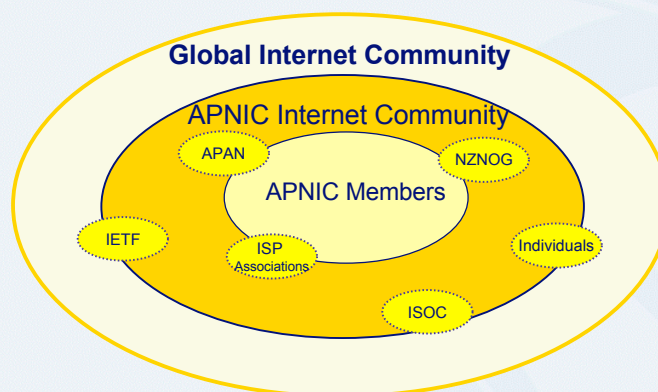
APNIC Community & Policy Development

What is the APNIC community?

- **Open** forum in the Asia Pacific
 - Open to any interested parties
- Voluntary participation
- Decisions made based on consensus
- Public meetings
- Mailing lists
 - web archived
- *A voice in regional Internet operations through participation in APNIC activities*

You are part of APNIC community!

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

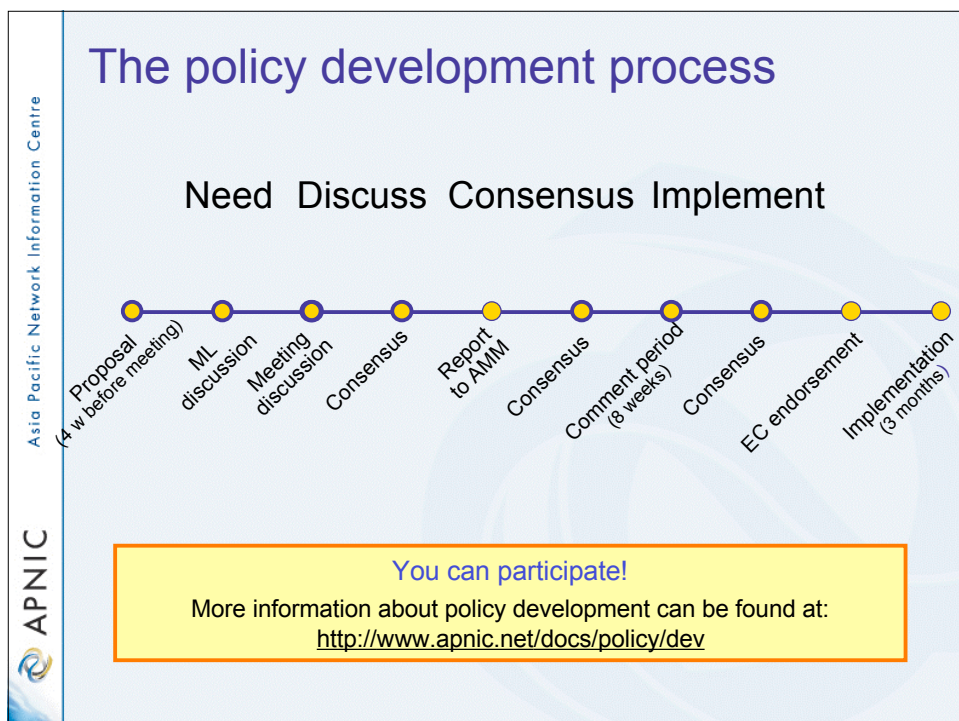
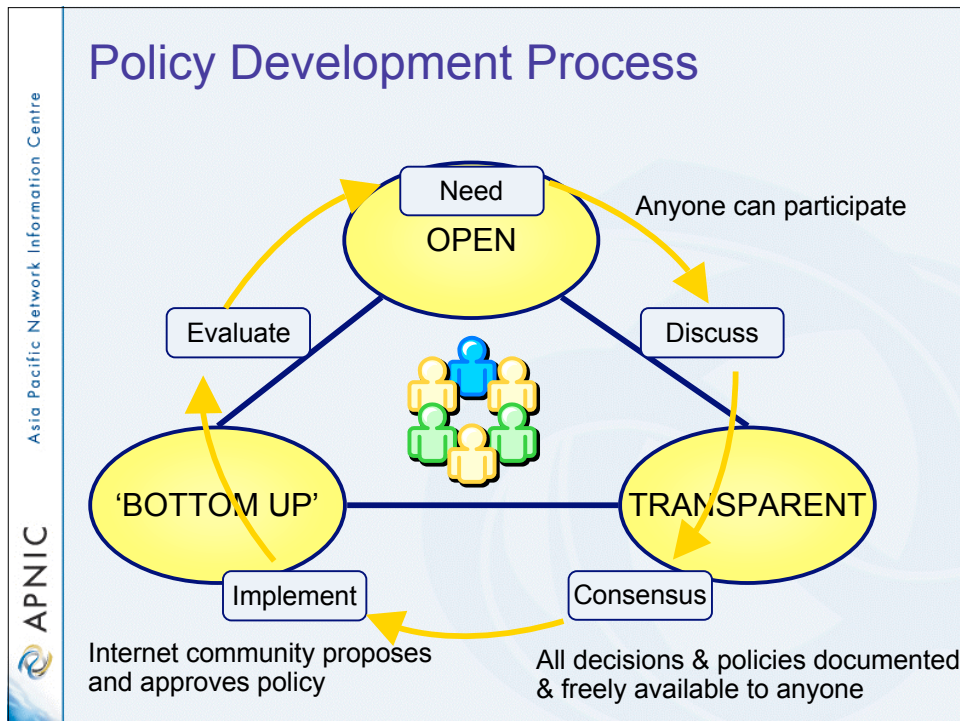


Policy development

- Industry self-regulatory process
 - Policy is developed by the AP Internet community to suit needs of region
 - Facilitated by RIR staff
- Policy implementation
 - APNIC shares with its members and their customers a collective responsibility
 - RIR process
 - ISPs and other affected parties

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



How to make your voice heard

- Contribute on the public mailing lists
 - <http://www.apnic.net/community/lists/index.html>
- Attend meetings
 - Or send a representative
 - Watch webcast (video streaming) from the meeting web site
 - Read live transcripts from the meeting web site
 - And express your opinion via Jabber chat
- Give feedback
 - Training or seminar events

Next meetings

- **APNIC 26**
 - Christchurch, New Zealand
 - 25 - 29 August 2008
- **APNIC 27**
- Held in conjunction with APRICOT 2009
 - Manila, Philippines
 - 18 - 27 February 2009
- **APNIC 28**
- The call for proposal
 - Will open soon for organisations interested in hosting APNIC 28
 - <http://www.apnic.net/meetings/upcoming/index.html>

APNIC meetings

- Participate remotely



- **Video streaming**

- Selected sessions are video streamed live via unicast and multicast



- **Audio streaming**

- For users with lower bandwidth follow live audio streamed in MP3 format



- **Live transcripts**


- Live transcripts of selected sessions available via Jabber and web browsers



- **Jabber chat**

- Jabber chat rooms give people around the world the chance to participate in meeting sessions in near real time


APNIC policies



Asia Pacific Network Information Centre

Internet registry allocation and assignment

Policies



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Allocation and assignment

Allocation

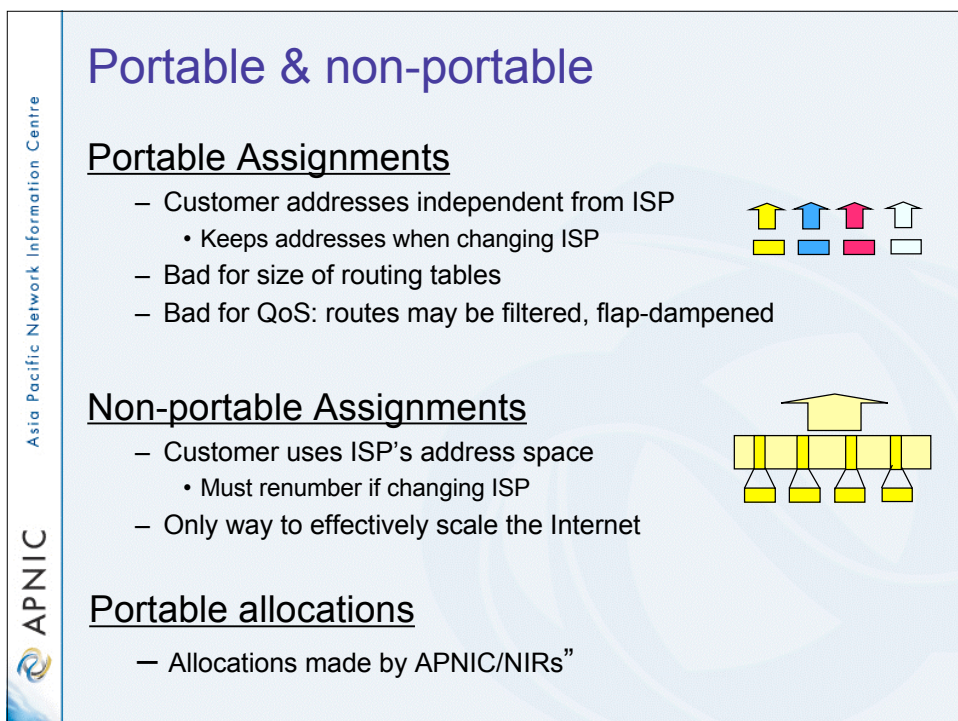
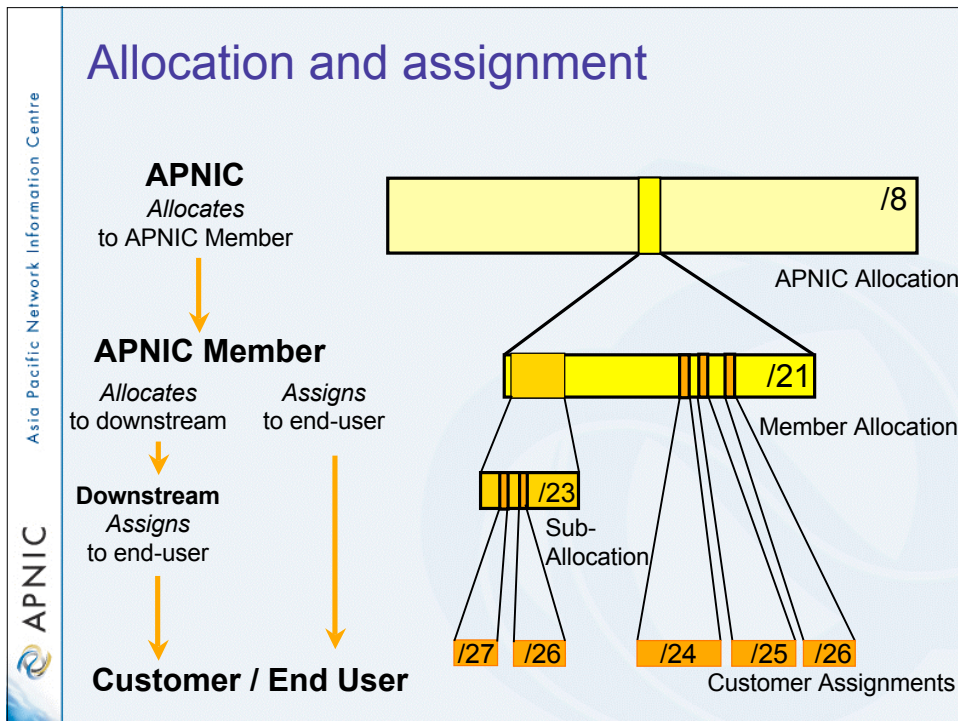
“A block of address space held by an IR (or downstream ISP) for subsequent allocation or assignment”

- Not yet used to address any networks

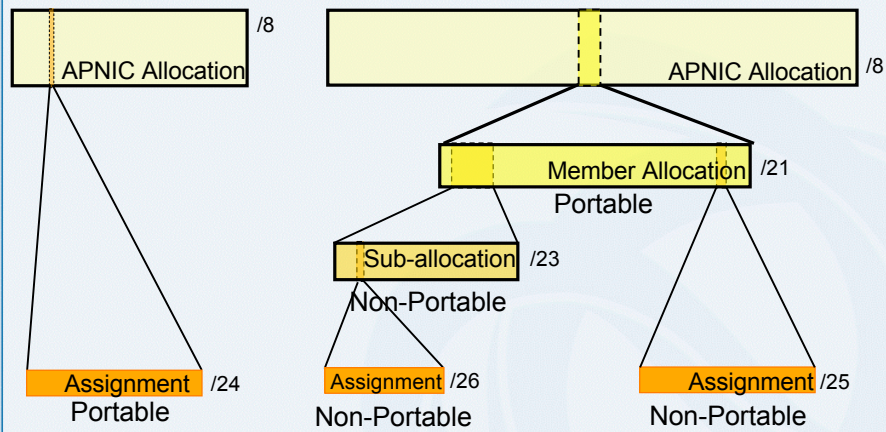
Assignment

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

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



Address management hierarchy



- Describes “portability” of the address space

Internet resource management objectives

Conservation

- Efficient use of resources
- Based on demonstrated need

Aggregation

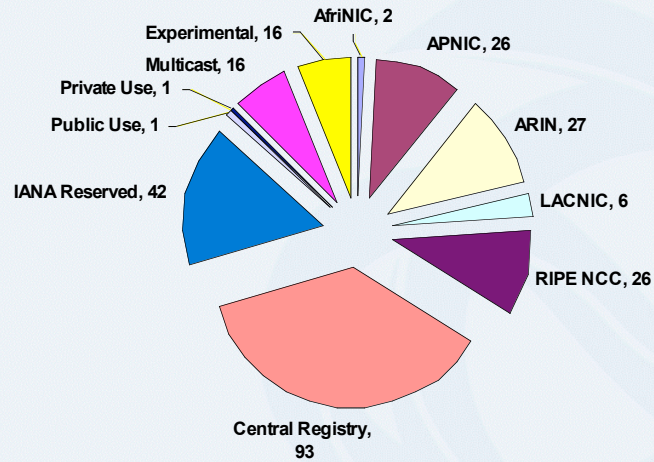
- Limit routing table growth
- Support provider-based routing

Registration

- Ensure uniqueness
- Facilitate trouble shooting

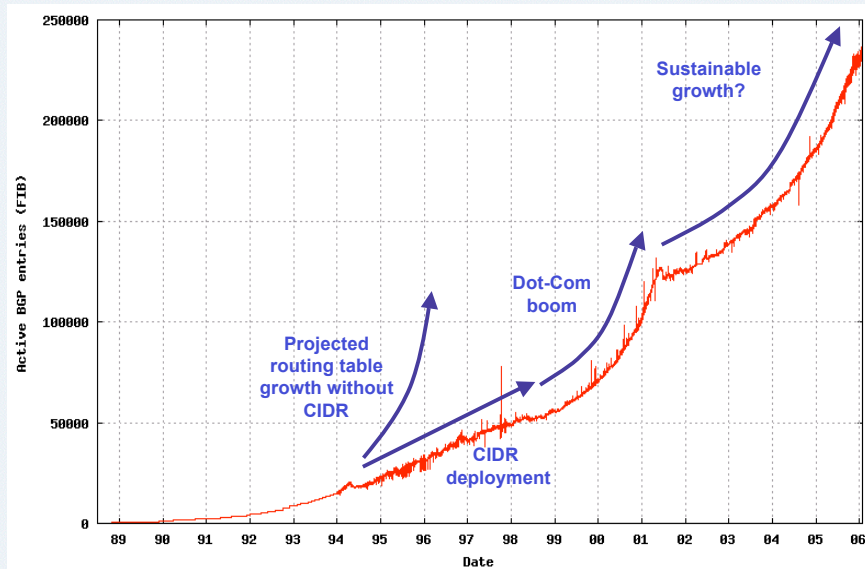
Uniqueness, fairness and consistency

Why do we need policies? - Global IPv4 Delegations (in /8)



Internet Number Resource Report, last update Dec 2007 by

Growth of global routing table



<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

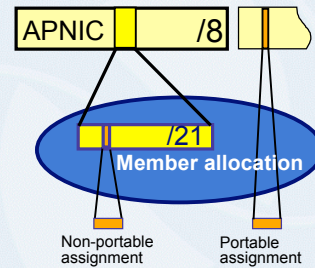
- Aggregation of allocation
 - Provider responsible for aggregation
 - Customer assignments /sub-allocations must be non-portable
- Allocations based on demonstrated need
 - Detailed documentation required
 - All address space held to be declared
 - Address space to be obtained from one source
 - routing considerations may apply
 - Stockpiling not permitted

Initial IPv4 allocation

- Initial (portable) allocation: /21(2048 addresses)
 - The allocation can be used for further assignments to customers or your own infrastructure.
 - Lowered from /20 to /21 as APNIC 17 consensus (Aug 2004)

Criteria

- 1a. Have used a /23 from upstream provider
Demonstrated efficient address usage
OR
- 1b. Show immediate need for /23
Can include customer projections & infrastructure equipment
2. Detailed plan for use of /22 within 1 year
3. Renumber to new space within 1 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

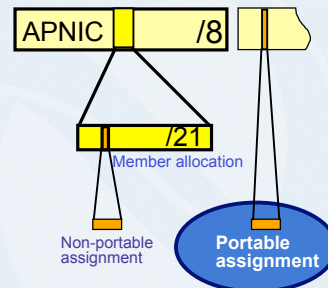
Portable assignments

- 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

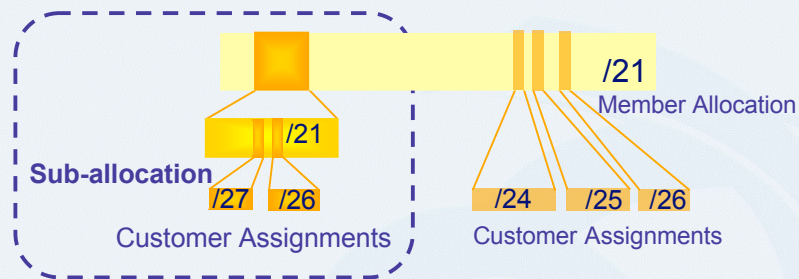
Demonstrate need to use 25% of requested space immediately and 50% within 1 year



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

Sub-allocations



- No max or min size
 - Max 1 year requirement
- Assignment Window & 2nd Opinion applies
 - to both sub-allocation & assignments
 - Sub-allocation holders don't need to send in 2nd 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
 - LIRs responsible for overall utilisation
 - Sub-allocation holders need to make efficient assignments
- Database registration
 - Sub-allocations & assignments to be registered in the db

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

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
- We will talk this topic in more details later

Internet Registry Procedures

Addressing Plan

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)



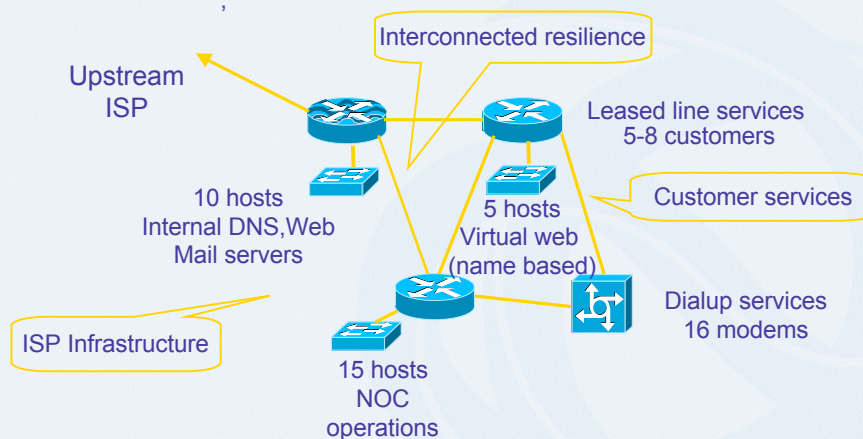
Ethernet switch
(layer 2, packet forwarding)

Addressing plan

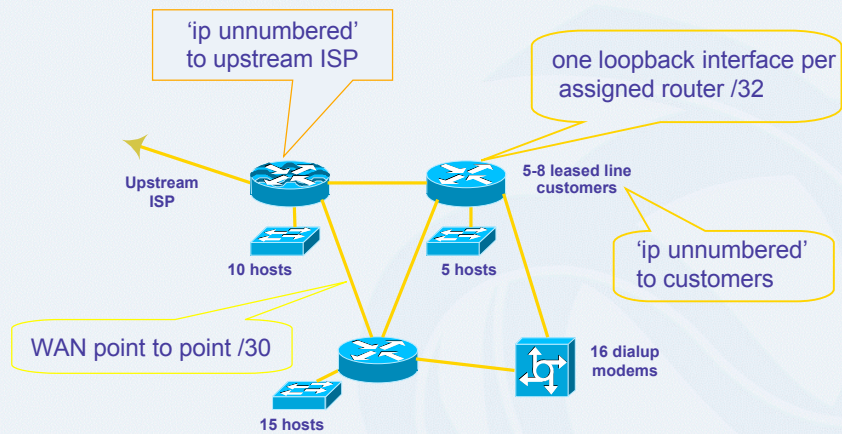
- Identify components of network
 - Customer services
 - ISP internal infrastructure
- Identify phases of deployment
 - Starting off, 6 months, 12 months
- Identify equipment and topology changes
 - Need for redundancy
 - Need for increased scale

Network plan

- Starting off



Network plan



Addressing plan

- Initial addressing plan

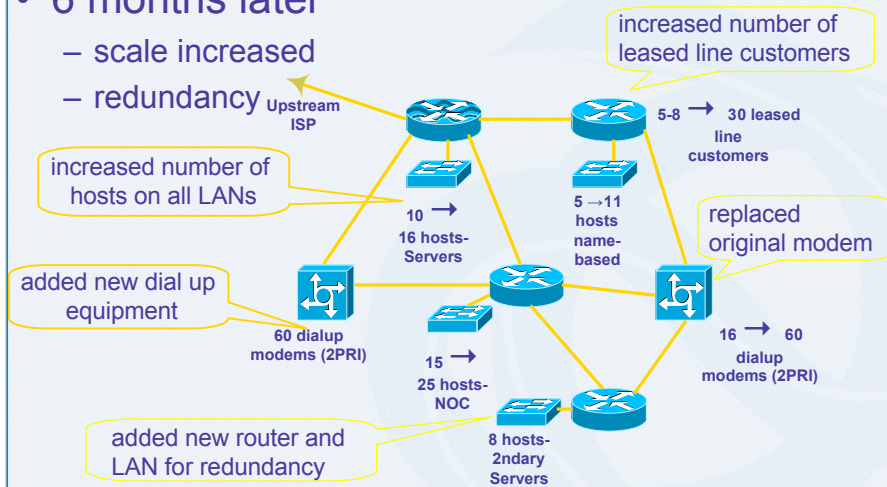
- numbers of host addresses (interfaces)

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:	2	router WAN ports (x 5 lines)

Network plan

- 6 months later

- scale increased
- redundancy



Addressing plan

- Network plan at 6 months

- increases in hosts (interfaces)

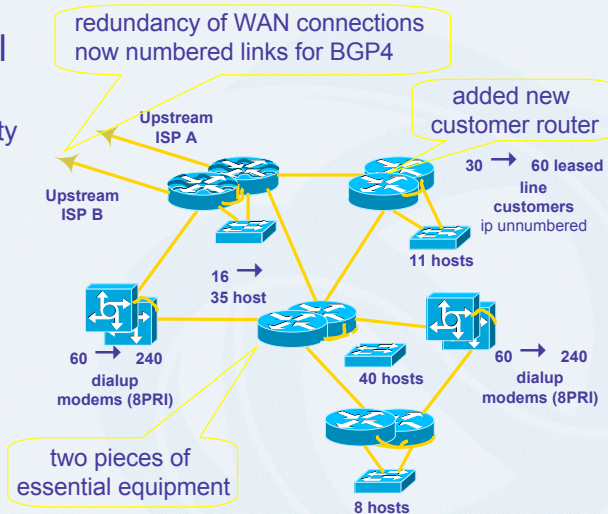
network-plan:	16/ 60	2 PRI dialup modems, vendor 'y'
network-plan:	5/ 11	LAN -web hosting (Name-based hosting)
network-plan:	128/ 512	30 leased line customers (pool)
network-plan:	15/ 25	LAN -NOC and Ops management
network-plan:	10/ 16	LAN -mail,DNS, web servers internal
network-plan:	4/ 6	loopback router interfaces
network-plan:	2/ 2	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*



Addressing plan


- Network plan at 12 months

-increases in hosts (interfaces)
-one year total

network-plan:	16/60/	240	8 PRI dialup modems, vendor x
network-plan:	0/60/	240	8 PRI dialup modems, vendor y
network-plan:	5/11/	11	LAN -web hosting (Name-based hosting)
network-plan:	128/512/	1020	60 leased line customers (pool)
network-plan:	15/25/	40	LAN -NOC and Ops management
network-plan:	10/16/	35	LAN -mail,DNS, web servers internal
network-plan:	0/8/	8	LAN-secondary servers
network-plan:	2/2/	2	router WAN ports (x 8 lines)
network-plan:	4/6	12	loopback router interfaces

Addressing plan

- Can now determine subnet sizes

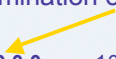


network-plan:	256	16/60/240	8 PRI dialup modems, vendor x
network-plan:	256	0/60/240	8 PRI dialup modems, vendor y
network-plan:	16	5/11/11	LAN -web hosting (Name-based hosting)
network-plan:	1024	128/512/1020	60 leased line customers (pool)
network-plan:	64	15/25/40	LAN -NOC and Ops management
network-plan:	64	10/16/35	LAN -mail,DNS, web servers internal
network-plan:	8	0/8/8	LAN-secondary servers
network-plan:	16	2/2/2	router WAN ports (x 8 lines)
network-plan:	16	4/6/12	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



network-plan:	0.0.0.0	1024	128/512/1020	60 leased line customers (pool)
network-plan:	0.0.4.0	256	16/60/240	8 PRI dial up modems, vendor x
network-plan:	0.0.5.0	256	0/60/240	8 PRI dial up modems, vendor y
network-plan:	0.0.6.0	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	0.0.6.64	64	15/25/40	LAN -NOC and Ops management
network-plan:	0.0.6.128	16	5/11/11	LAN -web hosting (Name-based hosting)
network-plan:	0.0.6.144	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.160	16	4/6/12	loopback router interfaces
network-plan:	0.0.6.176	16	2/2/2	router WAN ports (x8)

- cumulative total 0.0.6.208

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Addressing plan

– Addressing plan for network-plan

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

network-plan:	0.0.0.0	255.255.252.0	YES	1024	128/512/1020	60 leased customers
network-plan:	0.0.4.0	255.255.255.0	PART	256	16/60/240	8 PRI dial up modems..
network-plan:	0.0.5.0	255.255.255.0	PART	256	0/60/240	8 PRI dial up modems..
network-plan:	0.0.6.0	255.255.255.192	YES	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	0.0.6.64	255.255.255.192	YES	64	15/25/40	LAN -NOC & Ops mgmt
network-plan:	0.0.6.128	255.255.255.240	YES	16	5/11/11	LAN -web hosting (Name-based)
network-plan:	0.0.6.144	255.255.255.240	YES	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.160	255.255.255.240	YES	16	4/6/12	loopback router interfaces
network-plan:	0.0.6.176	255.255.255.252	YES	16	2/2/2	router WAN ports (x 8)

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Addressing plan

– Addressing plan complete

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

network-plan:	0.0.0.0	255.255.252.0	YES	1024	128/512/1020	60 leased line customers
network-plan:	0.0.4.0	255.255.255.0	PART	256	16/60/240	8 PRI dial up modems..
network-plan:	0.0.5.0	255.255.255.0	PART	256	0/60/240	8 PRI dial up modems..
network-plan:	0.0.6.0	255.255.255.192	YES	64	10/16/35	LAN -mail,DNS, web internal
network-plan:	0.0.6.64	255.255.255.192	YES	64	15/25/40	LAN -NOC & Ops mgmt
network-plan:	0.0.6.128	255.255.255.240	YES	16	5/11/11	LAN -web hosting (Name-based)
network-plan:	0.0.6.144	255.255.255.240	YES	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.160	255.255.255.240	YES	16	4/6/12	loopback router interfaces
network-plan:	0.0.6.176	255.255.255.252	YES	16	2/2/2	router WAN ports (x 8 lines)


– detailed, efficient and accurate



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Questions ?

Material available at: www.apnic.net/training/recent/



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ISP request and evaluation

ISP address request

members only

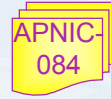
- Hostmaster Administrivia
 - <hostmaster@apnic.net> mailbox filtered
 - Requires member account name
 - Subject: IP Address Request [CONNECT-AU]
- Ticketing system
 - Every request is assigned a ticket
 - Please keep # in subject line of email eg.
 - [APNIC #14122] [CHINANET-CN]
- New staff at ISP
 - Require an 'introduction' to APNIC
 - To ensure confidentiality

ISP address request - Overview

- Contact Details
- Network Information
- Existing Customer Network Information
- Existing Infrastructure Network Information
- Future Network Plan
- Additional Information

ISP address request instructions

- Complete the documentation
 - ISP Address Request Form
 - Web Form:
 - <http://www.apnic.net/services/ipv4/>
 - 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.html>



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

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 implement services
 - 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
- 'No Questions Asked' return prefix policy
 - swap 3 or more discontinuous prefixes (ISP or customers) for single prefix, no charge
 - <ftp://ftp.apnic.net/apnic/docs/no-questions-policy>
 - Form for returning addresses
 - <ftp://ftp.apnic.net/apnic/docs/address-return-request>

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

- 1:1 contention ratio
 - Can be either statically or dynamically assigned
 - Means 1 IP address per customer
- Greater than 1:1 contention ratio
 - Preferred because conserves address space
- Choice of addressing is optional for members
 - dynamic addressing is encouraged
- Verification for DSL Services
 - Equipment details
 - Ex: BRAS, Number of ports
 - Purchase receipts

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 /21 '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



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Questions ?



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Assignment and sub-allocation procedures

Assignment Window &
2nd Opinion process

Second opinion request

- Assignment Window
- Second Opinion Request Form
- Evaluation

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

Why Assignment Window?

- Motivation
 - Support the LIR during start up
 - Standardise criteria for request evaluation
 - Familiarise the LIR with APNIC policies
 - Ensure accurate data is being kept
 - Treat everyone fairly

FAQ

- <http://www.apnic.net/faq/awfaq.html>

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2nd Opinion

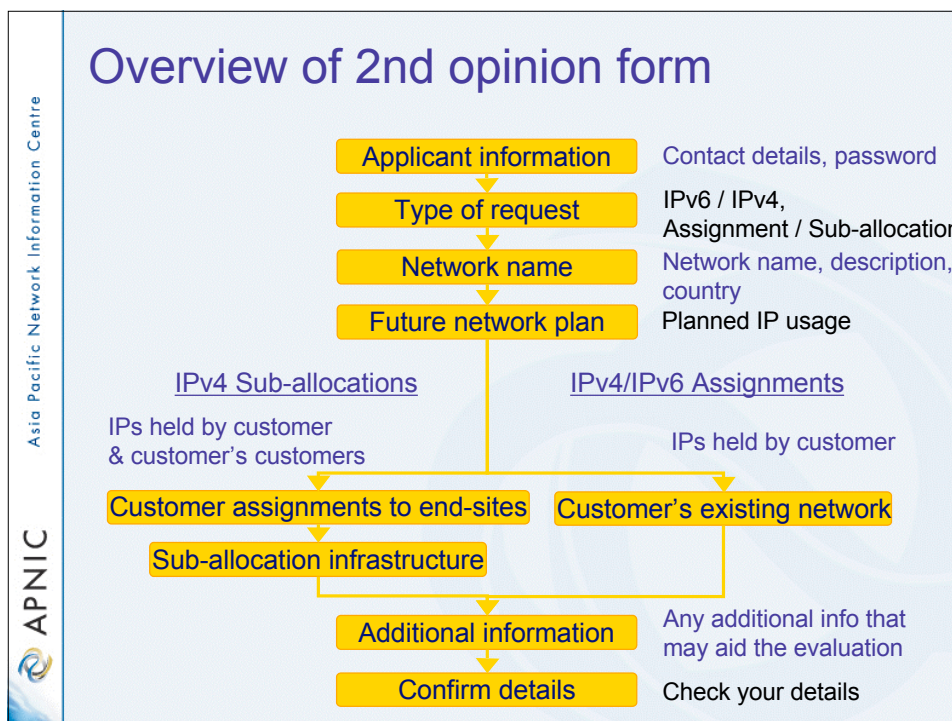
Second opinion request form

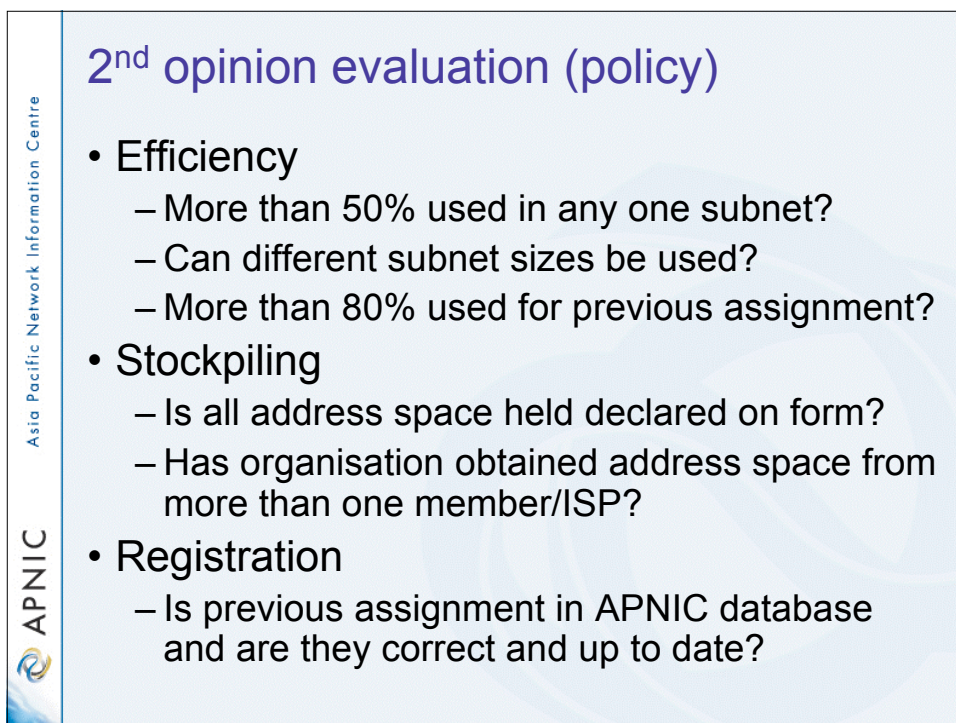
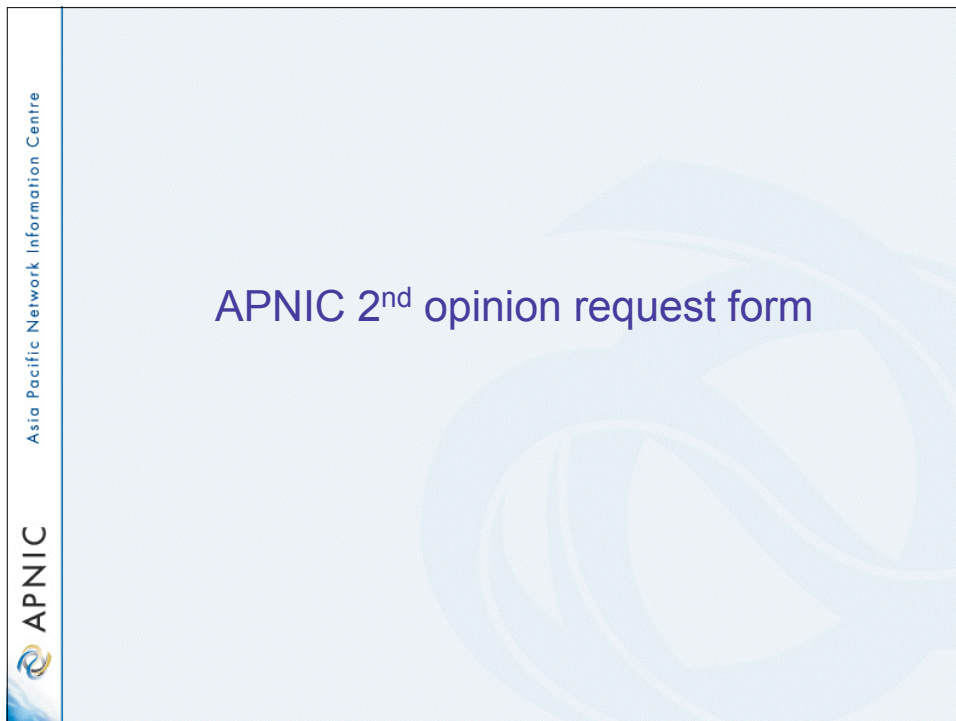
Used to seek approval for:

- IPv4 assignments & sub-allocations
- Multiple/additional IPv6 /48s to a single customer

Before you start:

- Separate form for each request
- Help buttons available
- Form can be saved by use of password





2nd Opinion

2nd opinion evaluation

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- 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

2nd Opinion

2nd opinion request approval

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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"




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gms
Opinion

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

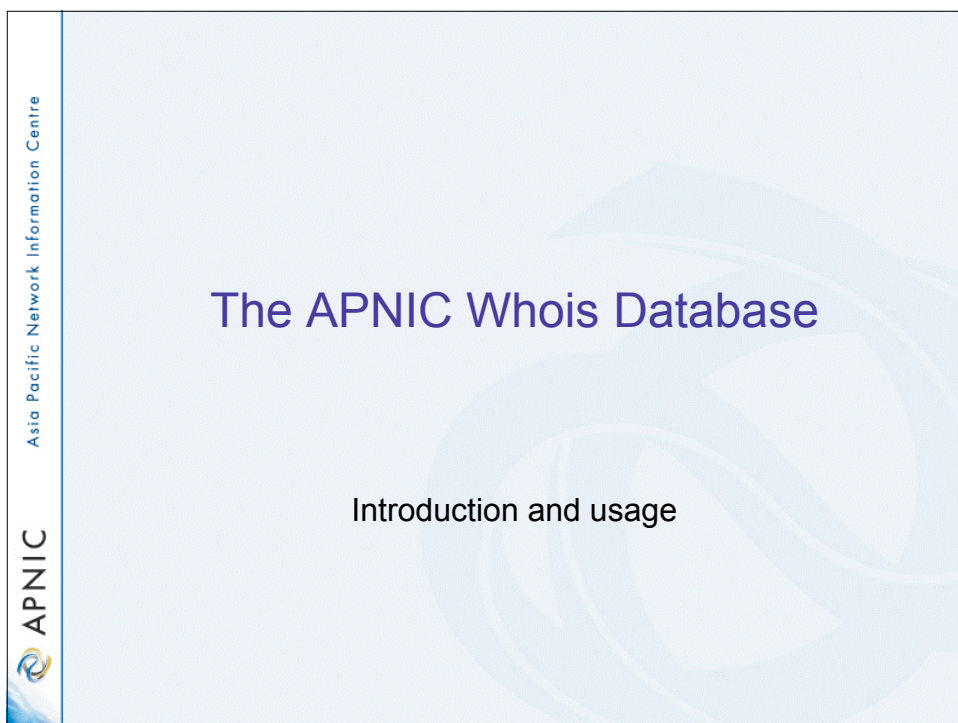
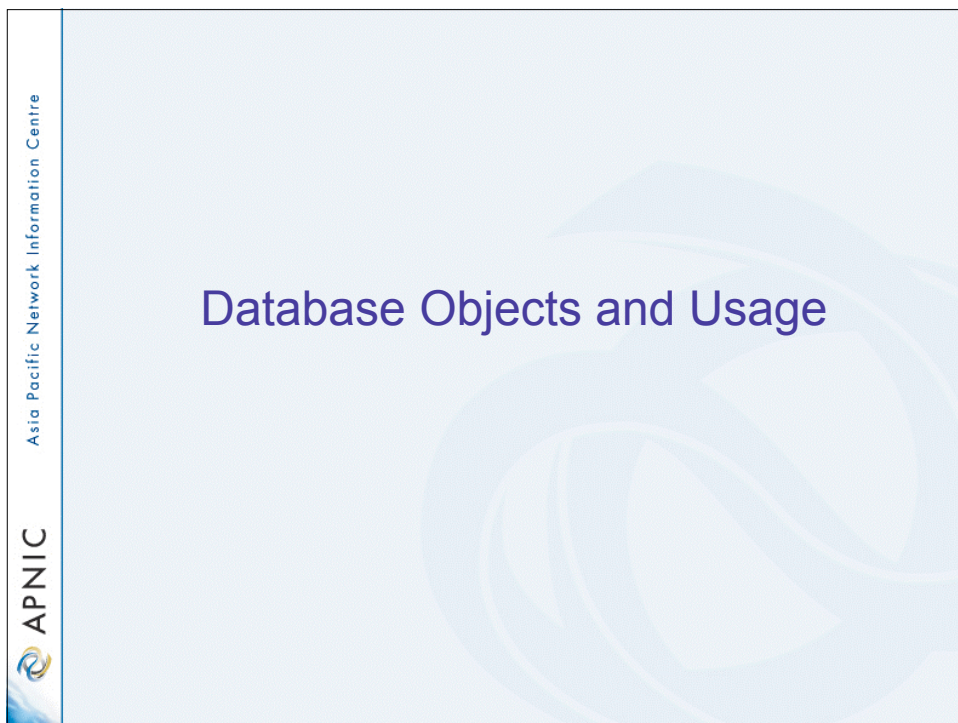


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Questions ?

Material available at: www.apnic.net/training/recent/



Overview

- What is the APNIC Whois Database?
- Why use it?
- Database query
- Database updating process

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

Object types

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

<http://www.apnic.net/db/>

Object templates

To obtain template structure*, use :

whois -t <object type>

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

```
person: [mandatory] [single] [primary/look-up key]
address: [mandatory] [multiple] [ ]
country: [mandatory] [single] [ ]
phone: [mandatory] [multiple] [ ]
fax-no: [optional] [multiple] [ ]
e-mail: [mandatory] [multiple] [look-up key]
nic-hdl: [mandatory] [single] [primary/look-up key]
remarks: [optional] [multiple] [ ]
notify: [optional] [multiple] [inverse key]
mnt-by: [mandatory] [multiple] [inverse key]
changed: [mandatory] [multiple] [ ]
source: [mandatory] [single] [ ]
```

*Recognised by the RIPE whois client/server

Person object example

- Person objects contain contact information

Attributes

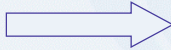
Values

```

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
  
```

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
  
```


Tip – Choosing your nic-hdl

- Automatic generation of nic-hdls

```
person: Ky Xander
```

```
...
```

```
nic-hdl: KX17-AP
```

- Specifying initials in your nic-hdl

```
role: SparkyNet Staff
```

```
...
```

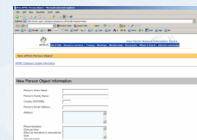
```
nic-hdl: SN123-AP
```

Creating a person object

Whois Database Guide:

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

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

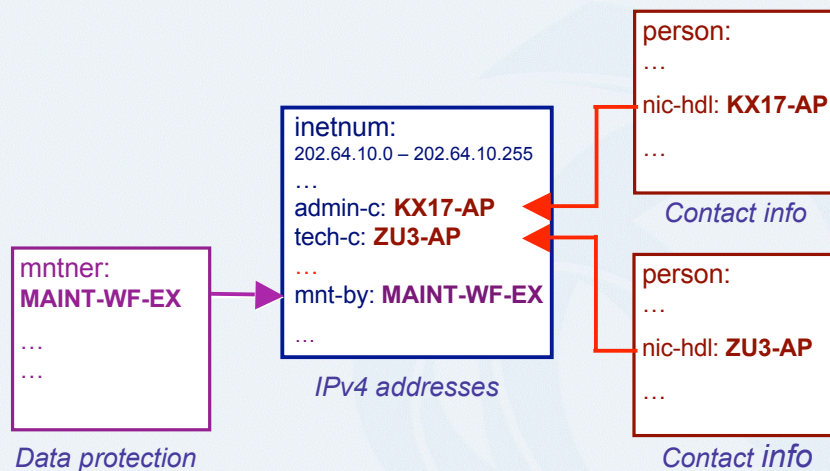
- Contain IP address allocations / assignments

Attributes

Values

inetnum:	202.51.64.0 - 202.51.95.255
netname:	CCNEP-NP-AP
descr:	Communication & Communicate Nepal Ltd
descr:	VSAT Service Provider, Kathmandu
country:	NP
admin-c:	AS75-AP
tech-c:	AS75-AP
mnt-by:	APNIC-HM
mnt-lower:	MAINT-NP-ARUN
changed:	hostmaster@apnic.net 20010205
status:	ALLOCATED PORTABLE
source:	APNIC

Inter-related objects



Admin-c and tech-c

- Responsibility – ‘admin’ contacts
 - Legal authority
 - Technical management
 - Network planning, backbone design
 - Deployment, capacity, and upgrade planning
- Expertise - ‘tech’ contacts
 - Routing, aggregation, BGP, etc
 - Addressing, subnetting, CIDR, etc

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

Why use the whois database?

- Register use of Internet Resources
 - Reverse DNS, IP assignments (public data), etc.
 - Ascertain custodianship of a resource
 - Fulfill responsibilities as resource holder
- Obtain details of technical contacts for a network
 - Investigate security incidents
 - Track source of network abuse or “spam” email

Basic whois database queries

- Unix
 - `whois -h whois.apnic.net <lookup key>`
- Web interface
 - <http://www.apnic.net/apnic-bin/whois2.pl>
- Look-up keys
 - usually the object name
 - Check template for look-up keys



Database query – look-up keys

person	name, nic-hdl, e-mail
role	name, nic-hdl, e-mail
mntner	maintainer name
inetnum	network number, name
domain	domain name
aut-num	as number
as-macro	as-macro name
route	route value
inet6num	network number, name

* whois supports queries on any of these objects/keys

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
```

Whois database query - web

Query the APNIC Whois Database - Microsoft Internet Explorer

Address: <http://www.apnic.net/apnic-bin/whois2.pl>

Query the APNIC Whois Database

Need help?

1. Type in search key

Search for: Search

3. 'Search Whois'

2. Search options (flags)

IP address lookups

- ☐ .I 1st level less specific
- ☐ .L All less specific
- ☐ .m 1st level more specific
- ☐ .M All more specific
- ☐ .x Exact match only
- ☐ .d Associated reverse domain

Miscellaneous queries

- ☐ - Inverse attributes
- ☐ -T Object types

Query hints

- Include "AS" in front of an AS number. Example: AS4808
- Include "F" (template only) or "V" (template and description) in front of an object name to view the template. Example: -I:inetnum

Further information

- APNIC Whois
- APNIC Whois

Whois database query - web

Query the APNIC Whois Database - Microsoft Internet Explorer

Address: <http://www.apnic.net/apnic-bin/whois2.pl>

Query the APNIC Whois Database

Need help?

- General search help
- Help tracking spam and hacking

% [whois.apnic.net node-1]
 % How to use this server <http://www.apnic.net/db/>
 % Whois data copyright terms <http://www.apnic.net/db/dbcopyright.html>

role:
 address: OPTUS IP ADMINISTRATORS
 address: 101 Miller Street address: North Sydney NSW 1585
 country: AU
 phone: +61-2-93427681
 phone: +61-2-93420848
 phone: +61-2-93420983
 phone: +61-2-93420813
 phone: +61-2-93420717
 fax-no: +61-2-9342-0998
 fax-no: +61-2-9342-6122
 e-mail: ipadmin@optus.net.au
 trouble: send spam/abuse reports to abuse@optus.net.au
 trouble: please use <http://www.apnic.net/db/spam.html>
 trouble: to identify networks before sending reports and
 trouble: always include full headers/logs.
 admin-c: NC8-AP
 tech-c: NC8-AP
 tech-c: CN39-AP
 tech-c: GE7-AP
 tech-c: PS176-AP
 nic-hdl: OA3-AP
 notify: hostmaster@optus.net.au
 mnt-by: MAINT-OPTUS-OM-AP
 changed: ipadmin@optus.net.au 20021120
 source: APNIC

Result of search on nic-hdl "OA3-AP" ('Optus IP administrators' role object)

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APNIC Whois web query - example

Welcome to APNIC - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.apnic.net/

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Policy

Mailing list / Major policies / How are policies developed?

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3-4 September, India

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Internet community

Internet governance / Partnerships / Events calendar / Root DNS nameservers

FAQs | Search | Sitemap

Whois search

Go

Advanced whois search

News

26-06-07 APNIC releases statement on IPv4 consumption / 22-06-07 IPv6 deployment panel at ICANN meeting / 11-05-07 APNIC 24 / SANGOO 10 fellowship applications now open

NRO news

APNIC is a member of the NRO / 03-05-07 APNIC elects Vincent Naurin to Address Council / 02-05-07 ASO AC selects Branimir Beka to serve a new term on the ICANN Board / 30-04-07 ICANN Nominating Committee Extends Deadline for Statements of Interest to 18 May 2007

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FAQs | Search | Sitemap

Whois search

202.12.29.10

Go

Advanced whois search

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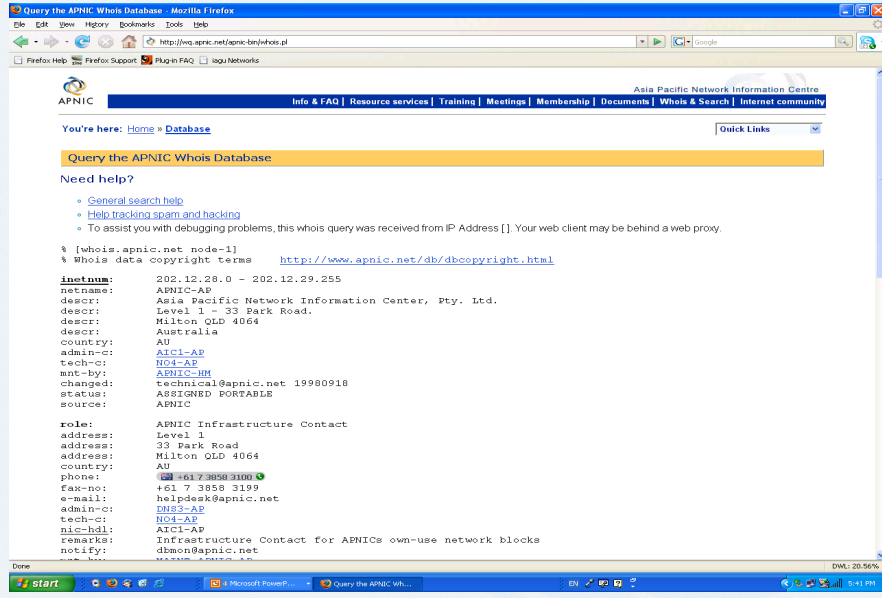
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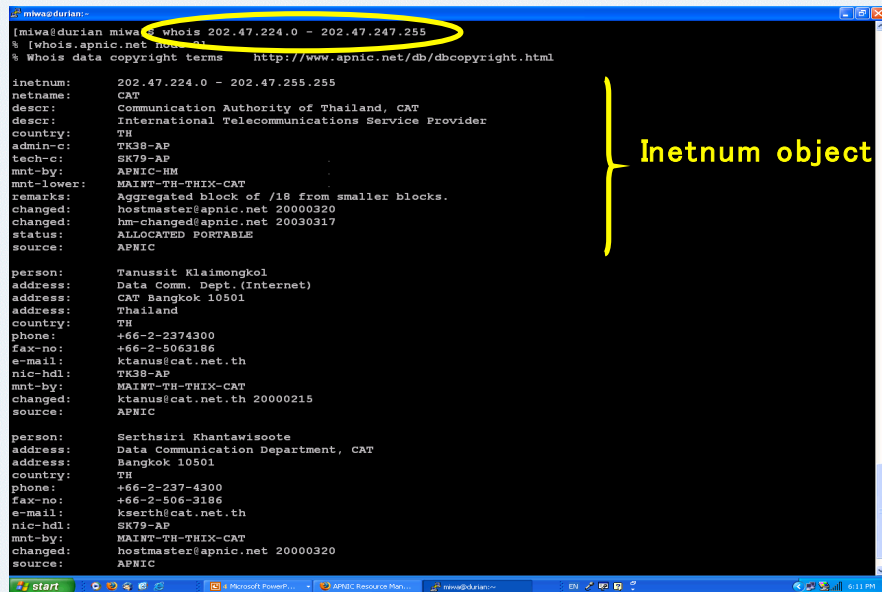
Done

start Microsoft PowerPoint Welcome to APNIC ... DWL 20.56% 5:40 PM

APNIC Whois web query - example



APNIC Whois command line query - example



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APNIC Whois command line query - example

```

[miwaldurian miwa]$ whois 202.47.224.0 - 202.47.247.255
% [whois.apnic.net node-2]
% Whois data copyright terms http://www.apnic.net/db/dbcopyright.html

inetnum: 202.47.224.0 - 202.47.255.255
netname: CAT
descr: Communication Authority of Thailand, CAT
country: TH
admin-c: TK38-AP
tech-c: SK79-AP
mnt-by: APNIC-HM
mnt-lower: MAINT-TH-THIX-CAT
remarks: Aggregated block of /18 from smaller blocks.
changed: hostmaster@apnic.net 20000320
changed: hm-changed@apnic.net 20030317
status: ALLOCATED PORTABLE
source: APNIC

person: Tanussit Klaimongkol
address: Data Comm. Dept. (Internet)
address: CAT Bangkok 10501
country: TH
phone: +66-2-2374300
fax-no: +66-2-5063186
e-mail: ktanus@cat.net.th
nic-hdl: TK38-AP
mnt-by: MAINT-TH-THIX-CAT
changed: ktanus@cat.net.th 20000215
source: APNIC

person: Serthsiiri Khantawisootte
address: Data Communication Department, CAT
address: Bangkok 10501
country: TH
phone: +66-2-237-4300
fax-no: +66-2-506-3186
e-mail: kserthth@cat.net.th
nic-hdl: SK79-AP
mnt-by: MAINT-TH-THIX-CAT
changed: hostmaster@apnic.net 20000320
source: APNIC

```

202.47.224.0 - 202.47.255.255

Network name

Country

Network description

nic-handle for administrative and technical contact

Network status

Database source

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APNIC Whois command line query - example

```

[miwaldurian miwa]$ whois 202.47.224.0 - 202.47.247.255
% [whois.apnic.net node-2]
% Whois data copyright terms http://www.apnic.net/db/dbcopyright.html

inetnum: 202.47.224.0 - 202.47.255.255
netname: CAT
descr: Communication Authority of Thailand, CAT
country: TH
admin-c: TK38-AP
tech-c: SK79-AP
mnt-by: APNIC-HM
mnt-lower: MAINT-TH-THIX-CAT
remarks: Aggregated block of /18 from smaller blocks.
changed: hostmaster@apnic.net 20000320
changed: hm-changed@apnic.net 20030317
status: ALLOCATED PORTABLE
source: APNIC

person: Tanussit Klaimongkol
address: Data Comm. Dept. (Internet)
address: CAT Bangkok 10501
country: TH
phone: +66-2-2374300
fax-no: +66-2-5063186
e-mail: ktanus@cat.net.th
nic-hdl: TK38-AP
mnt-by: MAINT-TH-THIX-CAT
changed: ktanus@cat.net.th 20000215
source: APNIC

person: Serthsiiri Khantawisootte
address: Data Communication Department, CAT
address: Bangkok 10501
country: TH
phone: +66-2-237-4300
fax-no: +66-2-506-3186
e-mail: kserthth@cat.net.th
nic-hdl: SK79-AP
mnt-by: MAINT-TH-THIX-CAT
changed: hostmaster@apnic.net 20000320
source: APNIC

```

Person object

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APNIC Whois command line query - example

```
[miwa@durian miwa]$ whois 202.47.224.0 - 202.47.247.255
% [whois.apnic.net node-2]
% Whois data copyright terms    http://www.apnic.net/db/dbcopyright.html

inetnum:        202.47.224.0 - 202.47.255.255
netname:        CAT
descr:          Communication Authority of Thailand, CAT
descr:          International Telecommunications Service Provider
country:        TH
admin-c:        TK38-AP
tech-c:         SK79-AP
mnt-by:         APNIC-HM
mnt-lower:      MAINT-TH-THIX-CAT
remarks:        Aggregated block of /18 from smaller blocks.
changed:        hostmaster@apnic.net 20000320
changed:        hmc-changed@apnic.net 20030317
status:         ALLOCATED PORTABLE
source:         APNIC

person:          Tanussit Klaimongkol
address:         Data Comm. Dept. (Internet)
address:         CAT Bangkok 10501
address:         Thailand
country:         TH
phone:           +66-2-2374300
fax-no:          +66-2-5063186
e-mail:          klanuss@cat.net.th
nic-hdl:         TK38-AP
mnt-by:         MAINT-TH-THIX-CAT
changed:        klanuss@cat.net.th 20000215
source:         APNIC

person:          Serthsiri Khantawisoote
address:         Data Communication Department, CAT
address:         Bangkok 10501
country:         TH
phone:           +66-2-237-4300
fax-no:          +66-2-506-3186
e-mail:          kserth@cat.net.th
nic-hdl:         SK79-AP
mnt-by:         MAINT-TH-THIX-CAT
changed:        hostmaster@apnic.net 20000320
source:         APNIC
```

nic-handle for administrative contact

Referencing to this person object

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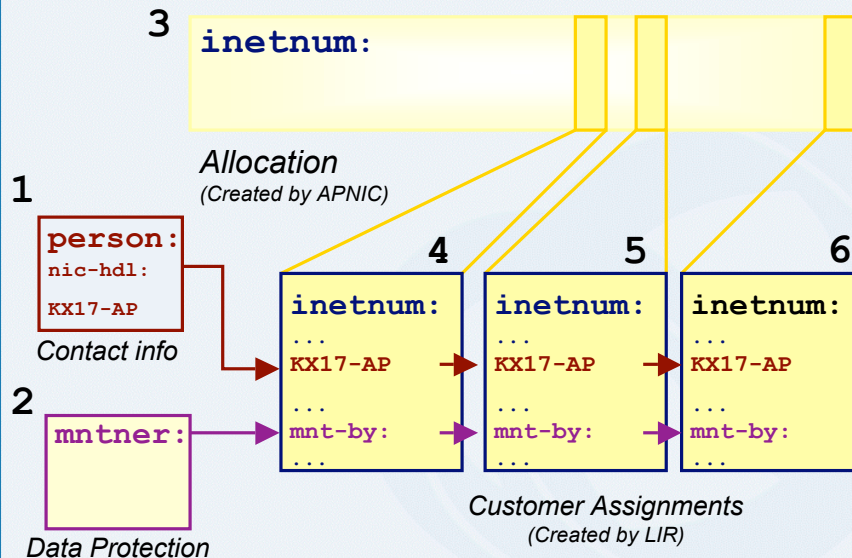
APNIC Whois database objects

LIR registration responsibilities

1. Create person objects for contacts
 - To provide contact info in other objects
2. Create mntner object
 - To provide protection of objects
 - (To be discussed later)
3. Create inetnum objects for all customer address assignments as private data
 - But you may change to be public data if you wish
 - Allocation object created by APNIC



Using the db – step by step



Whois database auto-responses

- Successful update **SUCCEEDED**
 - Objects accepted
- Warnings
 - Objects accepted but ambiguous
 - Objects corrected and accepted
- Errors **FAILED**
 - Objects NOT accepted



Don't understand the error message?

1. Help documentation
 - <http://www.apnic.net/docs/database-update-info.html>
2. Contact `<helpdesk@apnic.net>`
 - Include the error message

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>

Role object - example

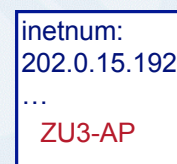
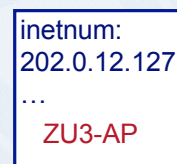
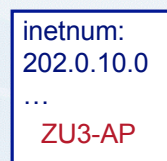
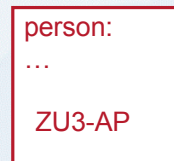
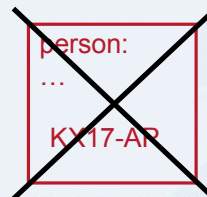
- Contains contact info for several contacts

Attributes	Values
role:	OPTUS IP ADMINISTRATORS
address:	101 Miller Street North Sydney
country:	AU
phone:	+61-2-93427681
phone:	+61-2-93420813
fax-no:	+61-2-9342-0998
fax-no:	+61-2-9342-6122
e-mail:	noc@optus.net.au
admin-c:	NC8-AP
tech-c:	NC8-AP
tech-c:	SC120-AP
nic-hdl:	OA3-AP
mnt-by:	MAINT-OPTUSCOM-AP
source:	APNIC

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.

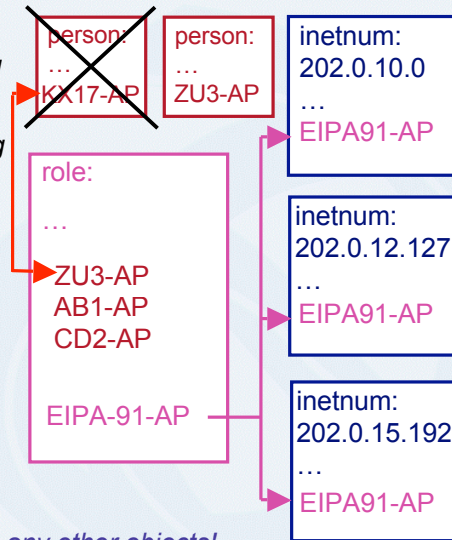


Replacing contacts in the db – using a role object

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

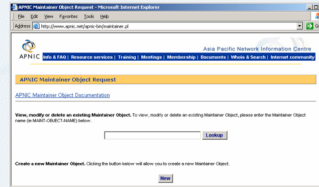


```

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
  
```

is in the APNIC database

Creating a maintainer object



1. Fill out webform
 - Provide:
 - Admin-c & tech-c
 - password
 - email address etc
2. Completed form will be sent to you
3. Forward request to maint-request@apnic.net
4. Maintainer will be created *manually*
 - Manual verification by APNIC Hostmasters
5. 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 authentication rule specified by its maintainer object

Authorisation mechanism

inetnum: 202.137.181.0 – 202.137.185.255
netname: EXAMPLENET-WF
descr: ExampleNet Service Provider

.....
mnt-by: MAINT-WF-EX

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
changed: kxander@example.com 20020731
source: APNIC

Maintainer specific attributes

- **mnt-nfy:**
 - Sends notification of any changes to maintained objects to email address specified
- **mnt-by:**
 - Maintainers must also be protected!
(Normally by themselves)
- **auth:**
 - Authentication method for this maintainer

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

```

Inetnum:      203.146.96.0 - 203.146.127.255
netname:      LOXINFO-TH
descr:        Loxley Information Company Ltd.
Descr:        304 Suapah Rd, Promprab,Bangkok
country:      TH
admin-c:      KS32-AP
tech-c:       CT2-AP
mnt-by:       APNIC-HM
mnt-lower:    LOXINFO-IS
changed:      hostmaster@apnic.net 19990714
source:       APNIC
  
```

① →
② →

1. Only APNIC can change this object
2. Only Loxinfo can create assignments within this allocation

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APNIC

Authentication/authorisation

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

```

Inetnum:      203.146.113.64 - 203.146.113.127
netname:      SCC-TH
descr:        Sukhothai Commercial College
Country:      TH
admin-c:      SI10-AP
tech-c:       VP5-AP
mnt-by:       LOXINFO-IS
changed:      voraluck@loxinfo.co.th 19990930
source:       APNIC
          
```

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APNIC

APNIC Whois Database update process

- Update transactions
 - Create a new object
 - Change an object
 - Delete an object
- Updates are submitted by email
 - Applies to public data only
 - E-mail to: <auto-dbm@apnic.net>
- Email message contains template representing new or updated object

Template

APNIC Whois Database update - web


- Creates a template through the web form

Template

- Template will be sent to you by email
- This should be forwarded to:

`<auto-dbm@apnic.net>`

- Common mistake

- Replying directly to the email 
 - (Adds extra character in front of each line)

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

APNIC Whois database update process

- Successful update
 - If Parse and Auth. steps succeed, database is updated
 - Confirmation by email to requestor
- Mirror to public server
 - Updates mirrored to “whois.apnic.net”
 - may take up to 5 minutes



Updating an existing public object

- Change relevant fields
- Add your maintainer password
- Update the changed attribute
- Email updated object to:

`<auto-dbm@apnic.net>`

- Note
 - Primary keys cannot be modified

Deleting a public object

- Copy object as-is in database into email
- Add your maintainer password
- Leave the changed attribute

```
inetnum:      202.182.224.0 - 202.182.225.255
netname:      SONY-HK
...
mnt-by:       MAINT-CNS-AP
changed:      ph@macroview.com 19990617
source:       APNIC
password:   x34zky
delete:     no longer required me@company.com
```

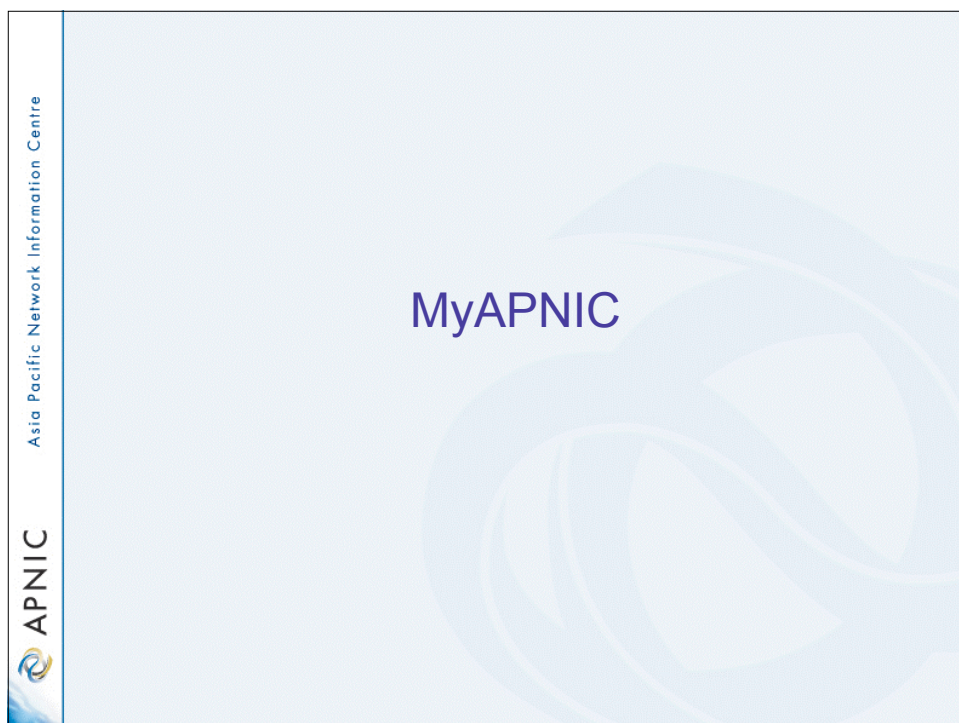
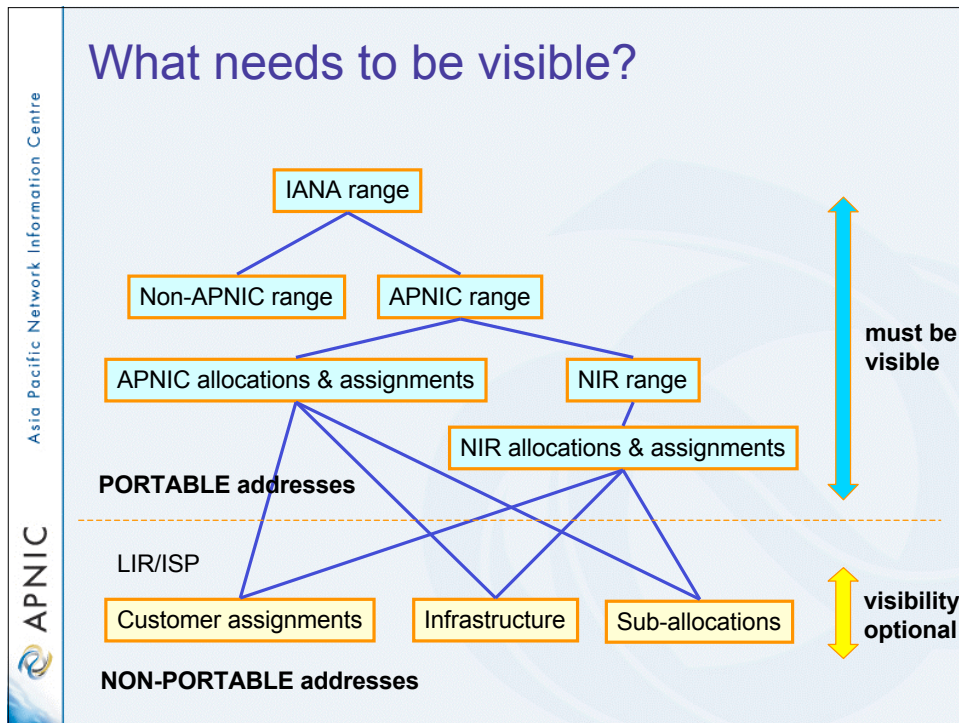
Note: Referenced objects cannot be deleted (02/99)

Forgotten the password?

- If you are an APNIC member
 - Are you an APNIC's authorised contact?
 - If yes,
 - send a request for password reset to helpdesk@apnic.net
 - If no,
 - become an authorised contact first
 - <http://www.apnic.net/info/faq/isp-request-tips.html#2>
- If you are not an APNIC member and you are holding legacy space
 - Send your request for password reset to helpdesk@apnic.net
 - Go through necessary procedures to confirm your custodianship before resetting password

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

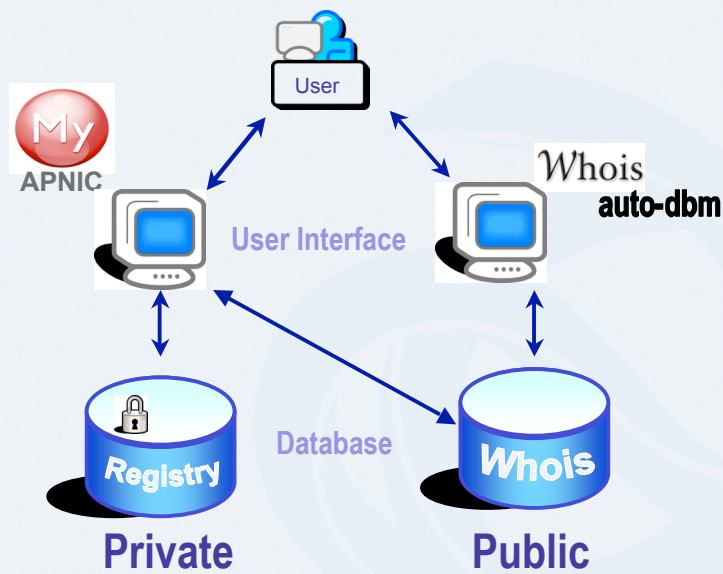


MyAPNIC

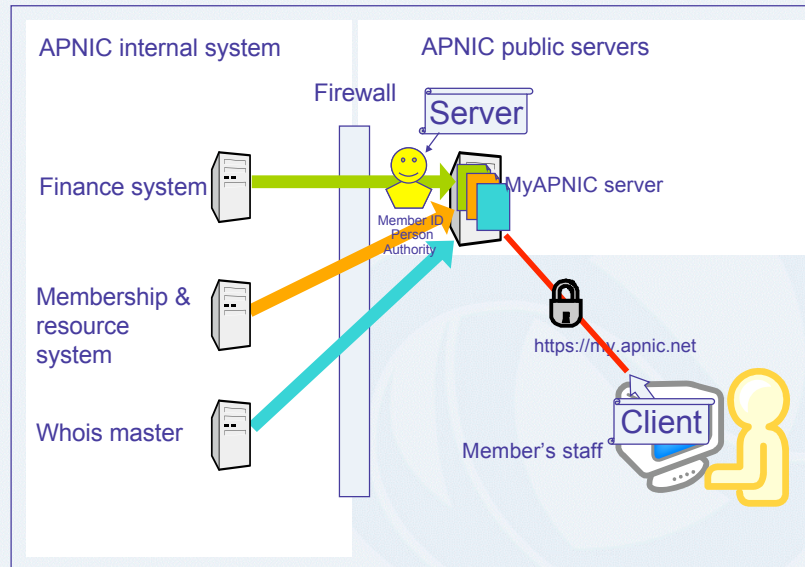


A day-to-day tool to manage your APNIC account and resources

Database tools



How it works



MyAPNIC menus

- Resource information
 - IPv4, IPv6, ASN
- Administration
 - Membership detail
 - Contact persons
 - Billing history
- Training
 - Training history
- Technical
 - Looking glass
- Tools


How can I obtain an APNIC digital certificate? (part A)

1. Fill in the online form:
<https://www.apnic.net/ca>
2. Submit the form
3. For faster processing, scan the form and your photo ID, attach the images to an e-mail, and send it to:
ramanager@apnic.net
 - Without the form, APNIC will not process your request

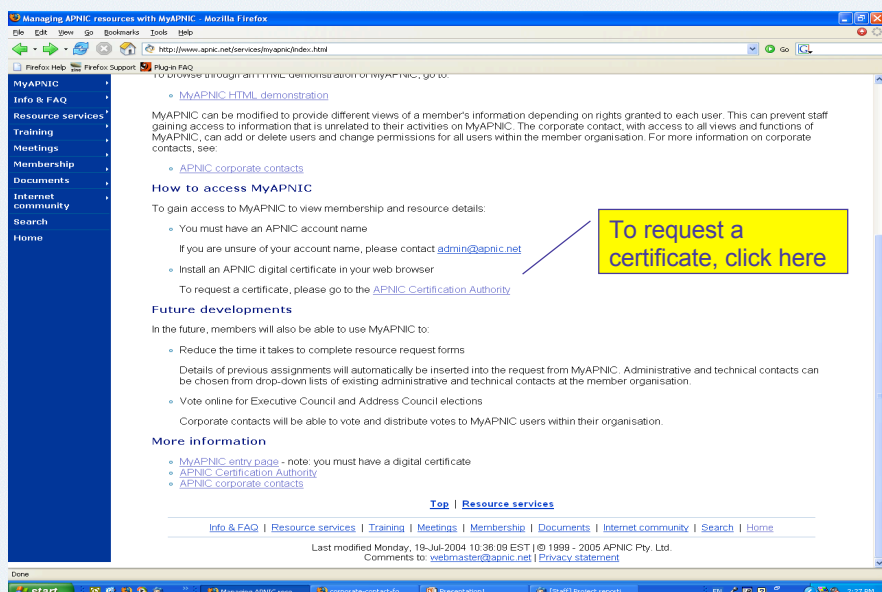
How to use an APNIC digital certificate? (part B)

1. Load client certificate
 - Once a new certificate is issued to you, load it into your browser
 - You can export your certificate to a different computer or to a different browser
2. Verify client certificate
3. Go to <https://my.apnic.net> to make sure everything is working fine

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APNIC digital certificate

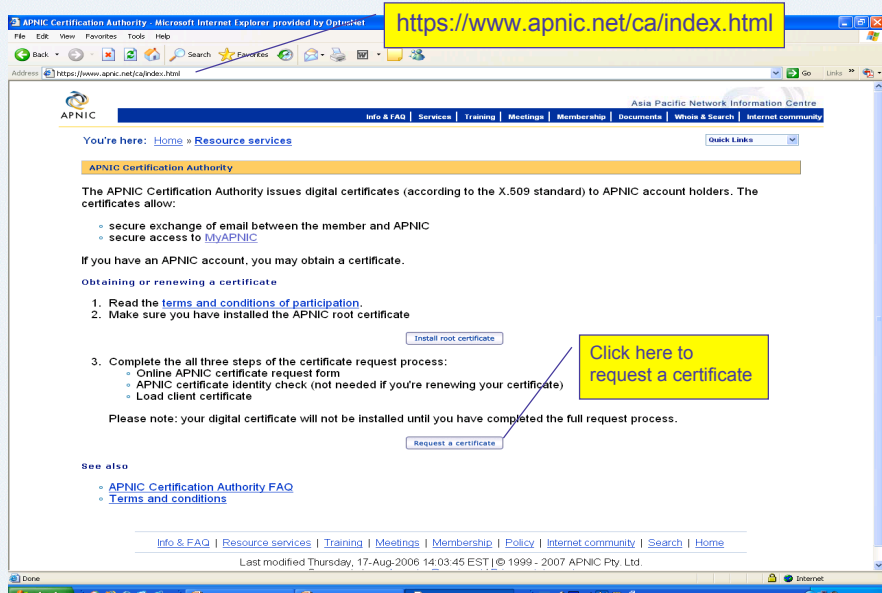


To request a certificate, click here

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Request a certificate



Click here to request a certificate

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)

My APNIC screen capture

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APNIC

Log in

MyAPNIC - Resources - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://my.apnic.net/resources/index.html

MyAPNIC - Resources

Resources Administration Training & Events Technical Tools

APNIC

MyAPNIC

Hello Log out

BEHINDER

Please register your whois maintainer.

[04 October 2007]

IP Calculator

The Internet Protocol Address Calculator is an open-source java-based tool. Network administrators can use this calculator to perform calculations on IPv4 and IPv6 address ranges. It can be downloaded for free from: <http://sourceforge.net/projects/ipcalculator>

[16 August 2007]

What's new!

Pay and renew your membership online

Download your whois data at any sublet level

Generate prefix report of your IP range

Add/update/delete whois objects

You're here: Home > Resources

Resources

Maintainer registration

Your maintainer is not registered in MyAPNIC. Register now

Maintainer registration

Please register your maintainer here. MyAPNIC will automatically insert the correct password whenever you update a whois object using any one of the registered maintainer. Only CRTP-PW and MDS-PW authentication can be registered.

Registered Maintainer

Add new maintainer	Authentication method	Password	Delete
<input type="text"/>	<input type="text"/>	<input type="password"/>	<input type="button" value="Save"/>

© 2001 - 2007 MyAPNIC Comments to: webmaster@apnic.net

Done my.apnic.net DWL 20.55%

start Microsoft PowerPoint MyAPNIC - Resources

Asia Pacific Network Information Centre

APNIC

Maintainer registration

MyAPNIC - Whois maintainers - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://my.apnic.net/resources/maintainer.html

MyAPNIC - Whois maintainers

Resources Administration Training & Events Technical Tools

APNIC

MyAPNIC

Hello Log out

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Please register your whois maintainer.

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Add new maintainer	Authentication method	Password	Delete
<input type="text"/>	<input type="text"/>	<input type="password"/>	<input type="button" value="Save"/>

© 2001 - 2007 MyAPNIC Comments to: webmaster@apnic.net

Done my.apnic.net DWL 20.55%

start Microsoft PowerPoint MyAPNIC - Whois mai...

[illegible]

MyAPNIC IPv6, Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://my.apnic.net/resources/ipv6.html

Firefox: Firefox Support Plug in FAQ Log in Networks

MIT http://csrc.net.go.jp/submitPublicIP.html 地球人ネットワーク先発申込: スレー Timeskeeper - Version 9.3.02 Welcome to APNIC MyAPNIC - IPv6

Resources Administration Training & Events Technical Tools

APNIC MyAPNIC

Hello Log out

REMEMBER

Please register your website maintainer.

[04 October 2007]

IP Calculator

The Internet Protocol Address Calculator is an open-source, java-based tool. Network administrators can use this calculator to perform calculations on IPv4 and IPv6 address ranges. It can be downloaded for free from: <http://sourceforge.net/projects/ipcalculator>

[16 August 2007]

What's new!

Pay and renew your membership online

Download your whois data at any subnet level

Generate prefix report of your IP range

Add/update/delete whois objects

You're here: Home > Resources > IPv6 details

Resources

Your maintainer is not registered in MyAPNIC. Register now

IPv6

Add public assignment
Add private assignment

Start IP	Length	Date	Assignment status	Download Public
2001:DB8::	/32	2007-06-22	Expanded graph: OTO	<input type="checkbox"/>

Done

start Renewauto back-up-200 Microsoft Po... MyAPNIC - ... EN 1:43 20.53%

my.apnic.net DWL 20.53%

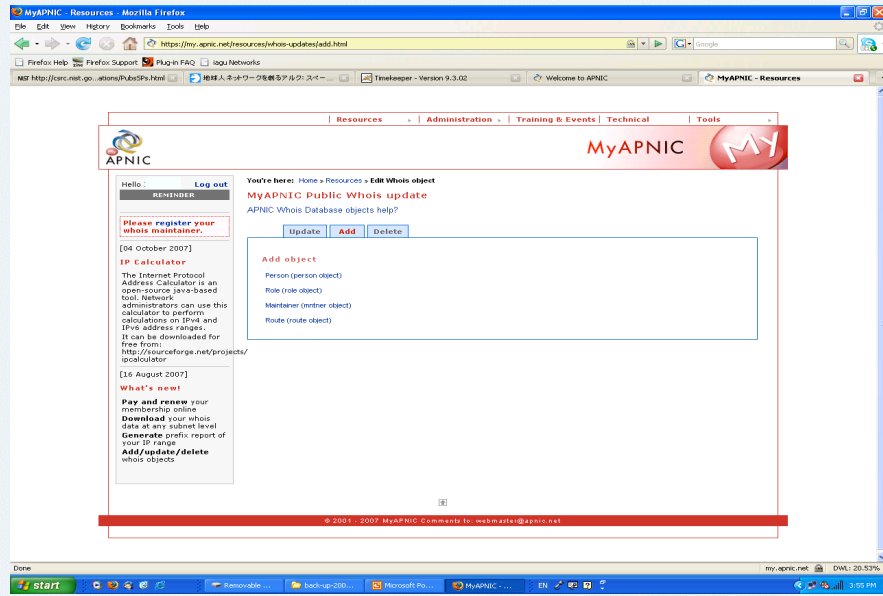
ASN management

The screenshot shows the MyAPNIC website in a Mozilla Firefox browser window. The page has a navigation bar with links: Resources, Administration, Training & Events, Technical, and Tools. The main content area is titled "MyAPNIC" and "AS numbers". It includes a sidebar with a "Log out" button, a "Please register your whois maintainer" message, and a "What's new!" section. The main content area displays a table with the header "239" and a "Download" button. The browser's address bar shows the URL "https://my.apnic.net/resources/asn.html".

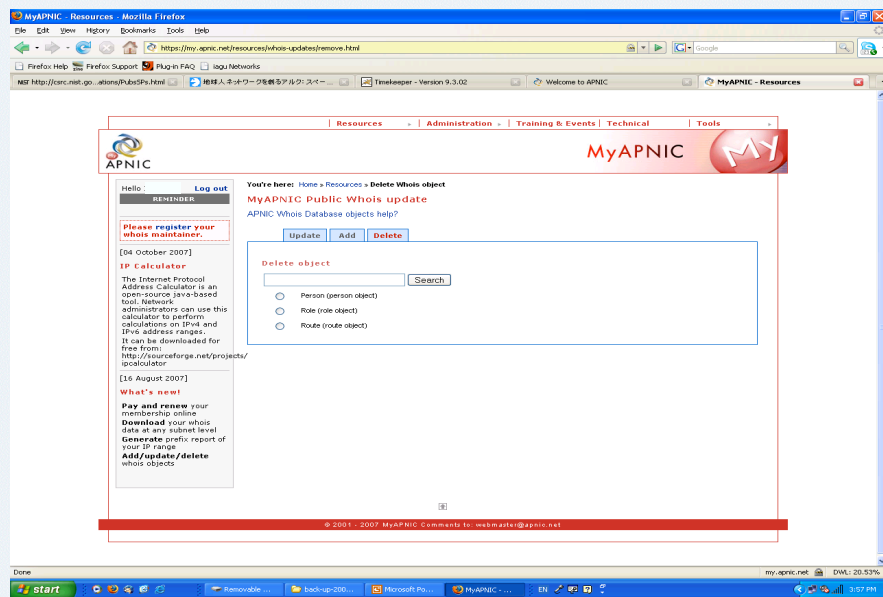
APNIC Whois DB “update”

The screenshot shows the MyAPNIC website in a Mozilla Firefox browser window. The page has a navigation bar with links: Resources, Administration, Training & Events, Technical, and Tools. The main content area is titled "MyAPNIC" and "APNIC Public Whois update". It includes a sidebar with a "Log out" button, a "Please register your whois maintainer" message, and a "What's new!" section. The main content area displays a form with the title "Update object" and a "Search" button. The form has three radio buttons: "Person (person object)", "Role (role object)", and "Route (route object)". The browser's address bar shows the URL "https://my.apnic.net/resources/whois-update.html".

APNIC Whois DB “add”



APNIC Whois DB “delete”



Open correspondence

MyAPNIC - Hostmaster correspondence - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://my.apnic.net/resources/tickets.html

Resources Administration Training & Events Technical Tools

APNIC MyAPNIC

Hello Log out

Remember

Please register your whois maintainer.

[04 October 2007]

IP Calculator

The Internet Protocol Address Calculator is an open-source java-based tool. Network administrators can use this calculator to perform calculations on IPv4 and IPv6 address ranges. It can be downloaded for free from: <http://sourceforge.net/projects/ipcalculator>

[16 August 2007]

What's new!

Pay and renew your membership online

Download your whois data at any subnet level

Generate prefix report of your IP range

Add/update/delete whois objects

You're here: Home > Resources > Open correspondence

Resources

Open correspondence

[New request](#)

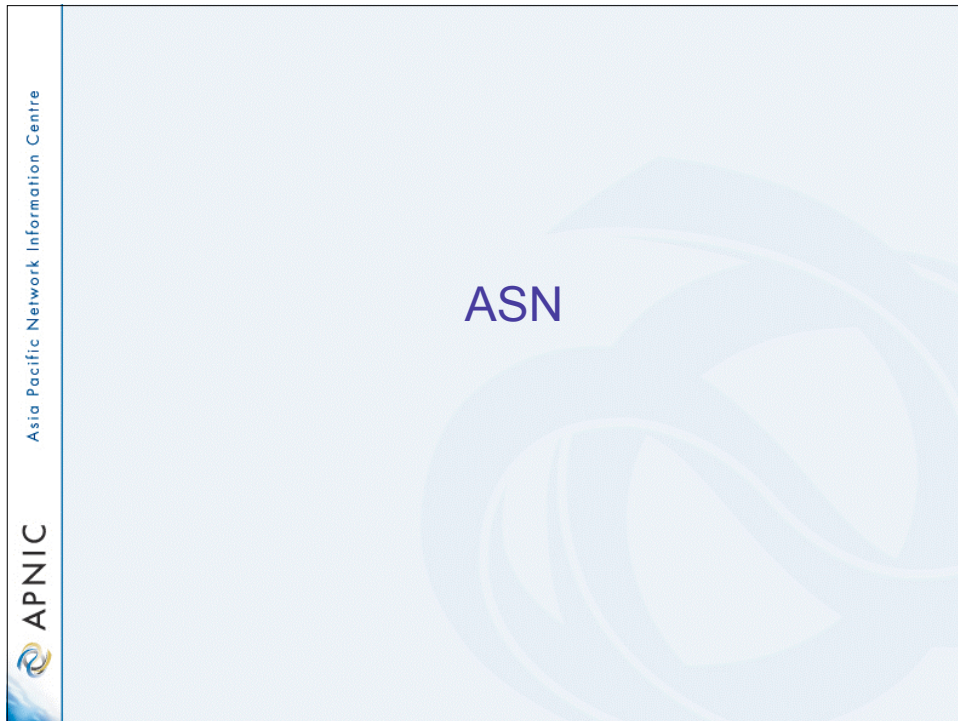
Ticket#	Status	Subject	Requestor	Created
12355	new	[APNIC-AP] Direct allocation request for "USEN-West"	miwa@apnic.net	Fri Nov 2 17:18:04 2007

© 2001 - 2007 MyAPNIC. Comments to: webmaster@apnic.net

Done my.apnic.net DWL: 20.47%

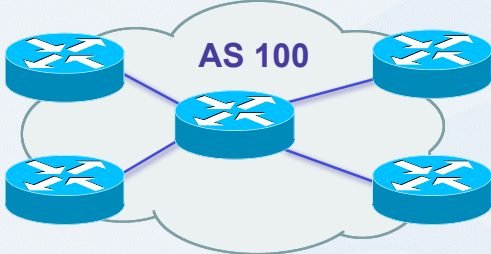
start 102-Dec-2007.gpt MyAPNIC - Hostmaster...

Questions ?



APNIC Asia Pacific Network Information Centre

What is an Autonomous System?



- Collection of networks with same routing policy
- Usually under single ownership, trust and 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 ASN

- Complete the request form
 - web form available:
 - <http://www.apnic.net/db/aut-num.html>
- Request form is parsed - real time
 - Must include routing policy
 - multiple import and export lines
 - Is checked for syntactical accuracy
 - based on RPSL (rfc2622)
 - Peers verified by querying routing table
 - [NO-PARSE] will not send request to parser



Requesting an ASN - Customers

1. Requested directly from APNIC
 - AS number is “portable”
 2. Requested via member
 - 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

ASN request form

Create Aut-num Object - Microsoft Internet Explorer

Address: <http://www.apnic.net/apnic-bin/creform.pl>

APNIC Asia Pacific Network Information Centre
[Info & FAQ](#) | [Resource services](#) | [Training](#) | [Meetings](#) | [Membership](#) | [Documents](#) | [Whois & Search](#) | [Internet community](#)

Create Aut-num Object

Aut-num Object

What is this form to be used for?
 This form assists in the creation and maintenance of aut-num objects. The aut-num describes the details of the registered owner of an Autonomous System and their routing policy for that AS. See [RFC 2622](#) for details.

Help completing this form
 See the [Guide to the APNIC AS Number Request Form](#). [Guide to the ASN request form](#)

(* indicates mandatory field.)

* **Name:** eg: Ky Xander
 The name of the person completing this form

* **Account-name:** eg: ACME-PH
 Your APNIC account name

* **Org-relationship:** eg: Consultant (or employee or...
 Your APNIC account name

Request form – routing policy

Create Aut-num Object - Microsoft Internet Explorer

Address: <http://www.apnic.net/apnic-bin/creform.pl>

* **Descr:** eg: Global Transit Inc. Transit AS
 A short description of this object and the name of the organisation associated with

* **Country:** eg: JP
 Name of the country of the admin-c

Import: eg: from AS9386 Action pref=100
 Routing information your AS will accept from neighbouring Autonomous Systems
 from AS1 Action pref=100; accept ANY
 from AS2 Action pref=100; accept ANY
 More information regarding RPSL syntax can be found in [RFC 2622](#)

Export: eg: to AS9444 Announce THIS-AS
 Routing information your AS will send to peer Autonomous Systems
 To AS1 Action pref=100; announce ANY
 To AS2 Action pref=100; announce ANY
 More information regarding RPSL syntax can be found in [RFC 2622](#)

Default: eg: to AS9386 Action pref=10
 If applicable, a description of how default routing policy is applied.
 To AS1 Action pref=100; announce ANY
 To AS2 Action pref=100; announce ANY
 More information regarding RPSL syntax can be found in [RFC 2622](#)

Aut-num object example

```
aut-num:      AS4777
as-name:      APNIC-NSPIX2-AS
descr:        Asia Pacific Network Information Centre
descr:        AS for NSPIX2, 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
```

**POLICY
RPSL**

4 byte AS number

Updated Jan 2007


This module is developed based on several articles written by Geoff Huston, APNIC Chief Scientist and George Michaelson, APNIC Senior R&D Officer

Background


- Current 2 byte ASN (16 bits)
 - Possibly run into the exhaustion by 2010
 - 4 byte ASN is developed by IETF
- 4 byte ASN distribution policy (32 bits)
 - Reached consensus in APNIC in 2006
- Timeline
 - APNIC started allocating 4 byte ASN upon specific request Jan 2007, default 2 byte ASN
 - Jan 2009: Default 4 byte ASN, 2 byte ASN on request
 - Jan 2010: 4 byte ASN only

Canonical textual form of 4 byte ASN

- 2 byte only ASN
 - May be represented as a 16 bit value decimal number, with no leading zeros, or “.” character.
 - They may be represented as 4 byte ASN.
- 4byte ASN
 - If their value lies in the range 0 – 65535
 - 4 byte ASN may be represented identically as 2 byte only ASN.
 - Otherwise, they MUST be represented identically as for 4 byte only ASN.
 - For values in the range 0 – 65535 the canonical 4 byte ASN representation
 - 0. <16 bit decimal value>
- 4 byte only ASN
 - MUST be represented as two pairs of 16 bit decimal values with no leading zeros, separated by the “.” character.
 - <high order 16 bit value in decimal> . <low order 16 bit value in decimal>
 - E.g., a 4 byte ASN of value 65546 (decimal)
 - 1.10
- APNIC resource range: 2.0 ~ 2.1023

**APNIC**
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Questions ?

**APNIC**
Asia Pacific Network Information Centre

IPv4 unallocated address space exhaustion

Acknowledgements

The material used in this course was created in collaboration with Randy Bush (IIJ) and Geoff Huston (APNIC) and includes material provided by them.

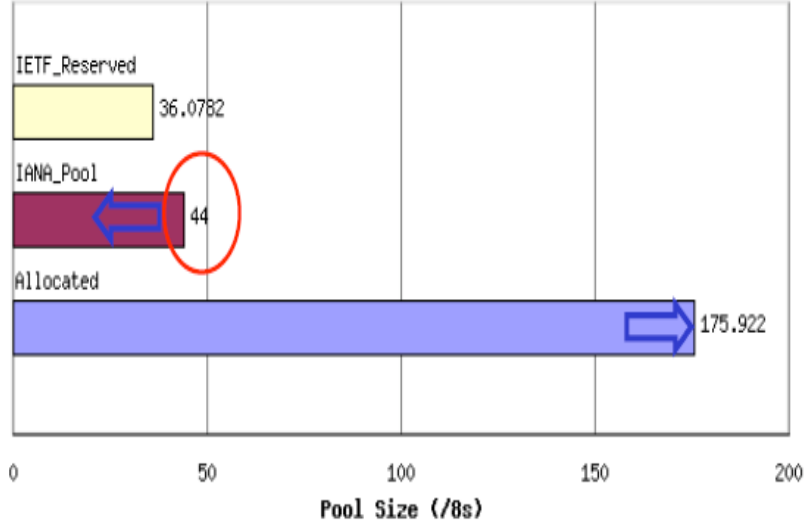
APNIC acknowledges with thanks and appreciation the contribution and support of the above.

IPv4 address exhaustion and IPv6 implementation

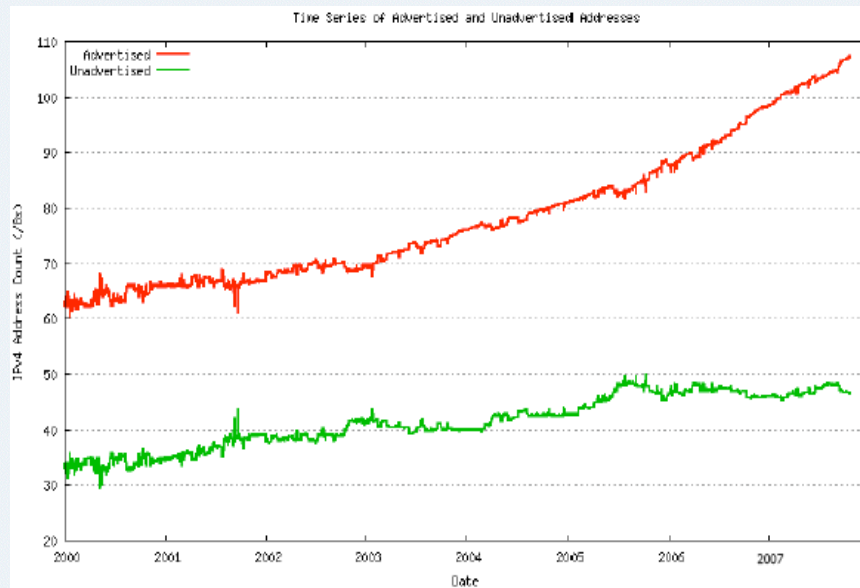
- Discussion
 - Does your company have a plan for coping with IPv4 unallocated address space exhaustion?
 - Are your staff educated about IPv6 technical knowledge?
 - Is your network equipment ready to deploy IPv6?
 - What other thought do you have?
- JPNIC community's effort
 - <http://www.nic.ad.jp/en/ip/ipv4pool/ipv4exh-report-071207-en.pdf>

Current status of IPv4

IPv4 Address Pool Status

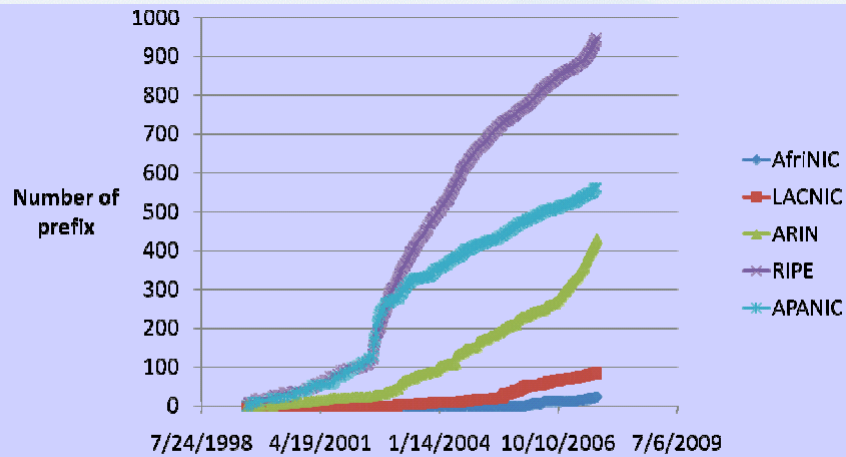


Advertised and unadvertised addresses



IPv6 allocation and announcements

• Prefix allocation distribution



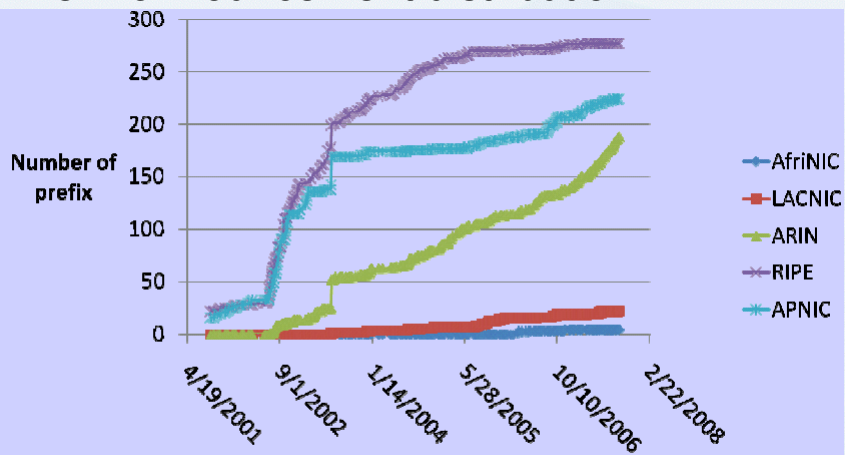
2007.10.22 IPv6 Alloc & Announce

Copyright 2007, R6net, LLC

<https://www.ripe.net/ripe/meetings/ripe-55/presentations/bush-ipv6-allocation>

IPv6 allocation and announcements

• Prefix announcement distribution



2007.10.22 IPv6 Alloc & Announce

Copyright 2007, R6net, LLC

<https://www.ripe.net/ripe/meetings/ripe-55/presentations/bush-ipv6-allocation>

APNIC 24 community resolution

- Endorsed at APNIC 24
 - [Community resolution on IPv4 and IPv6 issues, 7 September 2007](#)
- The APNIC community recognises that the remaining free pool of IPv4 address space is likely to be consumed within 2 to 4 years
 - Requires a concerted effort by the community
 - Responsible measures in managing remaining IPv4 addresses
 - Promote the adoption of IPv6
 - Call upon leading senior and expert members to provide strong leadership in the search of solutions to these issues

Where are we heading?

- IPv4 address consumption is speeding up
 - But remember “number of advertised address block” is about 1/3 of actually assigned/allocated address space
 - Gradually “Advertised addresses” will increase
 - Where is rapid consumption happening?
 - APNIC region
 - Possibly such address space will be traded in the market
- IPv4 UNALLOCATED address space exhaustion
 - According to Geoff's model (dated: 22 Oct 2007), IANA will allocate its last IPv4 /8 to an RIR on 22 May 2010
 - Tomorrow's prediction will be different!

Where are we heading?


- Some possible scenarios (but may need to implement all):
 - Persist in IPv4 networks using more NATs
 - NAT's deployment cost can be internalised by ISPs
 - NATs on steroid
 - Standardise its specification?
 - Address markets emerging for IPv4
 - Remember so much “unadvertised address space”
 - Routing fragmentation
 - IPv6 transition
 - But IPv6 is not backward compatible with IPv4 on the wire
 - So dual stack is mandatory
 - Dual stack requires IPv4 addresses
 - So we need to stretch IPv4

<https://www.ripe.net/ripe/meetings/ripe-55/presentations/huston>

Where are we heading?

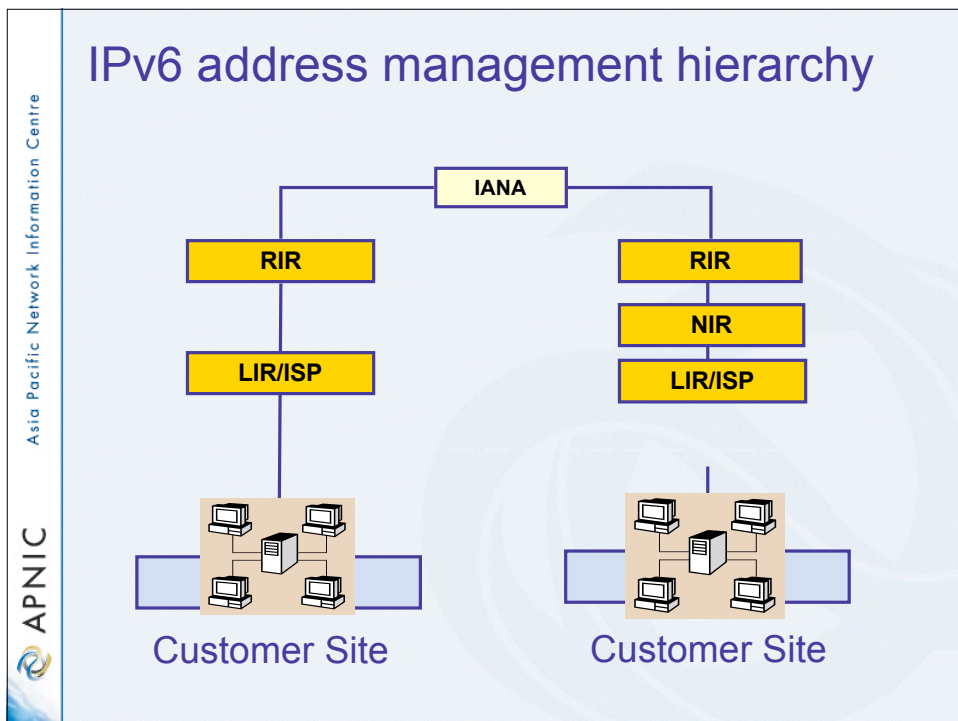
- We should preserve the functionality and integrity of the Internet as a service platform
 - Functionality of applications
 - Viability of routing
 - Capability to sustain continued growth
 - Integrity of the network infrastructure

<https://www.ripe.net/ripe/meetings/ripe-55/presentations/huston>



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IPv6 policy and procedures



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
- Balance conflict of interests

IPv6 initial allocation

- Initial allocation criteria
 - Plan to connect 200 end sites within 2 years
 - Default allocation (“slow start”)
- Initial allocation size is /32
 - Larger initial allocations can be made if justified according to:
 - IPv6 network infrastructure plan
 - Existing IPv4 infrastructure and customer base
- License model of allocation
 - Allocations are not considered permanent, but always subject to review and reclamation

End site assignment policy for IPv6

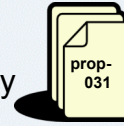
- Any size longer than /48
 - Decision is up to LIRs or ISPs
 - Implication: any size between /64 - /48
 - Global coordination is required
 - Assuming the HD ratio changes to a larger value
 - HD ratio measurement unit: /48 => /56
 - Implication: Register all assignments shorter than /56?
 - HD ratio: 0.8 => 0.94
 - Achieve more efficient address utilisation
 - useful lifetime of IPv6 to encompass a period in excess of 100 years



IPv6 utilisation

- Utilisation determined from end site assignments
 - LIR 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

Amend IPv6 assignment and utilisation requirement



- IPv6 assignment and utilisation requirement policy
 - HD ratio: 0.8 => 0.94
 - Measurement unit: /48 => /56
- The HD ratio threshold is
 - $HD = \log(\text{/56 units assigned}) / \log(16,777,216)$
 - $0.94 = 6,183,533 \times \text{/56 units}$
- Calculation of the HD ratio
 - Convert the assignment size into equivalent /56 units
 - Each /48 end site = $256 \times \text{/56 units}$
 - Each /52 end site = $16 \times \text{/56 units}$
 - Each /56 end site = $1 \times \text{/56 units}$
 - Each /60 end site = $1/16 \times \text{/56 units}$
 - Each /64 end site = $1/256 \times \text{/56 units}$
- Current status
 - Implemented

IPv6 utilisation (HD = 0.94)

- The ratio 0.94 will be implemented soon (March 2007)
- Percentage utilisation calculation

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

RFC 3194

"In a hierarchical address plan, as the size of the allocation increases, the density of assignments will decrease."

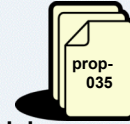
Subsequent allocation

- Must meet HD = 0.94 utilisation requirement of previous allocation (subject to change)
 - From March 2007
- 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

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 multihoming

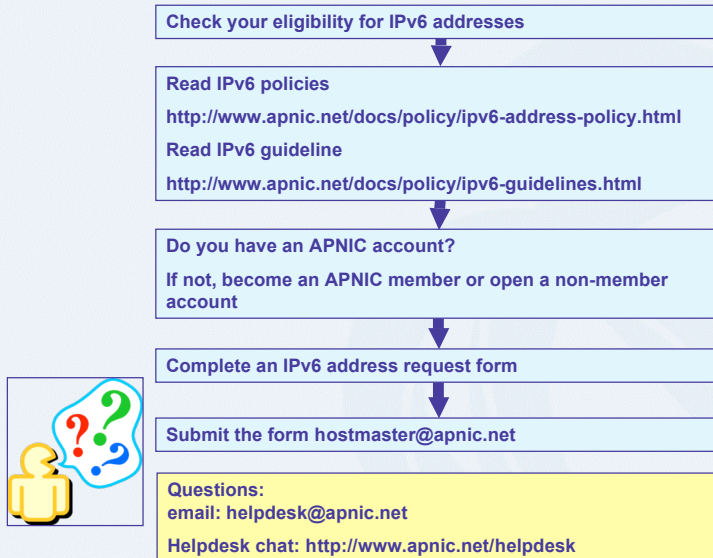


- The current policy did not allow IPv6 portable assignment to end-sites
 - Obstructs setting redundancy connectivity for stable network operation
 - Size: /48, or a shorter prefix if the end site can justify it
 - To be multihomed within 3 months
 - Assignment from a specified block separately from portable allocations address space
- Current status
 - Implemented

IPv6 policy – have your say!

- Limited experience of policy in action
 - Your feedback very important
 - Policy always subject to change and refinement
- Open discussion list
 - global-v6@lists.apnic.net (all regions)
 - SIG Policy mailing list (APNIC region)
- Documentation
 - FAQ information and more!
 - http://www.apnic.net/services/ipv6_guide.html
 - Guidelines document under development
 - To assist new requestors with policy

How do I apply for IPv6 addresses?



IPv6 address request form

- <http://ftp.apnic.net/apnic/docs/ipv6-alloc-request.txt>

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IPv6 address request form

The screenshot shows a web browser window with the title 'http://ftp.apnic.net/apnic/docs/ipv6-alloc-request.txt'. The page content includes the following sections:

- APNIC Document identity**
 - Title: APNIC IPv6 Allocation Request Form
 - Short title:
 - Document ref:
 - Version:
 - Date of original publication:
 - Date of this version:
 - Review scheduled:
 - Obsoletes:
 - Status: Active
 - Comments: n/a
- APNIC IPv6 Allocation Request Form**
- What is this form used for?**

This form is for use by organisations requesting IPv6 allocations that they will use for addressing their own infrastructure and making assignments to customers.

It may be used by APNIC account holders only.
- Other IP address request forms**

If you are an APNIC member seeking an IPv4 allocation, then use the "IPv4 ISP Request Form", at:

<http://www.apnic.net/eservices/ipv4/index.html> (web)

<ftp://ftp.apnic.net/apnic/docs/isp-address-request> (text)

If you are seeking a portable address assignment under APNIC's multihoming, ISP or critical infrastructure policies, then use the "APNIC Portable Assignment Request Form", at:

<ftp://ftp.apnic.net/apnic/docs/portable-assign-request>
- Eligibility for IPv6 allocation**

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IPv6 address request form

- Requester template
 - Name, email, acct-name, org-relationship:
- Network template
 - Netname, descr, country, admin-c, tech-c, remarks, changed, mnt-lower
- IPv6 usage template
 - Services, cust-types, cust-network, infrastructure, network-plan
- Additional information

Reverse DNS Delegation

Registry Procedures

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

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”



Delegation procedures

- Upon allocation, member is asked if they want /24 place holder domain objects with member maintainer
 - Gives member direct control
- Standard APNIC database object,
 - can be updated through online form or via email.
- Nameserver/domain set up verified before being submitted to the database.
- Protection by maintainer object
 - (auths: CRYPT-PW, PGP).
- Zone file updated 2-hourly

Example 'domain' object

domain:	124.54.202.in-addr.arpa
descr:	co-located server at mumbai
country:	IN
admin-c:	VT43-AP
tech-c:	IA15-AP
zone-c:	IA15-AP
nservers:	dns.vsnl.net.in
nservers:	giasbm01.vsnl.net.in
mnt-by:	MAINT-IN-VSNL
changed:	gpsingh@vsnl.net.in 20010612
source:	APNIC

Delegation procedures

– request form

- Complete the documentation
 - <http://www.apnic.net/db/domain.html>
- 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..

Reverse DNS request form

Create Domain Object - Microsoft Internet Explorer

Address <http://www.apnic.net/apnic-bin/creform.pl>

APNIC Info & FAQ | Resource services | Training | Meetings | Membership | Documents | Whois & Search | Internet community

Create Domain Object

Domain Object

What is this form to be used for?
This form assists in the creation and maintenance of domain objects. The domain class:

(* indicates mandatory field)

***Domain:**

***Descr** -- This is added by [http:// www.apnic.net/db/domain.html](http://www.apnic.net/db/domain.html) The reverse delegation xone for the

Country:

***Adminc**
List the NIC handles for the administrative contacts (admin-c). Other texttag : DNS4 -AP

An admin -c must be someone physically located at the site of the network.

Request form

Create Domain Object - Microsoft Internet Explorer

Address: http://www.apnic.net/apnic-bin/createform.pl

***Nserver**

Remarks:

Notify:

***Mntby:**

***Password**
 You must supply a password for one of the maintainers listed in this field

Mntlower:

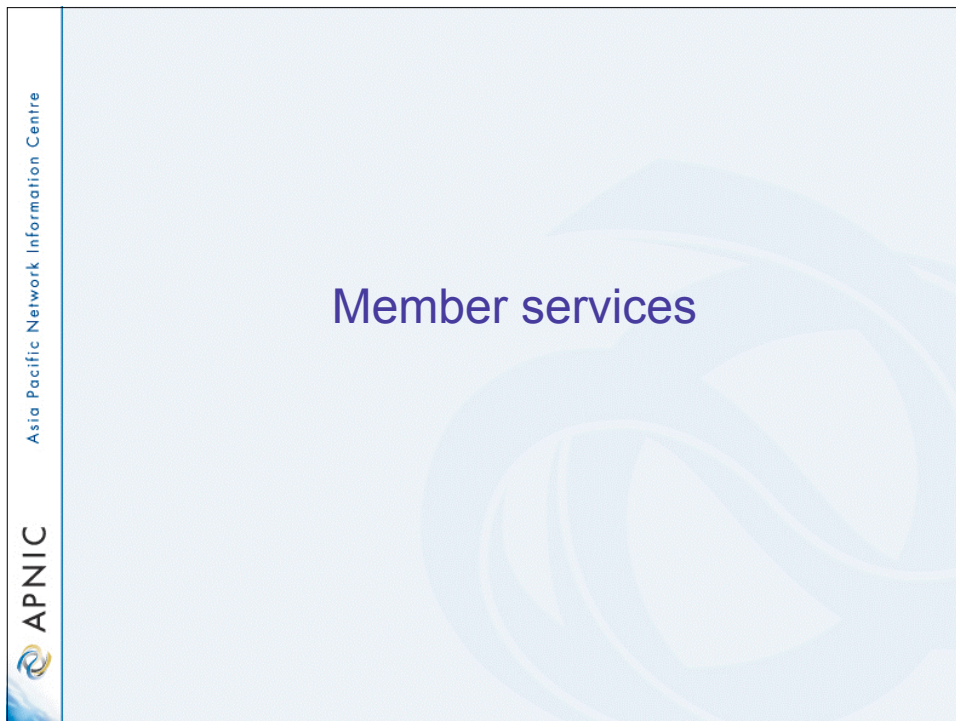
Evaluation

- 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

Creation of domain objects

- APNIC highly recommend you to use MyAPNIC when creating domain objects
 - MyAPNIC parser will check the maintainer of 'inetnum' object
 - If the password matches no errors will be returned
- Can use MyAPNIC to create multiple domain objects at once
 - ex: If you are allocated a /19, you can provide the full IP range and 32 domain objects can be created in one go

Questions?



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Member Services Helpdesk

- One point of contact for all member enquiries
- Online chat services

Helpdesk hours
9:00 am – 7:00 pm (AU EST, UTC + 10 hrs)

ph: +61 7 3858 3188 fax: 61 7 3858 3199

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

This slide features the APNIC logo and name on the left. The main content area has a light blue background with a faint, stylized graphic of a globe or network structure. The title 'Member Services Helpdesk' is centered in a dark blue font. Below the title, there are two bullet points listing services. A 'Helpdesk hours' section follows, with a time range. Contact information (phone and fax) is provided. A 'Helpdesk' icon is shown. The slide concludes with two main bullet points: 'More personalised service' and 'Faster response and resolution of queries', each with sub-points.

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APNIC Helpdesk chat

The screenshot shows a chat window titled "APNIC Helpdesk Chat". It indicates a session with "George of Helpdesk". The chat history shows a message from George: "Hello miwa. You are chatting to APNIC helpdesk. This is". The window includes a "Send" button and a status bar at the bottom showing "Online: 00:47".


The screenshot shows the APNIC Helpdesk chat page. It features a "Quick Links" section, a "Direct access to APNIC Hostmasters to resolve all enquiries" statement, and a "APNIC Helpdesk chat" section with an "Online" status indicator. Below this, it lists "Available during office hours except: (UTC + 10 hours)" with specific dates and times. A "Helpdesk queries" section lists faster responses for status of requests, help in completing application forms, membership enquiries, billing issues, and database enquiries. A "Note" at the bottom states: "Please send all resource requests to hostmaster@apnic.net".

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ICONS


The screenshot shows the home page of the ICONS (Internet Community of Online Networking Specialists) website. It features a search bar, a "Search by keywords" section with a list of terms including "apnic", "bind", "cidr", "consumption", "dns", "dnsec", "internet", "governance", "ipv6", "ipnic", "malaysia", "pacnog", "poin", "icons", "root", "server", "routing", "search", "security", "spam", "tao", and "voip". There is also a "Member login" section with a "Hello, miwa" message and a "Logout" button.

The screenshot shows the main content area of the ICONS website. It includes a "Home" section with a "Why ICONS?" description, a "Latest news" section with recent articles, and a "Popular ICONS blogs" section with featured blog posts. The website has a blue and orange color scheme with a navigation bar at the top.

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Discussion



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Thank you!

