

Asia Pacific Network Information Centre

APNIC

APNIC Training

Internet Resource Management

This material covers the current training presented on a 1-1.5 day course. The material can be customised and also combines with other topics and exercises

V1.2 20 Jul 2009

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Introduction

- Instructors

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Assumptions & Objectives

<p><u>Assumptions</u></p> <ul style="list-style-type: none"> - 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 	<p><u>Objectives</u></p> <ul style="list-style-type: none"> - 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.
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Overview

- IRMe
 - Introduction to APNIC
 - APNIC policy development process
 - Internet registry policies
 - Defining an Addressing Plan
 - IP address request
 - Second opinion request
 - IPv6 Overview
 - APNIC Whois database
 - MyAPNIC
 - Autonomous System Numbers
 - Reverse DNS
 - Summary

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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://www.apnic.net/meetings/28/index.html>
 - <http://www.apnic.net/community/lists/index.html>

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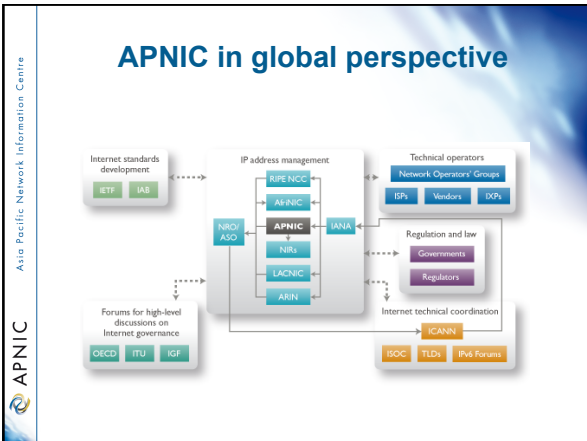
Where is the APNIC region?

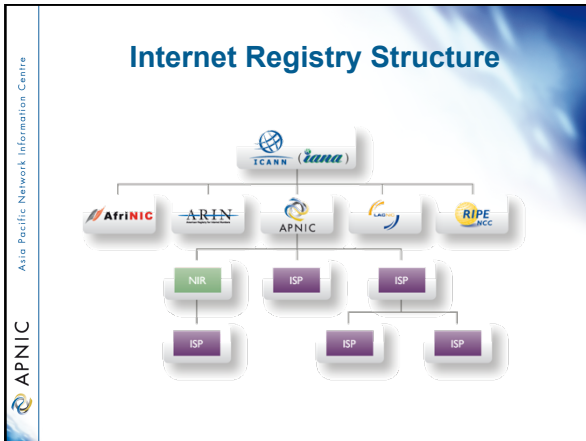
What does APNIC do?

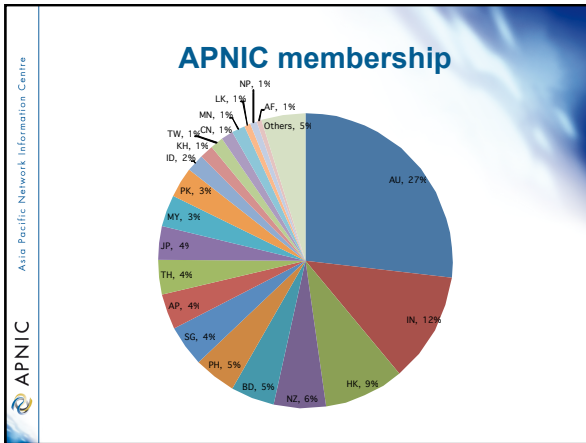
<p>Resource service</p> <ul style="list-style-type: none"> • IPv4, IPv6, ASNs • Reverse DNS delegation • Resource registration <ul style="list-style-type: none"> • Authoritative registration server <ul style="list-style-type: none"> • whois • IRR 	<p>Policy development</p> <ul style="list-style-type: none"> • Facilitating the policy development process • Implementing policy changes
<p>Information dissemination</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>Training</p> <ul style="list-style-type: none"> • Face to Face • Via e-learning <p>- Subsidised for members</p> <p>Schedule: http://www.apnic.net/training</p>

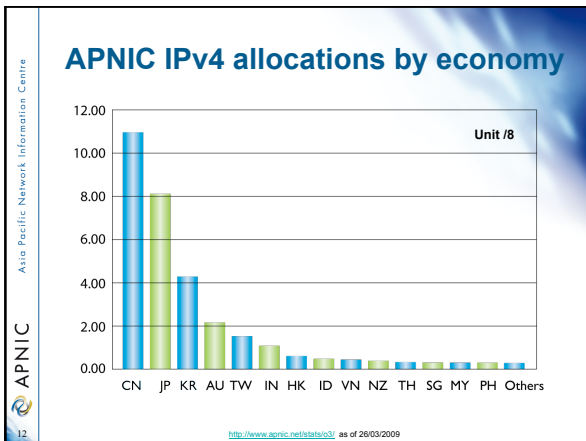
APNIC is NOT

- 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









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 Policy Development Process

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You are part of the APNIC Community!

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

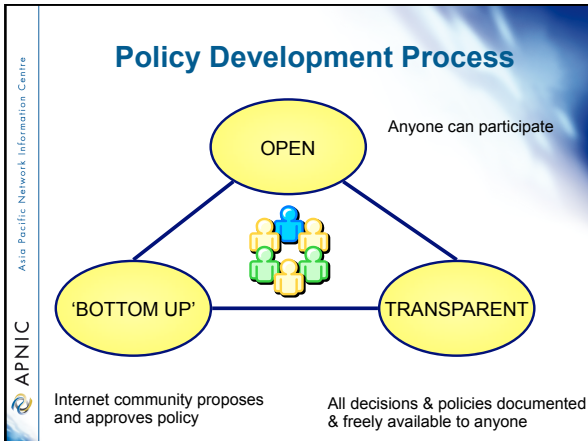
– A voice in regional Internet operations through participation in APNIC

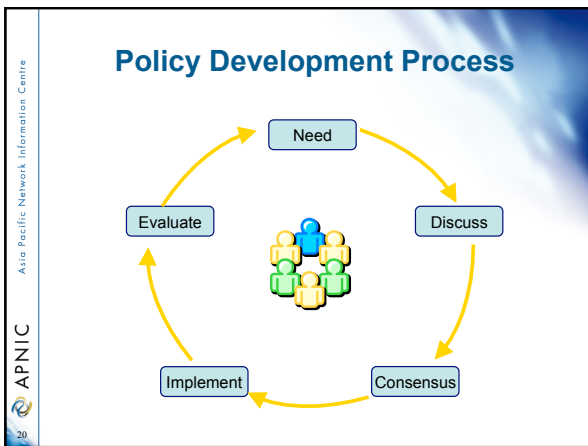
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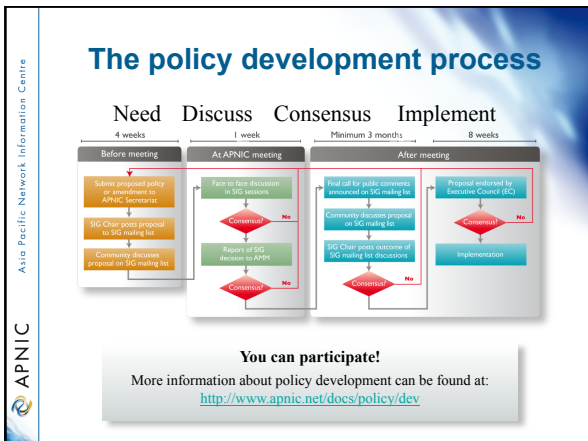
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Participation in policy development

- **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







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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 APNIC web site
 - And express your opinion via Jabber chat
- Give feedback
 - Training or seminar events

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Questions?

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Internet registry allocation and assignment

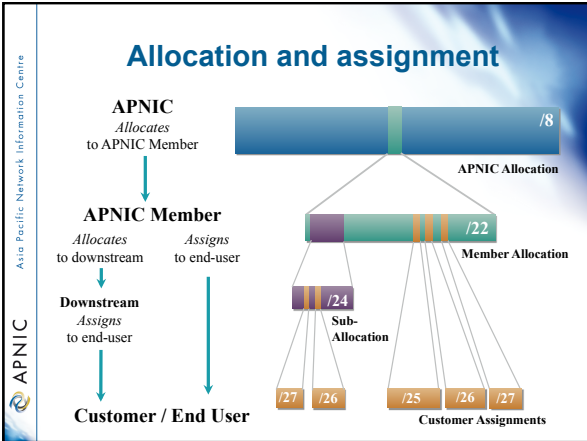
Policies

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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 ISP customers, or used for an ISP's infrastructure ('self-assignment')



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Portable & non-portable

Portable Assignments

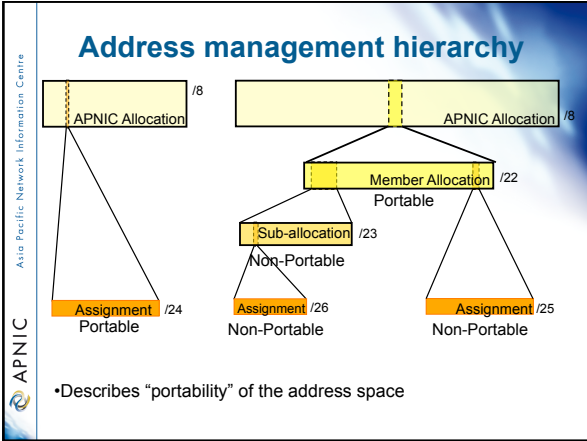
- Customer addresses independent from ISP
 - Keeps addresses when changing ISP
- Bad for size of routing tables
- Bad for QoS: routes may be filtered, flap-dampened

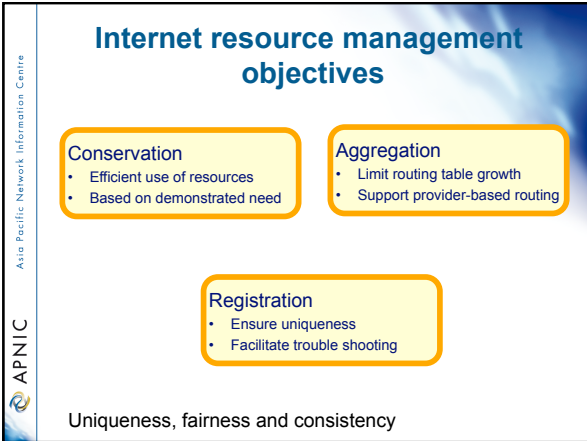
Non-portable Assignments

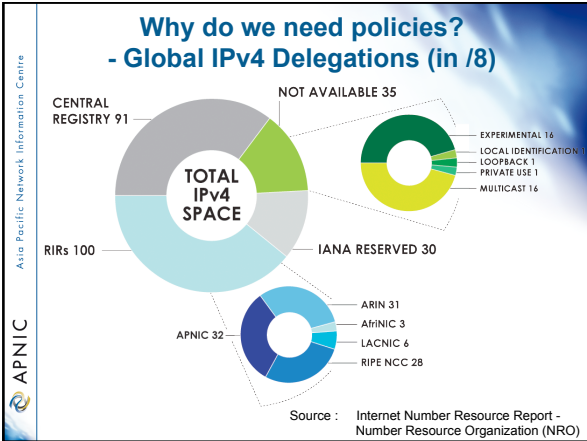
- Customer uses ISP's address space
 - Must renumber if changing ISP
- Only way to effectively scale the Internet

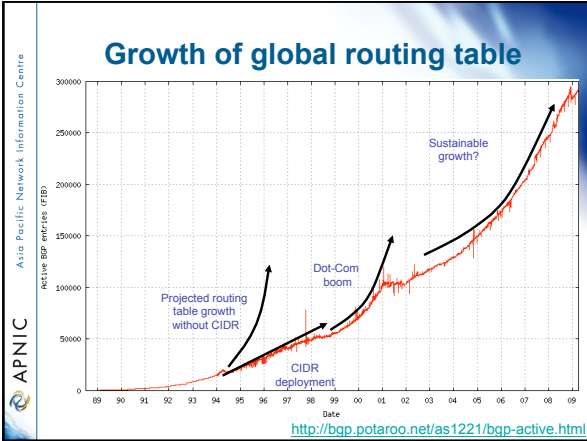
Portable allocations

- Allocations made by APNIC/NIRs"









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

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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

The diagram illustrates the hierarchy of IPv4 address space. At the top is a large yellow box labeled 'APNIC /8'. This space is divided into two sections: 'Non-portable assignment' on the left and 'Portable assignment' on the right. Within the 'Portable assignment' section, a smaller yellow box labeled 'Member allocation' is shown, which contains a blue box labeled '/22'.

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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

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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

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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

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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

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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

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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

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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

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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

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Requesting IP Resources

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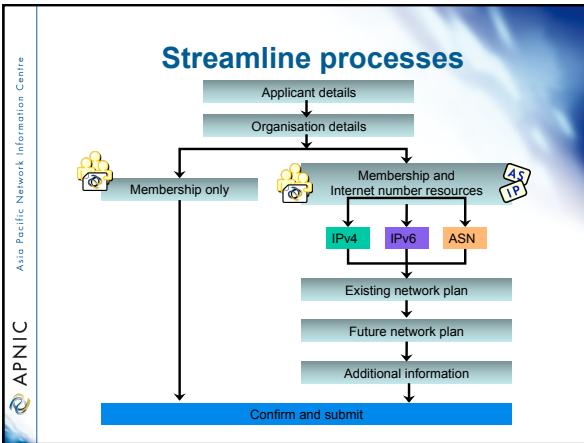
IP Address Request

- 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>

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ISP address request - Overview

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



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ISP address request

- Hostmaster Administration members only
 - <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

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ISP address request instructions

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



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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

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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

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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

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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?

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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

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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>

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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

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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

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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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Address Plan Example


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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..

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Some icons



Router
(layer 3, IP datagram forwarding)



Network Access Server
(layer 3, IP datagram forwarding)

Ethernet switch
(layer 2, packet forwarding)

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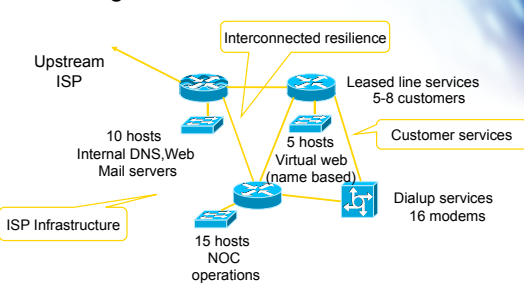
Addressing plan

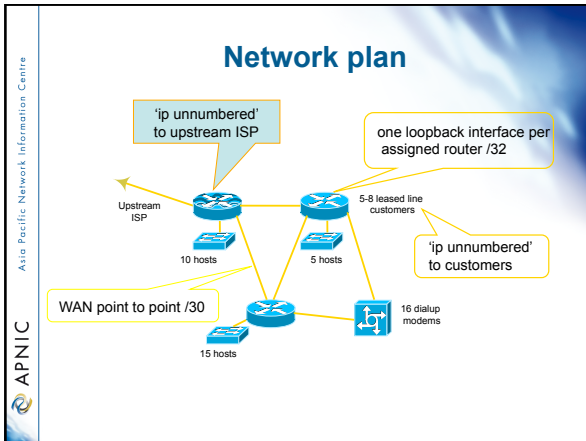
- Identify components of network
 - Customer services
 - ISP internal infrastructure
- Identify phases of deployment
 - Starting off, 6 months, 12 months
- Identify equipment and topology changes
 - Need for redundancy
 - Need for increased scale

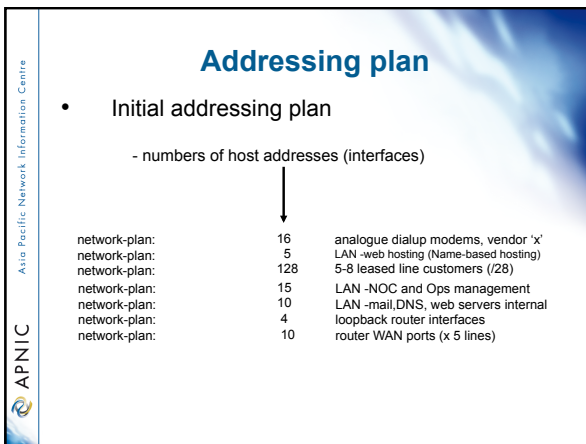
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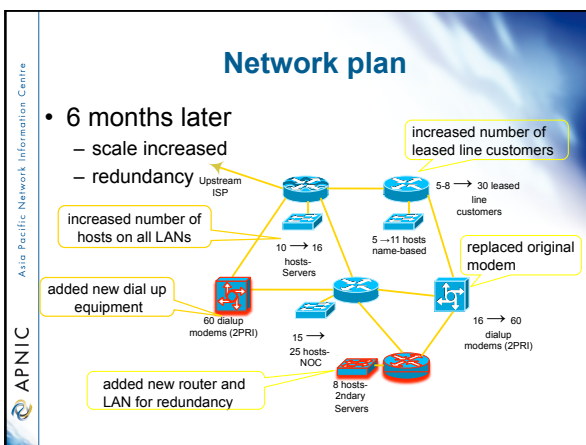
Network plan

- Starting off









Addressing plan

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

Changed description

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

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

Upstream ISP A, Upstream ISP B, 16 → 35 host, 11 hosts, 30 → 60 leased line customers ip unnumbered, 60 → 240 dialup modems (EPR1), 40 hosts, 60 → 240 dialup modems (EPR1), 8 hosts, two pieces of essential equipment

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:	128/480/ 960	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:	10/16/ 16	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	128/480/960	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:	16	0/8/8	LAN-secondary servers
network-plan:	32	10/16/16	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	128/480/960	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	32	10/16/16	router WAN ports (x8)
network-plan:	0.0.6.160	16	5/11/11	LAN -web hosting (Name-based hosting)
network-plan:	0.0.6.176	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.192	16	4/6/12	loopback router interfaces

– cumulative total 0.0.6.208

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	128/480/960	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	255.255.255.224	YES	32	10/16/16	Router WAN ports (x8)
network-plan:	0.0.6.160	255.255.255.240	YES	16	5/11/11	LAN -web hosting (Name-based)
network-plan:	0.0.6.176	255.255.255.240	YES	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.192	255.255.255.240	YES	16	4/6/12	loopback router interfaces

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	128/480/960	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 mgmnt
network-plan:	0.0.6.128	255.255.255.224	YES	32	10/16/16	Router WAN ports (x 8 lines
network-plan:	0.0.6.160	255.255.255.240	YES	16	5/11/11	LAN -web hosting (Name-based
network-plan:	0.0.6.176	255.255.255.240	YES	16	0/8/8	LAN -secondary servers
network-plan:	0.0.6.192	255.255.255.240	YES	16	4/6/12	Loopback router interfaces

– detailed, efficient and accurate

Questions?

Assignment and sub-allocation procedures

Assignment Window &
2nd Opinion process

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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

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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

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Overview of 2nd 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 **IPv4/IPv6 Assignments**

IPs held by customer & customer's customers IPs held by customer

Customer assignments to end-sites

Sub-allocation infrastructure

Customer's existing network

Additional information Any additional info that may aid the evaluation

Confirm details Check your details

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2nd 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?

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2nd 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

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2nd opinion request approval

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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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?

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IPv6 Overview

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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

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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



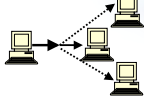
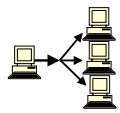
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IPv6 addressing

- 128 bits of address space
- Hexadecimal values of eight 16 bit fields
 - X:X:X:X:X:X:X (X=16 bit number, ex: A2FE)
 - 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

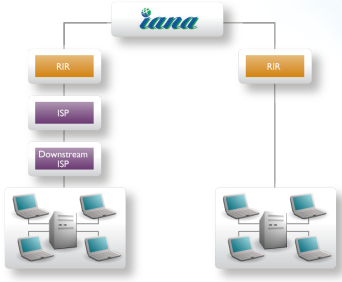
- **IPv6 Address type** 
 - Unicast
 - An identifier for a single interface
 - Anycast
 - An identifier for a set of interfaces
 - Multicast
 - An identifier for a group of nodes

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IPv6 Policies and Procedures

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IPv6 address management hierarchy



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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

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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

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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”)

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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.

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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

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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

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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

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IPv6 assignment and utilisation requirement

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

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IPv6 utilisation (HD = 0.94)

- 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."

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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

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IPv6 portable assignment for multihoming

- 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

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How do I apply for IPv6 addresses?

Check your eligibility for IPv6 addresses

↓

Read IPv6 policies
<http://www.apnic.net/docs/policy/ipv6-address-policy.html>

Read IPv6 guideline
<http://www.apnic.net/docs/policy/ipv6-guidelines.html>

↓

Do you have an APNIC account?
If not, become an APNIC member or open a non-member account

↓

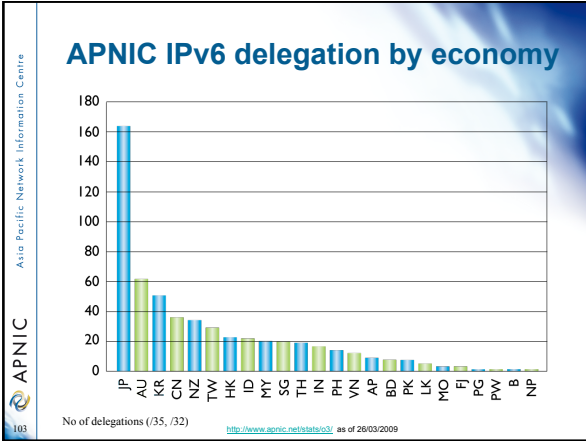
Complete an IPv6 address request form

↓

Submit the form hostmaster@apnic.net

↓

Questions:
email: helpdesk@apnic.net
Helpdesk chat: <http://www.apnic.net/helpdesk>



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Questions?

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APNIC Whois Database

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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

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Whois database query - clients

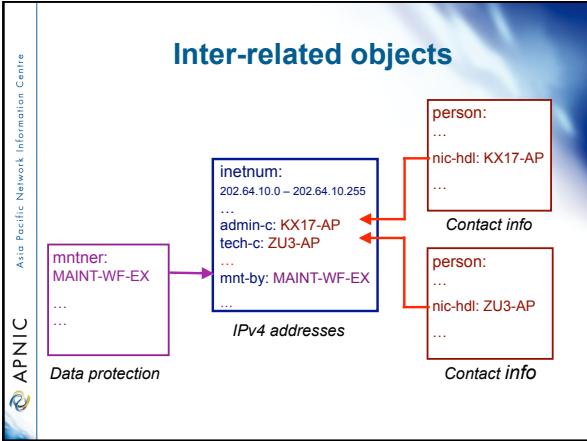
- Standard whois client
 - Included with many Unix distributions
 - RIPE extended whois client
 - <http://ftp.apnic.net/apnic/dbase/tools/ripe-dbase-client.tar.gz>
- Query via the APNIC website
 - <http://www.apnic.net/apnic-bin/whois2.pl>
- Query clients - MS-Windows etc
 - Many available

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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/>



Database query – look-up keys

OBJECT TYPE	ATTRIBUTES – 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

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

```

Creating a person object

Creating objects in Whois:
http://www.apnic.net/apnic-info/whois_search2/using-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

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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

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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
  
```

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APNIC Whois web query

The screenshot shows the APNIC website homepage. At the top, there is a navigation menu with links for Home, Services, Community, Events, Publications, and About APNIC. Below the navigation is a search bar and a 'Whois search' button. The main content area is divided into three columns: 'Internet resources' with links like 'Check your eligibility', 'Check your status', and 'Make a payment'; 'Participate' with links like 'APNIC Membership', 'Network & Security', and 'APNIC Awards'; and 'Get help' with links like 'Helpdesk', 'Network abuse', and 'Network 24x7'. At the bottom, there are logos for various partners and organizations, including 'member', 'isif', 'asia', 'iHO', 'APNIC', and 'Relief.Asia'.

Whois database query - web

http://www.apnic.net/apnic-bin/whois2.pl

Query the APNIC Whois Database

Need help?

1. Type in search key

2. Search options (flags)

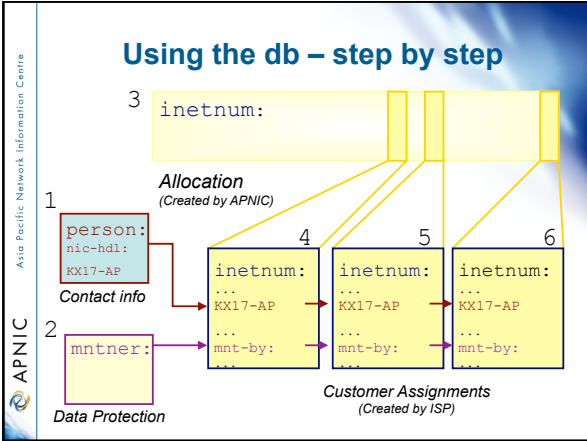
3. Search Whois

APNIC Whois command line query

john@macbook-pro:~\$

ISP 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 these to be public data if you wish
 - Allocation object created by APNIC



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:	NCS-AP
tech-c:	NCS-AP
tech-c:	SC120-AP
nic-hdl:	OAS-AP
mnt-by:	MAINT-OPTUSCOM-AP
source:	APNIC

-
- 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


mntnr: 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

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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

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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

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Authorisation mechanism

```
inetnum: 202.137.181.0 - 202.137.185.255
netname: EXAMPLNET-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
```

Note: A pink arrow points from the 'mnt-by' field in the first block to the 'mntner' block in the second.

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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

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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!

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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-TH can create assignments within this allocation

Authentication/authorisation

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

```

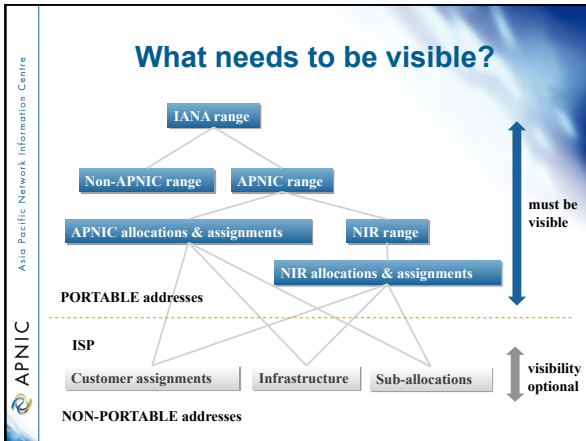
Inetnum: 203.146.113.64 - 203.146.113.127
netname: SCC-TH
descr: Sukhothai Commercial College
Country: TH
admin-c: SI10-AP
tech-c: VP5-AP
mnt-by: LOXINFO-IS
changed: voraluck@loxinfo.co.th 19990930
source: APNIC
  
```

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

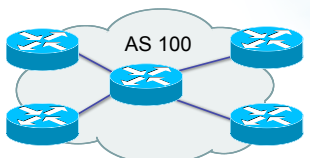


Questions?

ASN

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What is an Autonomous System?




- Collection of networks with same routing policy
- Usually under single ownership, trust or administrative control

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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



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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 

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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



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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

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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

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Questions?

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4 byte AS number

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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
 - Jan 2009: Default 4 byte ASN, 2 byte ASN on request
 - Jan 2010: 4 byte ASN only

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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>

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Canonical textual form of 4 byte ASN (Cont.)

- 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

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Questions?

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Reverse DNS Delegation

Registry Procedures

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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


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APNIC & Member responsibilities

- APNIC
 - Manage reverse delegations of address block distributed by APNIC
 - Process members' requests for reverse delegations of network allocations
- Members should
 - be familiar with APNIC procedures
 - ensure that addresses are reverse-mapped
 - maintain nameservers for allocations
 - Minimise pollution of DNS

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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" 

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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

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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
nserver:    dns.vsnl.net.in
nserver:    giasbm01.vsnl.net.in
mnt-by:     MAINT-IN-VSNL
changed:    gpsingh@vsnl.net.in 20010612
source:     APNIC
  
```

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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..

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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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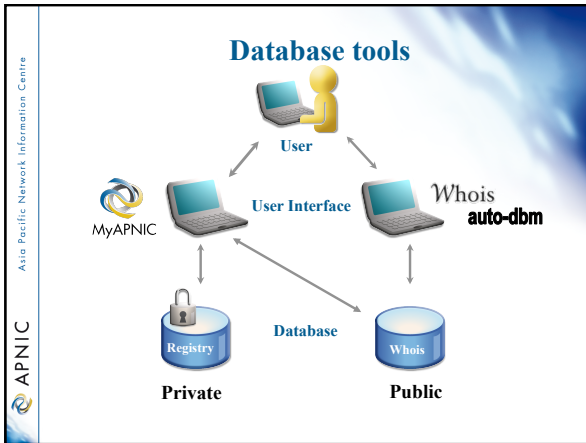
Questions?

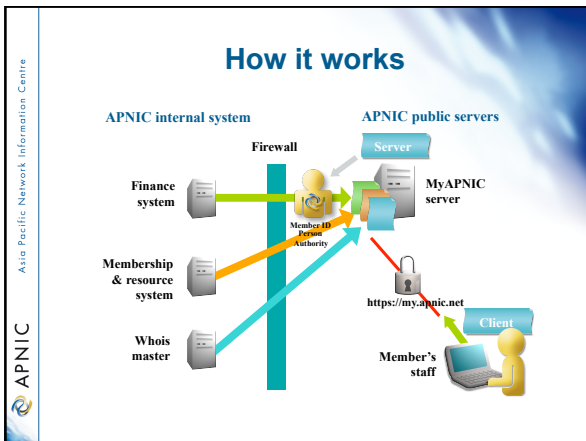
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MyAPNIC



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





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MyAPNIC functions

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

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Digital Certificates

- Are used:
 - to manage staff contacts. Only registered Corporate Contacts have the authority to change or approve users in MyAPNIC.
 - for online voting in the APNIC elections
 - to secure email exchange with APNIC

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

1. Fill in the online form: <http://www.apnic.net/services/manage-resources/digital-certificates/apply>
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

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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

Year SP: 2013-12-15 15:55

Home Services Externality Events Publications About APNIC Log in to MyAPNIC

Services

- Services APNIC provides
- Apply for resources
- Become a member
- Make a payment
- Manage Internet resources

APNIC

- Digital Certificates
 - APNIC Root Certificate
 - Trustee/Issuing
 - Certificate check
 - Apply**
 - Helpdesk

Apply for an APNIC Digital Certificate

Before Applying: Before applying for an APNIC Digital Certificate, please read the [Terms and Conditions](#) of the APNIC Certificate Authority. You will be asked to agree to these during the application process.

Digital Certificate application process

To request a certificate, click here

complete the online form and you must also provide physical documents to prove your identity to APNIC.

Step 1: Install the APNIC root certificate.
[Click here for instructions for installing the APNIC root certificate](#)

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Request a certificate

Apply for an APNIC Digital Certificate

Before Applying: Before applying for an APNIC Digital Certificate, please read the [Terms and Conditions](#) of the APNIC Certificate Authority. You will be asked to agree to these during the application process.

Digital Certificate application process

Before APNIC can issue you a Digital Certificate you must complete the online form and you must also provide physical documents to prove your identity to APNIC.

APNIC will not process your request until we receive these documents from you.

Step 1: Install the APNIC root certificate.
[Click here for instructions for installing the APNIC root certificate](#)

Step 2: Request an APNIC Digital Certificate. Fill in the [Certificate Request](#) form.

Click here to request a certificate

Step 3: Download the Identity Check Form

NOTE: This is not required if you are renewing your certificate

- Complete the Identity Check Form
- Make a copy of your photo identification to include in your request
- Email, fax or mail your Identity Check Form and photo to:
 - APNIC
 - 33 Park Road, P.O. Box 2131
 - Sydney
 - QLD 4004

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

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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)

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Member Services

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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



- **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





