Asia Pacific Network Information Centre

APNIC

Welcome!

APNIC Members Training Course

Internet Resource Management Essentials

24 February 2004, Kuala Lumpur, Malaysia

In conjunction with the APRICOT 2004 / APNIC 17

Introduction

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Assumptions & Objectives

Assumptions

- Are current or prospective APNIC members
- Have not submitted many IP requests
- Are not familiar / up-to-date with Internet resource policies & procedures

Objectives

- Teach members how to request Internet resources from APNIC
- Keep membership up-to-date with latest policies
- Liaise with members

Schedule

- APNIC's role in the Asia Pacific (5)
- Internet Registry Policies (16)
- Addressing Plan (38)

TEA BREAK (10:30 – 11:00)

- Requesting an IP allocation (54)
- APNIC database (81)
- IPv6(123)
- Summary (145)

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APNIC's role in the Asia Pacific

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Overview

- What is APNIC?
  - Regional Internet Registry
  - APNIC structure
- What Does APNIC do ?
  - APNIC Membership services
- Why APNIC ?
  - APNIC resources
  - APNIC environment
  - APNIC responsibilities

What is APNIC?

- RIR for the Asia Pacific
  - Regional Internet Registry
  - Regional authority for Internet Resource distribution
  - IPv4 & IPv6 addresses, ASNs, reverse dns delegation
- Industry self-regulatory body
  - Non-profit, neutral and independent
- Open membership-based structure

APNIC is not…

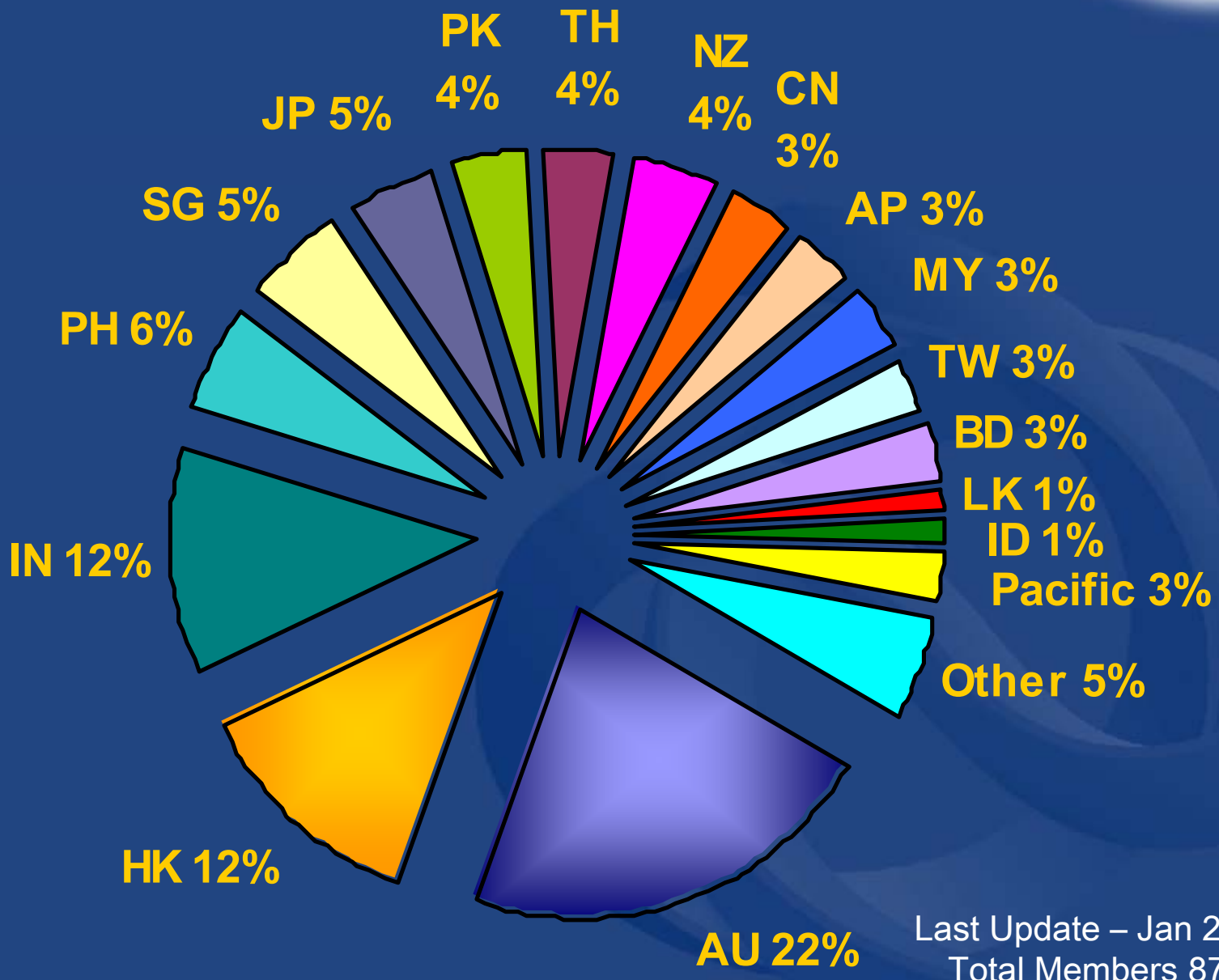
- Not a network operator
  - Does not provide networking services
    - Works closely with APRICOT forum
- Not a standards body
  - Does not develop technical standards
    - Works within IETF in relevant areas (IPv6 etc)
- Not a domain name registry or registrar
    - Will refer queries to relevant parties

APNIC structure

- Industry self-regulatory structure
  - Participation by those who use Internet resources
  - Consensus-based decision making
    - Eg. Policy changes, db requirements etc
  - Open and transparent
- Meetings and mailing lists
  - Open to anyone

APNIC region

APNIC Membership



Last Update – Jan 2004
Total Members 879

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APNIC Services & Activities

Resources Services

- IPv4, IPv6, ASN, reverse DNS
- Policy development
  - Approved and implemented by membership
- APNIC whois db
  - whois.apnic.net
  - Registration of resources

Information dissemination

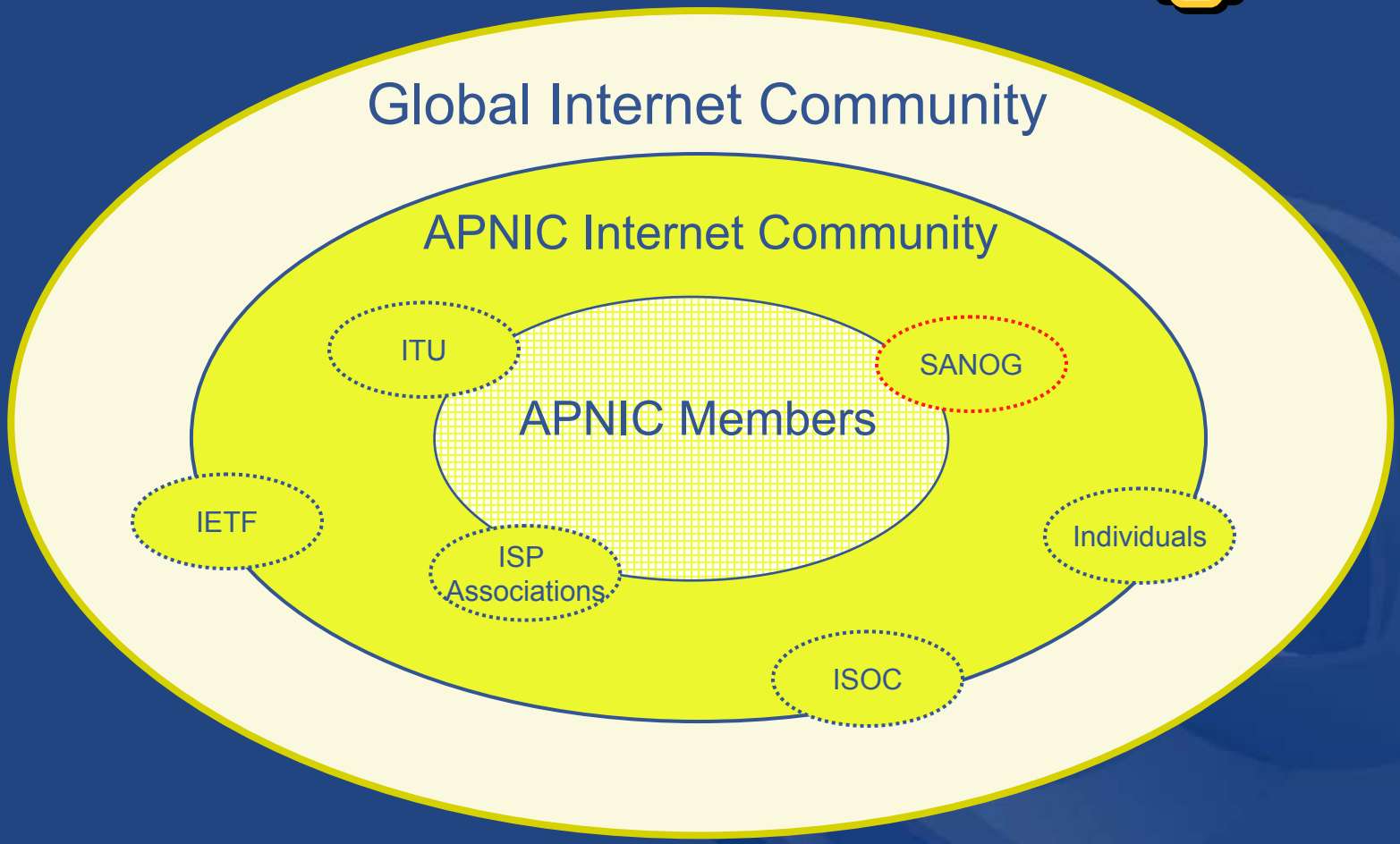
- APNIC meetings
- Web and ftp site
- Mailing lists
  - Open for anyone!
- Training Courses
  - Subsidised for members
- Co-ordination & liaison
  - With membership, other RIRs & other Internet Orgs.

What is the APNIC community?

- **Open** forum in the Asia Pacific
  - Open to any interested parties
- Voluntary participation
- Decisions made by consensus
- Public meetings
- Mailing lists
  - web archived

- *A voice in regional Internet operations through participation in APNIC activities*

“Internet Community”



Questions ?

Internet Registry Policy Development

Overview

- Policy Development
- Definitions
- Background
- Objectives & environment

Principles of policy development

- 'Bottom up', consensus based decision making
  - Community proposes and approves policy
  - No policies implemented without consensus of community
- Open and transparent
  - Anyone can attend
  - All decisions archived

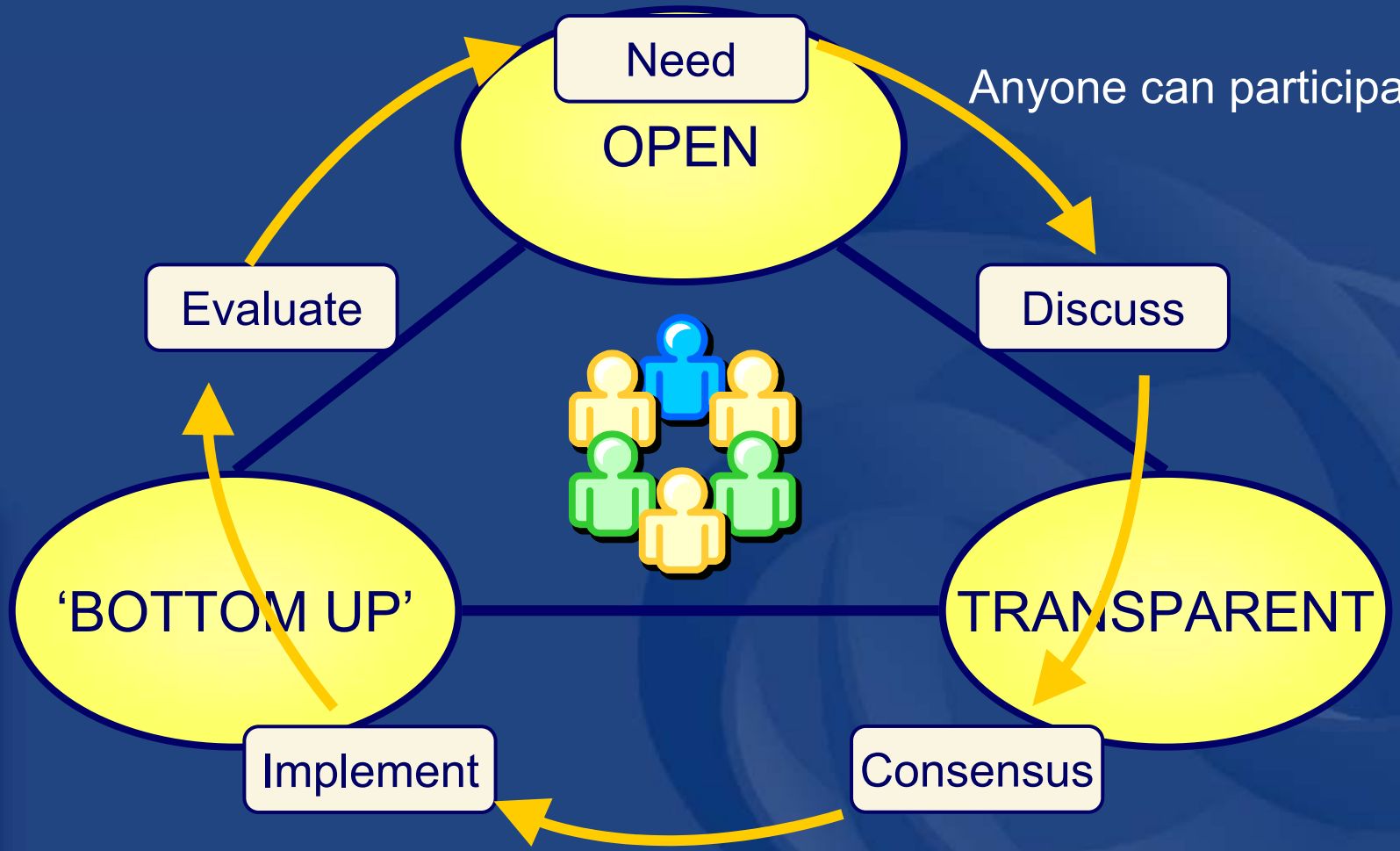
Participation in policy development

- 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

Definition – “Consensus”

- OED definition
  - “General agreement in opinion”
- Show of hands to judge ‘general agreement’
  - Often a count is taken to assist but is not essential
    - Those in favour, those against and abstentions
    - Each attendee has one vote
- If difficult to judge, unlikely to be consensus
  - Final call by chair

Principles of policy development process



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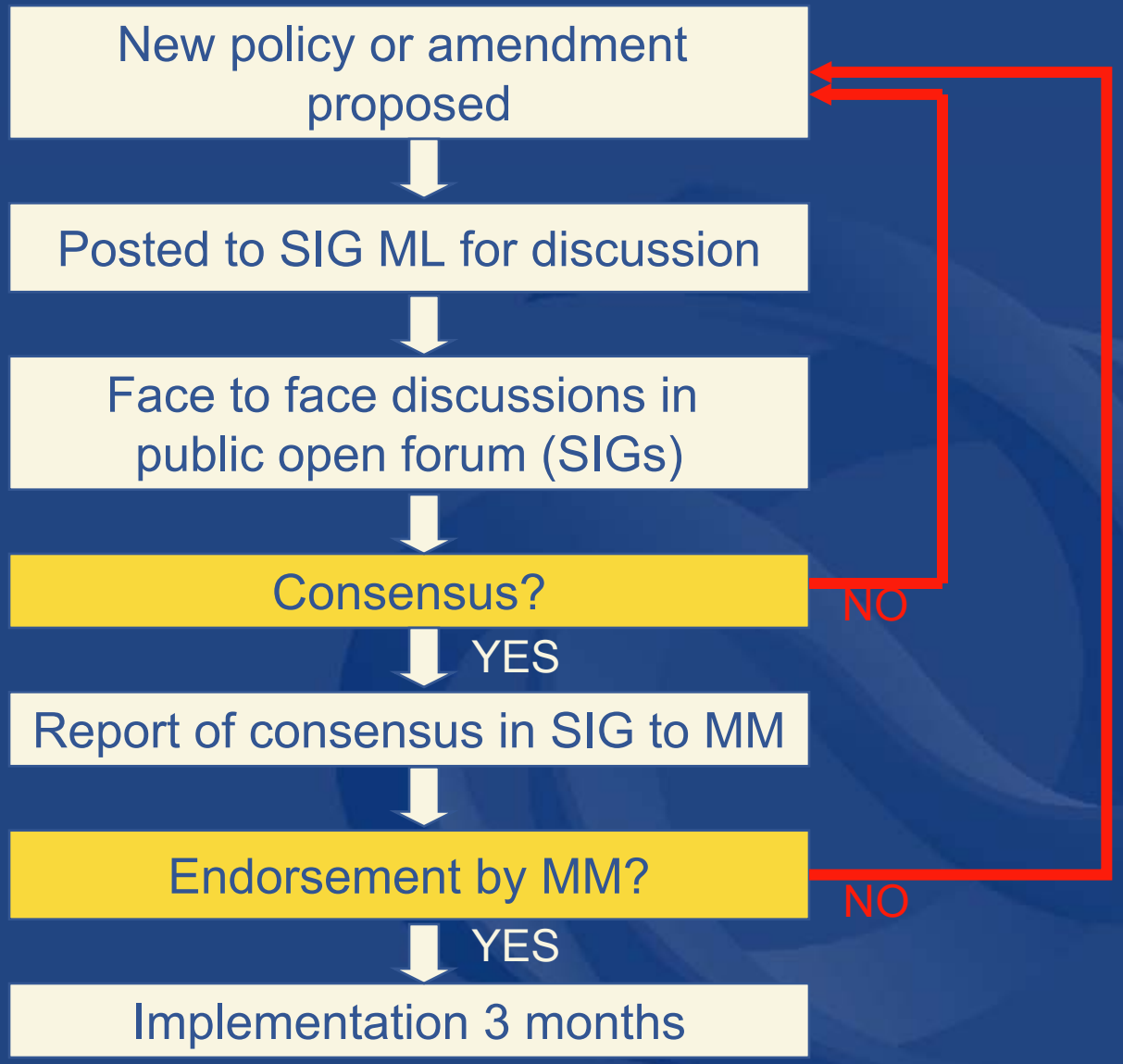
Elements of the process

How does it work? Self regula in practice



How to make your voice heard

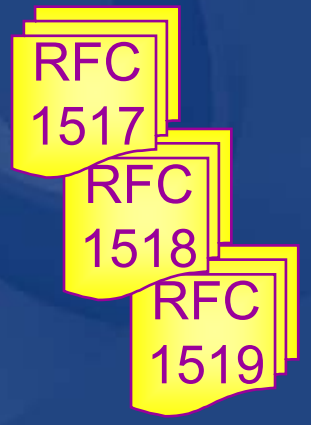
- Contribute on the public mailing lists
  - http://www.apnic.net/community/lists/
- Attend meetings
  - Or send a representative
  - Gather input at forums
- Give feedback
  - Training or seminar events
  - Through APNIC staff

Definitions

Classful and Classless

- Classful *(Obsolete)*
  - Wasteful address architecture
    - network boundaries are fixed at 8, 16 or 24 bits (class A, B, and C)
- **Classless**
  - Efficient architecture
    - network boundaries may occur at any bit (e.g. /12, /16, /19, /24 etc)
- CIDR
    - Classless Inter Domain Routing architecture
  - Allows *aggregation* of routes within ISPs infrastructure

Best Current Practice



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')

Allocation and Assignment

APNIC
Allocates
to APNIC Member

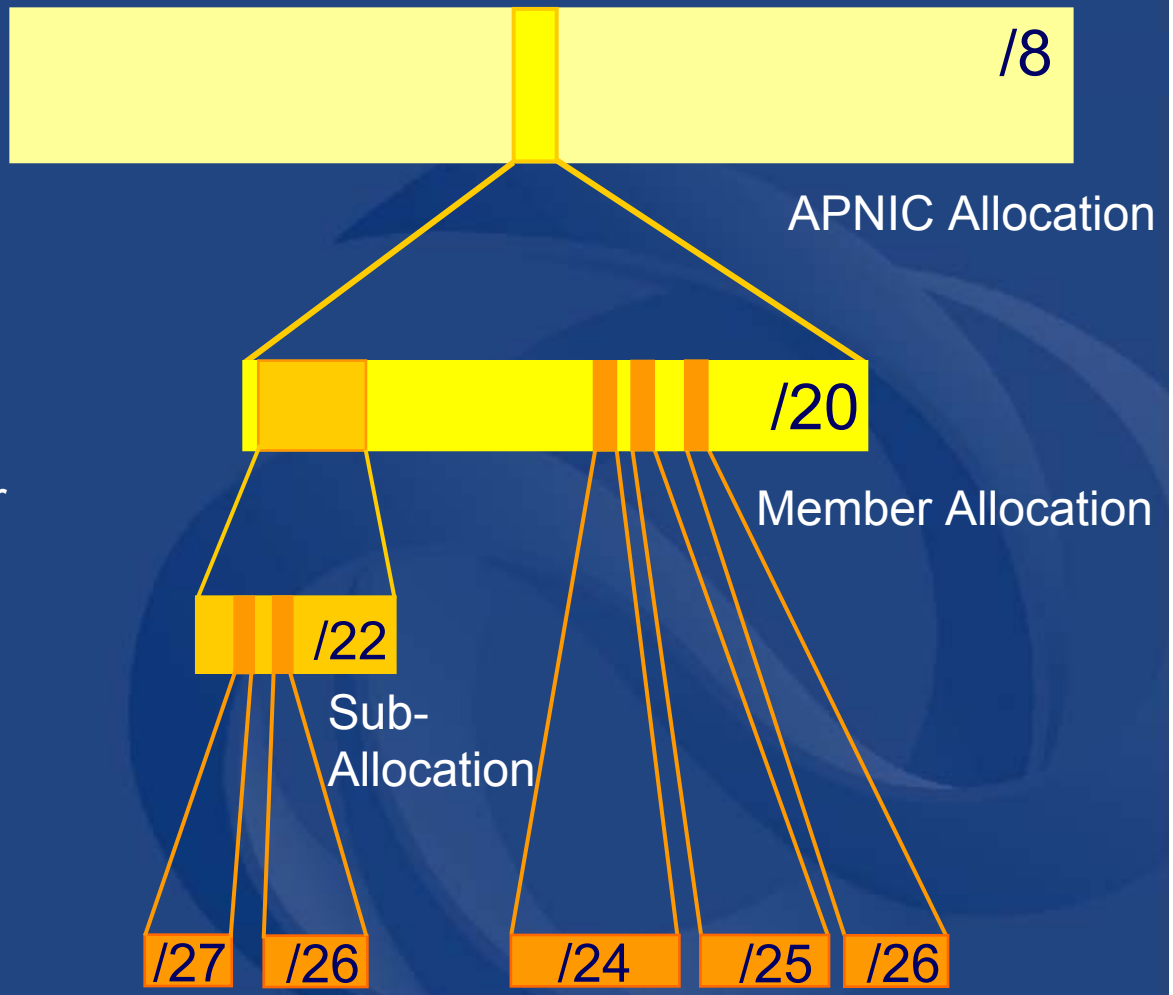
APNIC Member

Allocates
to downstream

Assigns
to end-user

Downstream
Assigns
to end-user

Customer / End User



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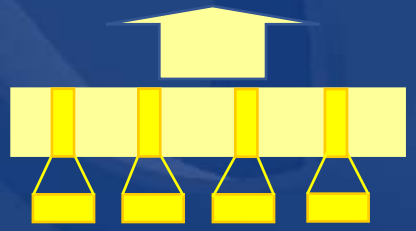
Portable & non-portable

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

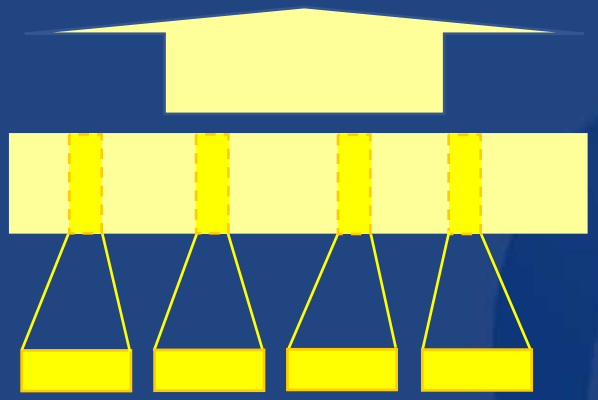


Aggregation and "portability"

Aggregation

BGP Announcement (1)

ISP Allocation

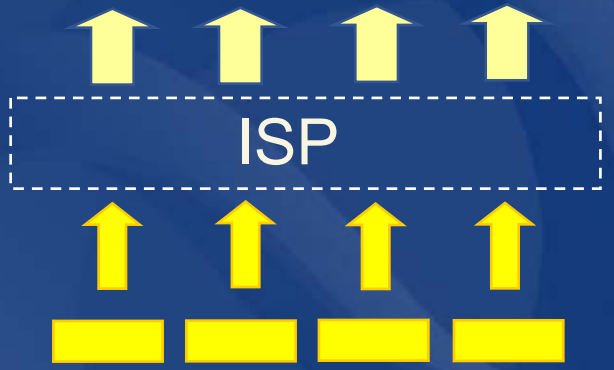


Customer Assignments

(Non-portable Assignments)

No Aggregation

BGP Announcements (4)



Customer Assignments

(Portable Assignments)

Objectives

APNIC policy objectives

Conservation

- Efficient use of resources
- Based on demonstrated need

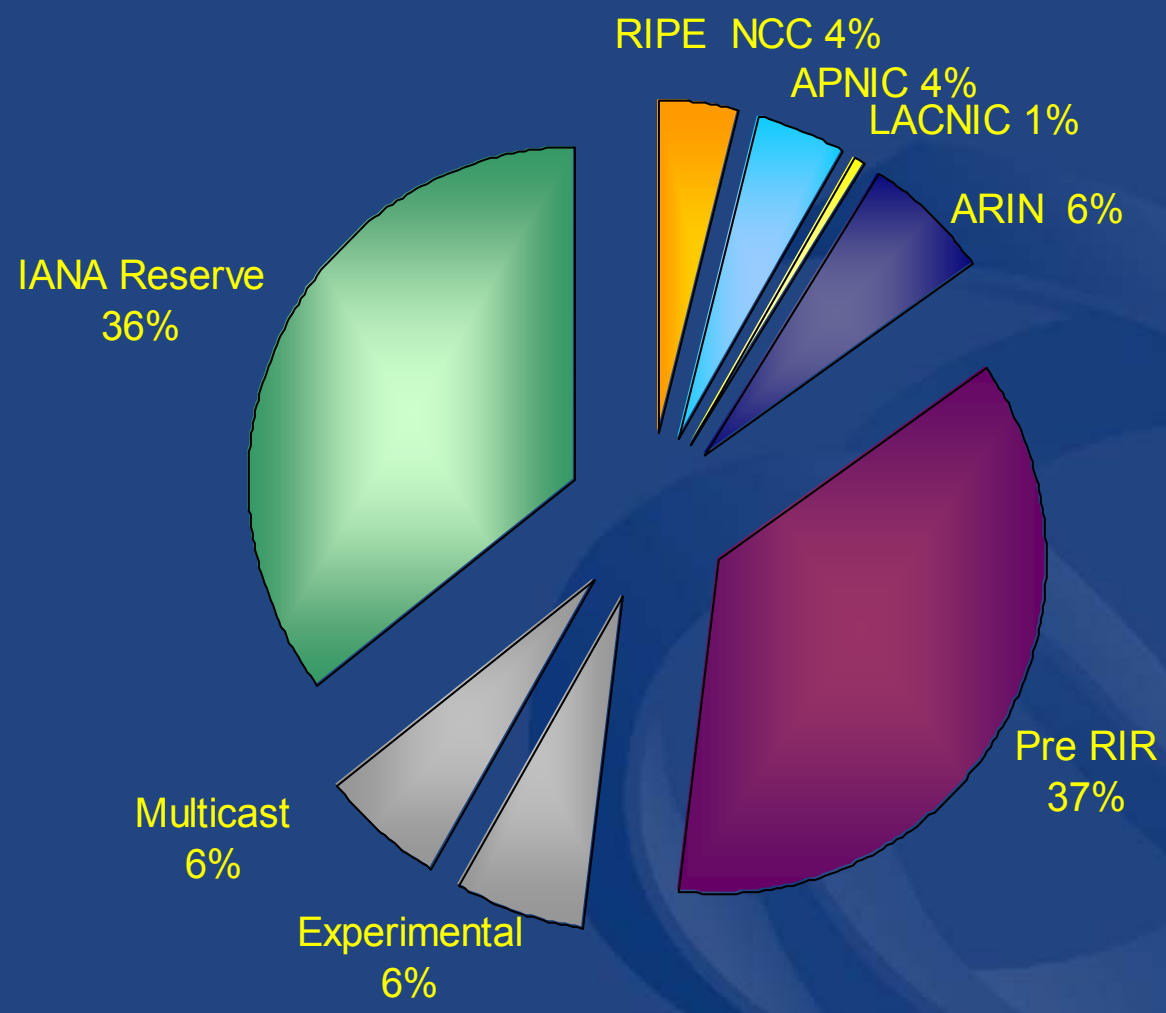
Aggregation

- Limit routing table growth
- Support provider-based routing

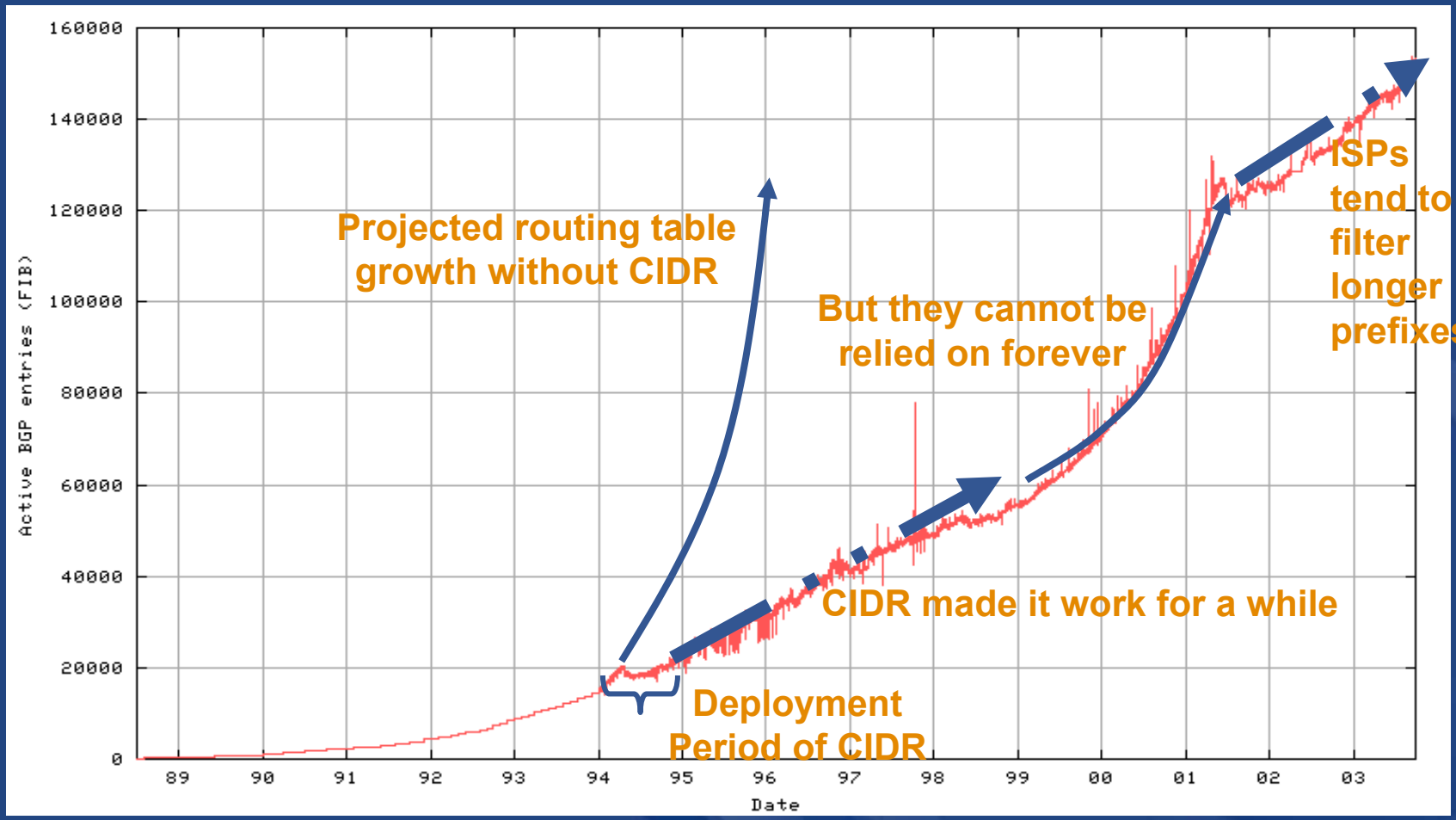
Registration

- Ensure uniqueness
- Facilitate trouble shooting

Why do we need policies?
- Global IPv4 Delegations



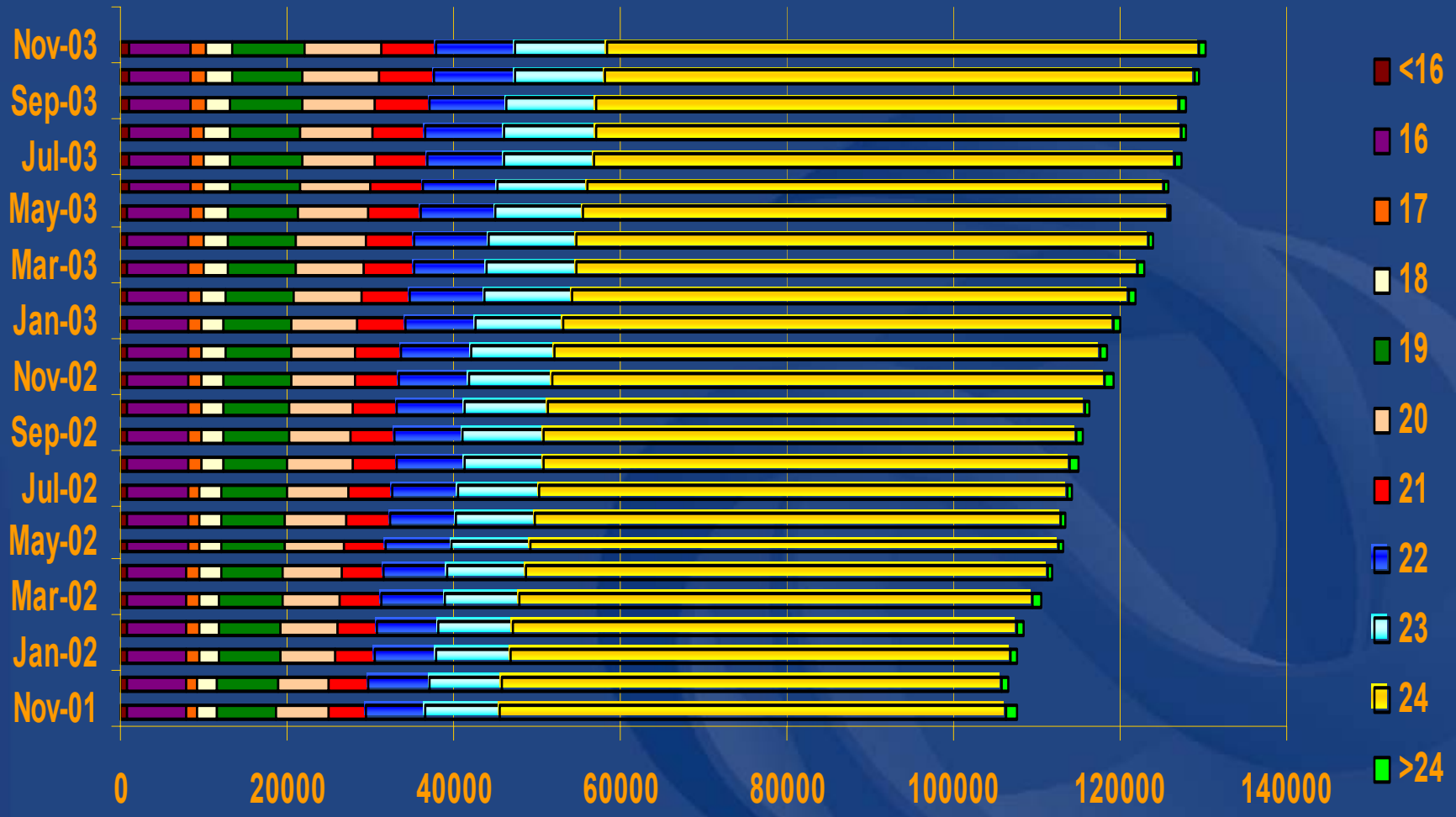
Growth of global routing table



http://bgp.potaroo.net/as1221/bgp-active.html

last updated 29 Sep 2003

Routing table prefix distribution



Last updated 20 Nov 2003

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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

Questions ?

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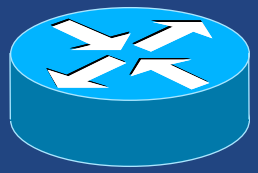
Internet Registry Procedures

Addressing Plan

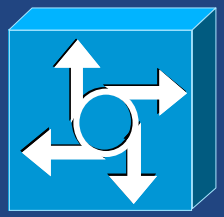
Addressing plan

- 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)

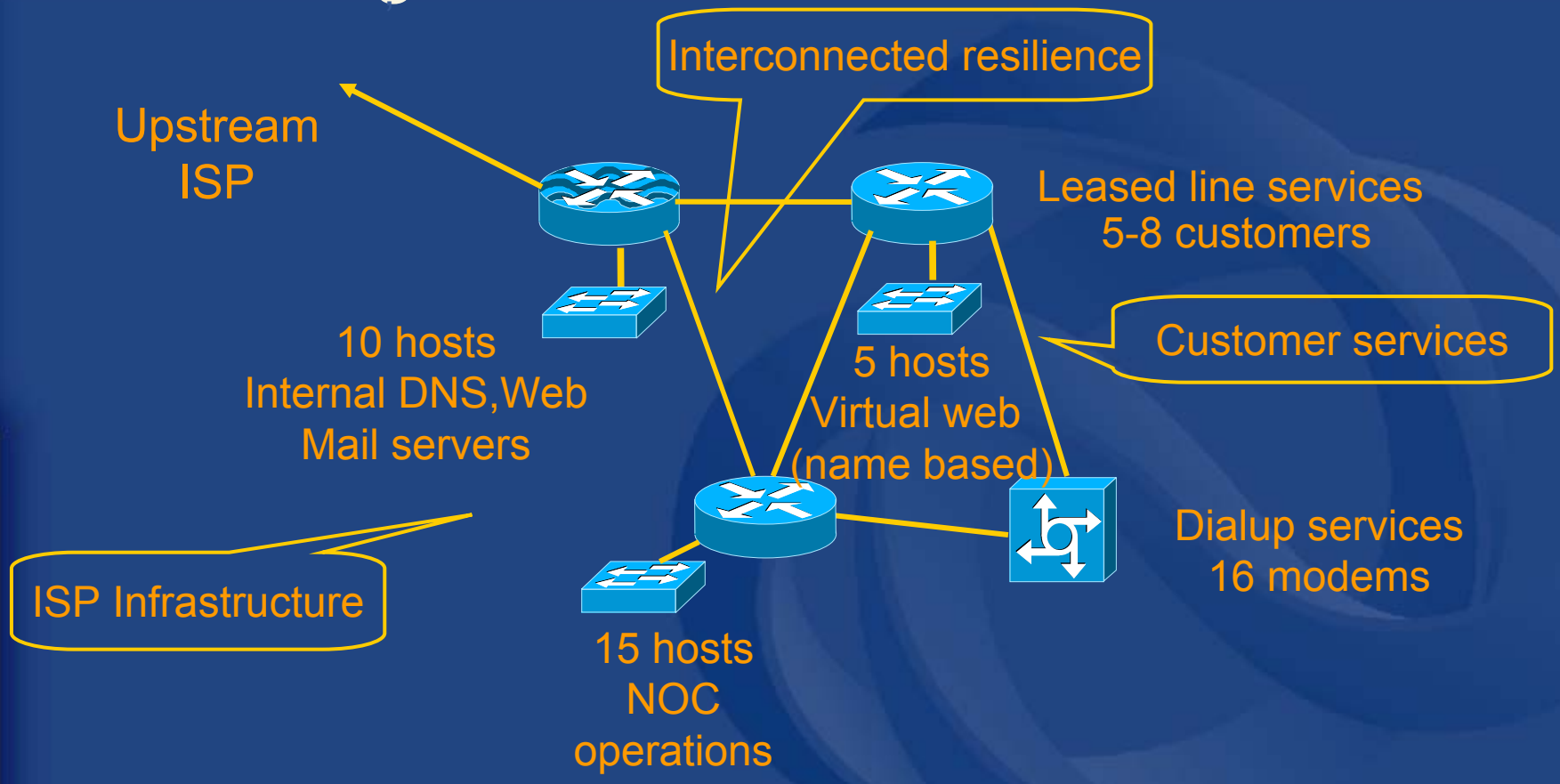
Ethernet switch
(layer 2, packet forwarding)

Addressing plan

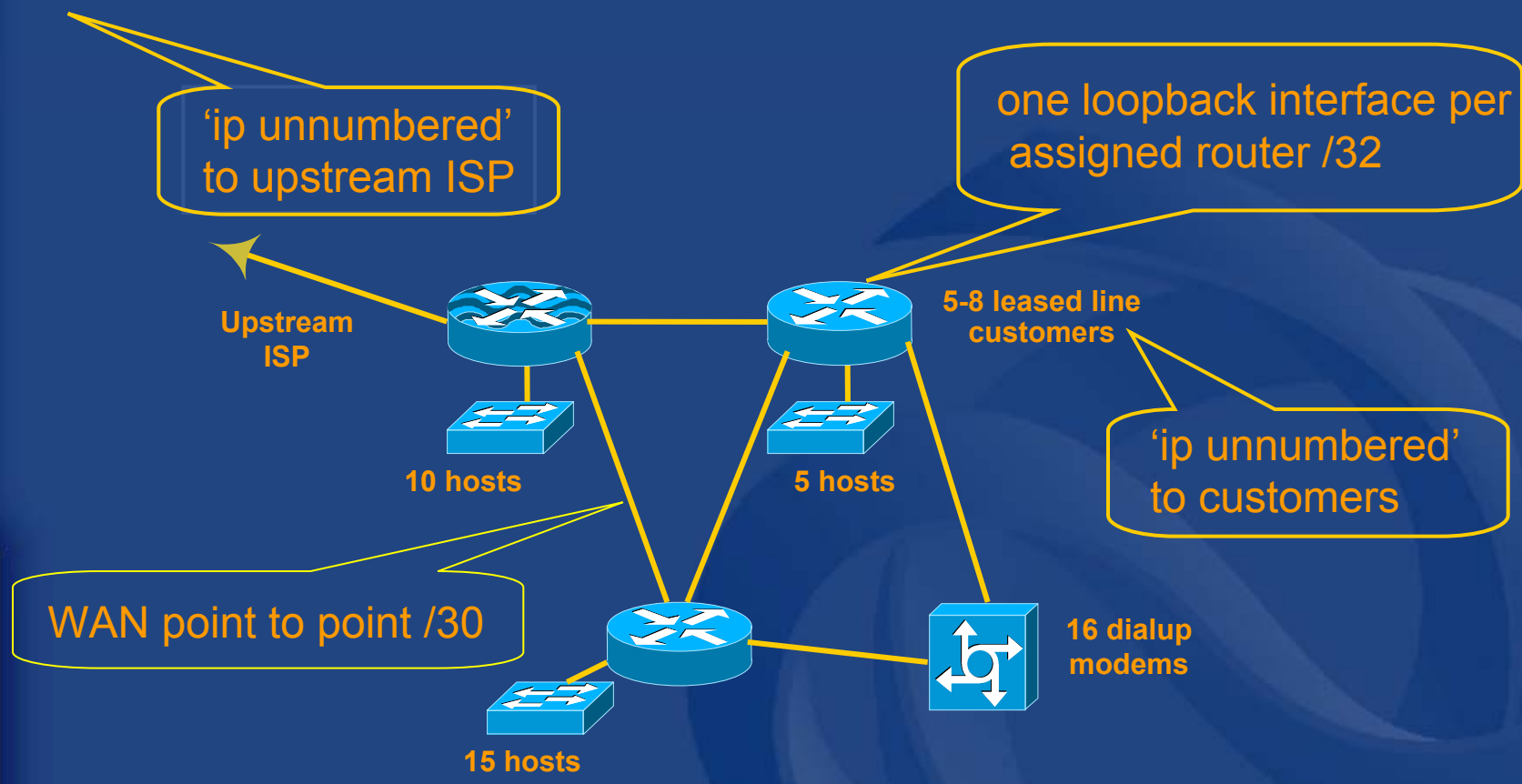
- Identify components of network
  - Customer services
  - ISP internal infrastructure
- Identify phases of deployment
  - Starting off, 6 months, 12 months
- Identify equipment and topology changes
  - Need for redundancy
  - Need for increased scale

Network plan

- Starting off



Network plan



Addressing plan

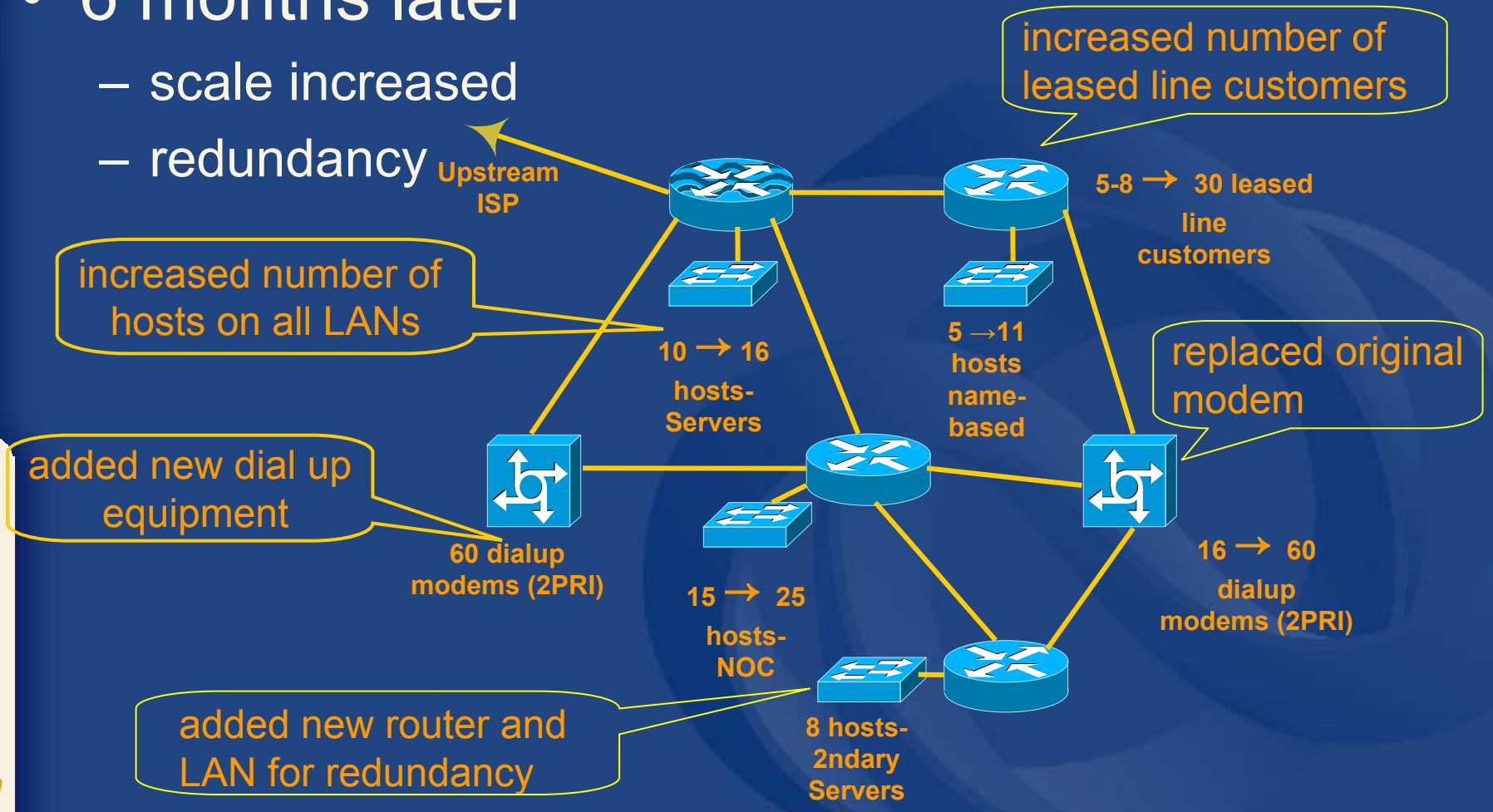
- Initial addressing plan

  - 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)

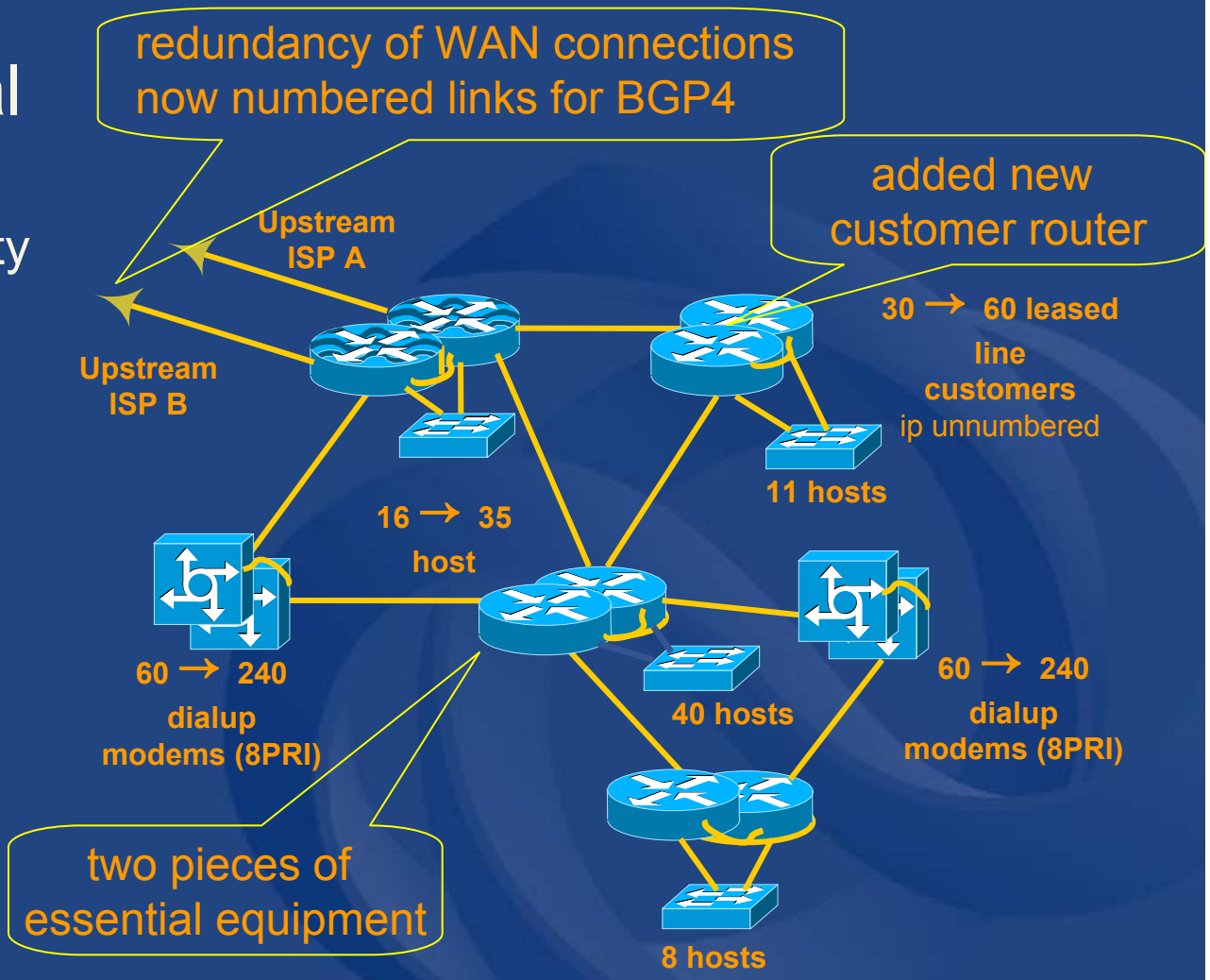
Changed description

network-plan:	16/	**60**	**2 PRI dialup modems, vendor 'y'**
network-plan:	5/	**11**	LAN -web hosting (Name-based hosting)
network-plan:	128/	**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**

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:	**4**	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**	4	2/2/2	router WAN ports (x8)

  – 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	128/512/1020	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**	4	2/2/2	router WAN ports (x 8)

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 mgmnt
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	4	2/2/2	router WAN ports (x 8 lines)

– detailed, efficient and accurate

Questions ?

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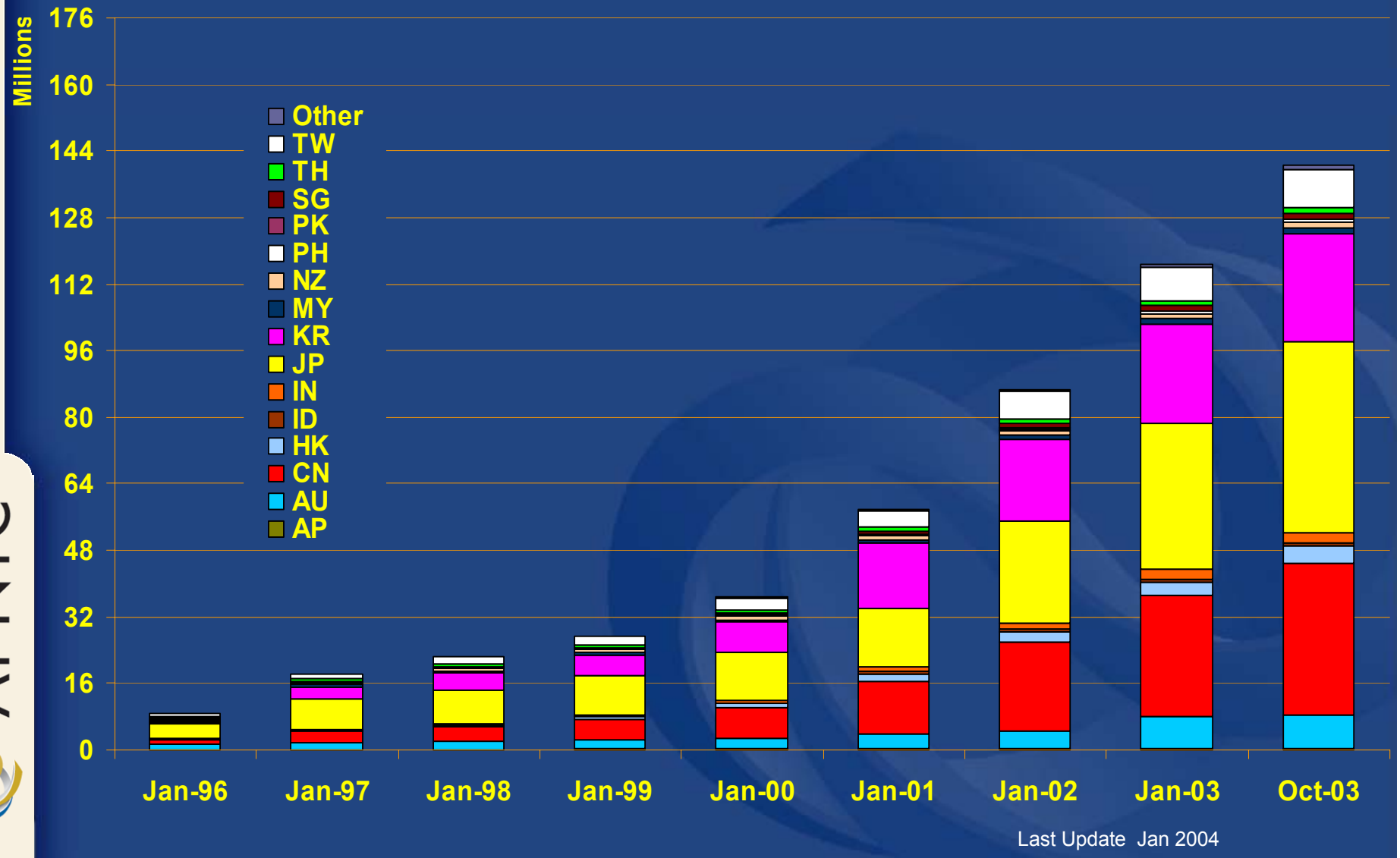
Internet Registry Polices & Procedures

IP Request

IP Growth in Asia Pacific



Last Update Jan 2004

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IP address request

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

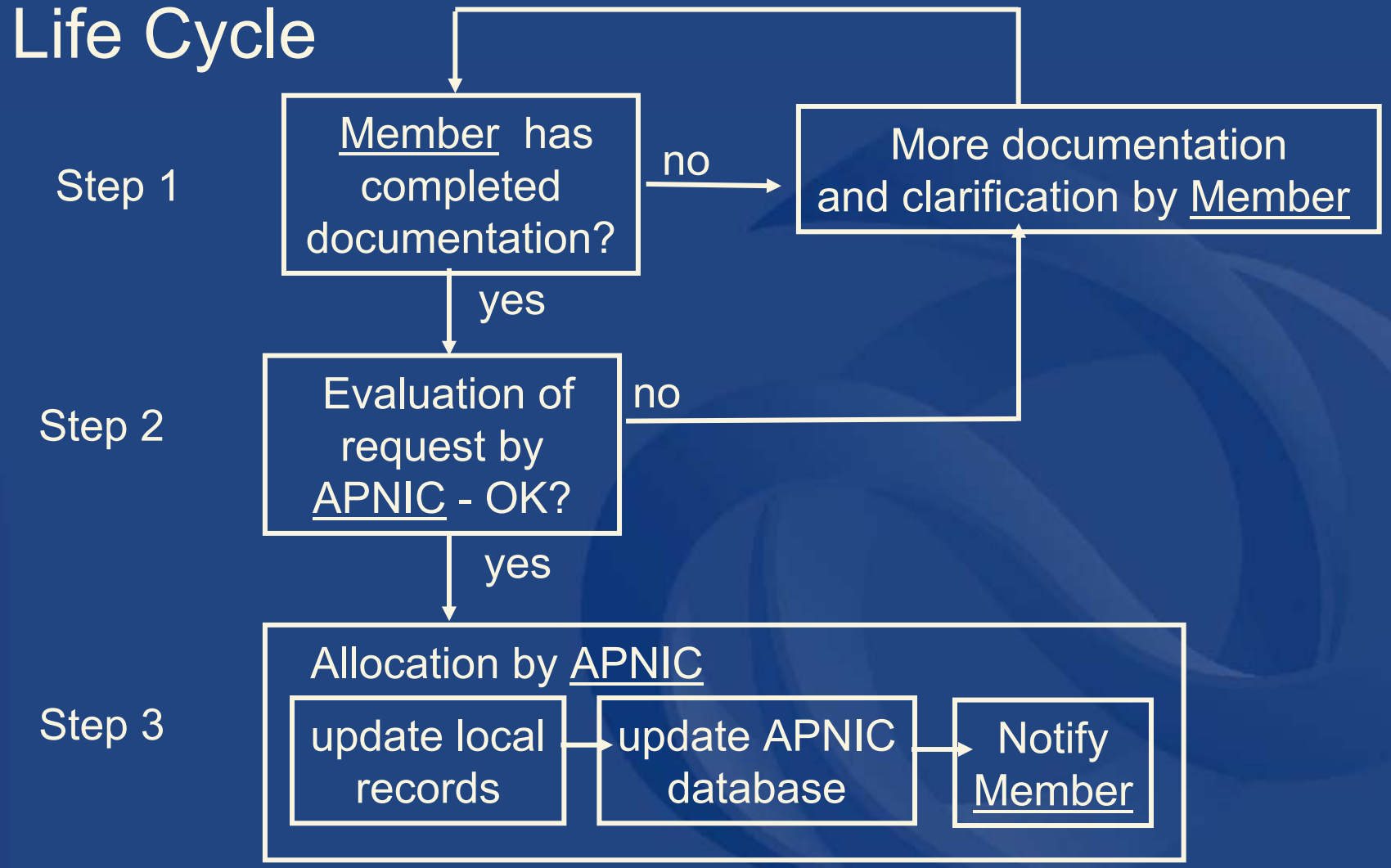
members only

- 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

IP address request

Life Cycle



IP address request - Overview

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

IP 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

Initial IPv4 allocation criteria

1a. Have used a /22 from upstream provider
   - Demonstrated efficient previous address usage

   OR

1b. Show immediate need for /22
   - Can include customer projections & infrastructure equipment

2. Detailed plan for use of /21 within a year

3. Renumber to new space within 1 year

   - Meet all policy requirements
     - Applicants may be required to show 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

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

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

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 /20 ‘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

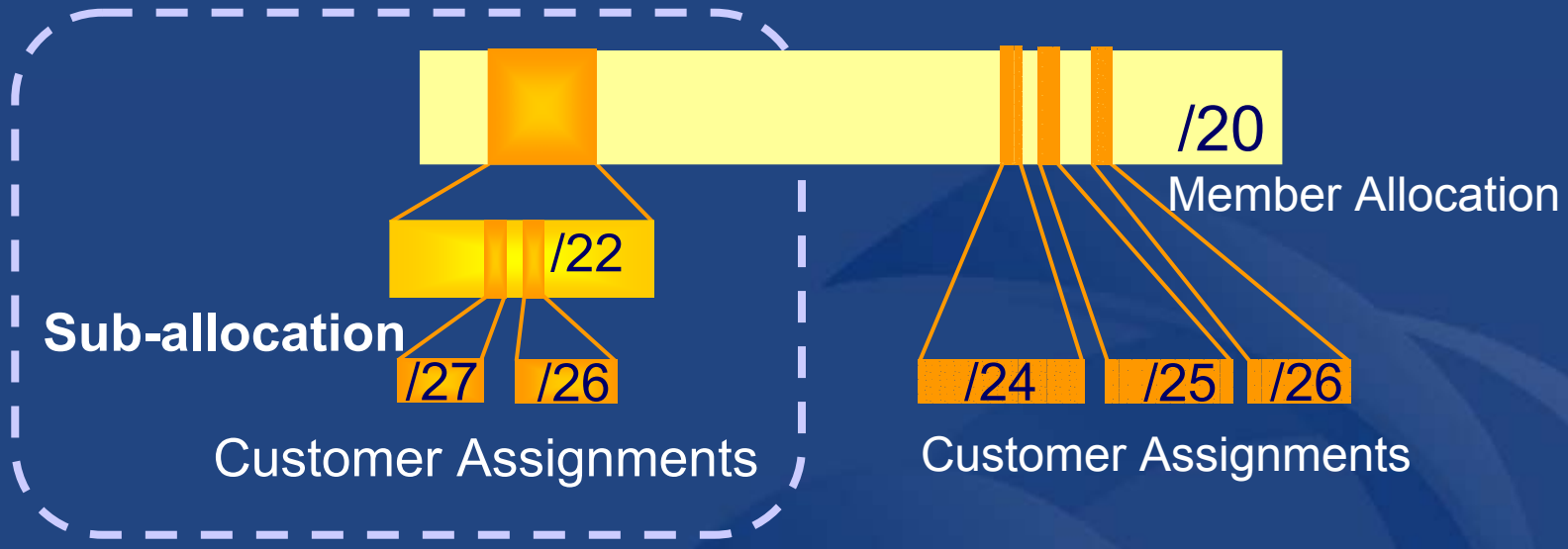
Evaluation guidelines – Cable/DSL

- Bootstrap criteria
  - Simplified, optional criteria
  - Assumption of /24 per CMTS
- Subsequent allocation
    - CMTS devices per headend
    - 3 month subscriber projection
    - Average growth per month
      - option: MRTG to support growth rate evaluation
    - equipment purchase receipts

Evaluation guidelines – 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

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

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

General assignment guidelines

- Static & Dynamic
  - Transient connections (dial-up)
    - dynamic recommended
  - Permanent connections
    - static assignments ok (1:1 contention ratio)
      - (dynamic encouraged)
- IP unnumbered
  - Encouraged when possible
    - Helps conserving IP addresses
      - statically routed, single-homed customer connections (no BGP)

      http://www.apnic.net/info/faq/ip_unnumb.html

Small multihoming assignment policy

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
- Meet all policy requirements or have the assignment revoked

IPv4 assignment policy for IXPs

Criteria

- 3 or more peers
- Demonstrate “open peering policy”

  - APNIC has a reserved block of space from which to make IXP assignments

Portable critical infrastructure assignments

- What is Critical Internet Infrastructure?
  - Domain registry infrastructure
    - Root DNS operators,
    - gTLD operators
    - ccTLD operators
  - Address Registry Infrastructure
    - RIRs & NIRs
    - IANA
- Why a specific policy ?
    - Protect stability of core Internet function
- Assignment sizes:
  - IPv4: /24
  - IPv6: /32

APNIC16 policy update

16th APNIC Open Policy meeting took place the 19th – 22nd August, Seoul, Korea

- Policy development proposal
  - Prop-001-v001: Revised policy development process
    - Text proposal on ML 1 month before meeting
    - 'Comment period' on ML 2 months after meeting

consensus

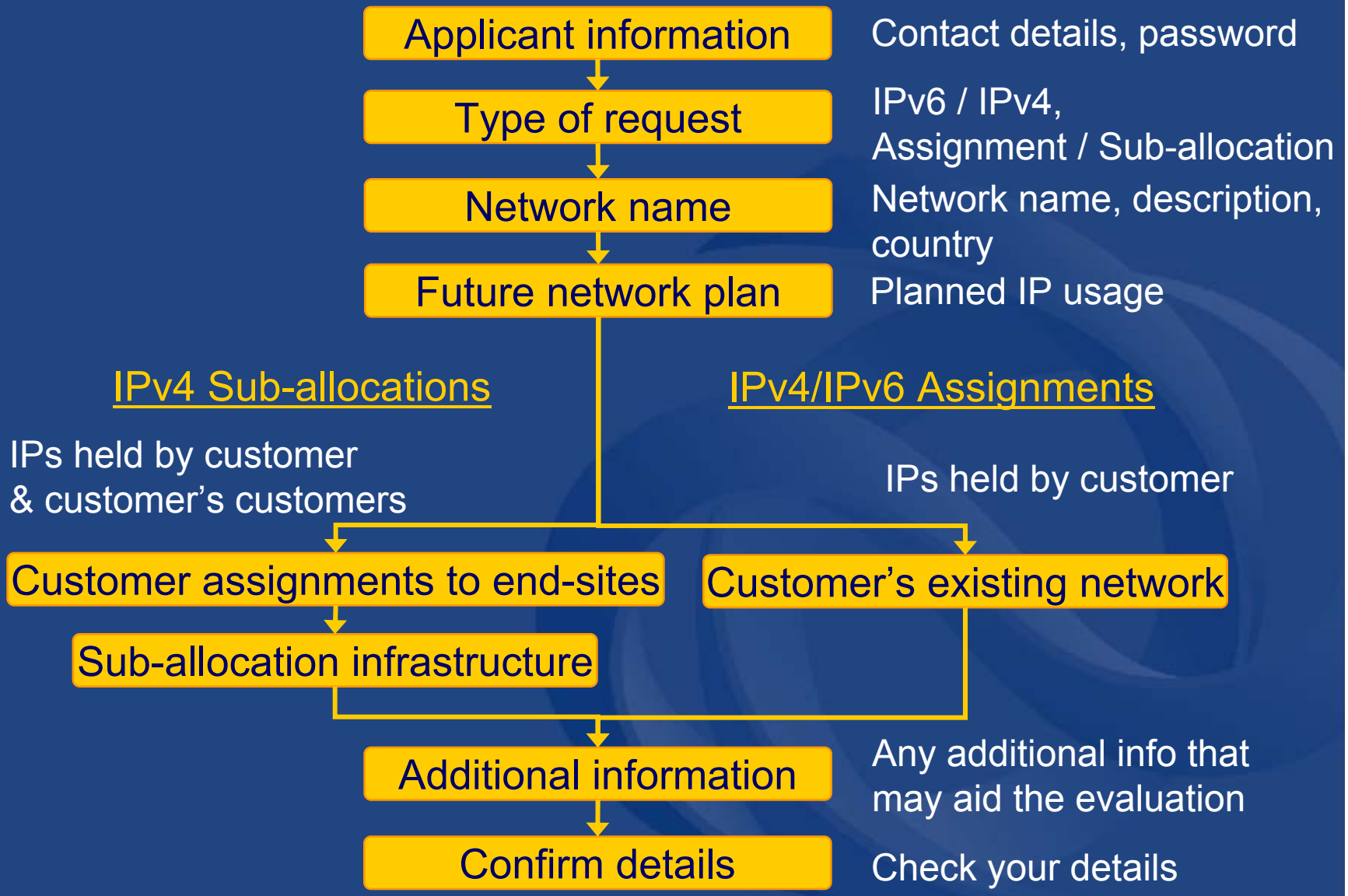
- IPv4 policy proposal
  - Prop-006-v001: Historical resource transfers
    - Allows transfers from 'historical' to 'current' status
    - Recipient must be an APNIC member
    - Address space subject to current policy framework

consensus

APNIC16 policy update

- IPv4/IPv6 policy proposal
  - Prop-011-v001: Revised IXP assignment policy
    - Definition amended, restriction on routing lifted
    - Further discussion required for remainder of proposal
- IPv6 informational proposal
  - Create a guidelines document to explain existing IPv6 policy

Overview of 2nd opinion



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?

Customer assignment

- Member updates internal records
  - Select address range to be assigned
  - Archive original documents sent to APNIC
  - Update APNIC database
- Clarify status of address space
  - APNIC requirement is ‘Non portable’
  - ‘Portable’ assignments are made by APNIC only with the end-user request form
    - Organisation must have technical requirement

Questions ?

Asia Pacific Network Information Centre

APNIC

The APNIC Database

Usage, Protection and Updating

What is the APNIC database?

- Public network management database
  - Operated by IRs
- Tracks network resources
  - IP addresses, ASNs, Reverse Domains, Routing policies
- Records administrative information
  - Contact information (persons/roles)
  - Authorisation

Object types

OBJECT	PURPOSE
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:  [optional]   [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]     [ ]
```

Person object example

- Person objects contain contact information

Attributes	Values
person:	Ajith Singh
address:	ExampleNet Service Provider
address:	2 Main St, Mount court
address:	Wallis and Futuna Islands
country:	WF
phone:	+680-368-0844
fax-no:	+680-367-1797
e-mail:	kxander@example.com
nic-hdl:	AS17-AP
mnt-by:	MAINT-WF-EX
changed:	asingh@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: AS17-AP

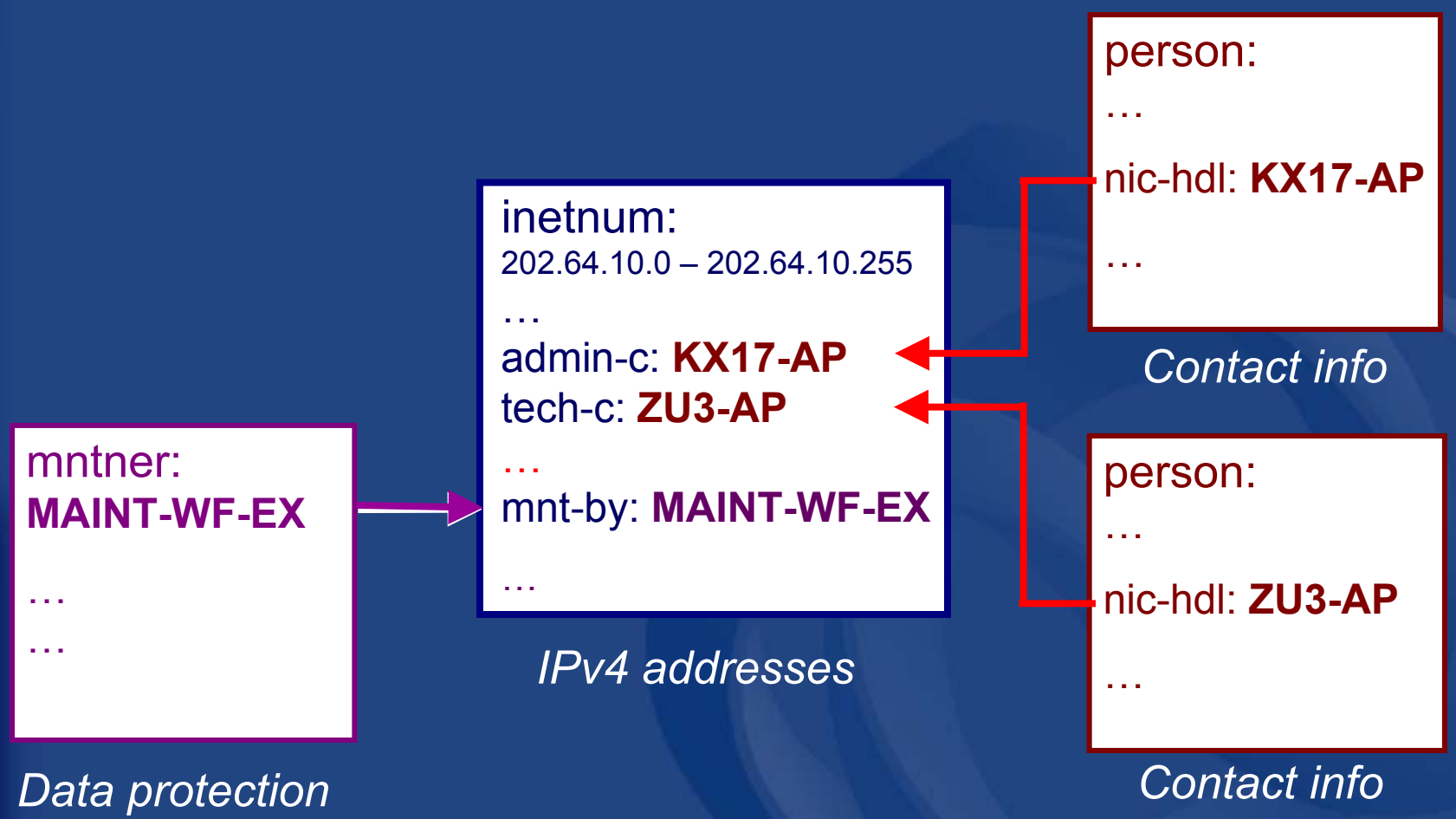
```
person:   Ajith Singh
address:      ExampleNet Service Provider
address:      2 Main St, Mount court
address:      Wallis and Futuna Islands
country:      WF
phone:        +680-368-0844
fax-no:       +680-367-1797
e-mail:       kxander@example.com
nic-hdl:  AS17-AP
mnt-by:       MAINT-WF-EX
changed:      kxander@example.com 20020731
source:       APNIC
```

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
status:	ALLOCATED PORTABLE
mnt-by:	APNIC-HM
mnt-lower:	MAINT-NP-ARUN
changed:	hostmaster@apnic.net 20010205
source:	APNIC

Inter-related objects



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

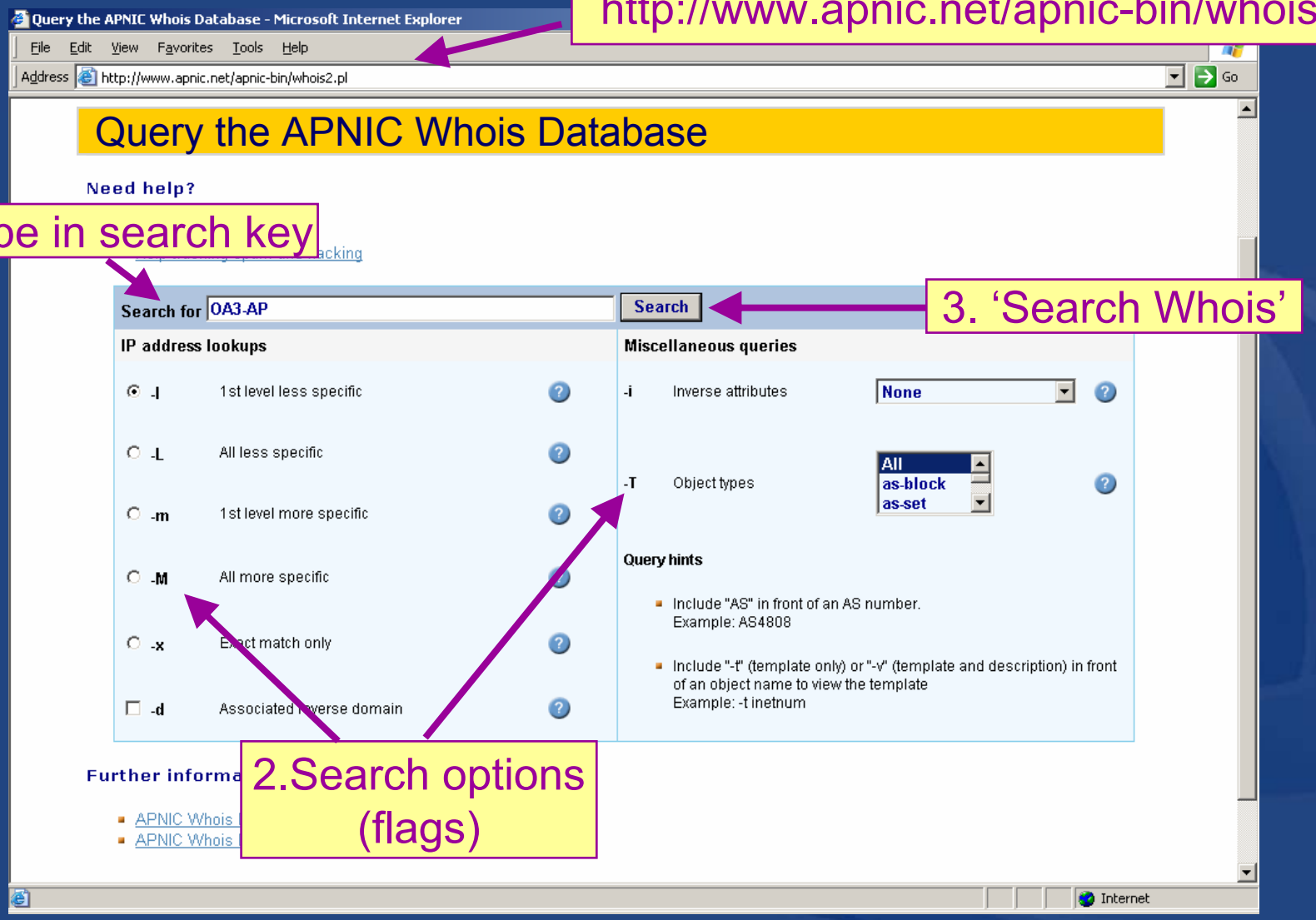
Database query (unix)- inetnum

```
% whois 203.127.128.0 - 203.127.159.255
% whois 203.127.128.0/19
% whois SINGNET-SG
```

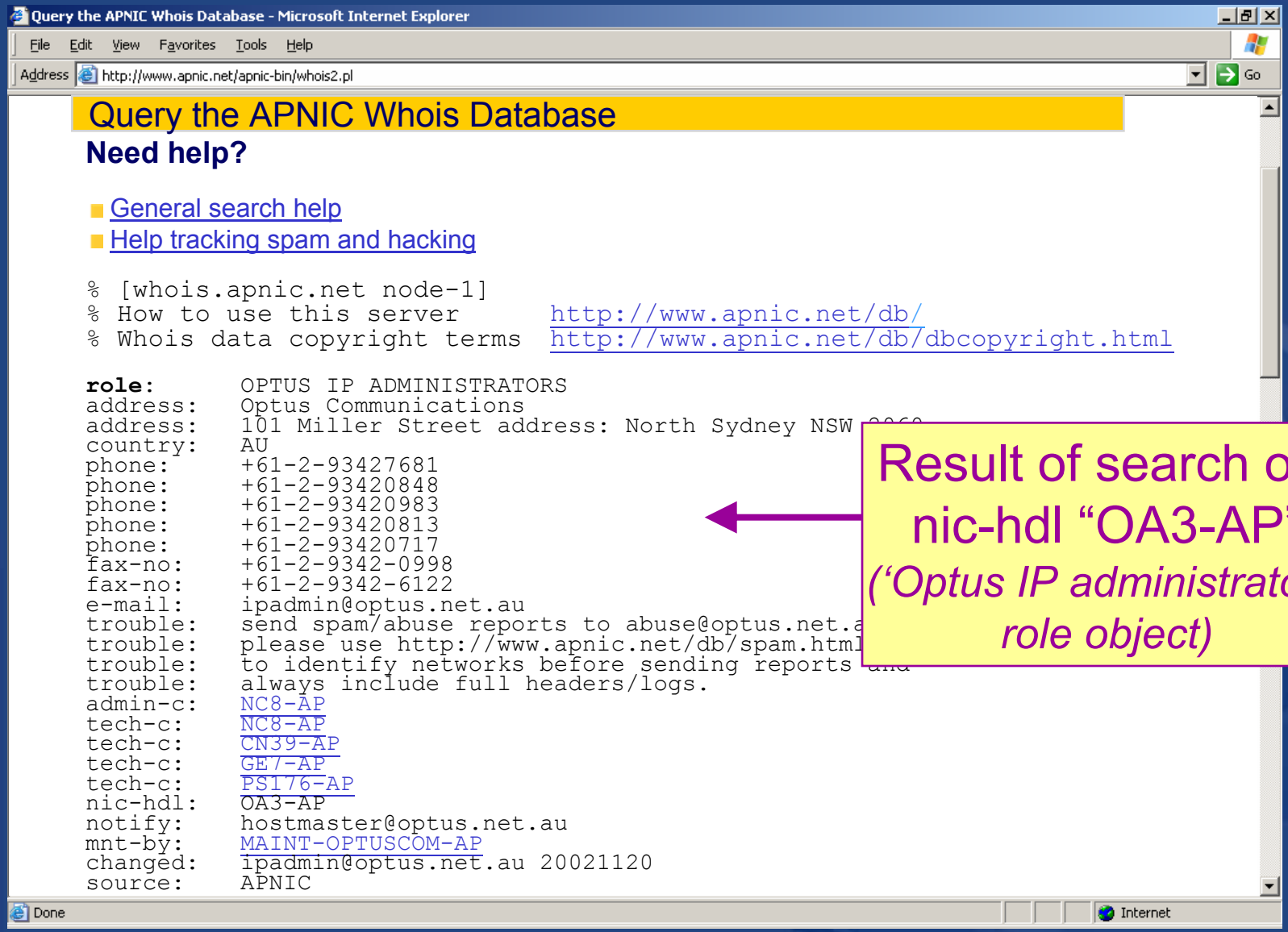
```
inetnum:    203.127.128.0 - 203.127.159.255
netname:    SINGNET-SG
descr:      Singapore Telecommunications Ltd
descr:      31, Exeter Road, #02-00, Podium Block
descr:      Comcentre, 0923
country:    SG
admin-c:    CWL3-AP
tech-c:     CWL3-AP
mnt-by:     APNIC-HM
changed:    hostmaster@apnic.net 19990803
source:     APNIC
```

- Note
  - Incomplete addresses padded with ".0"
  - Address without prefix interpreted as "/32"

Database query (web) - role



Database query (web) - role



Result of search on nic-hdl “OA3-AP” *(‘Optus IP administrators’ role object)*

Advanced database queries

– Flags used for inetnum queries

None find exact match
- l find one level less specific matches
- L find all less specific matches
- m find first level more specific matches
- M find all More specific matches
- x find exact match (if no match, nothing)
- d enables use of flags for reverse domains
- r turn off recursive lookups

Database query - inetnum

Asia Pacific Network Information Centre

APNIC

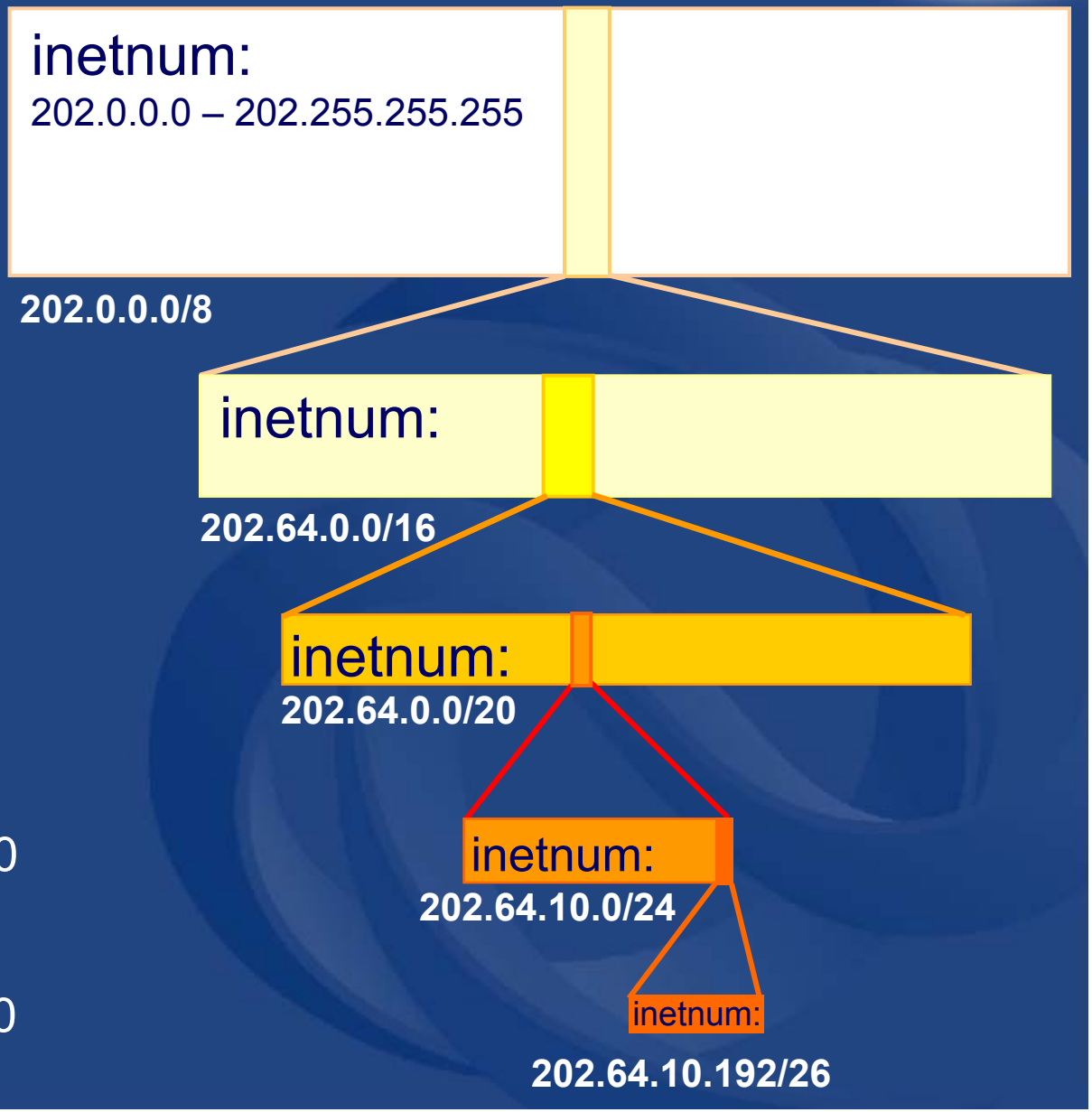
whois -L 202.64.0.0 /20
(all less specific)

whois -l 202.64.0.0 /20
(1 level less specific)

whois 202.64.0.0 /20

whois –m 202.64.0.0 /20
(1 level more specific)

whois –M 202.64.0.0 /20
(all more specific)



Database query - inetnum

'-M' will find all assignments in a range in the database

```
% whois -M 202.64.0.0/20
```

```
inetnum:     202.64.10.0 - 202.64.10.255
netname:     SILNET-AP
descr:       Satyam Infoway Pvt.Ltd.,
.....
inetnum:     202.64.12.128 - 202.64.12.255
netname:     SOFTCOMNET
descr:       SOFTCOM LAN (Internet)IP.
.....
inetnum:     202.64.15.192 - 202.64.15.255
descr:       SILNET
descr:       Satyam Infoway's Chennai LAN
.....
```

Recursive lookups

- whois 202.12.29.0

→ `inetnum` , `route` & `person`

recursion enabled by default

  - whois -r 202.12.29.0

→ `inetnum` & `route` ~~`person`~~

recursion turned off

  - whois -T inetnum 202.12.29.0

→ `inetnum` & `person`

'type' of object specified

  - whois -r -T inetnum 202.12.29.0

→ `inetnum`

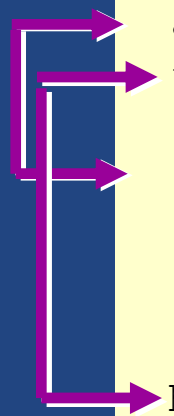
'type' of object specified & recursion turned off

Database query - recursion

Recursion is enabled by default

```
% whois 203.113.0.0/19

inetnum:      203.113.0.0 - 203.113.31.255
netname:      TOTNET-AP
descr:        Telephone Organization of THAILAND(TOT)
descr:        Telephone and IP Network Service Provider
descr:        State Enterprise Thailand Government
country:      TH
admin-c:      NM18-AP
tech-c:       RC80-AP
   ..... .
person:       Nopparat Maythaveekulchai
address:      YTEL-1234 Office
address:      Telephone Organization of THAILAND(TOT)
   ..... .
person:       Rungsun Channarukul
address:      YTEL-1234 OfficeP
address:      Telephone Organization of THAILAND(TOT)
```



Database query – no recursion

Turn off recursion '-r' no nic-handle lookup

```
% whois -r  203.113.0.0/19
```

```
inetnum:      203.113.0.0 - 203.113.31.255
netname:      TOTNET-AP
descr:        Telephone Organization of THAILAND(TOT)
descr:        Telephone and IP Network Service Provider
descr:        State Enterprise Thailand Government
country:      TH
admin-c:      NM18-AP
tech-c:       RC80-AP
mnt-by:       APNIC-HM
mnt-lower:    MAINT-TH-SS163-AP
changed:      hostmaster@apnic.net 19990922
source:       APNIC
```

Inverse queries

- Inverse queries are performed on inverse keys
  - *See object template (whois –t)*
- Returns all objects that reference the object with the key specified as a query argument
  - Practical when searching for objects in which a particular value is referenced, such as your nic-hdl
- Syntax: whois -i <attribute> <value>

Inverse queries - examples

- *What objects are referencing my nic-hdl?*
  - whois -ipn KX17-AP
- *In what objects am I registered as tech-c?*
  - whois –i tech-c KX17-AP
- *Return all domain objects where I am registered as admin-c, tech-c or zone-c*
  - whois -i admin-c,tech-c,zone-c -T domain KX17-AP

no space!

- *What objects are protected by my maintainer?*
  - whois -i mnt-by MAINT-WF-EX

Database query - inverse

Inverse lookup with '-i '

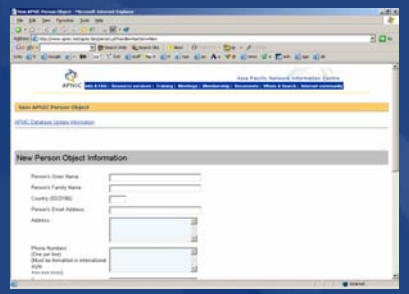
```
% whois -i person DK26-AP
```

```
inetnum:      202.101.128.0 - 202.101.159.255
netname:      CHINANET-FJ
descr:        chinanet fujian province network
country:      CN
admin-c:      DK26-AP
……
domain:       128.103.202.in-addr.arpa
descr:        in-addr.arpa zone for 128.103.202.in-addr.arpa
admin-c:      DK26-AP
…….
aut-num:      AS4811
as-name:      CHINANET-CORE-WAN-EAST
descr:        CHINANET core WAN EAST
descr:        connect to AT&T,OPTUS
country:      CN
admin-c:      DK26-AP
……
person:       Dongmei Kou
address:      A12,Xin-Jie-Kou-Wai Street,
address:      Beijing,100088
country:      CN
phone:        +86-10-62370437
nic-hdl:      DK26-AP
```

Creating a person object

Whois Database Guide:

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



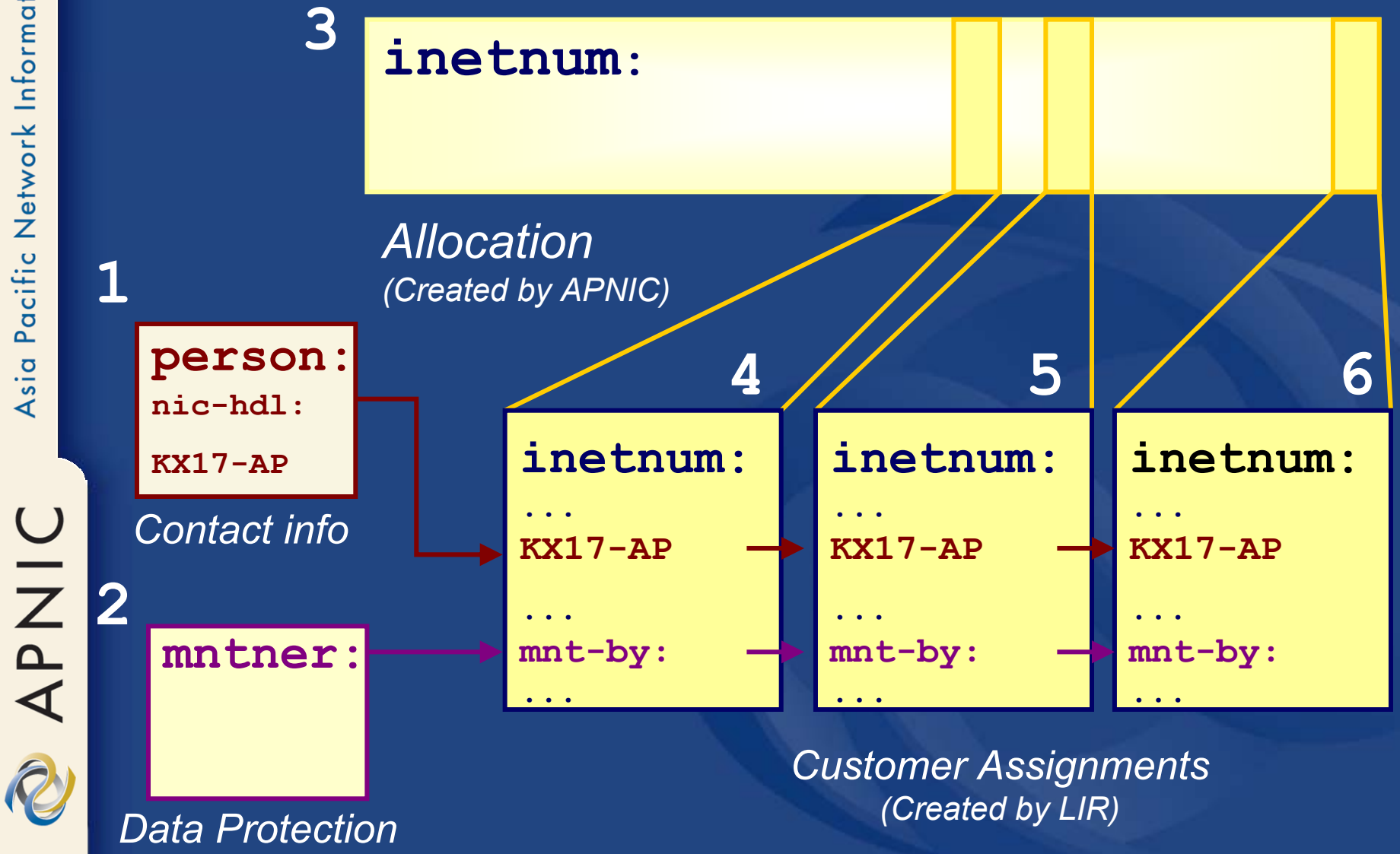
1. Fill out person object form on web
   - Name, e-mail, phone, address etc
   - Tick 'MNT-NEW' for temporary protection
2. Completed template is sent to you
3. Forward template to <auto-dbm@apnic.net>
4. Person object created and nic-hdl is generated

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*
   - (Allocation object created by APNIC)

Using the db – step by step



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

Database mailboxes

- Automatic request processing

Parse

<auto-dbm@apnic.net>

  - Automatic "robot" for all db updates
  - Email template for create/update/delete

- Database service support

<helpdesk@apnic.net>

  - E-mails answered by APNIC staff
  - 1 day response time

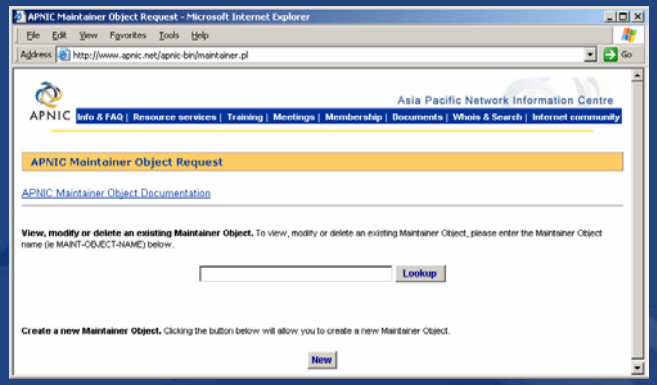
Database protection - maintainer object

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

- protects other objects in the APNIC database

Creating a maintainer object

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



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

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. Only APNIC can change this object
2. Only Loxinfo 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

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

Creating a role object

- Email
  - Whois –t role
    - Gives role object template
  - Complete all fields
    - With the nic-hdls of all contacts in your organisation
  - Send to

<auto-dbm@apnic.net>

Replacing contacts in the db
- using person objects

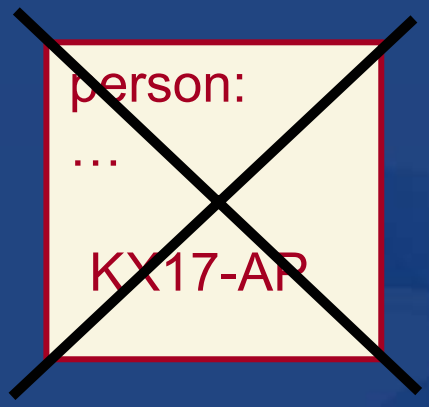
K. Xander is leaving my organisation. Z. Ulrich is replacing him.

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.



person:
…
ZU3-AP

inetnum:
202.0.10.0
…
ZU3-AP

inetnum:
202.0.12.127
…
ZU3-AP

inetnum:
202.0.15.192
…
ZU3-AP

Replacing contacts in the db
– *using a role object*

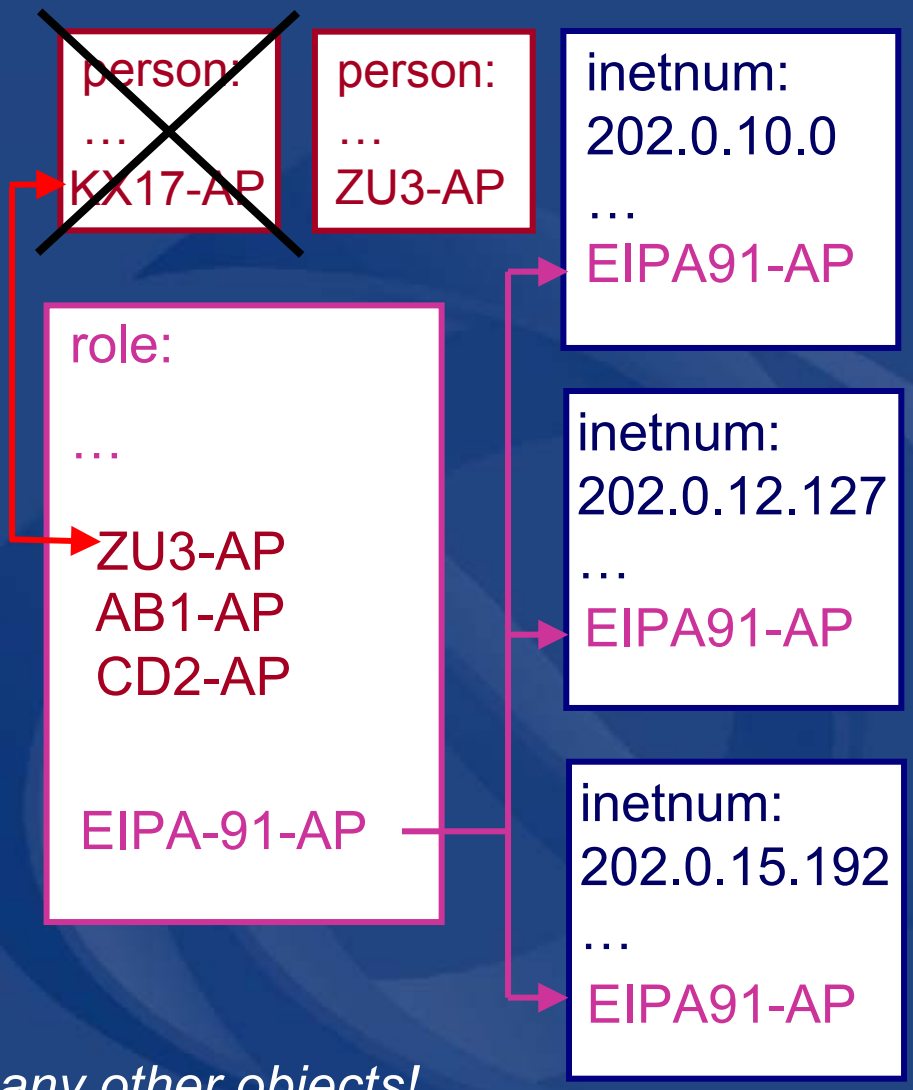
K. Xander is leaving my organisation. Z. Ulrich is replacing him.

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

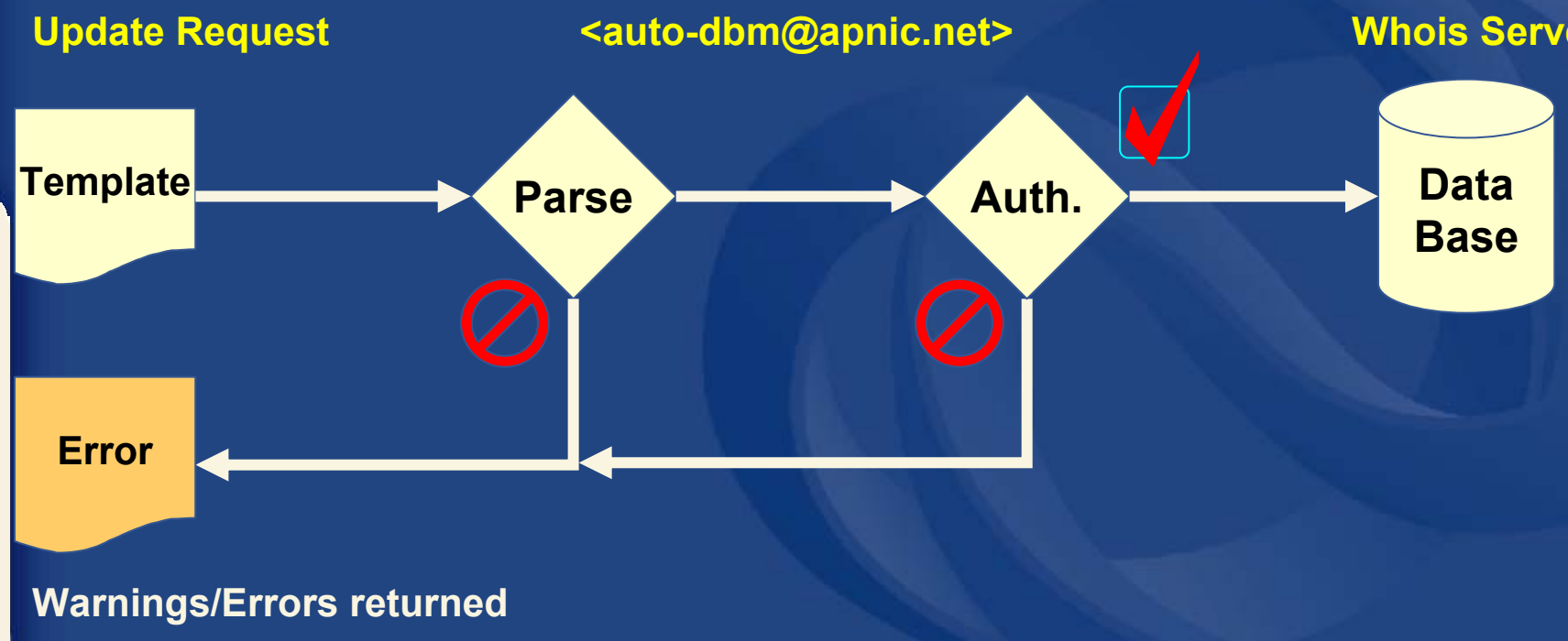
3. Delete old contact's person object.



No need to update any other objects!

Database update process

- Email requests to <auto-dbm@apnic.net>
- Each request contains an object template



Deleting an 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 ?

Requires legal documentation

Unfortunately we cannot change the password for the maintainer until we have received a fax with your company's letterhead confirming the request to modify the password.

In the fax, please include the following:

0. Attention: APNIC Database Administration Department
1. The APNIC Account name of your company and your personal nic handle. If you do not have an APNIC account, then please state 'NON-MEM'.
2. The current maintainer object which is to be modified, as obtained from 'whois –h whois.apnic.net MAINTAINER-OBJECT'
3. The new password/authorisation for the maintainer.
4. The signature of a contact for the maintainer.

Confirmation by fax required on company letter head

We do not recommend using personal names for maintainer objects

Questions ?

Asia Pacific Network Information Centre

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KUALA LUMPUR

IPv6

Overview, Policies & Procedures

Overview

- Rationale
- Addressing
- IPv6 Policies & Procedures
- Statistics

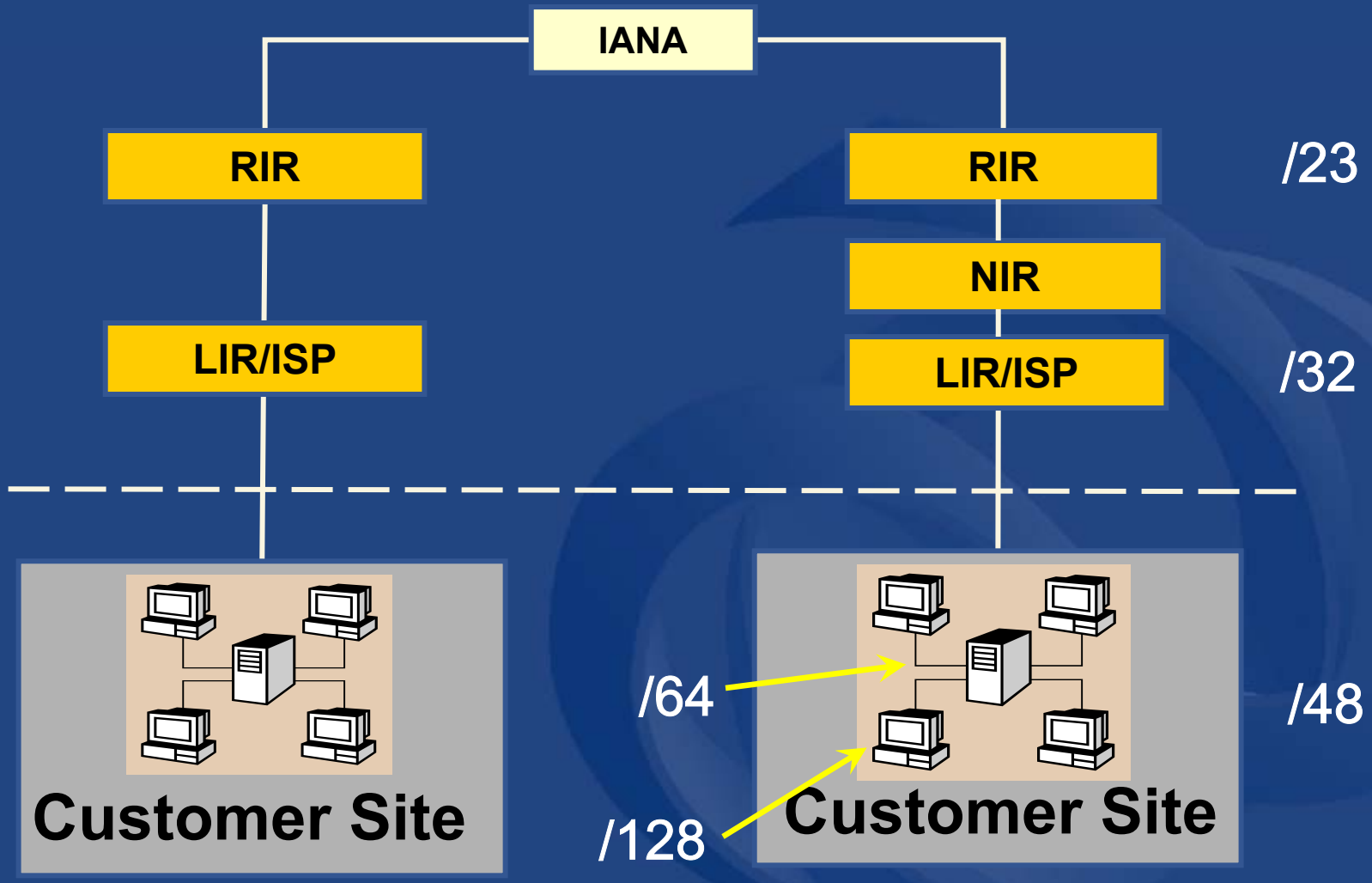
Rationale

- Address depletion concerns
  - Squeeze on available addresses space
- End to end connectivity no longer visible
    - Widespread use of NAT
- Scalability
  - Increase of backbone routing table size
    - Hierarchical routing (CIDR)

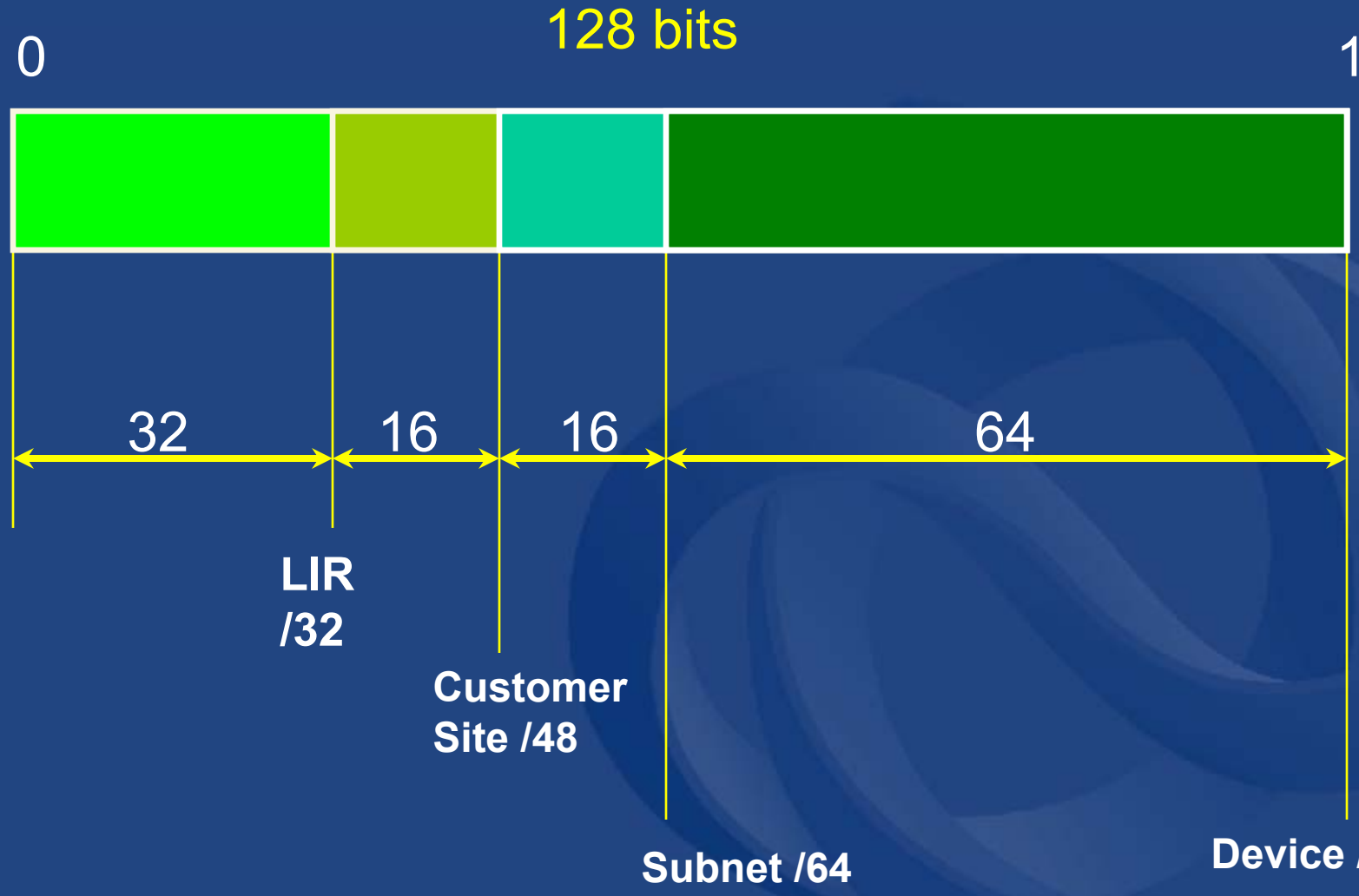
IPv6 addressing

- 128 bits of address space
- Hexadecimal values of eight 16 bit fields
  - X:X:X:X:X:X:X:X (X=16 bit number, eg: A2FE)
  - 16 bit number is converted to a 4 digit hexadecimal number
- Example:
  - FE38:DCE3:124C:C1A2:BA03:6735:EF1C:683D
  - 4EED:23:0:0:0:36E:125:2B
  - 32CB:10A2:0000:0000:0000:0000:3EFC:3C2A can be represented as 32CB:10A2::3EFC:3C2A

IPv6 address management hierarchy



IPv6 addressing structure



IPv6 address policy goals

- Efficient address usage
  - Avoid wasteful practices
- Aggregation
  - Hierarchical distribution
  - Aggregation of routing information
  - Limiting no of routing entries advertised into the Internet
- Minimise overhead
  - Associated with obtaining address space
- Registration, Uniqueness, Fairness & consistency

IPv6 initial allocation criteria

- Be an LIR
  - Not be an end site
- Plan for at least 200 /48 assignments to other organisations within 2 years
- Plan to provide IPv6 connectivity to organisations and to end sites

  - Initial allocation size: /32

IPv6 sub-allocation policy

- LIR to ISP allocation
  - Policy determined by LIR
- DB registration
  - All /48 and shorter prefix allocations and assignments must be registered

IPv6 utilisation requirement

- IPv6 utilisation measured according to HD-Ratio (RFC 3194):

$$\text{Utilisation}_{HD} = \frac{\log(\text{Assigned address space})}{\log(\text{Available address space})}$$

- IPv6 utilisation requirement is HD=0.80
  - Measured according to assignments only
    - E.g. ISP has assigned 10000 (/48s) addresses of /32

$$\frac{\log(\text{Assigned address space})}{\log(\text{Available address space})} = \frac{\log(10{,}000)}{\log(65{,}536)} = 0.83$$

IPv6 utilisation requirement (Cont.)

- HD Ratio utilisation requirement of 0.80

IPv6 Prefix	Site Address Bits	Total site address in /48s	Threshold (HD ratio 0.8)	Utilisation %
42	6	64	28	43.5%
36	12	4096	776	18.9%
35	13	8192	1351	16.5%
32	16	65536	7132	10.9%
29	19	524288	37641	7.2%
24	24	16777216	602249	3.6%
16	32	4294967296	50859008	1.2%
8	40	1099511627776	4294967296	0.4%
3	45	35184372088832	68719476736	0.2%

- RFC 3194
- “In a hierarchical address plan, as the size of the allocation increases, the density of assignments will decrease.”

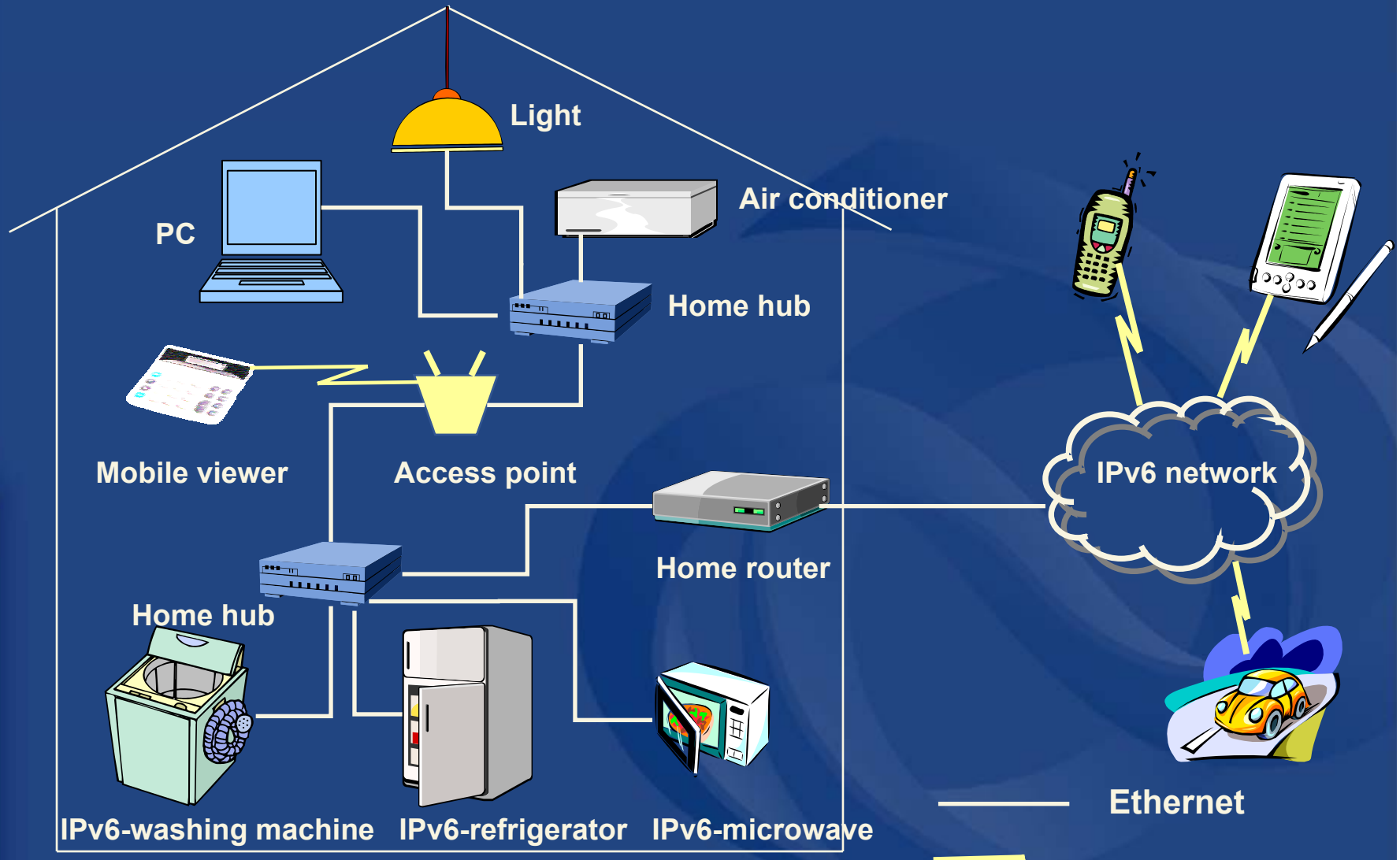
Other conditions

- License model of allocation
  - Allocations are not considered permanent, but always subject to review and reclamation
- Existing /35 Allocations
  - A number of /35s have been assigned under interim IPv6 policy
  - Holders of /35s eligible to request /32

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 - current experiments

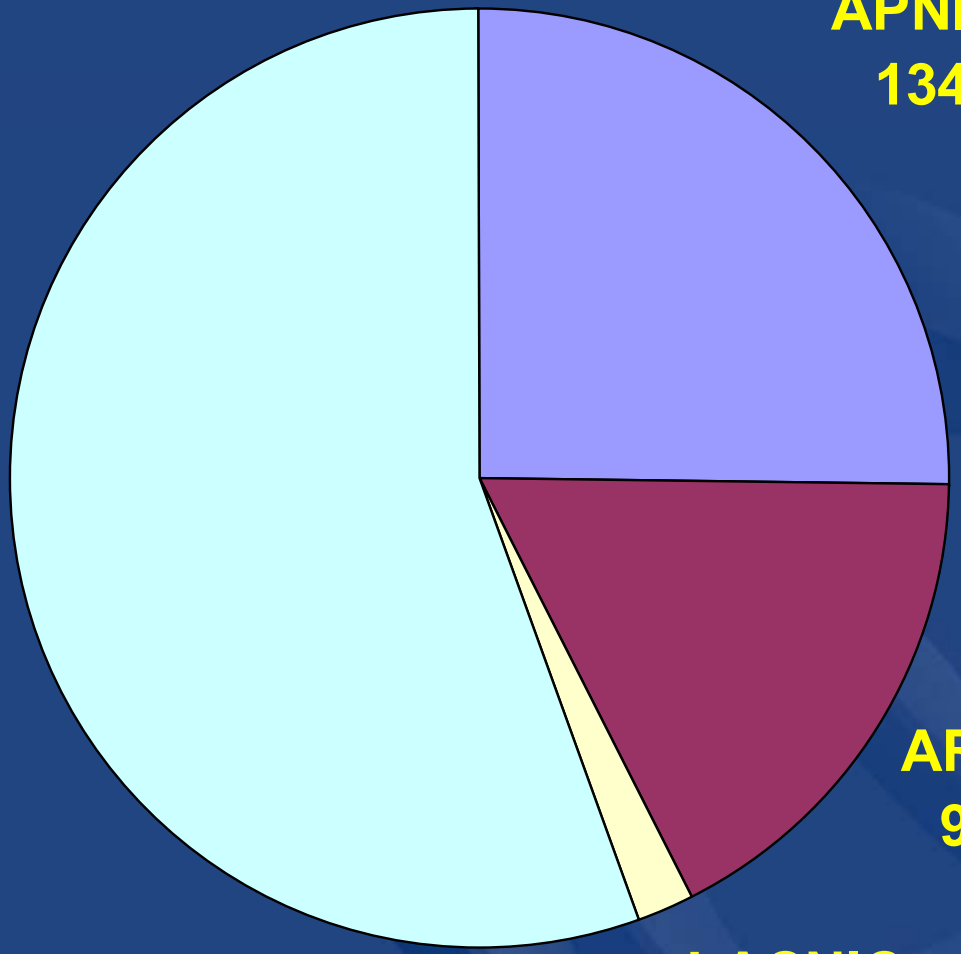


IPv6 Address Allocation Procedures

- IPv6 Allocations to RIRs from IANA
  - APNIC 2001:0200::/23
    2001:0C00::/23
    2001:0E00::/23
  - ARIN 2001:0400::/23
    2001:1800::/23
  - LACNIC 2001:1200::/23
  - RIPE NCC 2001:0600::/23
    2001:0800::/23
    2001:0A00::/23
    2001:1400::/23
    2001:1600::/23

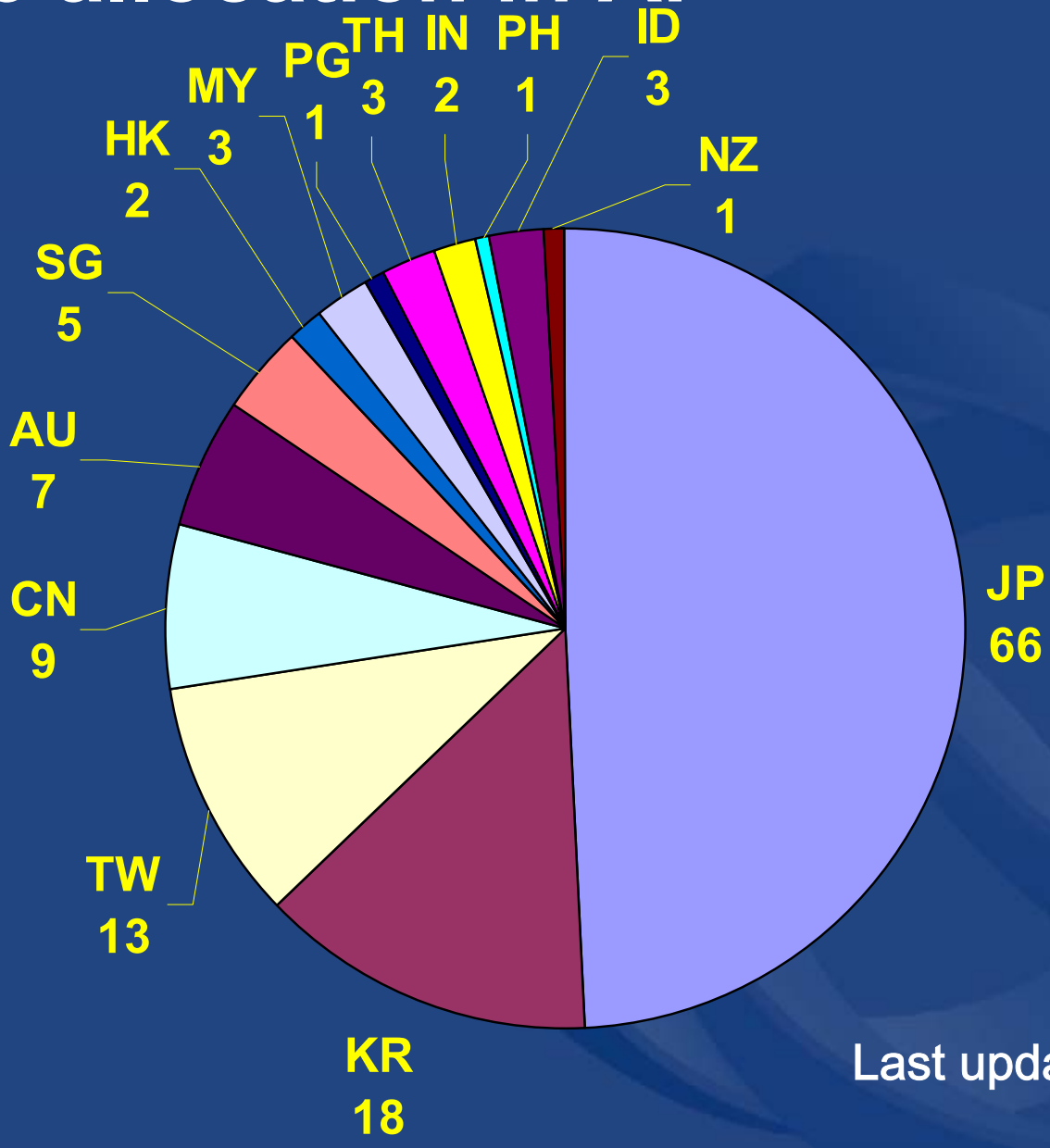
- IPv6 Address Request form http://ftp.apnic.net/apnic/docs/ipv6-alloc-request
- IPv6 FAQ http://www.apnic.net/faq/IPv6-FAQ.html

IPv6 RIRs distribution



Last update Jan 2004

IPv6 allocation in AP



Last update Jan 2004

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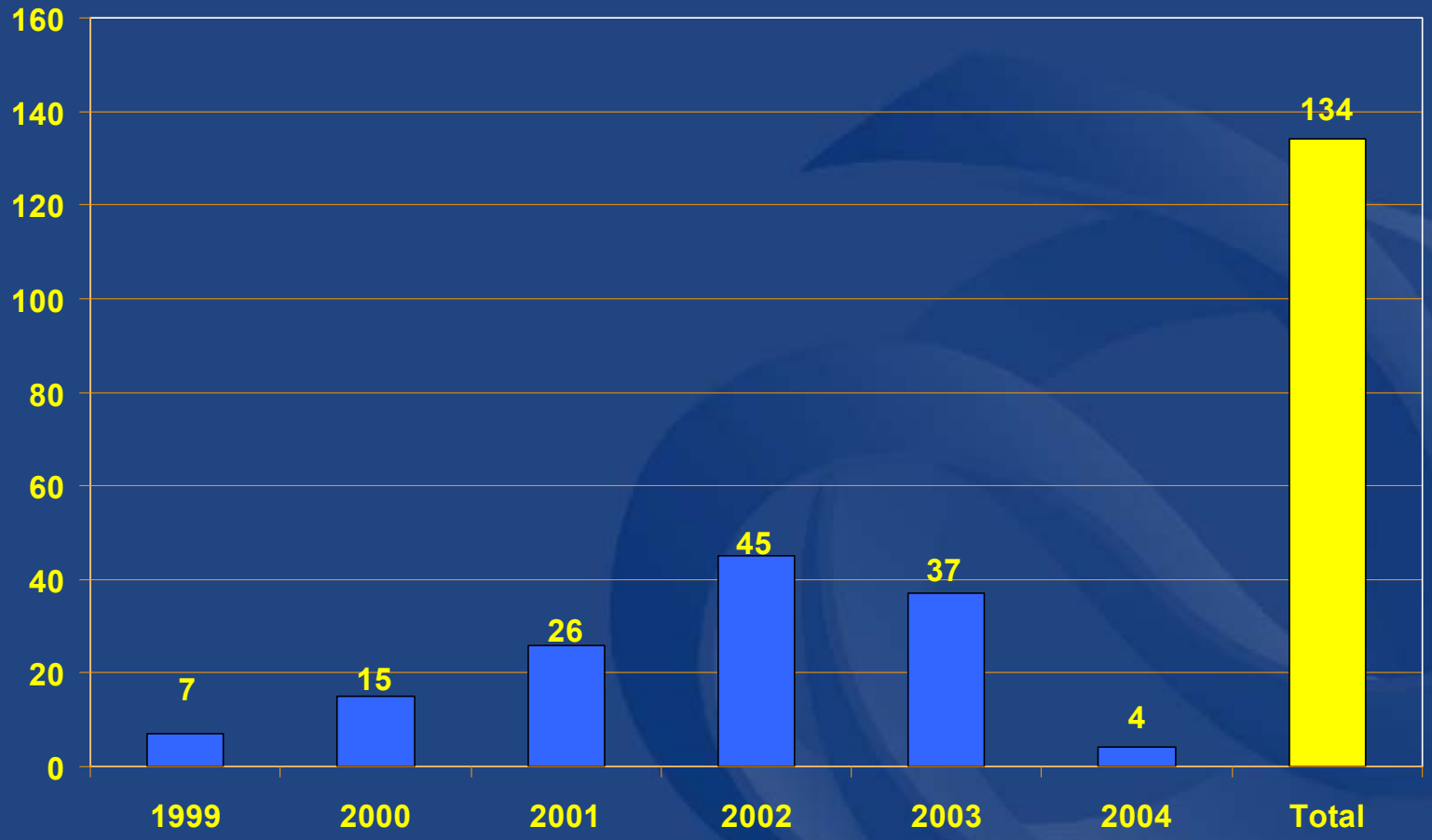
IPv6 allocation by year in AP



Last update Jan 2004

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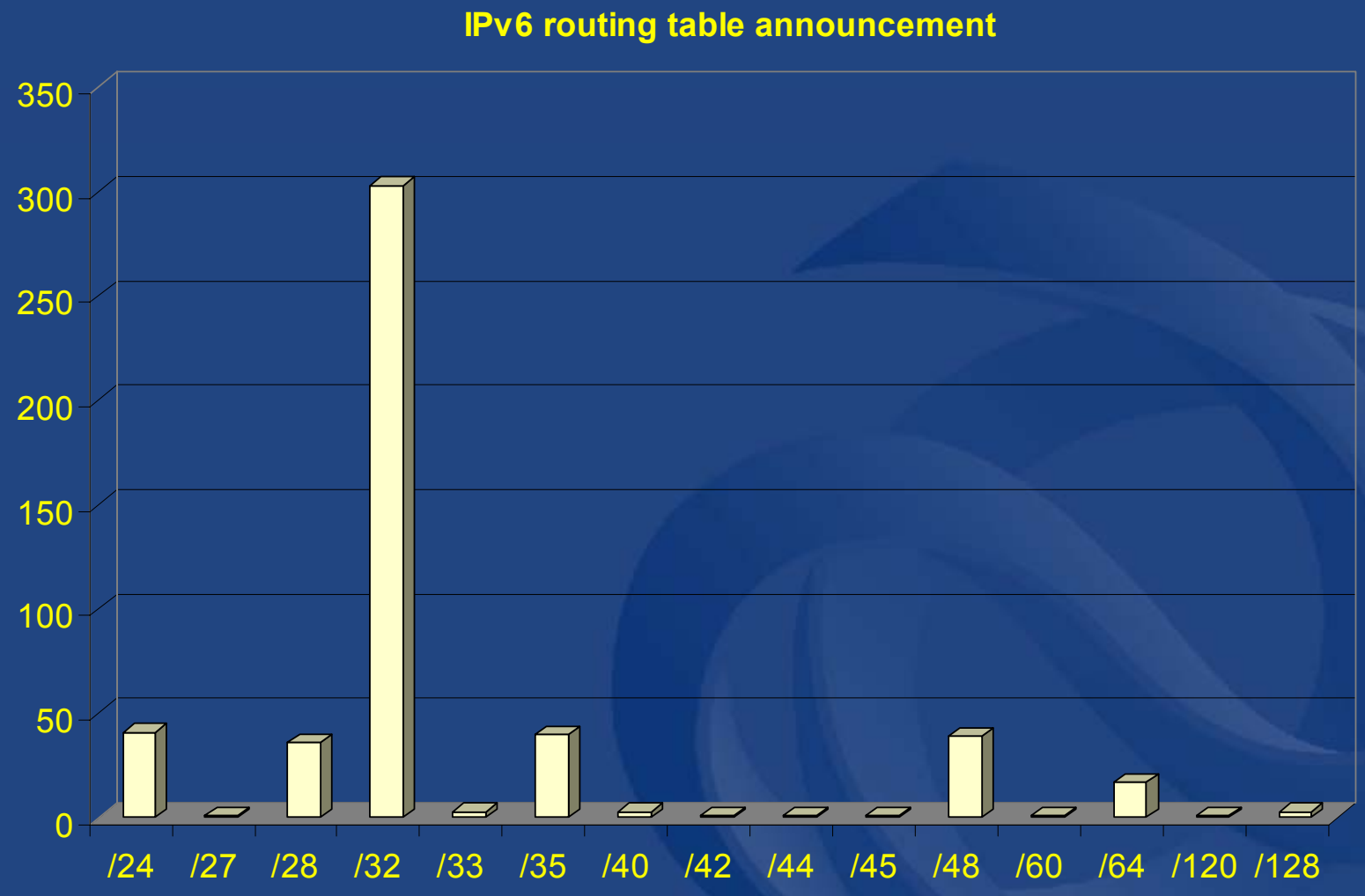
IPv6 routing table



Source: http://bgp.potaroo.net/v6/as1221/index.html

Last updated Jan 2004

Questions ?

References

- IPv6 Resource Guide
  - http://www.apnic.net/services/ipv6_guide.html
- IPv6 Policy Document
  - http://www.apnic.net/policies.html
- IPv6 Address request form
  - http://ftp.apnic.net/apnic/docs/ipv6-alloc-request
- Useful reading:
  - "The case for IPv6": http://www.6bone.net/misc/case-for-ipv6.html

FAQ

- http://www.apnic.net/info/faq/IPv6-FAQ.html

Questions ?

Summary

What we have covered today

Summary

- APNIC's role in the Asia Pacific
- Internet Registry Policies
- Addressing Plan
- How to request IP addresses
- APNIC Database
- IPv6 Overview and Policies

Summary - Responsibilities

- As an APNIC member and custodian of address space
  - Be aware of your responsibilities
  - Register customer assignments in APNIC database
    - Keep this data up-to-date & accurate
  - Educate your customers
  - Document your network in detail
    - Keep local records
  - Register reverse DNS delegations

Asia Pacific Network Information Centre

APNIC

Member Services Helpdesk

- One point of contact for all member enquiries

helpdesk@apnic.net
www.apnic.net/helpdesk

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
    - English
    - Filipino (Tagalog)
    - Hindi
    - Japanese
    - Mandarin
    - Telugu
    - Thai
    - Vietnamese
- *Faster response and resolution of queries*
  - IP resource applications, status of requests, membership enquiries, billing issues & database enquiries

Summary

- "Do the right thing"
  - Think about routing table size & scalability of Internet
  - Encourage renumbering
  - Announce aggregate prefixes
  - Think global not local

Thank you !!

Your feedback is appreciated

Supplementary Reading

Introduction

Regional Registry web sites

- APNIC:
  http://www.apnic.net
- ARIN:
  http://www.arin.net
- LACNIC:
  http://www.lacnic.net
- RIPE NCC:
  http://www.ripe.net

APNIC past meetings

http://www.apnic.net/meetings

Introduction

APNIC members

http://www.apnic.net/members.html

Membership

- Membership procedure

  http://www.apnic.net/membersteps.html
- Membership application form

  http://www.apnic.net/apnic-bin/membership-application.pl
- Membership fees

  http://www.apnic.net/docs/corpdocs/FeeSchedule.htm

Introduction to APNIC & IP Policy

Classless techniques

- CIDR
  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1517-19.txt
- Network Addressing when using CIDR
  ftp://ftp.uninett.no/pub/misc/eidnes-cidr.ps.Z
- Variable Length Subnet Table
  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1878.txt

Private Address Space

- Address Allocation for Private Internets
  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1918.txt
- Counter argument: “Unique addresses are good”
  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1814.txt

Bit boundary chart

addrs	bits	pref	class	mask
1	0	/32		255.255.255.255
2	1	/31		255.255.255.254
4	2	/30		255.255.255.252
8	3	/29		255.255.255.248
16	4	/28		255.255.255.240
32	5	/27		255.255.255.224
64	6	/26		255.255.255.192
128	7	/25		255.255.255.128
256	8	/24	1C	255.255.255
512	9	/23	2C	255.255.254
1,024	10	/22	4C	255.255.252
2,048	11	/21	8C	255.255.248
4,096	12	/20	16C	255.255.240
8,192	13	/19	32C	255.255.224
16,384	14	/18	64C	255.255.192
32,768	15	/17	128C	255.255.128
65,536	16	/16	1B	255.255
131,072	17	/15	2B	255.254
262,144	18	/14	4B	255.252
524,288	19	/13	8B	255.248
1,048,576	20	/12	16B	255.240
2,097,152	21	/11	32B	255.224
4,194,204	22	/10	64B	255.192
8,388,608	23	/9	128B	255.128
16,777,216	24	/8	1A	255
33,554,432	25	/7	2A	254
67,108,864	26	/6	4A	252
134,217,728	27	/5	8A	248
268,435,456	28	/4	16A	240
536,870,912	29	/3	32A	224
1,073,741,824	30	/2	64A	192

APNIC Mailing Lists

- apnic-talk
  - Open discussions relevant to APNIC community & members
- apnic-announce
  - Announcements of interest to the AP community
- sig-policy
  - IPv4 and IPv6 allocation and assignment policies
- global-v6
  - Global IPv6 policy mailing list

- subscribe via <majordomo@apnic.net>
- archives:

  http://ftp.apnic.net/apnic/mailing-lists

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

The RIR System

- *"Development of the Regional Internet Registry System"* Internet Protocol Journal
  - Short history of the Internet

http://www.cisco.com/warp/public/759/ipj_4-4/ipj_4-4_regional.html

Policies & Policy Environment

Policy Documentation

- Policies for address space management in the Asia Pacific region

  http://www.apnic.net/docs/policy/add-manage-policy.html

- RFC2050: Internet Registry IP allocation Guidelines

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2050.txt

Address Request Procedures

Addressing Guidelines

- "Designing Addressing Architectures for Routing & Switching", Howard C. Berkowitz

Address Request Forms

- ISP Address Request Form

  http://www.apnic.net/services/ipv4/
- Second-opinion Request Form

  http://www.apnic.net/services/second-opinion/
- No Questions Asked

  http://ftp.apnic.net/apnic/docs/no-questions-policy

APNIC Database

APNIC Database Documentation

- Updating information in the APNIC Database
  http://ftp.apnic.net/apnic/docs/database-update-info
- Maintainer & Person Object Request Form
  http://ftp.apnic.net/apnic/docs/mntner-person-request
- APNIC Maintainer Object Request
  http://www.apnic.net/apnic-bin/maintainer.pl
- APNIC Whois Database objects resource guide
  http://www.apnic.net/services/whois_guide.html

APNIC Database

RIPE Database Documentation

- RIPE Database Reference Manual

  http://www.ripe.net/docs/databaseref-manual.html

Database 'whois' Client

http://ftp.apnic.net/apnic/dbase/tools/ripe-dbase-client.tar.gz

Database web query

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

Person object template

person:	[mandatory]	[single]	[lookup key]
address:	[mandatory]	[multiple]	[ ]
country:	[optional]	[single]	[ ]
phone:	[mandatory]	[multiple]	[ ]
fax-no:	[optional]	[multiple]	[ ]
e-mail:	[mandatory]	[multiple]	[lookup 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]	[ ]

Role object template

```
role:     [mandatory] [single]     [lookup key]
address:  [mandatory] [multiple]   [ ]
country:  [optional]  [single]     [ ]
phone:    [mandatory] [multiple]   [ ]
fax-no:   [optional]  [multiple]   [ ]
e-mail:   [mandatory] [multiple]   [lookup key]
trouble:  [optional]  [multiple]   [ ]
admin-c:  [mandatory] [multiple]   [inverse key]
tech-c:   [mandatory] [multiple]   [inverse 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]     [ ]
```

Maintainer Object Template

```
mntner:      [mandatory] [single]   [primary/look-up key]
descr:       [mandatory] [multiple] [ ]
country:     [optional]  [single]   [ ]
admin-c:     [mandatory] [multiple] [inverse key]
tech-c:      [optional]  [multiple] [inverse key]
upd-to:      [mandatory] [multiple] [inverse key]
mnt-nfy:     [optional]  [multiple] [inverse key]
auth:        [mandatory] [multiple] [ ]
remarks:     [optional]  [multiple] [ ]
notify:      [optional]  [multiple] [inverse key]
mnt-by:      [mandatory] [multiple] [inverse key]
referral-by: [mandatory] [single]   [inverse key]
changed:     [mandatory] [multiple] [ ]
source:      [mandatory] [single]   [ ]
```

Inetnum object template

```
inetnum:     [mandatory]  [single]    [primary/look-up key]
netname:     [mandatory]  [single]    [lookup key]
descr:       [mandatory]  [multiple]  [ ]
country:     [mandatory]  [multiple]  [ ]
admin-c:     [mandatory]  [multiple]  [inverse key]
tech-c:      [mandatory]  [multiple]  [inverse key]
rev-srv:     [optional]   [multiple]  [inverse key]
status:      [mandatory]  [single]    [ ]
remarks:     [optional]   [multiple]  [ ]
notify:      [optional]   [multiple]  [inverse key]
mnt-by:      [mandatory]  [multiple]  [inverse key]
mnt-lower:   [optional]   [multiple]  [inverse key]
mnt-routes:  [optional]   [multiple]  [inverse key]
mnt-irt:     [optional]   [multiple]  [inverse key]
changed:     [mandatory]  [multiple]  [ ]
source:      [mandatory]  [single]    [ ]
```

Aut-num Object Template

aut-num:	[mandatory]	[single]	[primary/look-up key]
as-name:	[mandatory]	[single]	[ ]
descr:	[mandatory]	[multiple]	[ ]
country:	[optional]	[single]	[ ]
member-of:	[optional]	[multiple]	[ ]
import:	[optional]	[multiple]	[ ]
export:	[optional]	[multiple]	[ ]
default:	[optional]	[multiple]	[ ]
remarks:	[optional]	[multiple]	[ ]
admin-c:	[mandatory]	[multiple]	[inverse key]
tech-c:	[mandatory]	[multiple]	[inverse key]
cross-mnt:	[optional]	[multiple]	[inverse key]
cross-nfy:	[optional]	[multiple]	[inverse key]
notify:	[optional]	[multiple]	[inverse key]
mnt-lower:	[optional]	[multiple]	[inverse key]
mnt-routes:	[optional]	[multiple]	[inverse key]
mnt-by:	[mandatory]	[multiple]	[inverse key]
changed:	[mandatory]	[multiple]	[ ]
source:	[mandatory]	[single]	[ ]

Domain object template

```
domain:     [mandatory] [single]    [primary/look-up key]
descr:      [mandatory] [multiple]  [ ]
country:    [optional]  [single]    [ ]
admin-c:    [mandatory] [multiple]  [inverse key]
tech-c:     [mandatory] [multiple]  [inverse key]
zone-c:     [mandatory] [multiple]  [inverse key]
nserver:    [mandatory] [multiple]  [inverse key]
sub-dom:    [optional]  [multiple]  [inverse key]
dom-net:    [optional]  [multiple]  [ ]
remarks:    [optional]  [multiple]  [ ]
notify:     [optional]  [multiple]  [inverse key]
mnt-by:     [mandatory] [multiple]  [inverse key]
mnt-lower:  [optional]  [multiple]  [inverse key]
refer:      [optional]  [single]    [ ]
changed:    [mandatory] [multiple]  [ ]
source:     [mandatory] [single]    [ ]
```

Reverse DNS

Request Forms

- Guide to reverse zones

  http://www.apnic.net/db/revdel.html

- Registering your Rev Delegations with APNIC

  http://www.apnic.net/db/domain.html

Relevant RFCs

- Classless Delegations

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2317.txt

- Common DNS configuration errors

  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1537.txt

Reverse DNS

Documentation

- Domain name structure and delegation

  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1591.txt
- Domain administrators operations guide

  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1033.txt
- Taking care of your domain

  ftp://ftp.ripe.net/ripe/docs/ripe-114.txt
- Tools for DNS debugging

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2317.txt

AS Assignment Procedures

Policy

- Guidelines for the creation, selection, and registration of an AS

  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1930.txt

RFCs

- Routing Policy Specification Language (RPSL)

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2280.txt

- A dedicated AS for sites homed to a single provider

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2270.txt

- RFC1997: BGP Communities attribute

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2270.txt

IPv6

Policy Documents

- IPv6 Address Policy

  http://ftp.apnic.net/apnic/docs/ipv6-address-policy

- IPv6 Address request form

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

Useful reading

- The case for IPv6

  http://www.6bone.net/misc/case-for-ipv6.html

FAQ

http://www.apnic.net/info/faq/IPv6-FAQ.html

IPv6: HD Ratio 0.8

IPv6 prefix	Site addr bits	Total site addrs in /48s	Threshold	Util%
42	6	64	28	**43.5%**
36	12	4096	776	**18.9%**
35	13	8192	1351	**16.5%**
32	16	65536	7132	**10.9%**
29	19	524288	37641	**7.2%**
24	24	16777216	602249	**3.6%**
16	32	4294967296	50859008	**1.2%**
8	40	1099511627776	4294967296	**0.4%**
3	45	35184372088832	68719476736	**0.2%**

RFC3194 “The Host-Density Ratio for Address Assignment Efficiency”

Other supplementary reading

Operational Content Books

- *ISP Survival Guide*, Geoff Huston
- *Cisco ISP Essentials*, Philip Smith

BGP Table

http://www.telstra.net/ops/bgptable.html

http://www.merit.edu/ipma/reports

http://www.merit.edu/ipma/routing_table/mae-east/prefixlen.990212.html

http://www.employees.org/~tbates/cidr.hist.plot.html

Routing Instability

http://zounds.merit.net/cgi-bin/do.pl

Other supplementary reading

Routing & Mulithoming

- *Internet Routing Architectures* - Bassam Halabi
- BGP Communities Attribute

  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1997.txt

  http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1998.txt

Filtering

- Egress Filtering

  http://www.cisco.com/public/cons/isp

- Network Ingress Filtering: Defeating Denial of Service Attacks which employ IP Source Address Spoofing

  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2267.txt

Other Supplementary Reading

- Dampening case studies at
  http://www.cisco.com/warp/public/459/16.html
- Traceroute Server
  http://nitrous.digex.net
- Network Renumbering Overview: Why Would I Want It and What Is It Anyway?
  http://ftp.apnic.net/ietf/rfc/rfc2000/rfc2071.txt
- Procedures for Enterprise Renumbering
  http://www.isi.edu/div7/pier/papers.html
- NAT
  - The IP Network Address Translator
    http://ftp.apnic.net/ietf/rfc/rfc1000/rfc1631.txt